FOCUS

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The Circle Squared, Beyond Refutation

Stan Wagon

The circle has finally been squared! No, I do not mean that someone has found a flaw in the century-old proof that π is transcendental and that a straightedge and compass construction of π exists. I am instead referring to a famous problem that Alfred Tarski posed in 1925: Is it possible to partition a circle (with interior) into finitely many sets that can be rearranged (using isometries) so that they form a partition of a square? In short, Tarski's modern circle-squaring asks whether a circle is *equidecomposable* to a square. A proof that the circle can indeed be squared in Tarski's sense has just been announced by Miklós Laczkovich (Eötvös Loránd University, Budapest).

As occasionally happens in mathematics, this particular problem is easier to solve in higher dimensions, where the isometry group is richer. Because of the Banach-Tarski Paradox, a ball in three-space is equidecomposable with a cube; in fact, and this is why it is called a paradox, *any* two balls and cubes in three-space are equidecomposable, no matter what their volume (using nonmeasurable sets as pieces, obviously). But in the plane, where the isometry group is solvable, Lebesgue measure can be extended to a total, finitely-additive, isometry-invariant measure (Banach, 1923), which means that equidecomposable sets must have the same measure. It is not hard to see that any two polygons of the same area are equidecomposable (Tarski, 1924, using the classic Bolyai-Gerwien Theorem that any two polygons of the same area are geometrically equidecomposable (i.e., all pieces are triangles, and boundaries are ignored) and some easy set theory to deal with the boundaries of the pieces). This led to Tarski's circle-squaring problem. His result for polygons showed that any polygon could be squared in the modern sense. And so Tarski asked about the circle. For further historical details and references see my book, THE BANACH-TARSKI PARADOX (Cambridge, 1985), or my article in Vol. 3, No. 4 (1981) of THE MATHEMATICAL INTELLIGENCER. For a discussion of recent, but pre-Laczkovich, work, see a forthcoming paper by Richard Gardner in ATTI DEL SEMINARIO MATEMATICO E FISICO DELL' UNIVERSITA DI MODENA.

There had been very little progress on this problem, and it had become somewhat notorious because of the paucity of partial results and the difficulty of even guessing with any *(continued page 2)*

MAA Committee on Participation of Women Sponsors Panel on "How to Break into Print in Mathematics"

Frances A. Rosamond

This panel at the Phoenix meeting was intended to provide encouragement for women mathematicians, but its "how to" lessons will be useful to all mathematicians. The essentials of writing a research paper, expository article, or book from first conception to final acceptance were discussed by authors and editors. Panel members were: Doris W. Schattschneider, Moravian College; Joan P. Hutchinson, Smith College; Donald J. Albers, Menlo College; and Linda W. Brinn. Marjorie L. Stein of the US Postal Service was moderator. The organizer was Patricia C. Kenschaft, Chair of the MAA Committee on the Participation of Women.

This article summarizes the panelists' suggestions. Complete papers by panelists will appear in the NEWSLETTER of the Association for Women in Mathematics. Single copies will be available by sending $3 to AWM at Box 178, Wellesley College, Wellesley, Massachusetts 02181.

GETTING STARTED To find a topic and start to write you must overcome the familiar excuses described by Doris Schattschneider:

I don't have any ideas.
There's no one to talk to at my institution.
I don't teach at the graduate level.
My first paper was rejected.
I don't have enough time. ("Who does?" quipped Schattschneider.)
(*continued page 9)*

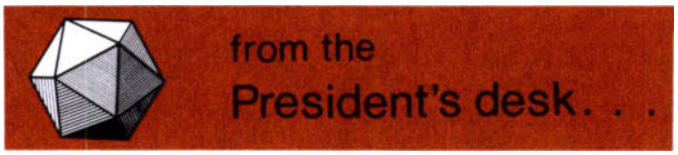
("Circle Squared, Beyond Refutation" continued from page 1)
confidence which way it might go. Commenting on this problem in the introduction to THE SCOTTISH BOOK (Birkhäuser, 1981), Paul Erdős has written: "This is a very beautiful problem. If it were my problem I would offer $1,000 for it—a very nice question, possibly very difficult. Really, one has no obvious method of attack."

Some partial results were known. Dubins, Hirsch, and Karush proved in 1963 that the circle could not be squared if "Jordan scissors" were used to form the pieces. And Richard Gardner proved in 1985 that the circle-squaring is impossible if the group of allowable motions is restricted to a discrete subgroup of isometries of the plane. Inspired to attack the problem by a lecture Gardner gave in Italy, Laczkovich has come up with a magnificent proof. Indeed, he obtains the stronger result that the circle is equidecomposable to the square using translations alone (and fewer than 10^{50} pieces). The adequacy of translations is quite surprising, for it reveals a previously unsuspected fact even in the case of triangles! Laczkovich proves, en route to his main result, that any two polygons of the same area are equidecomposable by translations alone. This is a completely new result, and definitely false for the case of geometric equidecomposability (i.e., the classical case where the dissection is effected by straight lines). The only convex polygons that are geometrically equidecomposable to a square using translations alone are the centrally symmetric ones (Hadwiger and Glur; see §10 of V. G. Boltianskii's book, HILBERT'S THIRD PROBLEM, Washington: V. H. Winston, 1978).

Laczkovich's method makes heavy use of the discrepancy of a planar set. To illustrate this notion and give a flavor of his proof, consider the main step in showing that an isosceles right triangle is translation-equidecomposable to a square. Let T be the triangle with vertices (0,0), (1,0), and (1,1). If L is a subset of the plane then $\hat{L}$ denotes the reduction of L modulo the unit square. The discrepancy of $\hat{L}$ with respect to T is the difference between the area of T (0.5) and the fraction of the points of $\hat{L}$ that lie in T. Laczkovich uses a sequence of sets, L_n, defined below that depend on vectors **x**, **y**, and **u** in the plane. His method requires points **x**, **y** in the plane such that **x**, **y**, (0,1), and (1,0) are linearly independent over the rationals and such that for all **u** in the plane the discrepancy of $\hat{L}_n$ approaches zero rapidly as a function of n. Here L_n denotes the set $\{ \mathbf{u} + k\mathbf{x} + m\mathbf{y} \ : \ 0 \le k, m < n \}$, and "rapidly" means that the order of magnitude of the discrepancy of $\hat{L}_n$ is bounded by $(\log n)^7/n^2$. If one can find points **x** and **y** that work simultaneously for T and for S, a subsquare of the unit square having area 0.5, then T and S can be shown to be translation-equidecomposable. Laczkovich shows that such points exist in this case and in the more general cases that arise in dealing with curved regions.

Laczkovich is able to apply his technique to show that an arbitrary disk (Jordan curve with interior) is translation-equidecomposable to a square. Open questions remain, the most noteworthy of which is the following relative of Hilbert's Third Problem. Is it true that a ball or a regular tetrahedron is translation-equidecomposable to a cube? The Banach Tarski Paradox says YES if arbitrary isometries may be used, and Dehn's 1900 solution to Hilbert's Third Problem says NO if only polyhedra may be used as pieces.

Stan Wagon jointly edits the MONTHLY's section, "The Teaching of Mathematics," with Joan P. Hutchinson, his wife, with whom he also shares a professorship at Smith College. This article is based on Laczkovich's preprint "Equidecomposability and discrepancy; a solution to Tarski's circle-squaring problem."



Lida K. Barrett, Mississippi State University

Committees, the Work of the Association, and You

As president of the MAA, I will from time to time comment on the workings of the Association and on other topics as seen from the president's viewpoint. I would like to begin this process with a discussion of the Association's committee structure. At each MAA meeting, in addition to the formal program, there is an immense amount of activity that takes place in committee meetings. The committee schedule for the Joint Mathematics Meetings in Phoenix called for meetings of 23 committees. Committee meetings began on the Sunday before the meeting with an all-day meeting of the Selection Committee for the new Executive Director. On Monday, the Executive and Finance Committees met all day, and the Board of Governors met on Tuesday. Concurrent with the regular meeting sessions on Wednesday through Saturday, there were committee meetings, breakfast, morning, lunch, afternoon, night; and on Sunday, there was a day-long meeting of the MAA Science Policy Committee.

How can an average member of the Association relate to this activity? How can a member with an interest in a particular committee learn what the committee is doing? How can a member who would like to serve on a committee have an opportunity to take part? Let me answer these questions in order.

At the meeting in Boulder, we will have available at the registration desk a list of the committees that will be meeting, along with the names of their chairs. Any member of MAA who wishes to attend a committee meeting and simply listen to the proceedings is welcome to do so. A number of the committees (for example, the Committee on Computers in Mathematics Education) have over the years welcomed all with an interest to visit the committee session. In a number of cases, new members of the committee have come from these visitors.

The Association regularly prints a committee list showing the membership of each committee, a list of all members who serve on national committees showing which committees they serve on, and for each of our 29 sections a list of its members who serve on national committees. We are making a significant effort to expand the participation in committees, particularly of women and minorities—we also try to represent the various sections and groups such as the two-year college faculty. Even with our large number of committees, there are only approximately 500 of our 25,000 individual members serving on committees at the national level. It is the general policy for an individual to serve no more than two terms on a given committee.

If you are interested in working on a particular committee, do consider joining its deliberations as an observer at a future national meeting. If you have particular expertise or experience that qualifies you for consideration for appointment to a committee, do not hesitate to send your name, description of your experience, and past MAA participation to Ken Ross, MAA Secretary. Generally, participation on national committees follows activities at the section level or previous activities in the mathematical community related to the topic of the committee. Susan Forman's column in FOCUS will keep us all informed about the activities of the many committees of the Association.

I will close these remarks by noting that many of the committees have been able to expand their effectiveness, work at more meaningful levels, and at a faster pace by finding external support for meetings and projects. Recent MAA activities have been supported by grants from the Sloan Foundation, the National Science Foundation, Ford Foundation, Carnegie Corporation, Exxon Education Foundation, and the Department of Education's Fund for the Improvement of Post-secondary Education. MAA is taking the lead in bringing about significant new directions for collegiate mathematics. It is through the activities of its committees that we are effective in accomplishing our goals.

MAA Board of Governors' Actions

Kenneth A. Ross, Secretary

This January meeting is a time of transition. At the official adjournment of the January meeting, following the concert by AMS President William Browder and outgoing MAA President Leonard Gillman, Leonard Gillman's term as President will end and Lida Barrett will begin her two-year term as President.

The January actions of the Board of Governors follow in brief. The Board elected two new Governors-at-Large. We have six Governors-at-Large; by tradition these represent certain special constituencies. Peter Drummond Taylor at Queen's University, Kingston, Ontario was elected from our Canadian members' constituency. Sylvia Trimble Bozeman at Spelman College in Atlanta was elected to represent our traditionally minority institutions.

The Board has approved three small bylaw changes that collectively will add the Chair of the Committee on Sections to the Executive Committee of the MAA. The MAA is the union of its twenty-nine sections and it is vital that there be a close interaction between them and the governing Officers of the MAA. For these reasons the Board approved the proposed changes. The bylaw changes are given in a separate article on page 4 of this newsletter and will be submitted for approval by the membership at the business meeting in Boulder. If they are approved, the chair of the Committee on Sections will also become a member of the Board.

The Board has authorized the creation of the standing Committee on Minority Participation in Mathematics. This was done not only for reasons of equity but also in recognition that the future of science and mathematics in this country depends on our intelligent adaptation to the reality that in the next century a large part of our work force will consist of minorities. This committee will carry on with the recommendations that came out of Louise Raphael's Task Force on Minorities in Mathematics. Among its far-reaching proposals is the establishment of an Office of Minority Participation in Mathematics within the MAA (see the article on the Task Force in the January-February 1989 FOCUS, page 13).

The Board endorsed the vision for school mathematics embodied in the NCTM Curriculum and Evaluation Standards for School Mathematics. These extensive STANDARDS were developed over a two-year period and will serve as the basis for the NCTM's effort to improve mathematics education in the 1990's. NCTM formally released its STANDARDS on March 21, 1989. The Board also endorsed a joint MAA-NCTM statement that parental involvement is essential for success in mathematics. FOCUS will report on the STANDARDS and on this statement in a later issue. The Board also received a thoughtful report from the AMATYC-MAA Task Force to Reduce the Need of Remedial Mathematics in College.

A great deal is going on in mathematics at the national level these days. At the Board meeting, three important components of the national effort were reported on by John W. Kenelly, Marcia P. Sward, and Kenneth M. Hoffman. John Kenelly reported on the status of the calculus project. (See the January-February 1989 FOCUS pages 1–3.) Ken Hoffman gave an update on the activities of his Office of Governmental and Public Affairs, which is JPBM's link to the government in Washington. JPBM stands for Joint Policy Board for Mathematics, a board jointly created and supported by the Association, the AMS, and SIAM. Marcia Sward reported on plans for a year of national dialogue in 1990. These efforts are part of the Mathematical Sciences Education Board's (MSEB's) long-term efforts to comprehensively analyze mathematics education. To successfully provide leadership, MSEB recognizes the need to interact in depth with numerous constituencies from teachers and parents to leaders in business and industry. And this means identifying where we stand, what our problems are, and persuading these other constituencies to move ahead. In 1989 four major reports will appear. The first, EVERYBODY COUNTS: A Report to the Nation on the Future of Mathematics Education, was published in January and a large mailing made it available to various constituencies. (See also Hans Oser's "Washington Viewpoint" column on page 6 of this issue of FOCUS.) Copies are available from the MAA; see the coupon on page 7. We urge you all to study the report and share it with your colleagues.

MAA Assists "Study in Depth" Your Ideas Sought

Lynn A. Steen, Chair, CUPM

The Association of American Colleges (AAC) is conducting a major study involving several academic disciplines concerning the student experience of the "study in depth" component of undergraduate education. CUPM, on behalf of MAA, will be carrying out the mathematics component of this study through an *ad hoc* Task Force of Jerry Goldstein, Eleanor Jones, David Lutzer, Alan Tucker, and Lynn Steen.

AAC is interested in four broad issues, suggested by the following questions:

- GOALS: What are the goals of the mathematics major? How are they reviewed and approved?
- COURSES: Do courses in the major build appropriately on one another? Is there a capstone, integrative experience?
- STUDENTS: Do student expectations for the major match faculty goals? Are there opportunities for students to reflect on the nature of mathematics as a profession and in relation to other fields?
- CONTEXT: Do the discipline boundaries make sense for undergraduates? How are linkages with other fields maintained and built into the curriculum?

CUPM is interested in receiving comments about these issues to help in preparation of the mathematics report for this multidisciplinary AAC study. Please send any suggestions or statements to Dr. Lynn A. Steen, AAC-MAA Task Force Chair, St. Olaf College, Northfield, MN 55057

Bylaws Change Proposed for August Business Meeting: Chair of Committee on Sections to Join MAA Board and Executive Committee

Because of the importance of the MAA Sections for the operation of the Association, the Board of Governors meeting in January approved a proposal that the chair of the Committee on Sections be elected by the Board of Governors and that the chair of the Committee on Sections, so elected, serve as a member of the Board and of the Executive Committee of the MAA.

The proposed changes in the Bylaws are all additions and they are shown in color with the sections of the Bylaws to which they are to be added. The full text of the Bylaws was last published in the March-April 1987 issue of FOCUS. These additions will be brought before the MAA business meeting at Boulder in August 1989 for approval.

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Article III—Board of Governors and Officers

III.2. There shall be a Board of Governors (herein called "the Board") to consist of the officers, the ex-presidents for terms of six years after the expiration of their respective presidential terms, the Editor of each of its three publications entitled THE AMERICAN MATHEMATICAL MONTHLY, THE COLLEGE MATHEMATICS JOURNAL, and MATHEMATICS MAGAZINE, the members of the Finance Committee, the chair of the Committee on Sections, and additional elected members (herein called "Governors"). It shall be the function of the Board to supervise all scholarly and scientific activities of the Association, to administer and control these activities, and to authorize expenditures of funds of the Association.

III.3. There shall be an Executive Committee of the Board consisting of the Officers of the Association, the chair of the Committee on Sections, and a current journal editor. It shall be the function of this Committee to review continually the policies and activities of the Association, to plan and organize new activities, to formulate in broad outline the programs of meetings and of publications, and in general to consider all matters of importance or interest to the Association. This Committee shall prepare the agenda for meetings of the Board and shall analyze the implications and aspects of all matters which are to come before the Board for decision. It shall present to the Board the viewpoints suggested by such analyses, as well as all such facts as may seem pertinent or as may in any way facilitate the Board's work.

Article VI—Sections

VI.7. There shall be a standing Committee on Sections through which the Board shall maintain general supervision over the activities of all Sections. The chair of the Committee on Sections shall be elected by the Board from one or more nominations by the Executive Committee and shall be a member of the Board and the Executive Committee. This Committee, in particular, shall study all matters involving creation of Sections or modification of boundaries of Sections and make appropriate recommendations to the Board.

Wolf Prize to be Awarded to Calderon and Milnor

The Wolf Prize for 1989 will be awarded equally to Alberto P. Calderon of the University of Chicago and John W. Milnor of the Institute for Advanced Study, who is now visiting SUNY, Stony Brook. Chaim Hertzog, President of Israel, will make the award in May in a ceremony at the Knesset in Jerusalem. The Wolf Prizes "to promote science and art for the benefit of mankind" carry a stipend of $100,000 and are funded by the foundation established in 1981 by the late Dr. Ricardo Wolf.

Calderon's contributions begin with his work with his teacher Antoni Zygmund on singular integral operators. The primordial example is the Hilbert transform, $g = Tf$, of a function f given by:

$$g(x) = \frac{1}{\pi} \lim \left(\int_{x-A}^{x-\epsilon} f(t) \frac{dt}{t-x} + \int_{x+\epsilon}^{x+A} f(t) \frac{dt}{t-x} \right)$$

where the limit is taken as A increases to infinity and as ϵ decreases to zero. This transform is connected to complex analysis by the fact that the real and complex parts of a function holomorphic in the upper-half plane are, up to signs, Hilbert transforms of each other. This integral formula for g has a singularity of its kernel $1/(t-x)$ at $t = x$ and that is where singular integrals enter the picture. The integral formula for g together with the formula for integration by

parts suggest how higher derivatives of g may be expressed as singualr integrals. Exploiting these singular integrals allows one to extend differential operators to wider classes of functions and prove results using closure properties of such classes. An outline of this that includes a description of these early contributions is given in Charles Fefferman's "Recent progress in classical Fourier analysis," pages 95–118 in PROCEEDINGS OF THE INTERNATIONAL CONGRESS OF MATHEMATICIANS, VANCOUVER, BC, 1974, published by the Canadian Mathematics Congress, 1975. Details may be found in E. M. Stein's SINGULAR INTEGRALS AND DIFFERENTIABILITY PROPERTIES OF FUNCTIONS, Princeton University Press, 1970.

Alberto P. Calderon

Calderon and Zygmund studied singular integral operators in real n-space. These results were the point of departure for Calderon's proof of the uniqueness of solutions to the higher-order Cauchy problem for partial differential systems. Calderon extended this work to apply to local solvability of more general systems of PDE's, and this work led to the important concept of pseudodifferential operators as developed by Calderon and others. As a source on this later work, Charles Fefferman recommends Calderon's survey paper "Commutators, singular integrals on Lipschitz curves, and applications" in Volume 1, pages 85–96, PROCEEDINGS OF THE INTERNATIONAL CONGRESS OF MATHEMATICIANS, HELSINKI, 1978, Acad. Sci. Fennica, Helsinski,1980. Fefferman cautions that Calderon is too modest in describing the importance of the field and of Calderon's own contributions. "Whenever people think of PDE's today they use pseudodifferential operators," Fefferman said. The details on these methods can be found in Michael E. Taylor's book. Brief descriptions of all this can be found in either edition of the ENCYCLOPEDIC DICTIONARY OF MATHEMATICS whose English translations are published by MIT Press.

John Milnor's contributions to geometry and topology have been marked from the start by the depth of geometric insight and the elegance of execution. Robion Kirby recalls that his contemporaries spoke of "the great god Milnor." Michael Spivak, one of Milnor's thesis students, would not speculate on which of Milnor's papers was most representative of his powers, but he offered as evidence of his true genius the following, composed quickly in response to the seemingly impossible Princeton common-room challenge of composing a limerick based on the name of department member C.D. Papakyriakopolous:

The infamous lemma of Dehn
Drove many a person insane,
But Christos Pap-
A-kryia-kop-
O-lous learned it without any pain.

As an undergraduate in a differential geometry class taught by A. W. Tucker at Princeton, Milnor learned of the then unproven conjecture of Borsuk: that the total curvature of a knot in 3-space must exceed 4π . He discovered a proof that worked for smooth knots. Following ideas of R. H. Fox, he extended the notion of total curvature to apply to arbitrary knotted circles in 3-space and proved Borsuk's conjecture for such knots as well. This paper, "On the total curvature of knots" appeared in ANNALS OF MATHEMATICS (2) **52**, 1950, pages 248-257. Milnor was then nineteen.

John W. Milnor

In 1956 Milnor published his surprising discovery that the topological 7-sphere admitted several nondiffeomorphic differentiable structures. Writing for the PROCEEDINGS of the 1962 International Congress, Hassler Whitney surveyed Milnor's contributions on the occasion of Milnor's award of the Fields Medal. Whitney begins by outlining Milnor's constructions and citing Milnor's discovery of these exotic differentiable structures on spheres as the beginning of the study of differential structures on manifolds as such. Whitney also sketches Milnor's counterexample to the Hauptvermutung—the conjecture that homeomorphic polyhedra have isomorphic cell subdivisions. Finally, he directs his readers to Milnor's talk on microbundles at that International Congress. Microbundles are to topological manifolds what vector bundles are to differentiable manifolds. Raoul Bott said that the discovery of exotic spheres "just blew us away," but that Milnor's greatest contributions were to the techniques for the classification of manifolds and in his work on algebraic singularities. For a sense of how this area of topology has developed, Milnor recommends Laurence C. Siebenmann's and Robion Kirby's FOUNDATIONAL ESSAYS ON TOPOLOGICAL MANIFOLDS, SMOOTHING, AND TRIANGULATIONS, Princeton University Press, 1977.

From the mid 1970's to 1980 or so, Milnor spent considerable time working on a manuscript dealing with the geometry of basic physics, but in his words, "the successive drafts failed to converge." In 1988 the paper "On iterated maps of the interval," written by Milnor and William P. Thurston, appeared in DYNAMICAL SYSTEMS, J. C. Alexander, Springer Lecture Notes 1342, New York, 1988, pages 465–563. This is the first of his work on dynamical systems to be published. One may look forward to "Self-similarity and hairiness in the Mandelbrot set" which was the basis for his invited MAA address at the January 1987 annual meeting and which will appear in COMPUTERS AND GEOMETRY, edited by Martin C. Tangora, Marcel Dekker, to appear in 1989.

MAA members may know Milnor best for books such as TOPOLOGY FROM THE DIFFERENTIABLE VIEWPOINT, University Press of Virginia, 1965 and expository articles such as "Analytic proofs of the hairy ball theorem and the Brouwer fixedpoint theorem" in the MONTHLY, 1978, pages 521–524 and "Hyperbolic geometry: the first 150 years" in BAMS, 1982, pages 9–24.

Solicitation Glitch Corrected

Responding to urgings from members, the MAA staff moved to upgrade the merging and purging of the mailing lists used to solicit new members. These solicitations brought our membership to 27,000 in 1988, up from 18,500 in 1984. A side effect is that current members are occasionally invited to join—as if we didn't know they already belonged. We do know this, but it is difficult to eliminate all duplicate names by a computer search. That is why we went to a new supplier, who came with high recommendations and proven capability, but an error on that supplier's part led to over half of the current members receiving solicitations. We apologize for any inconvenience. The error has been found and corrected, new procedures are in place, and we are at work recovering the extra costs. Please bear with us, let us know of problems should they arise in the future, and pass our invitation on to another, if you still have it.

WASHINGTON OUTLOOK . . .

Hans Oser

EVERYBODY COUNTS: Three-Year Study of US Mathematics Education Released

At a Washington press conference, held jointly by the National Academy of Sciences and the National Academy of Engineering, the long-awaited report, EVERYBODY COUNTS: A Report to the Nation on the Future of Mathematics Education, was released to the public on January 26. Prepared jointly (under the auspices of the National Research Council) by the Mathematical Sciences Education Board, the Board on Mathematical Sciences, and the Committee on the Mathematical Sciences in the Year 2000, the report outlines a strategy for reforming math instruction in our schools and colleges over the next two decades.

In the foreword to the report, the President of the National Academy of Sciences, Frank Press, signals the commitment of the two Academies and the Institute of Medicine to participate in the long-term work of rebuilding mathematics education in the United States.

The press conference was opened by Robert M. White, President of the National Academy of Engineering. He praised the panels' work and echoed the message put forth by Frank Press. White had encouraged the mathematics education community during an earlier gathering at the Academy to be a pump, and not a filter, in the process of educating our young people in the sciences and engineering.

In a departure from the usual format, the press conference began with a live class, consisting of eight sixth-graders and their teacher, Paula Duckett, from River Terrace Community School in Northeast Washington. During a 25-minute period, the students took measurements of each others' shoulder widths and arm lengths. After entering the measurements in a table and calculating the ratio of the two measurements for each person (using a pocket calculator), they discussed the numbers with their teacher. They speculated on the proximity of that ratio to the golden mean, the number 1.6, which they had discussed previously in the context of art and architecture. Shirley Hill, Chair of the MSEB, stated that the purpose of this classroom demonstration was to show that group learning and interaction can lead to better involvement by the students. The demonstration also signals a departure from the traditional doctrine of teaching "the way it was taught:" in this exercise, the students developed an appreciation for the magnitude of numbers, a critical attitude towards accepting measured results, and demonstrated that learning mathematics is not necessarily restricted to the individual, but that it can be a collective effort by a group learning together.

In separate statements, the chair of the BMS, Phillip Griffith, and J. Fred Bucy, chairman of the Committee on the Mathematical Sciences in the Year 2000 (usually referred to as MS 2000), offered their assessments for the need of substantial reform. They conveyed a sense of urgency, and a commitment among the teachers of mathematics, to begin the long process of changing the curriculum for the year 2000 and beyond.

While admitting that the situation in the U.S. is unique among nations with its highly decentralized educational system, all speakers were confident that the proposed reforms would be adopted in due time without a massive infusion of new federal money. To the contrary, Bucy said, there is now $330 billion being spent for education in the U.S. and spending it more wisely will allow carrying out part of the reforms within the current system. (Of that amount, more than $25 billion is spent for math education nationwide.)

Other members of the panel were Marcia Sward, Executive Director of the MSEB, and Ronald Douglas, State University of New York at Stony Brook. Reporters from national and local news media raised the (rather anticipated) question whether calculators in the classroom prevent students from learning the "basics." Behind this question looms the suspicion that our children must be trained exactly the same way we learned mathematics in school. What needs to be understood is that mathematics did not stand still and that exciting developments have taken place in the past few decades that need to be taught. Getting the students to participate in discovery, rather than drilling them mindlessly, will be a challenge for the teachers in the 1990's and beyond. No longer can we accept the excuse "my child does not have any aptitude for math," or we shall find a majority of high school graduates entering the work force as "innumerates." Industry now has to retrain high school graduates in order for them to develop the skills necessary to operate complex machinery, diagnose malfunctioning components in measuring instruments and to be able to decide when intervention is necessary in automated manufacturing systems.

Asked by reporters what kind of math is not now being taught, the panel suggested that students have to get better at problem solving, statistical quality control, and to appreciate mathematics for its significance for the understanding of real world problems in biology, the environment, economics, manufacturing, science, and engineering. Current attitudes must be changed said Shirley Hill, Chair of the MSEB, and the pressure has to be kept on the system at all levels and in all components, including the textbook publishers, testing services, parents, teachers, and students. The momentum for reform is there, it is important not to lose it. The future of our children and the country depends on a successful reform in the way we teach and what we teach.

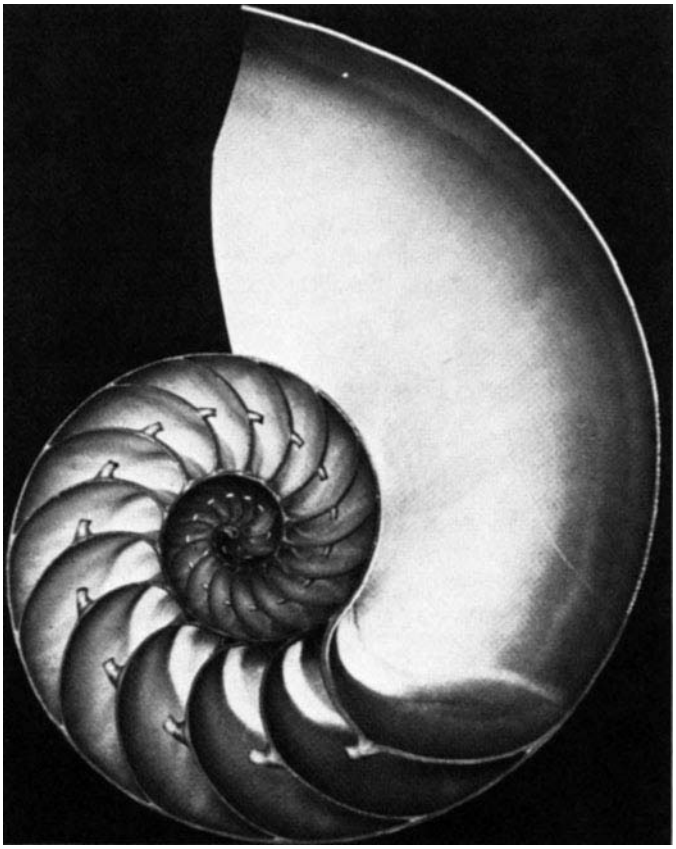
As math instruction in the secondary schools improves, less time will be needed for remedial teaching in the colleges, thus allowing teachers to spend more time with individual students. We cannot envision future math teachers without at least a bachelor's degree in mathematics to teach our high school students. A lack of appreciation of new developments in science and engineering on the part of teachers is often cited as a reason why high school science and math are being perceived as dull and irrelevant. We must change that attitude.

It is appropriate to mention that there is still another player in the league of science education who is equally committed to reform: the National Science Foundation. NSF Director Erich Bloch, in a dinner speech the night before the release of the report, endorsed its main objectives, the new standards of instruction, upgrading of the teaching profession, and development of more effective procedures for assessing student proficiency. He called the report a milestone and praised the mathematics research community for its readiness to be influential in effecting the changes in math education that are imminent both at the precollege and undergraduate levels. He warned the audience, however, that this report was just a beginning, and that continuous involvement by all participants will be necessary. NSF, he said, expects to be a part in this effort.

Toward the Future: NCTM STANDARDS and AAAS PROJECT 2061 Reports Join EVERYBODY COUNTS

The National Council of Teachers of Mathematics released its new Curriculum and Evaluation STANDARDS FOR SCHOOL MATHEMATICS on March 21 and the American Association for the Advancement of Science released its PROJECT 2061 reports in six paperbacked volumes in the same month. The NCTM STANDARDS will be central in developing new school curricula to carry forward the reforms suggested in that report and in EVERYBODY COUNTS. An overview of the NCTM effort will be given in a forthcoming FOCUS article. Those wishing copies of the report may order them from the NCTM (see below). Project 2061 looks forward to the return of Halley's Comet and the three sections of the report most relevant to mathematics are: SCIENCE FOR ALL AMERICANS (the overview) and the two separate panel reports MATHEMATICS and PHYSICAL AND INFORMATION SCIENCES AND ENGINEERING. These are obtainable from AAAS (see below). Note the phrase "... for all Americans," which resonates strongly with the spirit of EVERYBODY COUNTS.

For the NCTM STANDARDS send a check or purchase order ($25) to the NCTM, 1906 Association Drive, Reston, VA 22091. VISA or MasterCard orders can be phoned to: (703) 620-9840. The 2061 volumes are available from: AAAS Books, Department 2061, P.O. Box 753, Waldorf, MD 20604 at $14.50 for SCIENCE FOR ALL AMERICANS, and $7.50 for the panel reports. These are the general prices; member and/or quantity purchase discounts may be available and taxes may be applicable in some locations (CA, for instance).



The spiral nautilus shell. Is it related to the golden ratio, and if so why?

Questions for Everybody: A Rich Lode in NRC Report

When Mrs. Paula Druckett's 6th grade mathematics class met on January 26 in the Lecture Hall of the National Academies of Science the questions they considered were of interest not only because they bore upon the future of mathematics education. These kids observed and measured arm lengths, heights, etc.; they carefully recorded the units as well as the numbers. Thanks to the calculator, they found the dimensionless ratios related to shape that might otherwise be overlooked because of differences in size. Is the human form proportioned, as some suggest, according to the golden ratio? These students knew this question and how to address it.

On the wall was the picture of a nautilus shell. Are its proportions that of the golden rectangle? Such a shell is shown here so that FOCUS readers can consider this question for themselves. Build a spiral of squares whose side lengths are the consecutive Fibonacci numbers; you get something suggestive of the nautilus's spiral. Is this a hit or a miss; accident or design—and if it is design, what purpose does it serve? The Fibonacci numbers turn up as the numbers of spirals of florets in sunflowers and in other ways in the plant world. The mathematics of a mechanism that explains this has been worked out. See, for example, "Phyllotaxis and the Fibonacci Series" G. J. Mitchison, SCIENCE, **196** (270–275), 1977, or "On the Diffusion Theory of Phyllotaxis" David A. Young, THE JOURNAL OF THEORETICAL BIOLOGY, **71** (421–432), 1978.

EVERYBODY COUNTS is full of questions that students at many levels can attack and that arise directly from the real world, but also lead to interesting mathematical problems. The examples below give a sense of these questions:

"How is it possible for an AIDS test that is 95% accurate to be misleading [on] 90% of ... [the cases where it is positive] when used in mass testing? Issue such as this are central to public policy, yet require a basic knowledge of probability to be understood properly." **Editorial Note.** The ELISA test is the standard one for the HIV antibody. The probabilty of a false positive reading is 0.07; the probablity of a false negative reading is 0.023. The latter error should be more worrysome because this test is routinely used to screen donated blood.

"Two banks are offering car loans with monthly payments of $100. One has an interest rate of 16%; the other has a higher rate of 18% together with a premium for a free color television (worth $400). If you need a $5,000 loan and would really like the color TV, which bank should you choose?" **Editorial Note**. This requires calculation. The discounting of future dollars adds a twist. Practically, the car's value is likely to fall below the outstanding loan balance, a problem for the bank. Take the money, the TV, and run?

MAA members may order EVERYBODY COUNTS from the MAA at $7.50 (discounted from $7.95 list). Postage and handling free on prepaid orders. Remember card number, expiration date, and signature with VISA or MasterCard orders.

Order from: MAA, 1529 Eighteenth Street Northwest, Washington, DC 20036. Order code ERC. For quantity discounts check with the National Academy Press, Washington DC.

The Use of Computer Algebra Systems in the Undergraduate Mathematics Curriculum

Zaven A. Karian
Chair, Subcommittee on Symbolic Computation

Recent initiatives underscore the importance of computer algebra systems (CAS) in undergraduate mathematics. Speakers and working groups at the Sloan Foundation supported conferences "Toward a Lean and Lively Calculus" and "Calculus for a New Century," and identified CAS as a major force for change in calculus, noting that as these systems become widely available to students in desk-top environments a thorough reassessment of course objectives will be necessary.

Colleges and universities began curricular experiments using CAS in undergraduate courses, especially for calculus. Those involved in developing symbolic computer packages worked to refine the performance and user interface to make them more appropriate to student use. Currently Donald Small of Colby College is conducting nationwide workshops to introduce faculty to the potential of CAS; these are supported by NSF.

The Alfred P. Sloan Foundation recognized the value of incorporating symbolic computation in calculus instruction by playing a leading role in bringing this technology and its pedagogic consequences to the attention of the mathematics community through pilot projects funded in late 1986. A year after this initiative, the National Science Foundation launched a larger and broader program to reform calculus instruction; many of the NSF-supported calculus projects exploit CAS.

National interest in the impact of CAS on science and engineering curriculum is also growing. The June 1989 meeting of the American Society of Engineering Education will dedicate an entire day to issues of CAS. More than 2,000 engineers will attend this conference; others will read about it in ASEE publications.

We are at a crossroads. There is growing conviction that CAS should by fully exploited; yet, there is considerable uncertainty and, even apprehension about this technology.

The MAA decided to provide the institutional leadership to continue the activity begun two years ago. At the 1988 summer meeting of the MAA its Committee on the Undergraduate Program in Mathematics (CUPM) established a Subcommittee on Symbolic Computation.

This new Subcommittee (James Daniel, Wade Ellis, Jr., Joan Hundhausen, Zaven Karian (Chair), Robert Lopez, Arnold Ostebee, Warren Page, Donald Small, David Smith, and Jerry Uhl) will coordinate with three other major CUPM subcommittees which are looking at service courses, at calculus, and at the first two years of college mathematics, and at the mathematical sciences major. These CUPM subcommittees will shape recommendations for undergraduate mathematics for the 1990's.

The charge to the Subcommittee on Symbolic Computation is: to coordinate the existing activities in the use of CAS, to promote new initiatives, and to disseminate work being done in this area to the mathematics and science community. More specifically, the Subcommittee intends to:

- heighten awareness of the emerging CAS technology and its consequences for undergraduate mathematics instruction;

- commission experts to develop instructional materials (problem sets, classroom demonstrations, special notes, etc.) usable by novices in symbolic computation;

- provide a forum for the exchange of views between mathematicians and those from cognate disciplines where what is taught in undergraduate mathematics is put to use;

- connect the relatively few CAS "experts" and the many interested mathematics educators by sponsoring speakers, panel sessions, and contributed paper sessions at national as well as sectional meetings of the MAA;

- place lecturers and consultants on the instructional use of CAS on the MAA lecturer's and consultant's lists through the appropriate MAA committees.

Shortly after the establishment of the Subcommittee on Symbolic Computation, the MAA received a two-year grant from the Alfred P. Sloan Foundation to expedite the work of the Subcommittee. With this announcement the Subcommittee invites the participation of the mathematics community in its various activities. If you are interested in the work of the Subcommittee, contact its chair (Zaven Karian, Department of Mathematical Sciences, Denison University, Granville, OH 43023). The Subcommittee on Symbolic Computation would also like to bring to the attention of the mathematics community the NSF regional workshops on the use of CAS. Forthcoming 2-day and 5-day workshops, with room and board expenses supported by the NSF grant, include the following:

CAS RELATED WORKSHOPS AND CONFERENCES
April 14–16, 1989 Rollins College FL. Instructor: Doug Child. Local contact person: Linda Gentry.
May 19–21, 1989 Trinity University, TX. Instructor: Stan Devitt. Local contact person: Don Bailey.
June 12–16, 1989 Massachusetts Institute of Technology, MA, Computers and Mathematics Conference. There will be a 3 hour CAS tutorial by Michael Henle and Stan Devitt at this conference. Contact: Heather Schmidt at (914) 769-2725.
July 24–28, 1989 St. Olaf College, MN. Instructors: Paul Zorn and Michael Henle. Local contact person: Arnie Ostebee.
November 3–4, 1989 Colby College, ME. Instructor: Donald Small. Local contact person: Bruce Frech.

For information about a specific workshop, get in touch with the local contact person; general information about the workshops can be obtained from Donald Small of Colby College.

Scholarship Funds for Women to Be Established

The Dorothy L. Bernstein fund is being establishing by family and friends of Professor Bernstein, formerly president of the MAA, to perpetuate her memory and to encourage women studying mathematics. Those wishing to contribute should contact Dr. Y. C. Druznin, 421 South Van Ness Avenue #27, Los Angeles, CA 90020, who is coordinating efforts to establish this fund.

The Executive Council of the Association for Women in Mathematics (AWM) has established the Alice T. Schafer prize in recognition of the years of leadership and service Alice Schafer, president of the Association from 1976-1978, has given to AWM. Beginning in 1990, the prize will be awarded annually to an undergraduate woman for excellence in mathematics. Contributions to the fund may be sent to Tricia Cross, Executive Director, AWM, Box 178, Wellesley College, Wellesley, MA 02181.

CRAFTY Calculus Request

The CUPM Subcommittee on Calculus Reform and the First Two Years (CRAFTY) is planning a compendium of exemplary calculus projects and experiments, whether supported by outside funds or not. If you have a calculus program that other people should know about, please send a brief description (less than three pages) to Thomas W. Tucker, Mathematics Department, Colgate University, Hamilton, NY 13346.

CCIME Plans Visualization Project

Steve Cunningham and Walter Zimmermann

For many students seeing is believing and the right picture can lead to understanding. Past images were hand-drawn or even mental, but visualization has taken on new life with advances in computer graphics. The NSF report VISUALIZATION IN SCIENTIFIC COMPUTING has shown the importance of these developments for research. At its January meeting the MAA's Committee on Computers in Mathematics Education (CCIME) endorsed development of a parallel volume that will do the same job for teaching that the NSF volume does for research. We will edit this collection, tentatively titled VISUALIZATION IN MATHEMATICS (VIM) and slated for the MAA's Notes series. This article describes the project and invites contributions.

VIM will have two parts. The first is: ISSUES in Visualization, concerned with broad aspects of visualization in mathematics including: ■ Philosophical Issues (What is Visualization?), ■ Historical Issues (Visualization in the History of Mathematics), ■ Psychological Issues (Visualization in Mathematical Thinking), ■ Pedagogical Issues (The Effective Use of Visualization in Teaching and Learning), ■ Visualization Technology (Computers and Visualization), ■ Visualization Software (The Design of Effective Educational Graphics Software), ■ The Scope of Visualization (A Survey of Applications of Visualization), ■ Cultural and Social Issues (The Status of Visualization in Culture and Society), and ■ Economic and Political Issues (Rewards of and Funding for Visualization Research).

For the first part, ISSUES, we invite papers which focus on one of these issues or deal broadly with a spectrum of issues. Contributors are free to suggest other topics or issues of a similar nature.

Part Two is: CASE STUDIES in Visualization, which will include examples from specific fields of mathematics including visualization in ■ Calculus, Vector Analysis, and Differential Equations, ■ Group Theory, Graph Theory, or Other Topics in Discrete Mathematics, ■ Probability Theory and Statistics, ■ Real or Complex Analysis, and ■ Linear Algebra. Additional possible areas include: ■ Visualizing Stochastic Processes, ■ Visualizing Complex Dynamical Systems and Chaos, ■ Algorithm Animation, and ■ Visualization in Scientific Computing.

For the second part, CASE STUDIES, papers may discuss the use of visualization with or without the aid of computers. Computer technology or software may be described where relevant, but *papers should focus on the role of visualization in teaching and learning of mathematics,* especially undergraduate mathematics.

If you are interested in submitting a paper or if you want further information, including timelines, please write to: Professor Walter Zimmermann, Department of Mathematics, University of the Pacific, Stockton, CA 95211.

Steve Cunningham is Professor of Computer Science at California State College, Stanislaus and is Chair of the ACM's SIGGRAPH Education Subcommittee. As such he serves as liaison for this project with CCIME. Walter Zimmermann is a member of the MAA's CCIME.

("How to Break into Print" continued from page 1)

The first excuse, the panelists agreed, is rarely true. Be attentive to your own mathematical interests. Discuss and refine your ideas until you are ready to write.

□ Reading journals is essential. Begin a correspondence with the author of an appealing article. The correspondence will enrich your ideas and may result in a co-authored work.

□ Offer to referee manuscripts for journals you read regularly. You will see others' less polished efforts and gain a sense of how a paper evolves.

□ Attend a seminar. Offer to write up the lecture notes, suggested Schattschneider. Your name may not appear on a published version, but you will gain valuable writing experience, contacts, and self-confidence. If you are a department chair or experienced author, offer to become a mentor for junior colleagues. Encourage them, proofread their work, and guide them through their first papers.

□ Get ideas through advising students on term papers and activities. Try to coauthor papers with students. You need not teach at the graduate level to write exposition for undergraduates or for others outside the field. Perhaps you can describe a fresh teaching strategy. According to Joan Hutchinson's study of 400 manuscripts submitted to the "Teaching Section" of the MONTHLY, over a two and one-half year period, only six percent of submissions have women authors. There are many women teachers — let's write!

□ Solve problems in journals. Donald Albers reminded us that we start out in school learning to write words and sentences; we build up to paragraphs and eventually whole pages. Give yourself a parallel experience by starting out writing one page for say, "Classroom Capsules" or the THE MATHEMATICAL SPECTRUM, or a book review. If you are rejected, you can say, "I spent only 40 hours on one page" rather than "I spent 400 hours on this manuscript."

□ Place value on your ideas. Joan Hutchinson's study, cited above, revealed that the acceptance rate for women was the same as for all authors, 25 percent. If your teaching ideas have not been published in the past 5–15 years, then you may be helping the mathematical community by submitting them. Your ideas may spark and nurture someone else's.

□ Be your own best critic. This doesn't mean being excessively hard on yourself. Do a background search, compile a reasonable bibliography, write and rewrite. For comment on mathematical accuracy and originality, send your final draft to a knowledgeable colleague for an informal "referee" opinion. After revision, submit a manuscript. The work may not be perfect, but let the editor and reviewers give you guidance. The important thing is to get started!

There's no denying that writing an article takes a long time. Therefore, begin today by starting a file on your topic. Include citations that extend or contrast with your ideas. Plan library time to develop

an up-to-date and thorough bibliography. This will show editors that you've established the historical context for your ideas and that you've checked that your ideas haven't already been published. Writing is often improved by a sustained period of conscious work followed by letting it rest. Keep talking and thinking about your topic and adding to your file until it generates a manuscript.

Women may feel hesitant if they perceive writing as an isolating activity. It need not be. The acceptance rate for co-authored papers is actually higher!

ORGANIZING AND PROOFREADING Since most journals have a backlog of one to two years and five times as many submissions as published articles, your paper must catch the editor's eye with a sharp, letter-quality appearance, an interesting title that conveys the essence of the paper, an opening paragraph that sets the context and grabs attention, and a list of recent references. Doris Schattschneider reported that roughly 50 percent of all articles are rejected immediately by the editor without further consideration. Get off on the right foot, make sure that you send your work to the current editor and follow the journal's published instructions to authors. The first page of your paper must indicate that you have a carefully written and interesting paper if you are to make it past the first cut.

Poor writing is a common reason for rejection. Improve your style by referring to THE ELEMENTS OF STYLE by Strunk and White. Other guides suggested by the panel are WRITING MATHEMATICS WELL by L. Gillman, available from the MAA, THE CAREFUL WRITER by I. M. Bernstein, HOW TO WRITE MATHEMATICS by P. Halmos, available from the AMS, and the forthcoming MAA book by D. Knuth et al. on mathematical writing.

Check the readability of your manuscript by reading it aloud. Ask an English professor if your writing flows and ask students if they get the gist of your presentation. Pay attention when your colleague says "such and such isn't clear." Overcome the temptation to give a defensive explanation. Instead of deciding you have a slow-witted colleague, ask how your article might be made clearer.

A framework for organizing writing using Polyá's four steps in problem-solving emerged from the panel. Understand the Problem, Devise a Plan, Carry Out the Plan, Look Back. Parallel Polyá by answering questions such as, "Under what conditions was this done? Are there related, analogous ideas worth exploring? Can these arguments be used to prove something else?"

A manuscript worth submitting deserves several careful readings and revisions; these will be more time consuming than the original writing. Keep notation accurate and its use minimal. Define unfamiliar terms. Justify your assertions and provide clear, accurate graphics. Include examples. Saving the first draft of your manuscript is helpful. After version six, go back and reread version one. Something valuable may have been lost in the revision.

Editors and referees want your writing to look good in print, observed Schattschneider. If their suggestions seem off the mark, then you were not communicating clearly. Even if you don't agree, try to figure out their reasons and rewrite to take their suggestions into consideration. If you can't revise and it has to be your way, then explain to the editor why this is so.

CHOOSING A JOURNAL There are two approaches to writing: choose a journal and let that decision determine your presentation, or write first and then choose an appropriate journal. Either method requires you to identify your audience so you don't write a a level too high or too low for your reader. Often the journal will seem to choose itself.

Go to a comprehensive library and list all the possible journals as if you were a new student. Identify those with articles similar to yours or with authors from similar schools. The panelists suggested considering foreign journals and those out of field, such as computer science.

Write for sample copies. Ask the editor about the backlog, the acceptance rate and the refereeing policy. A heavy backlog may require a shorter paper. Do not be unduly distressed by a rejection letter and never give up after one journal—or two or three. You will find a fit with the right journal and the right editor.

Perseverance and flexibility are essential for success. The panelists emphasized the importance of continued correspondence with the editor and reviewers. If the journal is taking too long, however, you may withdraw your paper from consideration and submit it elsewhere. On the other hand, if the editor asks you to rewrite, but sure to resubmit, because the chances for acceptance are now very good. You are the author: the initiative is yours.

Frances A. Rosamond is department chair at National University in San Diego, California and is active in the Association for Women in Mathematics as well as being member of the MAA's Committee on the Participation of Women.

Scheduling of Joint Meetings

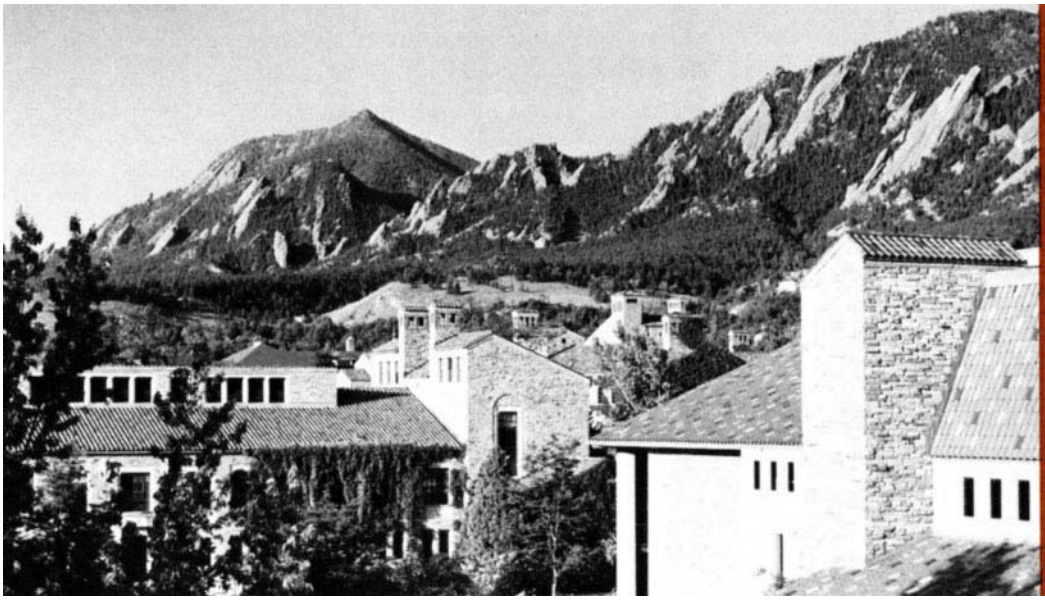
Robert M. Fossum, Secretary, AMS
Kenneth A. Ross, Secretary, MAA

Let us briefly explain just how the scientific portions of Joint Mathematics Meetings are scheduled. The responsibility for scheduling lies with the AMS-MAA Joint Meetings Committee. The four voting members of this committee are the Executive Directors and Secretaries of the two organizations. Hope Daly, Director of Meetings, serves as a professional consultant to the committee. The sequencing of the scientific program is primarily the responsibility of the MAA Secretary and one of the four AMS Associate Secretaries in consultation with the AMS Meetings Department. Efforts are made to avoid concurrent scheduling of closely related program items, but some conflicts are nonetheless inevitable.

Over the decades various agreements concerning scheduling have been made. One rule is that there shall be no scientific program conflicting with business meetings. There are also agreements to avoid, as much as possible, conflicts with the major addresses that are designed for a broad audience: the MAA Hedrick Lectures, the first two AMS Colloquium Lectures, and the AMS-MAA Invited Addresses. In addition, each organization has separately required that none of its own regular programming conflict with its own invited addresses. We believe that these agreements have strengthened the meetings.

A problem developed in that some meeting attendees found too many different events of interest scheduled simultaneously during one time period of the meeting and too few events scheduled at another time period.

The remedy was easy: The AMS and MAA each agreed to relax the no-conflict rule for their separate schedules. Beginning with the summer meeting in Boulder, the combined program will be more evenly spread out. The total number of conflicting activities will remain about the same, but attendees will generally find more choices available to them and a more even schedule over all.



Summer Meetings Boulder Colorado August 7-10 1989

Exciting is the word for the program at these meetings, with Persi Diaconis as the MAA's Hedrick Lecturer speaking on randomness and the mathematics of mixing things up, and with William P. Thurston as the AMS's Colloquium Lecturer speaking on "Geometry, groups, and self-similar tilings." At these meetings the AMS will launch its Progress in Mathematics Lectures with talks by Haim Brezis on "Liquid Crystals" and by Dusa McDuff on PDE methods in symplectic geometry.

Titles in a program announcement can only hint at what is to come, so a few more words about the AMS-MAA invited speakers are in order. John Conway will give a simple algorithm for solving integral quadratic forms. This algorithm gives a picture in the hyperbolic plane, a landscape that reveals much about such forms. Shizuo Kakutani will show us the common principles underlying duality in analysis, the simplest examples of which concern Hilbert spaces or L_p spaces. Serge Lang's title, "Case studies in political opinions passed off as science and mathematics," describes his content well, but one must hear this talk to realize how far these abuses go, the need to combat them, and the energy with which Lang has moved against them. Jean Taylor will speak on how the shapes of crystals can be figured out by using minimum energy conditions.

The MAA will give nine minicourses at this meeting. There is also a full scientific program; see the next two pages. Please note the joint session on EVERYBODY COUNTS and special activities of other organizations including the Pi Mu Epsilon's 75th anniversary celebration.

Boulder is beautifully situated on the eastern slopes of the Rockies, minutes away from excellent hiking and close to some of the pleasantest climbing routes in the country. Major parks and recreation areas are within easy driving distance. This meeting gives mathematicians and their families an unusual opportunity to combine vocation and recreation, so look the program over and come join your colleagues in Colorado in August.

IMPORTANT DEADLINES

AMS Abstracts	
For consideration for special sessions	**May 16**
Of contributed papers	**June 6**
MAA Abstracts	
Of contributed papers	**May 17**
Summer List of Applicants	**June 1**
Preregistration and Housing	**June 1**
MAA Minicourse Preregistration	**June 1**
Motions for AMS Business Meeting	**July 7**
MAA Banquet (50% refund)	**July 14**
Western Hoe Down (50% refund)	**July 14**
ΠME Banquet (50% refund)	**July 14**
Rocky Mountain National Park Tour (50% refund)	**July 14**
Housing Changes and Cancellations with Housing Bureau	**July 17**
Residence Hall Package Cancellation (90% refund)	**July 17**
Preregistration Cancellations (50% refund)	**July 31**

Invited Addresses

There will be five invited fifty-minute addresses. The names of the speakers, their affiliations, the dates, times, and titles follow:

John W. Addison, Jr., University of California, Berkeley, *Selfdual quantifiers: a unifying theme in mathematics and logic*, 8:40 a.m., Tuesday;

Linda Keen, Herbert H. Lehman College, CUNY, *Iteration of rational maps and symbolic dynamics*, 2:30 p.m., Monday;

Mary Ellen Rudin, University of Wisconsin, Madison, *Metrizability in manifolds*, 3:35 p.m., Monday;

Wolfgang M. Schmidt, University of Colorado, Boulder, *The number of solutions of Diophantine equations*, 8:40 a.m., Thursday; and

Nancy K. Stanton, University of Notre Dame, *The Riemann mapping non-theorem*, 3:35 p.m., Wednesday.

MAA PROGRAM

Sunday, August 6

8:30 a.m. – 4:00 p.m. **Board of Governors' Meeting**

Monday, August 7

8:45 a.m. – 10:45 a.m. **Minicourse #1 (Part A):** *The use of personal computers in an introductory linear algebra course,* Homer Bechtell, University of New Hampshire

8:45 a.m. – 10:45 a.m. **Minicourse #2 (Part A):** *Combinatorics via functional equations,* Donald R. Snow, Brigham Young University

11:00 a.m. – 11:50 a.m. **AMS-MAA Invited Address:** *Crystals, in equilibrium and otherwise,* Jean E. Taylor, Rutgers University

2:30 p.m. – 3:20 p.m. **Invited Address:** *Iteration of rational maps and symbolic dynamics,* Linda Keen, Herbert H. Lehman College, CUNY

2:30 p.m. – 4:00 p.m. **AMS-MAA Panel Discussion:** *Everybody counts,* John A. Thorpe, SUNY at Buffalo and chair of the MAA Science Policy Committee, moderator

3:35 p.m. – 4:25 p.m. **Invited Address:** *Metrizability in manifolds,* Mary Ellen Rudin, University of Wisconsin, Madison

4:00 p.m. – 6:00 p.m. **Minicourse #1 (Part B):** *The use of personal computers in an introductory linear algebra course,* Homer Bechtell, University of New Hampshire

4:00 p.m. – 6:00 p.m. **Minicourse #2 (Part B):** *Combinatorics via functional equations,* Donald R. Snow, Brigham Young University

4:00 p.m. – 6:00 p.m. **Minicourse #3 (Part A):** *Chaotic dynamical systems,* Robert L. Devaney, Boston University

4:40 p.m. – 6:40 p.m. **Section Officers' Meeting**

Tuesday, August 8

8:00 a.m. – 9:55 a.m. **Contributed Paper Session:** *Pedagogical uses of symbolic computer systems,* Arnold M. Ostebee, St. Olaf College

8:00 a.m. – 10:00 a.m. **Minicourse #3 (Part B):** *Chaotic dynamical systems,* Robert L. Devaney, Boston University

8:00 a.m. – 10:00 a.m. **Minicourse #4 (Part A):** *Faculty-managed programs that produce minority mathematics majors,* Ray Shiflett, California State Polytechnic University, Pomona and Uri Treisman, University of California, Berkeley

8:00 a.m. – 10:00 a.m. **Minicourse #5 (Part A):** *Starting, funding and sustaining mathematics laboratories,* Stavros N. Busenberg, Harvey Mudd College

8:30 a.m. – 9:55 a.m. **Panel Discussion:** *Public hearing on accreditation,* sponsored by ad hoc Committee on Accreditation, John D. Fulton, chair

8:40 a.m. – 9:30 a.m. **Invited Address:** *Selfdual quantifiers: a unifying theme in mathematics and logic,* John W. Addison, Jr., University of California, Berkeley

10:10 a.m. – 11:00 a.m. **AMS-MAA Invited Address:** *Case studies of political opinions passed off as science and mathematics,* Serge Lang, Yale University

11:15 a.m. – 12:15 p.m. **Hedrick Lecture I:** *The mathematics of mixing things up: From card shuffling to counting and back,* Persi Diaconis, Harvard University

2:25 p.m. – 4:25 p.m. **Minicourse #3 (Part C):** *Chaotic dynamical systems,* Robert L. Devaney, Boston University

2:25 p.m. – 4:25 p.m. **Minicourse #4 (Part B):** *Faculty-managed programs that produce minority mathematics majors,* Ray Shiflett, California State Polytechnic University, Pomona and Uri Treisman, University of California, Berkeley

2:25 p.m. – 4:25 p.m. **Minicourse #5 (Part B):** *Starting, funding and sustaining mathematics laboratories,* Stavros N. Busenberg, Harvey Mudd College

2:30 p.m. – 4:20 p.m. **Contributed Paper Session:** *Pedagogical uses of symbolic computer systems,* Arnold M. Ostebee, St. Olaf College

2:30 p.m. – 4:20 p.m. **Contributed Paper Session:** *Calculus revision,* Thomas W. Tucker, Colgate University

2:30 p.m. – 4:20 p.m. **MAA-PME Undergraduate Student Paper Session**

MAA Program Committee: Lawrence W. Baggett (chair), Lisl Gaal, Richard Andrew Holley, Jay Huber, John M. Smith (ex-officio), Richard Summerhill, Audrey A. Terras, Sylvia Wiegand, and Herbert S. Wilf

AMS-MAA Joint Program Committee: Sheldon Axler (chair), Alexandra Bellow, Hugh Montgomery, and Mary Ellen Rudin

Local Arrangements Committee: Larry W. Baggett, William L. Briggs, Richard Andrew Holley, Frieda K. Holley, William H. Jaco (ex-officio), Andy Roy Magid (ex-officio), Arlan Ramsay (chair), William N. Reinhardt, Kenneth A. Ross (ex-officio), and Richard L. Roth.

Wednesday, August 9

8:00 a.m. – 9:55 a.m.	**Contributed Paper Session:** *Calculus revision,* Thomas W. Tucker, Colgate University
8:00 a.m. – 9:55 a.m.	**MAA-PME Undergraduate Student Paper Session**
8:00 a.m. – 10:00 a.m.	**Minicourse #6 (Part A):** *Group theory through art,* Thomas Brylawski, University of North Carolina
8:00 a.m. – 10:00 a.m.	**Minicourse #7 (Part A):** *HP-28S short course for nearly inexperienced users,* Jerold Mathews, Iowa State University
8:30 a.m. – 9:55 a.m.	**A Forum on Mathematics Majors:** *Are we teaching majors the right mathematics? Are we teaching it the right way?* sponsored by CUPM Subcommittee on the Major in the Mathematical Sciences, Bettye Anne Case, chair
10:10 a.m. – 11:00 a.m.	**AMS-MAA Invited Address:** *The principle of duality in mathematical analysis,* Shizuo Kakutani, Yale University
11:15 a.m. – 12:15 p.m.	**Hedrick Lecture II:** *The mathematics of mixing things up: Reversible chains and eigenvalues of the Laplacian,* Persi Diaconis, Harvard University
2:30 p.m. – 3:20 p.m.	**AMS-MAA-PME Invited Address:** *The mathematics of identification numbers,* Joseph A. Gallian, University of Minnesota, Duluth
2:30 p.m. – 4:30 p.m.	**Minicourse #6 (Part B):** *Group theory through art,* Thomas Brylawski, University of North Carolina
2:30 p.m. – 4:30 p.m.	**Minicourse #8 (Part A):** *Applications of the HP-28S for experienced users,* Thomas W. Tucker, Colgate University
3:35 p.m. – 4:25 p.m.	**Invited Address:** *The Riemann mapping non-theorem,* Nancy K. Stanton, University of Notre Dame
4:40 p.m. – 5:40 p.m.	**Prize Session and Business Meeting:** Beckenbach Book Prize; Merten M. Hasse Prize; Allendoerfer, Ford and Pólya Awards
5:45 p.m. – 10:00 p.m.	**Banquet for 25-Year Members**

Thursday, August 10

8:00 a.m. – 9:55 a.m.	**Panel Discussion:** *The role of the computer in calclulus reform,* sponsored by the Committee on Computers in Mathematics Education (CCIME), David A. Smith, chair
8:00 a.m. – 10:00 a.m.	**Minicourse #7 (Part B):** *HP-28S short course for nearly inexperienced users,* Jerold Mathews, Iowa State University
8:00 a.m. – 10:00 a.m.	**Minicourse #9 (Part A):** *A seminar on women in mathematics,* Miriam P. Cooney csc, Saint Mary's College
8:40 a.m. – 9:30 a.m.	**Invited Address:** *The number of solutions of Diophantine equations,* Wolfgang M. Schmidt, University of Colorado, Boulder
10:10 a.m. – 11:00 a.m.	**AMS-MAA Invited Address:** $ax^2+hxy+cy^2=n$, John H. Conway, Princeton University
11:15 a.m. – 12:15 p.m.	**Hedrick Lecture III:** *The mathematics of mixing things up: Modern Markov chain theory,* Persi Diaconis, Harvard University
1:15 p.m. – 3:15 p.m.	**Minicourse #8 (Part B):** *Applications of the HP-28S for experienced users,* Thomas W. Tucker, Colgate University
1:15 p.m. – 3:15 p.m.	**Minicourse #9 (Part B):** *A seminar on women in mathematics,* Miriam P. Cooney csc, Saint Mary's College
1:15 p.m. – 6:00 p.m.	**Contributed Paper Session:** *Students as consultants,* Hedley C. Morris, San Jose State University

HEDRICK LECTURES

The 37th Earle Raymond Hedrick Lectures will be given by **Persi Diaconis** of Harvard University. These lectures are scheduled at 11:15 a.m. on Tuesday, Wednesday, and Thursday, August 8–10. The titles of the lectures are as follows: Lecture I – "The mathematics of mixing things up: From card shuffling to counting and back;" Lecture II – "The mathematics of mixing things up: Reversible chains and eigenvalues of the Laplacian;" Lecture III – "The mathematics of mixing things up: Modern Markov chain theory."

COLLOQUIUM LECTURES

A series of four Colloquium Lectures will be given by **William P. Thurston** of Princeton University. The title of this lecture series is "Geometry, groups, and self-similar tilings." The lectures will be given at 1:15 p.m. daily, Monday through Wednesday, August 7–9, and at 3:00 p.m. on Thursday, August 10.

AMS-MAA-Pi Mu Epsilon Special Address

Pi Mu Epsilon, Inc., the national honorary mathematical society founded in 1914 at Syracuse University, will celebrate its 75th anniversary at the Boulder meetings.

In honor of the occasion, AMS and MAA will cosponsor with Pi Mu Epsilon an invited address on *The mathematics of identification numbers* by Joseph A. Gallian, University of Minnesota, Duluth. This talk is scheduled for Wednesday, August 9, at 2:30 p.m.

Minicourses (see form page 35)

Nine Minicourses are being offered by the MAA. The names and affiliations of the organizers, the topics, the dates and times of their meetings, and the enrollment limitations of each are as follows:

Minicourse #1: *The use of personal computers in an introductory linear algebra course* is being organized by Homer Bechtell, University of New Hampshire. Part A is scheduled from 8:45 a.m. to 10:45 a.m. on Monday, August 7, and Part B from 4:00 p.m. to 6:00 p.m. on Monday, August 7. Enrollment is limited to 80.

The effective use of personal computers in an undergraduate linear algebra course is the focus of this course. In Part A, goals and strategies for their implementation are established through the use of the less sophisticated software. This is followed by a review of the mathematical literacy required for a student to be proficient with the software. By removing the constraints imposed by computation, attention is directed toward the design of problem sets that reenforce the fundamentals in the underlying theory. Among the areas in an introductory course in which challenging exercises are needed are the sum and intersection of vector spaces, the LU-decomposition, least squares, projections, quadratic forms, and orthogonal transformations. In Part B, a format will be suggested through examples for each area. Participant involvement will be encouraged. Experience in teaching undergraduate linear algebra is the only prerequisite. Computer anxiety is permitted.

Minicourse #2: *Combinatorics via functional equations* is being organized by Donald R. Snow, Brigham Young University. Part A is scheduled from 8:45 a.m. to 10:45 a.m. on Monday, August 7, and Part B from 4:00 p.m. to 6:00 p.m. on Monday, August 7. Enrollment is limited to 80.

Many combinatorial functions can be described, studied, and unified by using a simple functional equations approach. These functions include combinations and permutations with various allowable repetitions or no repetitions, sums of the powers of the integers formulas, and many generalizations of these. This gives a method of describing the functions based on its combinatorial interpretation, studying its properties, obtaining its generating function in a direct manner, showing how all these functions are related, and giving several new results. Some of these combinatorial functions yield generalizations of Pascal's Triangle and their proprieties yield generalizations of the Pascal triangle properties of binomial coefficients. Some of these more interesting properties will be illustrated using computer printouts. The needed background in functional equations will be developed in the Minicourse so only a knowledge of calculus will be assumed.

Minicourse #3: *Chaotic dynamical systems* is being organized by Robert L. Devaney, Boston University. Part A is scheduled from 4:00 p.m. to 6:00 p.m. on Monday, August 7, Part B from 8:00 a.m. to 10:00 a.m. on Tuesday, August 8, and Part C from 2:25 p.m. to 4:25 p.m. on Tuesday, August 8. Enrollment is limited to 80.

The goal of this Minicourse is to introduce some of the main ideas of dynamical systems theory in as simple a setting as possible, namely, iteration of functions of a single real or complex variable. Lectures will be devoted to such topics as chaos, Julia sets, the Mandelbrot set, and bifurcations. Computer graphics experiments which yield the fascinating images from dynamics will be described. Most of the lectures will be aimed at describing the mathematics behind the concept of "chaos," but some time will be devoted to ways to incorporate ideas from dynamics into the undergraduate curriculum, ranging from precalculus and calculus courses to advanced student research projects.

Minicourse #4: *Faculty-managed programs that produce minority mathematics majors* is being organized by Ray Shiflett, California State Polytechnic University, Pomona, and Uri Treisman, University of California, Berkeley. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Tuesday, August 8, and Part B from 2:25 p.m. to 4:25 p.m. on Tuesday, August 8. Enrollment is limited to 40.

Freshman Calculus and Pre-calculus have been burial grounds for the aspirations of the great majority of Black and Hispanic students who enter college to prepare for careers in mathematics- or science-based professions. These courses have been insuperable barriers, even for minority students who are well prepared mathematically and who want to become mathematics majors. This Minicourse is an exploration of a faculty-managed and departmentally-based approach to helping students excel in first-year college mathematics. It is an alternative to remedial or developmental programs–the standard responses to minority student failure. The approach has led to dramatic improvements in Black and Hispanic students' performance at Berkeley, where it was developed in the mid-1970's. It has now been adapted successfully at Cal Poly Pomona and at more than 30 other colleges and universites nationwide.

Minicourse #5: *Starting, funding and sustaining mathematics laboratories* is being organized by Stavros N. Busenberg, Harvey Mudd College. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Tuesday, August 8, and Part B from 2:25 p.m. to 4:25 p.m. on Tuesday, August 8. Enrollment is limited to 75.

This course will familiarize participants with successful examples of the use of computer laboratories in the undergraduate mathematics curriculum. The course will feature descriptions of ongoing examples of such laboratories by three or four faculty who have been involved in them at a variety of settings: a small college, a private university, a large state university, and a two-year college. The presentations will describe the curricular innovations that have been made possible by the availability of a mathematics computer laboratory, the software that has been found to be useful, and the means by which the laboratories obtained their initial fund and continuing support.

Part of the Minicourse will outline sources of funding and methods for increasing the probability of success for proposals for such funding. A representative (current or recent past) of the National Science Foundation will be available to give first-hand information about funding possibilities there.

Minicourse #6: *Group theory through art* is being organized by Thomas Brylawski, University of North Carolina, Chapel Hill. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Wednesday, August 9, and Part B from 2:30 p.m. to 4:30 p.m. on Wednesday, August 9. Enrollment is limited to 80.

This Minicourse will explore how most of the theory introduced in a first course in group theory can be illustrated (and better understood) using discrete groups of isometries (frieze and wallpaper patterns). Using only synthetic plane geometry as a basis, the two-dimensional groups will be classified. In classification concepts such a isomorphism (of both groups and short exact sequences), examples of subgroup, index, centralizer, conjugate, quotient group, free abelian groups, homomorphism, commutator, etc. occur naturally and are illustrated by patterns from many cultures (e.g., many colored patterns each give examples of non-isomorphic groups, each isomorphic to a subgroup of the other). Hand-in-hand with this analytic theory, going from the pattern to its symmetry group, goes the synthetic theory of creating patterns from the group and a fundamental region. Here, kaleidoscopes illustrate generators and relations, word problems, and Dirichlet tessellations.

Minicourse #7: *HP-28S short course for nearly inexperienced users* is being organized by Jerold Mathews, Iowa State University. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Wednesday, August 9, and Part B from 8:00 a.m. to 10:00 a.m. on Thursday, August 10. Enrollment is limited to 80.

This Minicourse will provide a jump-start for nearly inexperienced users toward using the power of the HP-28S. Each participant is expected to bring along an HP-28S (those with an HP28C will be able to participate fully, excepting one or two topics). The course will include an introduction to reverse Polish and algebraic entry modes, use of some of the built-in functions, and writing, entering, editing, and running user-written functions and programs. A handout will be distributed, including course notes, programs, and a bibliography of HP-28S literature and program sources. Participants will work through (i.e., discuss, enter, edit, and run) built-ins including (as time permits) SOLV, DRAW, CROSS, DOT, MOD, FACT, LR, IFTE, and d/dx., as well as several programs. These may include a program for the game in which the player chooses a positive integer n, replaces it by n/2 or 3n+1, depending on whether n is even or odd, and then repeats until 1 is obtained (if ever), a Pythagorean triples generator, recursive and a non-recursive Fibonacci sequence programs, a polar plotting program, and a Newtons method program. We will try to arrange a program exchange for those who are interested.

Minicourse #8: *Applications of the HP-28S for experienced users* is being organized by Thomas W. Tucker, Colgate University. Part A is scheduled from 2:30 p.m. to 4:30 p.m. on Wednesday, August 9, and Part B from 1:15 p.m. to 3:15 p.m. on Thursday, August 10. Enrollment is limited to 80.

This Minicourse will illustrate uses of the HP-28S supercalculator in various undergraduate mathematics courses. Particular emphasis will be given to the creation of environments customized for experimenting or problem-solving in a given part of a course: curve sketching for calculus with various features (automatic range finding, single-button computation of extrema and inflection points), comparison of numerical integration techniques also for calculus, numerical solution of differential equations and trajectory plotting, pivoting and matrix editing, and viewing for linear algebra, curve fitting for data analysis, routines for number theory (factoring, prime testing, linear congruence solving, powering). Although there will be some playing around with fractals or music, attention will generally be restricted to things the HP-28S can do quickly and easily; things best left to a computer (e.g. 3-dimensional graphics) are left to a computer.

Participants will be expected to bring their own HP-28S calculators and be comfortable with the main features of the HP-28S. In particular, it is assumed that participants have done some programming on the calculator.

Minicourse #9: *A seminar on women in mathematics* is being organized by Miriam P. Cooney csc, Saint Mary's College, Notre Dame, Indiana. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Thursday, August 10, and Part B from 1:15 p.m. to 3:15 p.m. on Thursday, August 10. Enrollment is limited to 30.

The goal of this Minicourse is to prepare participants to conduct a seminar that identifies women mathematicians (past and present), studies their lives and the mathematical times as a context for their work, and reveals mathematics as a human pursuit. Applying the assumption that social-emotional aspects of learning are important to students of mathematics, the Minicourse will provide strategies for creating a seminar that provides a support group to encourage potential mathematics majors, both women and men.

The content of the Minicourse, like the seminar, will include history and stories of women mathematicians, gender bias and its historic causes, research on gender differences, alternate teaching/learning styles, and research on "women's ways of knowing." The format will follow seminar-style discussions, including consideration of the difficulties in learning the discussion process as a mode of teaching. Readings and a syllabus will be sent to participants prior to the meeting.

Participants interested in attending any of the MAA Minicourses should complete the MAA Minicourse Preregistration Form **and send it directly to the MAA office at the address given on the form so as to arrive prior to the June 1 deadline. DO NOT SEND THIS FORM TO PROVIDENCE. Please note that these MAA Minicourses are NOT the AMS Short Course.** After the deadline, potential participants are encouraged to call the MAA headquarters at 800-331-1622.

Please note that prepayment is required. Payment can be made by check payable to MAA (Canadian checks must be marked "in U.S. funds") or VISA or MASTERCARD credit cards.

The MAA Minicourses are open only to persons who register for the Joint Mathematics Meetings and pay the Joint Meetings registration fee. **If the only reason for registering for the Joint Meetings is to gain admission to a MAA Minicourse, this should be indicated by checking the appropriate box on the MAA Minicourse Preregistration Form. Then, if the Minicourse is fully subscribed, full refund can be made of the Joint Meetings preregistration fee. Otherwise, the Joint Meetings preregistration will be processed, and then be subject to the 50% refund rule. Participants should take care when cancelling Minicourse preregistration to make clear their intention as to their Joint Meetings preregistration, since if no instruction is given, the Joint Meetings registration will also be cancelled. PREREGISTRATION FORMS FOR THE JOINT MEETINGS SHOULD BE MAILED TO PROVIDENCE PRIOR TO THE DEADLINE OF JUNE 1.**

The registration fee for each MAA Minicourse is $30.

Contributed Papers

Contributed papers are being accepted on three topics in collegiate mathematics. The topics, the names and affiliations of the organizers, and days they will meet are:

- *Pedagogical uses of symbolic computer systems*, Arnold M. Ostebee, St. Olaf College, Tuesday morning and afternoon; Monday afternoon if needed.

  Symbolic computer systems (also known as computer algebra systems) make machine-based graphical, numerical, and symbolic computing accessible to students. Examples of such systems are muMATH, Derive, Macsyma, Maple, Mathematica, Reduce, SMP, and the HP-28S calculator. Papers are invited that describe experiences using symbolic computer systems in instructional settings at all levels, from pre-calculus to graduate-level courses.

- *Calculus revision*, Thomas W. Tucker, Colgate University, for the CUPM Subcommittee on Calculus Reform and the First Two Years, Tuesday afternoon and Wednesday morning; Wednesday afternoon if needed.

  The session will feature papers describing recent developments in revising the content and pedagogy of calculus. This is a continuation of the session *What is happening with calculus revision* presented at Phoenix, January 1989.

- *Students as consultants*, Hedley C. Morris, San Jose State University, Thursday afternoon; Thursday morning if needed.

  Papers are solicited on special programs or mathematics clinics for advanced undergraduates who have served as part of a consulting team to nearby industry. Talks by students who have participated are particularly encouraged.

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 at 1529 Eighteenth Street, NW, Washington, DC 20036 **by May 17**:

1. Title
2. Intended session
3. A one-paragraph abstract (for distribution at the meeting)
4. A one-page outline of the presentation

Please see information about audio-visual equipment for these sessions which follows.

Undergraduate Student Paper Session

The Second Undergraduate Student Paper Session is sponsored by MAA in conjunction with Pi Mu Epsilon, the undergraduate mathematics honorary society, and the MAA Student Sections. The talks are scheduled for Tuesday afternoon, August 8, and Wednesday morning, August 9. Nominations for papers from sections of MAA, mathematics departments, and other interested parties, with a brief abstract, should be sent to Ron Barnes, Department of Applied Mathematical Sciences, University of Houston-Downtown, 1 Main Street, Houston, TX 77002. Deadline for nominations is **May 15, 1989**.

Other MAA Sessions

Public Hearing on Accreditation

The ad hoc Committee on Accreditation (John D. Fulton, chair) is sponsoring a "public hearing" while in the process of drafting an accreditation document for undergraduate mathematics. It will propose accreditation for mathematics among U.S. colleges (including two-year) and universities and will include guidelines for accreditation. Alternatively, the completed document could be used as a model to delineate guidelines for undergraduate programs in the mathematical sciences. John D. Fulton, University of West Florida, will moderate the panel. Participants are Calvin T. Long, Washington State University and Lynn A. Steen, St. Olaf College. This session is scheduled from 8:30 a.m. to 9:55 a.m. on Tuesday, August 8.

A Forum on Mathematics Majors

A forum on *Are we teaching majors the right mathematics? Are we teaching it the right way?* is scheduled from 8:30 a.m. to 9:55 a.m. on Wednesday, August 9. The participants include Bettye Anne Case, Florida State University, who is chair of the CUPM Subcommittee on the Major in the Mathematical Sciences; James R.C. Leitzel, Ohio State University, who is chair of the Committee on the Mathematical Education of Teachers (COMET); and Lynn A. Steen, St. Olaf College, who is chair of the Committee on the Undergraduate Program in Mathematics (CUPM).

Computers in Calculus Reform

The Committee on Computers in Mathematics Education (CCIME) is sponsoring a panel discussion on *The role of the computer in calculus reform.* The moderator for this panel is Eugene A. Herman, Grinnell College. Participants include Robert L. Devaney, Boston University; Kenneth R. Hoffman, Hampshire College; David A. Smith, Duke University and chair of CCIME; and Paul Zorn, St. Olaf College. This session is scheduled from 8:00 a.m. to 9:55 a.m. on Thursday, August 10.

Audio-Visual Equipment

Rooms where MAA sessions will be held are equipped with one overhead projector and screen. (Invited 50-minute speakers are automatically provided with two overhead projectors.) **Blackboards will be available only in some rooms.**

Persons having other equipment needs should contact the secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403) as soon as possible, but in any case prior to **June 1**.

Upon written request, the following projection equipment will be made available: one additional overhead projector/screen, 35mm carousel slide projector, 16mm film projector, or VHS video cassette recorder with one color monitor.

Speakers requiring special equipment are required to submit their needs **in writing prior to June 1**.

Prize Session and Business Meeting

The MAA Prize Session and Business Meeting is scheduled from 4:40 p.m. to 5:40 p.m. on Wednesday, August 9. The 1989 Beckenbach Book Prize and Merten M. Hasse Prize will be awarded. In addition, the 1989 Carl B. Allendoerfer, Lester R. Ford, and George Pólya Awards will be presented. A bylaw change that would add the chair of the Committee on Sections to the Executive Committee will be voted on by the membership. This meeting is open to all members of the Association.

Board of Governors

The MAA Board of Governors will meet at 8:30 a.m. on Sunday, August 6. This meeting is open to all members of the Association.

Section Officers

There will be a Section Officers' meeting at 4:40 p.m. on Monday, August 7.

MAA Banquet for 25-year Members

The MAA is planning its fourteenth annual banquet for those individuals who have been members of the Association for twenty-five years or more. The banquet will be held on Wednesday, August 9, in the University Club dining room. A reception with cash bar will take place from 5:45 p.m. to 6:30 p.m. Dinner will be served at 6:30 p.m.

The menu includes tossed salad, filet mignon, baked potato, broccoli with cheese, rolls and butter, French silk pie, and coffee. **Please note that all tickets for this banquet must be purchased through preregistration, since a guarantee must be given to the caterer.** Tickets are $21 each; the price includes the gratuity. Interested participants should complete the appropriate section of the Preregistration/Housing Form and include appropriate payment. In the event of cancellations, a 50% refund of the amount paid for the ticket will be made if notification is received in Providence by July 14. After that date, no refund can be given.

AMS-MAA Invited Addresses

By invitation of the AMS-MAA Joint Program Committee (Sheldon Axler, chairman; Alexandra Bellow; Hugh Montgomery; and Mary Ellen Rudin), four speakers will address the AMS and MAA on the history and development of mathematics. The names of the speakers, their affiliations, the titles, dates, and times of their talks follow:

John H. Conway, Princeton University, $ax^2 + hxy + cy^2 = n$, 10:10 a.m. Thursday.

Shizuo Kakutani, Yale University, *The principle of duality in mathematical analysis*, 10:10 a.m. Wednesday.

Serge Lang, Yale University, *Case studies of political opinions passed off as science and mathematics*, 10:10 a.m. Tuesday.

Jean E. Taylor, Rutgers University, *Crystals, in equilibrium and otherwise*, 11:00 a.m. Monday.

Other AMS–MAA Joint Sessions

Everybody Counts Panel Discussion

The AMS and MAA are cosponsoring a panel discussion of the recent report *Everybody Counts*. This report, which was prepared by the Mathematical Sciences Education Board of the National Research Council, describes weaknesses in our mathematics education enterprise and issues a call for action. The panel will outline the findings of the report and discuss how the mathematical community can help. John A. Thorpe, SUNY at Buffalo and Chair of the MAA Science Policy Committee, is the organizer and moderator. This session is scheduled from 2:30 p.m. to 4:00 p.m. on Monday, August 7.

92nd Summer Meeting of the AMS August 7–10, 1989

Progress in Mathematics Lectures

Beginning with the Boulder meetings, the Society will inaugurate a new kind of lecture series titled *Progress in Mathematics*. This series will provide a forum for the exposition of mathematical topics that have come into prominence in the past five years. The members of the Selection Committee for these lectures are Armand Borel, Paul H. Rabinowitz, Hugo Rossi, John T. Tate, and Alan Weinstein.

The names and affiliations of the speakers, their titles, and the days and times they will talk are as follows:

Haim Brezis, Rutgers University and Université de Paris VI, *Liquid crystals*, 1:15 p.m. Thursday.

Dusa McDuff, SUNY at Stony Brook, *Applications of PDE methods by Gromov, Floer, and others to symplectic geometry of manifolds*, 2:30 p.m. Tuesday.

Invited Addresses

There will be two fifty-minute invited addresses. The names of the speakers, their affiliations, the dates, times and titles of their talks follow: Maury D. Bramson, University of Wisconsin, Madison, *Asymptotic densities for diffusing particles in certain basic chemical reactions*, 9:35 a.m. Monday. Howard A. Masur, University of Illinois at Chicago, *The dynamics of billiards in polygons*, 8:30 a.m. Monday.

Special Sessions

There will be five special sessions of selected twenty-minute papers as follows: *History of orthogonal polynomials*, Richard A. Askey, University of Wisconsin, Madison; *Mathematical questions in computational geometry*, George J. Fix and Rangabhary Kannan, University of Texas at Arlington; *Free boundary problems and partial differential equations*, Kirk E. Lancaster, Wichita State University, and Edward W. Stredulinsky, Lawrence University; *Dynamics and moduli space*, Howard A. Masur and John Smillie, Cornell University; *Computational number theory and applications*, Kevin S. McCurley, I.B.M. Almaden.

There will be sessions for contributed papers Monday morning and afternoon, Tuesday morning, Wednesday morning and afternoon, and Thursday morning and afternoon.

Short Course on Cryptology and Computational Number Theory

The AMS Short Course on *Cryptology and computational number theory* will be held on Sunday and Monday, August 6 and 7. Speakers include Shafi Goldwasser, Arjen K. Lenstra, Kevin S. McCurley, Jeffrey C. Lagarias, and Carl Pomerance.

Activities of Other Organizations

The **Association for Women in Mathematics** (AWM) is sponsoring a panel discussion on *Women in operations research: Their work and experiences*, on Tuesday, August 8, at 9:00 a.m. The moderator is Jill P. Mesirov, Thinking Machines Corporation. Panelists are Margaret Brandeau, Stanford University; Janice Hammond, Harvard Business School; and Margaret Wright, AT&T Bell Laboratories.

The AWM Membership Meeting will be held at 8:30 a.m. on Tuesday, August 8.

An open reception is planned for Tuesday evening, August 8, at 9:30 p.m.

The **Joint Policy Board for Mathematics** (JPBM) Committee for Mathematics Department Heads has organized a National Meeting of Department Heads at 7:00 p.m. on Monday, August 7, organized by Tom Trotter, Arizona State University.

As previously mentioned, **Pi Mu Epsilon** is celebrating its 75th anniversary in Boulder. ΠΜΕ encourages institutions to send student speakers and delegates to its Diamond Jubilee. Travel grants will be available for student participants. For further information, please contact Eileen Poiani, Saint Peter's College, 2641 Kennedy Boulevard, Jersey City, NJ 07306 or Robert Woodside, Department of Mathematics, East Carolina University, Greenville, NC 27858.

The ΠΜΕ Reception will be held on Monday, August 7, at 7:00 p.m. There will be sessions for contributed papers Tuesday morning and afternoon and Wednesday morning. The ΠΜΕ Council will meet from noon to 1:00 p.m. on Tuesday, August 8.

ΠΜΕ invites all participants to help celebrate its 75th anniversary at the Western Hoe Down on Tuesday evening, August 8, at 6:30 p.m. A special program of entertainment will be presented by ΠΜΕ members.

The ΠΜΕ Dutch Treat Breakfast will take place on Wednesday, August 9, at 8:00 a.m.

The ΠΜΕ Banquet will take place on Wednesday, August 9, at 6:30 p.m. followed by the Frame Lecture. The banquet will be held in the Aspen Room, located in the University Memorial Center on campus.

Please note that all tickets for this banquet must be purchased through preregistration, since a guarantee must be given to the caterer. Tickets are $9 each; the price includes gratuity. The menu includes tossed salad, chicken crepes in lemon sauce, vegetable, rice, rolls with butter, fresh fruit tort, coffee and nonalcoholic punch. Interested participants should complete the appropriate section of the Preregistration/Housing Form and include appropriate payment. In the event of cancellations, a 50% refund of the amount paid for the ticket will be made if notification is received in Providence **by July 14**. After that date, no refund can be given.

The J. Sutherland Frame Lecture will be delivered on Wednesday, August 9, at 8:30 p.m. by Jane Cronin Scanlon, Rutgers University, on *Entrainment of frequency: A recurring theme.*

ΠΜΕ will cosponsor undergraduate student paper sessions with MAA. Further information can be found in the MAA section of this announcement.

There will be an exhibit of ΠΜΕ memorabilia on campus at a location to be announced. Materials for this exhibit are on loan from Syracuse University where ΠΜΕ was founded in 1914.

Other Events of Interest

Book Sales

Books published by the AMS and MAA will be sold at discounted prices somewhat below the cost for the same books purchased by mail. **These discounts will be available only to registered participants wearing the official meeting badge.** VISA and MASTERCARD credit cards will be accepted for book sale purchases at the meeting. The book sales will be open the same days and hours as the exhibits.

AMS Members' Information Booth

Please visit the AMS members' booth in the exhibit area during the meeting. Complimentary coffee and tea will be served for participants. Carol-Ann Blackwood, Member Services Manager of the Society, will be at the members' booth to meet members personally. Bring Mrs. Blackwood your comments and compliments about member services.

Exhibits

The book and educational media exhibits are open Monday through Thursday, August 7–10. The hours they are open are 1:00 p.m. to 5:00 p.m. on Monday, 9:00 a.m. to 5:00 p.m. Tuesday and Wednesday, and 9:00 a.m. to noon on Thursday. All participants are encouraged to visit the exhibits during the meeting.

Summer List of Applicants

At the direction of the AMS-MAA-SIAM Committee on Employment Opportunities, which is charged with operation of the Employment Register and with the publication of *Employment Information in the Mathematical Sciences*,

the Society will publish a Summer List of mathematical scientists seeking employment for distribution at the Boulder meeting.

Copies of the 1989 summer list of applicants will be available at the Transparencies section of the registration desk for $5. Following the meeting, they may be purchased from the AMS office in Providence for $7. This list should prove useful to employers who have last-minute openings in the latter part of the summer or in the fall.

The deadline for receipt of applicant forms to appear in this summer list is June 1.

The applicant preregistration résumé and instructions on its completion can be found in this issue.

Instead of an Employment Register at the Summer Meeting in Boulder, there will be an opportunity for posting of both applicant résumé forms and employers' announcements of open positions in or near the main meeting registration area. There will be no special room set aside for interviews. No provisions will be made by the Society for interviews; arrangements will be the responsibility of each employer and applicant. Messages may be left in the message box located in the registration area.

Special applicant and employer forms will be available at the Transparencies section of the registration desk both for applicants to post résumés and for employers to post forms announcing positions.

Applicants who submit an applicant form, but do not plan to attend the meeting, will appear on the printed list only. There is no provision made for posting résumés for participants who do not attend the meeting. No printed lists of employers or applicants who register at the meeting will be available after the meeting.

How to Preregister (see form page 33)

The importance of early preregistration cannot be overemphasized. Some of the benefits of early preregistration are a guaranteed room at the university, inclusion in the alphabetical list of preregistrants displayed in the registration area, reduced waiting time at the Joint Meetings Registration Desk, and registration at fees considerably lower than the fees that will be charged for registration at the meeting.

Preregistration for these meetings must be completed by June 1, 1989.

It is essential that the Preregistration/Housing Form (found at the back of this issue) be completed fully and clearly. In the case of several preregistrations from the same family, **each** family member who is preregistering should complete a separate copy of the Preregistration/Housing Form, but all preregistrations from one family may be covered by one payment. Please print or type the information requested, and be sure to complete all sections. Absence of information (missing credit card numbers, incomplete addresses, etc.) causes a delay in the processing of preregistration for that person.

Please provide your nickname if you wish this information to be printed on your badge. Also, it is planned to make available at the meeting a list of preregistrants by area of interest. If you wish to be included in this list, please provide the *Mathematical Reviews* classification number of your major area of interest on the Preregistration/Housing Form. The master copy of this list will be available for review by participants at the Message Center section of the registration desk.

Modes of payment which are acceptable, provided they are payable in U.S. dollars to the order of the American Mathematical Society, are U.S. Postal Money Orders, certified U.S. bank checks, U.S. bank money orders, personal checks drawn on a U.S. bank, or credit card (Visa or MasterCard only).

Receipt of the Preregistration/Housing Form and payment will be acknowledged by the Mathematics Meetings Housing Bureau. Participants are advised to bring a copy of this acknowledgement with them to Boulder.

The Joint Meetings registration fees at the meeting will be 30% higher than the preregistration fees listed below.

Joint Mathematics Meetings

Member of AMS, Canadian Mathematical Society, MAA, ΠME	$63
Emeritus Member of AMS, MAA	$18
Nonmember	$98
Student/Unemployed	$18

AMS Short Course

Student/Unemployed	$15
All Other Participants	$40

MAA Minicourses
(if openings available)

Minicourses # 1 – 9	$30

A $5 charge will be imposed for all invoices prepared when preregistration forms are submitted without accompanying check(s) for the preregistration fee(s) or are accompanied by an amount insufficient to cover the total payments due. We are sorry, but it is not possible for the Mathematics Meetings Housing Bureau to refund amounts less than $2. Preregistration forms received well before the deadline of June 1 which are not accompanied by correct payment will be returned to the participant with a request for resubmission with full payment. This will, of course, delay the processing of any housing request.

An income tax deduction is allowed for education expenses, including registration fees, cost of travel, meals and lodging incurred to (i) maintain or improve skills in one's employment or trade or business or (ii) meet express requirements of an employer or a law imposed as a condition to retention of employment, job status, or rate of compensation. This is true even for education that leads to a degree. However, the Tax Reform Act of 1986 has introduced significant changes to this area. In general, the deduction for meals is limited to 80% of the cost. Unreimbursed employee educational expenses are subject to a 2% of adjusted gross income floor. However, there are exceptions to these rules. Therefore, one should contact one's tax advisor to determine the applicability of these provisions.

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

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

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

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

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

How to Obtain Residence Hall Accomodations (see form page 34)

The use of the services offered by the Mathematics Meetings Housing Bureau requires preregistration for the Joint Mathematics Meetings. All reservation requests for university accommodations must be received in writing and be processed through the Housing Bureau. Telephone requests cannot be accepted. **Please do not contact the university directly, since they will only refer callers back to the Housing Bureau.** Preregistrants will receive an acknowledgement of their room requests. **However, the university is responsible for making room assignments in the residence halls.**

Participants desiring confirmed reservations in the University of Colorado, Boulder, residence halls should read carefully the section on **University Housing** and then choose preferred accommodations. This information should be indicated clearly in the Housing Section of the Preregistration/Housing Form, and the form submitted with the appropriate payment in full **so as to arrive no later than June 1, 1989**.

Participants who are able to do so are urged to share a room whenever possible. This procedure can be economically beneficial. The housing form should be fully completed to ensure proper assignment of rooms. Participants planning to share accommodations should provide the name of the person with whom they plan to occupy a room. Each participant should, however, complete a separate Preregistration/Housing Form. Parties planning to share rooms should send their forms together in the same envelope, if possible. **If two participants arriving on different days plan to share a double room, each participant must submit the per person amount due applicable to his or her particular choice.**

Housing payments for residence hall accommodations will be forwarded to the University of Colorado, Boulder, on your behalf.

Accommodations

University Housing

Participants desiring confirmed reservations for on-campus housing **must preregister** and send payment in full for housing to the Mathematics Meetings Housing Bureau **prior to the June 1, 1989 deadline**. Participants in the Joint Mathematics Meetings may occupy residence hall rooms at the University of Colorado during the period August 4 to August 11 only. **All must check out by 10:00 am on August 11. (Check-in time is 10:00 a.m.) All rooms on campus are offered through a room/board package ONLY.** A very limited number of rooms on campus will be available for those participants who do not preregister but plan on attending the meetings and registering on site. Such rooms are based on space availability ONLY. (See section on **Room and Board Rates** for more information.) All check-ins and room assignments will be done in the Kittredge Commons Office, located in the Commons Building on the Upper level of the North Wing. (See section on **Check-In Locations and Times** for more information.) The Kittredge Commons Office will not, however, accept any payments for housing assigned through preregistration. **ALL** advance payments for housing must be sent to the Housing Bureau, located in Providence. (See Preregistration/Housing form.) **ALL** balances due on preregistration and/or housing must paid at the Meetings Registration Desk during the hours registration is open. Payments at the Meetings Registration Desk can be made with cash, personal checks, travelers' checks, Visa, and MasterCard. No other credit cards will be accepted. The Meetings Registration Desk will not, however, accept payments for university housing that was not assigned through preregistration (walk-in room assignments). Payments for rooms assigned after preregistration are due at check-in time and must be made at the university check-in desk. Payments at the university check-in desk can be made with cash, traveler's checks, personal checks, Visa and MasterCard. No other credit cards will be accepted.

Participants requesting housing on the University of Colorado campus will be assigned to a hall in the Kittredge Complex. The Housing Bureau will forward their request for housing to the university, who will assign **all** rooms. **The Housing Bureau is not responsible for any room assignments in the residence halls.**

Families with children will be allowed to stay in the dormitories. Children over 13 years of age will be charged the full adult room and board rate. Children six to 13 years of age occupying a room separate from that of their parent(s) will be charged the child room and board rate. Children six to 13 years of age staying in the same room as their parent(s) but not occupying a bed will not be charged a room rate; however, there will be a rollaway charge **plus** a child board rate. Sleeping bags are not permitted in the rooms. Children six to 13 years of age staying in the same room as their parent(s) and occupying a bed will be charged the child room and board rate. There is **no** charge for board for children under six years old; however, they will be charged for the use of a rollaway, crib, or bed. The maximum number of occupants allowed in one room is two adults and one

child. (See section on **Hotel Accommodations** below for alternate housing for families.)

Residence halls at the University of Colorado have three floors, no elevators, and limited ramps. (Only a few residence halls are accessible to the handicapped.) All single rooms contain a single bed, chest of drawers, one closet, one chair, one desk, a telephone and a desk light. At check-in, participants receive bed linen, a pillow, a blanket, towels, soap, and a drinking glass. Participants are advised to bring their own washcloths, alarm clock, clothes hangers, and fans. Rooms will be prepared for occupancy in advance and housekeeping service will be provided Monday through Friday. There is a daily linen change, including towels.

Each building in the Kittredge Complex has three wings. Each wing has a crossover lounge and one or two laundry rooms. Ironing boards and coin operated washers and dryers are provided in the laundry rooms; however, participants will have to provide their own laundry detergent. A limited supply of clothes irons are available at the Commons Office, which can be checked out with an ID or meal card. Buildings are **not** air conditioned; however, the weather is usually quite cool at night. There is a bathroom for each gender on each floor of the residence halls. These will be clearly identified. There are vending machines in each residence hall. Firearms, fireworks, pets, or open containers of alcohol are not permitted in or around the residence halls; however alcoholic beverages are permitted inside sleeping rooms for those of legal age. Smoking and nonsmoking rooms are available. Participants can request smoking or nonsmoking rooms on the Preregistration/Housing Form. There is an adequate fire alarm system in the residence halls; however, there are no smoke alarms in the rooms.

Check-In Locations and Times

All check-ins and room assignments will be done in the Kittredge Commons Office, located in the Commons Building on the upper level of the North Wing. The office is open Sunday through Friday from 7:00 a.m. to 11:00 p.m. and Saturday from 7:00 a.m. to 9:00 p.m. Should assistance be needed when the office is closed, a Conference Aide will be on duty, whose name and telephone extension will be posted in front of the desk of the Commons Office. Participants planning to arrive later than the hours stated above should notify the Housing Bureau well in advance so that special arrangements can be made.

Directions to the Kittredge Complex are as follows: Take the Baseline Exit off of Highway 36. Turn west on Baseline to Broadway. Turn right on Broadway (off of Baseline). Follow Broadway to Regent Drive. Turn right on Regent Drive (off of Broadway). Continue on Regent Drive to Kittredge Loop Drive, which is immediately before the Planetarium. Turn right on Kittredge Loop Drive. Take the first left. The Kittredge Commons parking lot is next to the Planetarium. Directions to specific residence halls will be provided.

At the time of check-in, participants who requested rooms through the Mathematics Meetings Housing Bureau will be checked against a master list (Housing Bureau receipt may prove useful) and asked to sign a bill to be used solely for the purpose of verifying the university's billing figures. Each person will also receive one room key, an information sheet, and meal cards. Those participants being assigned a room onsite by the check-in desk will be required to fill out a housing form and pay for their room, thus enabling them to receive a room key. Spouses desiring a room key must follow this procedure also. **Please note that, although there is no deposit required for keys, a penalty of $10 will be imposed for each key lost or not returned.** It is the responsibility of the Mathematics Meetings Housing Bureau to collect this penalty. Therefore, it is requested that proper caution be exercised to avoid this charge. At checkout, all keys must be returned to the check-in desk. Should the clerk not be present, please ensure that your name is left at the check-in desk with the key. Participants can park temporarily in the Visitor's Parking Lot, located just outside of the Commons Office, while checking in. There will be students available to help carry bags.

Room and Board Rates

The rates given on the back of the Preregistration/Housing Form found on page 35 apply for residence hall accommodations at the University of Colorado. There is a 2.53% city tax applied to the board portion and a 5.5% city tax applied to the room portion.

The university allows a maximum of two adults and one child in each room. Should a family with two children request accommodations, two rooms would be required and the double rate (with appropriate adjustments for children six to 13 years of age) applies in each case. Meals for children under six years of age are free.

Please note that a minimum room-and-board package would be one night's lodging, one dinner and one breakfast. The university will accept changes in packages reserved up until two weeks prior to check-in. After that, **no changes may be made**. Any requested exceptions to this policy should be addressed to Elise Graninger, Conference Manager, (303) 492-6777. With the exception of August 4 and August 8, all daily room and board packages include dinner on the night of arrival and breakfast the next day. The last meal of a package will be breakfast. **There will not be any refunds issued for meals missed.** On August 4, there are **no meals** included in the package and on August 8, there is **no dinner** included in the package. Any participant not attending the social event on August 8 but planning to dine on campus should indicate this on the preregistration form **AND** purchase a meal card at the Meetings Registration Desk for that meal. The cost for this meal card is $7.75 per person. **Meal tickets are nonrefundable.**

Food Services

Residence hall guests may dine either in the East or West dining rooms of the Commons Building, which may be approached from both sides of the serving area using either of the stone stairways from the ground floor of the Commons. There are no ramps for handicapped; however, service elevators can be used if sufficient notice is given

ahead of time to Elise Graninger, Conference Manager, (303) 492-6777. Serving hours for breakfast are 6:30 a.m. to 8:00 a.m. Serving hours for dinner are 5:00 p.m. to 6:30 p.m. (As long as someone is inside the dining hall by 6:30 p.m., he/she will be served.) Meal tickets must be presented at each meal for admission to the dining area. Children must be accompanied by parents in the dining area. A typical breakfast is eggs, ham, bacon, sausage, cereal, toast, muffins, assorted fresh fruit, juices, etc. A typical dinner offers one or two entrees, vegetables, rolls, salad bar, desserts, fresh fruit, ice cream, and beverages. Servings are generous; unlimited seconds are allowed. There are no Kosher meals available.

A very limited number of meals is available on a cash basis for guests in the dining rooms.

Within the University Memorial Center on campus there are several eating establishments located in the Grill, which is a food court. Serving hours are from 7:00 a.m. to 5:00 p.m. There is also a sit-down dining area, The Tabor Inn. Lunch is served there from 11:00 a.m. to 1:00 p.m.

There are also several restaurants within the immediate vicinity of the university, on Arapahoe Avenue. They range from fast food (burgers, pizza, tacos, etc.) to ethnic.

Hotel Accommodations

As an alternative to university housing, the Housing Bureau lists the following hotels/motels with group rates. All are located within walking distance of the university. Rates are subject to a 9.4% state room tax and are firm.

Participants should make their own reservations early, directly with the hotels/motels, and should identify themselves as participants in the Joint Mathematics Meetings. Participants making reservations should be prepared to remit a one night's deposit to the hotel or motel **or** give a major credit card number in order to guarantee their room reservation.

In all cases "single" refers to one person in one bed; "double" refers to two persons in one bed; and "twin double" refers to two persons in two beds. A rollaway cot for an extra person can be added to a room; however, not all hotels are able to do so and for those that do, the number of cots available is limited and given on a first-come, first-served basis.

Participants should be aware that it is general hotel practice in most cities to hold a nonguaranteed reservation until 6:00 p.m. only. When one guarantees a reservation by paying a deposit or submitting a credit card number as guarantee in advance, however, the hotel usually will honor this reservation up until checkout time the following day. If the individual holding the reservation has not checked in by that time, the room is then released for sale, and the hotel retains the deposit or applies one night's room charge to the credit card number submitted.

If you hold a guaranteed reservation at a hotel, but are informed upon arrival that there is no room for you, there are certain things you can request the hotel do. First, they should provide for a room at another hotel in town for that evening, at no charge. (You have already paid for the first night when you made your deposit.) They should pay for taxi fares to the other hotel that evening, and back to the meetings the following morning. They should also pay for one telephone toll call so that you can let people know you are not at the hotel you expected. They should make every effort to find a room for you in their hotel the following day, and if successful, pay your taxi fares to and from the second hotel so that you can pick up your baggage and bring it to the first hotel. Not all hotels in all cities follow this practice, so your request for these services may bring mixed results, or none at all.

Clarion Harvest House (Headquarters) Across the street from the Northeast end of the University campus

1345 28th Street

Boulder, CO 80302

Telephone: 303-443-3850

Single	$60
Double	$60
Suites	Upon request

Full service hotel, restaurant, lounge, free parking, indoor/outdoor pools, tennis courts, volleyball courts, workout room, jacuzzi, and jogging trail. Children 12 years and younger are free in same room as parents. Visa, MasterCard, American Express, and Diner's Club credit cards accepted. **The Clarion is the headquarters hotel, and so there is a very LIMITED number of rooms available. Participants are strongly advised to make their reservations with this hotel VERY EARLY.**

Holiday Inn Across the street from the East side of campus (near Events Center)

800 28th Street

Boulder, CO 80303

Telephone: 303-443-3322

Single	$52
Double	$52
Triple	$52
Triple w/cot*	$60
Quadruple	$52
Quadruple w/cot	$60
Suites	Upon request

* Cots are **very limited**, based on availability.

Full service hotel. Restaurant, lounge, indoor recreation center that includes indoor swimming pool, and jacuzzi, free parking. Children 18 years and younger are free in same room as parents. Visa, MasterCard, American Express, and Diner's Club credit cards accepted. Personal checks are accepted only with a major credit card and drivers' license.

Best Western Boulder Inn Across the street from the Southeast corner of campus

770 28th Street

Boulder, CO 80303

Telephone: 303-449-3800

Single	$48
Double (1 bed)	$48
Double (2 beds)	$54
Triple	$58
Triple w/cot	$64
Quadruple	$58
Quadruple w/cot	$64
Suites	Upon request
*Room-Car package	$69.95

Cots are **very limited** and based on availability.

Full service hotel. Outdoor swimming pool, free parking, restaurant, fitness club, free continental breakfast, and lounge. Children 16 years and younger are free in same room as parents. Visa, MasterCard, American Express, and Diner's Club credit cards accepted. Personal checks are accepted with one form of identification and a major credit card. Upon check-in, all guests will be asked to fill out a registration card and must have some official form of identification.

*The Best Western Boulder Inn offers a Room and Car package that includes sleeping room (1 or 2 beds), rental car with free unlimited mileage, complimentary continental breakfast, car pickup and return at Denver Stapleton Airport or hotel lobby, complimentary nearby health club privileges, free morning newspapers, and free local telephone calls. **ROOM AND CAR ARE SUBJECT TO AVAILABILITY and 48 hour advance reservation is requested. Participants are advised to call early for this special deal!** For further information and reservations, call 303-449-3800 or 1-800-233-8469.

Broker Inn Two blocks from the Southeast corner of campus
555 30th Street
Boulder, CO 80303
Telephone: 303-444-3330

Single	$49 (on weekends only)
Single (1 bed)	$53 (on weekdays)
Double (1 bed)	$49 (on weekends only)
Double (1 bed)	$63 (on weekdays)
Double (2 beds)	$49 (on weekends only)
Double (2 beds)	$63 (on weekdays)
Triple (2 beds)	$63

King size beds are $10 additional

Full service hotel. Outdoor swimming pool, jacuzzi, free parking, restaurant, lounge, and aerobic & fitness club. Children 18 years and younger are free in same room as parents. Visa, MasterCard, American Express, and Diner's Club credit cards accepted.

Highlander Inn Across the street from the East corner of campus (near Events Center)
970 28th Street
Boulder, CO 80303
Telephone: 303-443-7800

Single	$46.95
Double (1 bed)	$48.95
Double (2 beds)	$48.95
Triple	$50.95
Quadruple	$52.95
King Suites and Apartment Suites	Upon request

Single rooms have queen size beds, while double rooms contain one queen size bed and one double bed. King size beds and waterbeds (**very limited**) are available upon request and at a higher rate.There are no rollaways available. There is also no restaurant on the property. The nearest restaurant, Perkins, is one-and-one-half blocks away. Outdoor solar-heated swimming pool, free parking.

Marriott Residence Inn Two miles Northeast of campus
All suites hotel
3030 Center Green Drive
Boulder, CO 80301
Telephone: 303-449-5545 or 800-331-3131

Studio (1 Bedroom - 1 to 6 nights)	$ 99
Studio (1 Bedroom - 7 to 29 nights)	$ 89
Penthouse (2 Bedroom - 1 to 6 nights)	$119
Penthouse (2 Bedroom - 7 to 29 nights)	$109

Rollaways are $10 extra.
Studio suites accommodate up to three people; penthouse suites accommodate up to four people. There is no restaurant on the property. The nearest restaurant is the Boulder Court, on 28th Street. The Residence Inn offers many other amenities including fully-equipped kitchens, grocery shopping service, private entrances, private patios or balconies, living rooms with fireplaces, free continential breakfast, free parking, outdoor pool, and jacuzzi and sport court. Visa, MasterCard, American Express, and Diner's Club credit cards accepted.

Participants should be aware that when major conventions occur in any city, additional safety problems are created, especially at night. Those who are attending the meetings alone, or who are concerned about walking to and from the meetings after dark, are encouraged to choose a hotel in close proximity to the campus. Participants are also urged to read the "Words to the Wise" in the local information insert in the program they receive at the meetings.

Registration at the Meetings

Meeting preregistration and registration fees only partially cover expenses of holding meetings. All mathematicians who wish to attend sessions are expected to register, and should be prepared to show their meeting badge, if so requested. Badges are required to obtain discounts at the AMS and MAA Book Sales and to cash a check with the meeting cashier. If a preregistrant should arrive too late in the day to pick up his/her badge, he/she may show the acknowledgement received from the Mathematics Meetings Housing Bureau as proof of registration.

The fees for Joint Meetings registration at the meeting listed below are 30% more than the preregistration fees.

Joint Mathematics Meetings

Member of AMS, Canadian Mathematical Society, MAA, ΠME	$ 82
Emeritus Member of AMS, MAA	$ 23
Nonmember	$127
Student/Unemployed	$ 23

AMS Short Course

Student/Unemployed	$ 20
All Other Participants	$ 50

MAA Minicourses
(if openings available)

Minicourses # 1–9 $ 30

Modes of payment which are acceptable, provided they are payable in U.S. dollars to the order of the American Mathematical Society, are U.S. Postal Money Orders, certified U.S. Bank checks, U.S. bank money orders, personal checks drawn on a U.S. bank, or credit card (Visa or MasterCard only).

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

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

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

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

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

Registration Dates and Times

AMS Short Course

Sunday, August 6 8:30 a.m. to 2:30 p.m.

Joint Mathematics Meetings
[and MAA Minicourses (until filled)]

Sunday, August 6 3:00 p.m. to 7:00 p.m.
Monday, August 7
through 7:30 a.m. to 4:00 p.m.
Wednesday, August 9
Thursday, August 10 7:30 a.m. to 1:00 p.m.

Registration Desk Services

Assistance, Comments, and Complaints

A log for registering participants' comments or complaints about the meeting is kept at the Transparencies section of the registration desk. All participants are encouraged to use this method of helping to improve future meetings. Comments on all phases of the meeting are welcome. If a written reply is desired, participants should furnish their name and address.

Participants with problems of an immediate nature requiring action at the meeting should see the Director of Meetings, who will try to assist them.

Audio-Visual Assistance

A member of the AMS/MAA staff will be available to advise or consult with speakers on audio-visual usage.

Rooms where special sessions and contributed paper sessions will be held are equipped with an overhead projector and screen. **Blackboards will be available only in some rooms.**

Baggage and Coat Check

Baggage and coats may be left in the Joint Meetings registration area **only** during the hours that registration is open. The staff cannot, however, take responsibility for lost or stolen articles.

Check Cashing

The Joint Meetings cashier will cash personal or traveler's checks up to $50, upon presentation of the official meeting registration badge, provided there is enough cash on hand. Canadian checks must be marked for payment in U.S. funds. It is advisable that participants bring traveler's checks with them. When funds are low the cashier will not be able to cash checks, and traveler's checks can be easily cashed at local banks, restaurants, or hotels.

Local Information

This section of the desk will be staffed by members of the Local Arrangements Committee and other volunteers from the Boulder mathematical community.

Lost and Found

See the Joint Meetings cashier. Also, participants can check at the Administrative Wing in the Engineering Center.

Mail

All mail and telegrams for persons attending the meetings should be addressed as follows: Name of Participant, Joint Mathematics Meetings, c/o Office of Conference Services, 500 30th Street, University of Colorado Campus Box 454, Boulder, Colorado 80309-0454. Mail and telegrams so addressed may be picked up at the mailbox in the registration area during the hours the registration desk is open. U.S. mail not picked up will be forwarded after the meeting to the mailing address given on the participant's registration record.

Personal and Telephone Messages

Participants wishing to exchange messages during the meeting should use the mailbox mentioned above. Message pads and pencils are provided. It is regretted that such messages left in the box cannot be forwarded to participants after the meeting is over.

A telephone message center is located in the registration area to receive incoming calls for participants. **The center is open from August 6 through 10, during the hours that the Joint Mathematics Meetings registration desk is open.** Messages will be taken and the name of any individual for whom a message has been received will be posted until the message has been picked up at the message center. Once the registration desk has closed for the day there is no mechanism for contacting participants other than calling them directly at their hotel. The telephone number of the message center is 303-492-4186.

Transparencies

Speakers wishing to prepare transparencies in advance of their talk will find the necessary materials and copying machines at this section of the registration desk. A member of the staff will assist and advise speakers on the best procedures and methods for preparation of their material. There is a modest charge for these materials.

Visual Index

An alphabetical list of registered participants, including local addresses and arrival and departure dates, is maintained in the registration area.

Miscellaneous Information

Athletic Facilities

Indoor facilities are in the Recreation Center, located near the north edge of the campus, just west of the stadium. This building contains a swimming pool, a diving pool, an ice rink, a weight room, a fitness systems room with stationary bicycles and other equipment, courts for handball, racquetball and squash, and a room for volleyball and basketball. Tickets for use of this facility can be purchased on a daily basis for $2.50, or on a weekly basis for $7, at the main entrance to the building. Additional family members under the age of five are free. Over age five the cost is the same as for the first member, up to a maximum cost for a family of $21 for a week. Participants should bring their meeting badges when purchasing the tickets. The building is open as follows: Monday and Wednesday 7:30 a.m. to midnight, Tuesday and Thursday 6:30 a.m. to midnight, Friday 7:30 a.m. to 11:00 p.m., Saturday 9:00 a.m. to 11:00 p.m., and Sunday from 10:00 a.m. to 10:00 p.m. Tennis courts can be found just south of the Kittredge Complex of dormitories. Sign-up sheets are available for reserving courts of all kinds, one day in advance. Reservations can be made by calling 492-6561.

Camping and RV Facilities

August is the highest month of the season, as possibly everyone knows.

Several campgrounds are managed by the National Forest Service in Roosevelt National Forest, west of Boulder. Most are not more than an hour's drive from town. All but one will have a water supply and trash pickup, and those will cost $6 per night. Olive Ridge, 1.5 miles north of Allenspark, may be on a reservation basis in August; call 303-444-6001 for information. The others are on a first-come-first-camper basis.

Boulder Mountain Lodge, on Four Mile Canyon Road, is a private camping facility, costing $14 per night. Electricity and a hot tub are provided. They do not take reservations, but are willing to tell how crowded it is one or two days ahead: 1-800-458-0882.

Boulder County Fairgrounds Campground is at 9595 Nelson Road, Longmont. The nightly base rate is $10, electricity is $2, and water is $1. Anyone staying seven nights pays for just six nights. Reservations can be made by calling 303-678-1525 starting in May.

Car Rental

It has been arranged for participants to rent cars for the Boulder meetings from Thrifty Rent A Car. To book a reservation, participants should call 1-800-367-2277, extension 314 between 8:00 a.m. and 4:30 p.m. Central Time and tell the operator that they will be attending the Joint Mathematics Meetings in Boulder, Colorado, August 7 – 10. Normal renter and credit requirements apply, including a valid driver's license, major credit card, and minimum rental age. Taxes, refueling, and optional insurance (the property damage waiver is $8.95 per day) are not included in the rental costs.

[Note, as long as one has collision coverage on one's car at home, and it is not driven while one is on vacation, most insurance companies will cover collision (PDW, formerly CDW) on the rental car; so there is no need to purchase it from the rental company. However, coverage will not extend if the rental car is for business purposes. Participants should check with their insurance agent for clarification of their specific policy.] The following rates include unlimited mileage:

	Day	Week
Economy	$24.99	$ 99.99
Compact	26.99	109.99
Mid Size	27.99	129.99
Full Size (four doors)	29.99	149.99
Luxury (3 day notice)	34.95	244.65

Child Care

Boulder has more than a few child care facilities that accept drop-in clients. A booklet listing more will be available at the local information desk, but some are listed here. It is advisable to call a week or two in advance to verify availability.

Jack and Jill Preschool and Kindergarten, 303-442-1571, 1301 North Street, Boulder, CO 80302. Director: Ruth Jones. Ages: 2 1/2 to 8. Hours: 6:30 a.m. to 6:00 p.m. Rates: $17/day, $72/week, $2/hour.

Kinder Learning Center, 303-440-0749, 3600 Hazelwood Court, Boulder, CO 80302. Director: Amy L. Austin. Ages: 12 months to 12 years. Hours: 6:30 a.m. to 6:00 p.m. Rates: $22/day, $73/week for over 2 1/2.

Sacred Heart Childcare Program, 303-443-0684, 1317 Mapleton Avenue, Boulder, CO 80302. Director: Louis Coenon. Ages: 3 to 12. Hours: 7:00 a.m. to 6:00 p.m. Rates: $2/hour.

Y.W.C.A., 303-449-1951, 1410 Mapleton, Boulder, CO 80302. Director: Molly Cropp. Ages: 0 to 12. Hours: 7:00 a.m. to 6:00 p.m. Rates: $1/hour to $3/hour.

In addition, a Parent-Child Lounge will be located near the Joint Meetings registration area. It will be furnished with casual furniture, a crib, a changing area, some assorted toys and a televison set. Any child using this lounge **MUST** be accompanied by a parent (not simply an adult) who must be responsible for supervision of the child. This lounge will be unattended and parents assume all responsibility for their children. This lounge will only be open during the hours of registration and all persons must leave the lounge at the close of registration each day.

Handicapped

Most session rooms on campus are accessible by wheelchair. The university will provide alternate accommodations if necessary. Please contact Arlan Ramsay, Department of Mathematics, Campus Box 426, University of Colorado, Boulder, CO 80309-0426, if there are any questions.

Participants with special needs should be sure to indicate this on the Preregistration/Housing Form.

Libraries

Norlin Library is the main library on the campus. Most mathematics books and journals are in the Math-Physics Library in the east end of Duane Physics Building on level one.

The main branch of the Boulder Public Library is at 1000 Canyon Boulevard.

Local Information

For following directions, remember that the mountains are to the west of Boulder. There are many things to do in the mountains near Boulder, including trails that start in the city. Please visit the Local Information section of the Meetings Registration Desk to get more information about the hiking trails. Some start at the west end of Baseline Road (Gregory Canyon, or Chautauqua Park), or at the National Center for Atmospheric Research (NCAR) at the west end of Table Mesa Drive, or at the west end of Mapleton Avenue.

Flagstaff Mountain is a city park. There is a bicycle and jogging/walking trail that runs along Boulder Creek starting near the mouth of the canyon and going out to 55th Street.

NCAR and NIST (National Institute of Standards and Technology) are places to visit, as are museums on campus and in Denver. Central City, Leadville, and Georgetown are historical small cities. Rocky Mountain National Park is an hour's drive north of Boulder on US36. Mesa Verde is in the Southwest Corner of the state, and all the roads that can be taken to arrive there go past beautiful scenery. Visit the Local Information section for more hints on where to go after the meeting.

Be aware that it is easier to sunburn at higher altitudes and easier to get dehydrated. Sunblock and water bottles are essentials of hiking.

Medical Services

Boulder Community Hospital is at Broadway and Balsam; follow Broadway north from downtown, or go west from 28th Street on Valmont (which connects to Balsam).

Boulder Memorial Hospital is at 311 Mapleton; go north on Broadway and turn left on Mapleton.

Boulder Medical Center has an Urgent Care Center for walk-in patients and is also located at Broadway and Balsam. Hours are 8:00 a.m. to 7:00 p.m.

For all emergencies, on or off campus, dial 911.

Parking

Participants staying on campus can purchase permits for the Kittredge Permit Parking Lots for $1 per day at the check-in desk, located in the Kittredge Commons Office. These lots are only available for those residing at Kittredge.

Participants driving in but not staying on campus can purchase stickers at a cost of $3 per day for the Visitors' Parking Lot, located across the street from the University Memorial Center. **These stickers do not include in and out priveleges. A new sticker will have to be presented to the attendant every time one leaves the lot.** These stickers can be purchased at the Transparencies section of the Meetings Registration Desk, located in the University Memorial Center.

The Permit Parking Lot located next to the Engineering building is free on weekends.

Smoking

Please note that smoking is not allowed in any of the buildings on the university campus, except for specially designated areas. Smoking is not allowed in any of the sessions.

Social Events

ΠME invites all participants to help celebrate its 75th anniversary at the Western Hoe Down on Tuesday evening, August 8, at 6:30 p.m. A special program of entertainment will be presented by ΠME members, and a local square dance caller will show you how to swing your partner and do-si-do.

The Hoe Down will take place in the Gardens at the Clarion Harvest House. The hotel is located across the street from the Northeast corner of campus. The menu includes barbecue chicken, ribs, and beef brisket, baked beans, creamed corn, tossed salad, Southern slaw, apple cobbler, corn muffins, coffee, and tea. The children's menu includes soft drinks. For vegetarians, a vegetarian lasagne will replace the three meats on the menu. Participants may indicate their meal preference on the Preregistration/Housing Form.

Tickets are $19 for adults' regular meal, $16 for vegetarian meal, and $9 for children five through 12 years of age. There is no charge for children under five years of age; however, if bringing a child under five years of age, please indicate on the Preregistration/Housing Form. Tickets may be purchased through preregistration by completing the appropriate section of the Preregistration/Housing Form, and enclosing the proper payment. Please note that 50% refund can be made on Western Hoe Down tickets **until July 14**. After July 14, no refunds are possible.

Rocky Mountain National Park Tour

Most airlines offer specially reduced fares requiring that one stay over on Saturday night. Because the Boulder meetings end on Thursday, August 10, it is not feasible for most participants to plan to stay over on Saturday, August 12, but it might be possible for a large number to plan to arrive in Boulder on Saturday, August 4. Since there is no scientific program planned over that weekend, special arrangements have been made for early arrivals to participate in an unguided bus trip to Rocky Mountain National Park on Sunday, August 6.

Buses will leave from the University Memorial Center on campus at 9:00 a.m. on Sunday, August 6, and travel to the park via rugged North St. Vrain Canyon. The buses will arrive at Estes Park at 10:00 a.m. and proceed to Bear Lake. From 10:30 a.m. until 12:30 p.m. participants will be on their own for hiking, etc. There is a series of hiking trails from the Bear Lake Trail Head linking Bear Lake, Dream Lake, and Emerald Lake. These

are not difficult trails, and the scenery is breathtaking. Participants are urged to bring their cameras.

At 12:30 p.m., the buses will depart Bear Lake for Estes Park for lunch (the cost of which is not included in the ticket price). At 2:00 p.m., the buses will depart Estes Park for the return to campus, arriving about 3:00 p.m., in plenty of time to register for the meeting, and have a leisurely dinner with friends.

The price of the bus ticket is $12 per person, with no price differential for children. In addition, participants will be required to pay a $2 admission fee to the park upon arrival. (Children 16 years of age or under are admitted to the park free.) The deadline for purchase of tickets is June 1. Interested participants should request their tickets on the Preregistration/Housing form and remit the total amount due. 50% will be refunded for tickets canceled in writing prior to July 14. After July 14, no refunds will be possible.

Travel

In August, Colorado is on Mountain Daylight Time. Airline passengers will arrive at Stapleton International Airport in Denver. From there regular bus service to Boulder via downtown Denver costs $2 and takes 1.25 hours. The Boulder Airporter runs a shuttle service, leaving every hour, costing $8 and taking about 40 minutes. Call 303-499-1559 for reservations.

For some years now, the AMS-MAA Joint Meetings Committee has engaged a travel agent for the January and August Joint Meetings in an effort to ensure that everyone attending these meetings is able to obtain the best possible airfare. This service is presently being performed by Meetings, Incentives, Conventions of America, Inc. (MICA); their advertisement can be found elsewhere in this meeting announcement. Although any travel agent can obtain Supersaver or other such published promotional fares, only MICA can obtain the special additional 5% discount over and above these fares, and the 40% off regular coach fare. The latter, of course, is financially beneficial only when one does not qualify for one of the promotional fares. Participants should pay particular attention to the cancellation policies stated in the ad.

Weather

Boulder is mainly on the plain, but next to (small) mountains. The humidity tends to be very low (20% to 30%). High temperatures at the time of the meeting average 84°F and the temperature drops rapidly in the evening with overnight lows averaging 58°F. Of course, in the mountains it will be cooler. Afternoon and evening thundershowers are fairly common but usually brief. Keep an eye out for rainbows, if you like them.

November 10–11 Southeastern Small College Computing Conference, Samford University, Birmingham, AL. Theme: In Support of Computing in the Small Colleges. For information, contact: Frank Cheatham, Campbellsville College, 200 West College Street, Campbellsville, KY 42718; (502) 465-8158.

(Calendar continued from back cover)

July 3–7 1989 IFIP Conference on Modeling and Optimization, Leipzig University of Technology, GDR. For information, contact: Secretariat, Dr. K. Tammer, Leipzig University of Technology, Mathematics, and Informatics, PF66, Leipzig 7030, GDR.

July 3–August 11 Program in Mathematics for Young Scientists, sponsored by Boston University and NSF. Professors David Fried and Glenn Stevens, Directors. An intensive experience in number theory and abstract algebra to approximately thirty gifted high school students. For information, contact: PROMYS, Department of Mathematics, Boston University, 111 Cummington Street, Boston, MA 02215; (617) 353-2560.

July 6–9 Third Workshop of the Mathematicians and Education Reform Network, University of Minnesota, Minneapolis, MN. See Second Workshp of the Mathematicians and Education Reform Network above (May 4–7) for information.

July 17–21 SIAM 1989 Annual Meeting, San Diego, CA. For information, contact: SIAM Conference Coordinator, 117 South Seventeenth Street, 14th Floor, Philadelphia, PA 19103-5052; (215) 564-2929; FAX: 215564-4174; E-Mail: siam@wharton.upenn.edu.

July 17–August 4 NSF Rocky Mountain Mathematics Consortium Summer Conference at the University of Wyoming: Matrix Theory for Applications. Faculty stipends and a limited number of scholarships available. For information and application forms, contact: A. Duane Porter, Mathematics Department, Box 3036, University of Wyoming, Laramie, WY 82071.

July 26–28 Ohio Section Summer Short Course, Topics in Additive Number Theory, at Findlay College. For information, contact: Anne Albert, Division of Mathematics and Computer Science, Findlay College, Findlay, OH 45840; (419) 424-4543.

August 18–20 Ohio State University Workshop: Using Computer Graphing to Enhance the Teaching and Learning of Precalculus Mathematics, Columbus, OH. Participent stipend of $250 available. For information and application, contact: Dr. Bert K. Waits, The Ohio State University, Department of Mathematics, 231 West Eighteenth Avenue, Columbus, OH 43210

August 28–September 1 NSF-CBMS Regional Research Conference in the Mathematical Sciences: Singular Integral Operators, University of Montana. F. Michael Christ, principle speaker, will deliver two one-hour lectures each day. Applicants wishing to present a paper should submit a title and abstract before April 30, 1989. For information, contact W. R. Derrick, Mathematics Department, University of Montana, Missoula, MT 59802; (406) 243-4171; ma_wrd@umt.

October 6–7 Conference on Issues in the Teaching of Calculus, Miami University. Principal speakers: Lida K. Barrett, Thomas W. Tucker, and J. Jerry Uhl, Jr. To request informtion or submit abstracts, contact: Fred Gass or Tom Farmer, Department of Mathematics and Statistics, Miami University, Oxford, OH 45056. Abstract deadline May 15. Conference programs with information concerning preregistration and housing will be available after July 17, 1989.

November 2–4 Second Annual Conference on Technology in Collegiate Mathematics at The Ohio State University. Registration fee is $40.00. For information and registration materials, contact: Dr. Bert Waits at The Ohio State University, Department of Mathematics, 231 West Eighteenth Avenue, Columbus, OH 43210. (Also see page 5 of the January-February 1989 FOCUS.)

November 6–10 SIAM Conference on Geometric Design, organized by Robert E. Barnhill of Arizona State University and held there. Teleological modeling, computer graphics, parametric curves and surfaces in CAGD, images of matrices, domain processing and manipulation, surface fitting and other related subjects. For information, contact: SIAM Conference Coordinator 117 South Seventeenth Street, 14th Floor, Philadelphia, PA 19103-5052.

(continued at left)

AIRLINE INFORMATION
SPECIAL AIRFARES
1-800-888-6422

MICA, Inc., the official travel management firm for the Joint Mathematics Meetings to be held in Boulder, Colorado, August 7–10, 1989, has arranged for special discounts aboard United Airlines!

Save 5% off published promotional fares, meeting all restrictions, or 40% off regular roundtrip coach fares, with a 7 day advance purchase. The lowest fares require a Saturday night stay, are subject to an airline change/cancellation penalty, and may be purchased at least 30 days prior to departure.

Every Joint Mathematics Meetings participant will also receive $100,000 flight insurance with each ticket purchased through MICA aboard any airline.

United Airlines has been designated as the official airline for the Boulder meetings because it provides the best service for the majority of participants around the country. For some participants, United may not provide optimal service, but since the airlines permit only one carrier to be designated as the official airline, other airlines will not offer the discount convention airfares. However, if United does not provide convenient service to and from your location, MICA will inform you of the best available service and fare on another airline.

Call Today Toll-Free and Save:
1-800-888-6422
Monday – Friday, 8:30 am – 6:00 pm EST

Meetings, Incentives, Conventions of America, Inc. (MICA, Inc.)
Suite 303, 195 Farmington Avenue, Farmington, CT 06032

Summer List of Applicants

Instructions for Applicant Form on facing page

The form. Forms submitted by job applicants who attend the August meetings in Boulder will be posted. The first impression a prospective employer has of an applicant may be based on the appearance of this form.

The forms should be carefully typed using a fresh black ribbon. The best results are obtained with a carbon-coated polyethylene film ribbon, but satisfactory results may be obtained using a ribbon made of nylon or other woven fabric if suitable care is exercised. It is important that the keys be clean and make a sharp, clear impression. Use a correcting typewriter or correction tape or fluid if necessary. Submit the original typed version only. Hand lettered forms are acceptable if prepared carefully.

The summary strip. Information provided here will be used to prepare a printed list of applicants for distribution to employers. Please supply all information requested, and **confine your characters to the boxes provided.** Use the codes below. Circled letters identify corresponding items on the form and the strip.

Address forms to the Mathematics Meetings Housing Bureau, P. O. Box 6887, Providence, RI 02940. The deadline for receipt is **June 1, 1989.**

(A) Specialties

AL = Algebra	AN = Analysis
BI = Biomathematics	BS = Biostatistics
CB = Combinatorics	CM = Communication
CN = Control	CS = Computer Science
CT = Circuits	DE = Differential Equations
EC = Economics	ED = Mathematical Education
FA = Functional Analysis	FI = Financial Mathematics
FL = Fluid Mechanics	GE = Geometry
HM = History of Math	LO = Logic
MB = Mathematical Biology	ME = Mechanics
MO = Modelling	MP = Mathematical Physics
MS = Management Science	NA = Numerical Analysis
NT = Number Theory	OR = Operations Research
PR = Probability	SA = Systems Analysis
ST = Statistics	TO = Topology

(B) Career Objectives

AR = Academic Research	AT = Academic Teaching
NR = Nonacademic R&D	NC = Nonacad. Consulting
NS = Nonacademic Supervision	

(H) (I) Duties

T = Teaching	U = Undergraduate
G = Graduate	R = Research
C = Consulting	A = Administration
S = Supervision	IND = Industry
GOV = Government	DP = Data Processing

Location

E = East		S = South
C = Central		M = Mountain
W = West	O = Outside U.S.	I = Indifferent

(L) U.S. Citizenship Status

C = U.S. Citizen	P = Permanent Resident
T = Temporary Resident	N = Non-U.S. Citizen

Summer List of Applicants

Mathematical Sciences Employment Register

August 1989 Boulder, Colorado

(Please type. See instructions on facing page.)

APPLICANT: Name_____

Mailing address (include zip code) _____

Ⓐ Specialties_____

Ⓑ Career objectives and accomplishments

ACADEMIC: ☐ Research, ☐ Teaching

NON-ACADEMIC: ☐ Research and Development, ☐ Consulting, ☐ Supervision

Near-term career goals_____

Significant achievements or projects, including role_____

Honors and offices_____

Other (e.g., paper to be presented at THIS meeting)_____

Selected titles of papers, reports, books, patents_____

Ⓒ Degree Year Institution

____ ____ _____

____ ____ _____

____ ____ _____

Ⓓ No. of abstracts, internal reports____

Ⓔ No. of papers accepted____

Ⓕ No. of books and patents____

EMPLOYMENT HISTORY:

	Present	Previous	Previous
Ⓖ Employer			
Position			
Ⓗ Duties			
Years	____ to ____	____ to ____	____ to ____

DESIRED POSITION:_____

Ⓘ Duties_____

Ⓙ Available mo.____ /yr.____ Location_____ Salary____

Ⓚ References (Name and Institution)

Ⓛ Citizenship: (check one) ☐ U.S. Citizen ☐ Non-U.S. Citizen, Permanent Resident ☐ Non-U.S. Citizen, Temporary Resident

Ⓜ **I plan to attend the Summer Meeting** yes ☐ no ☐

SUMMARY STRIP

Family Name, First Name, Mailing Address,

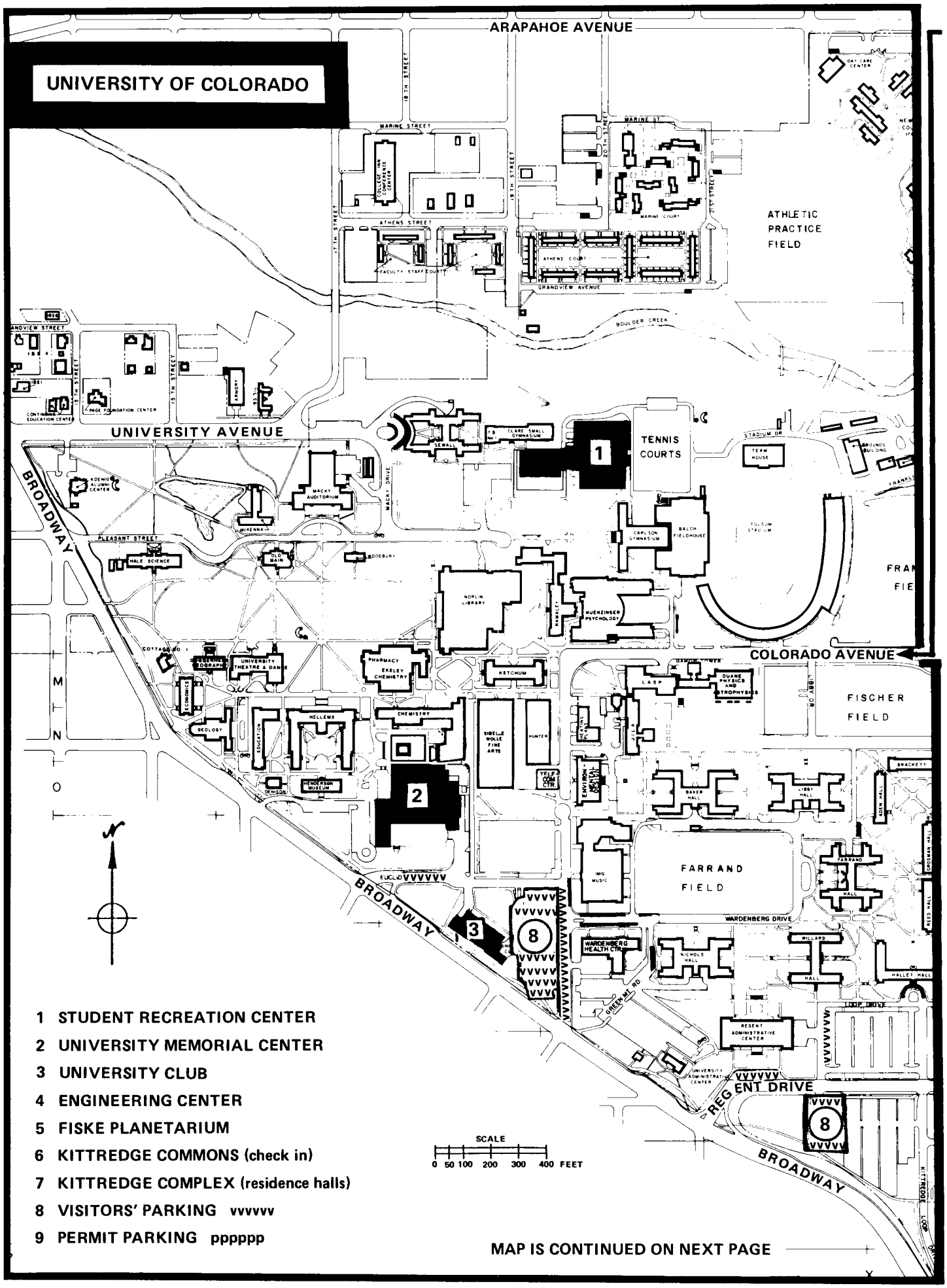
Address (cont'd.), Address (cont'd.), State & Zip Code, Ⓐ Specialties,

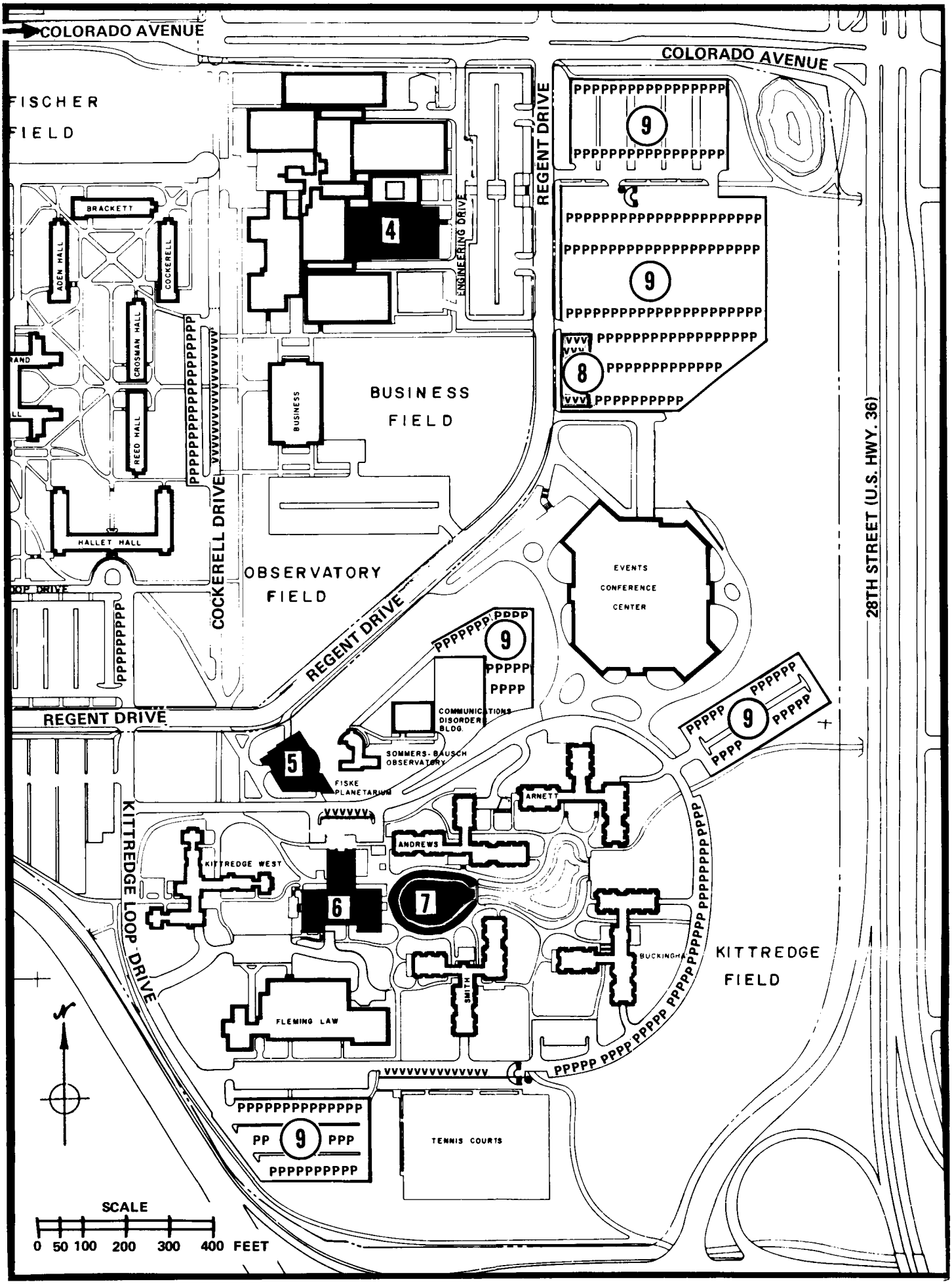
Ⓑ Career objectives, Ⓒ Highest Degree, Ⓒ Yr., Ⓒ Institution, Ⓓ, Ⓔ, Ⓕ, Ⓖ Most recent employer,

Ⓗ Present duties, Ⓘ Desired duties, Ⓙ Available mo./yr., Ⓛ,

EMPLOYMENT FORMS

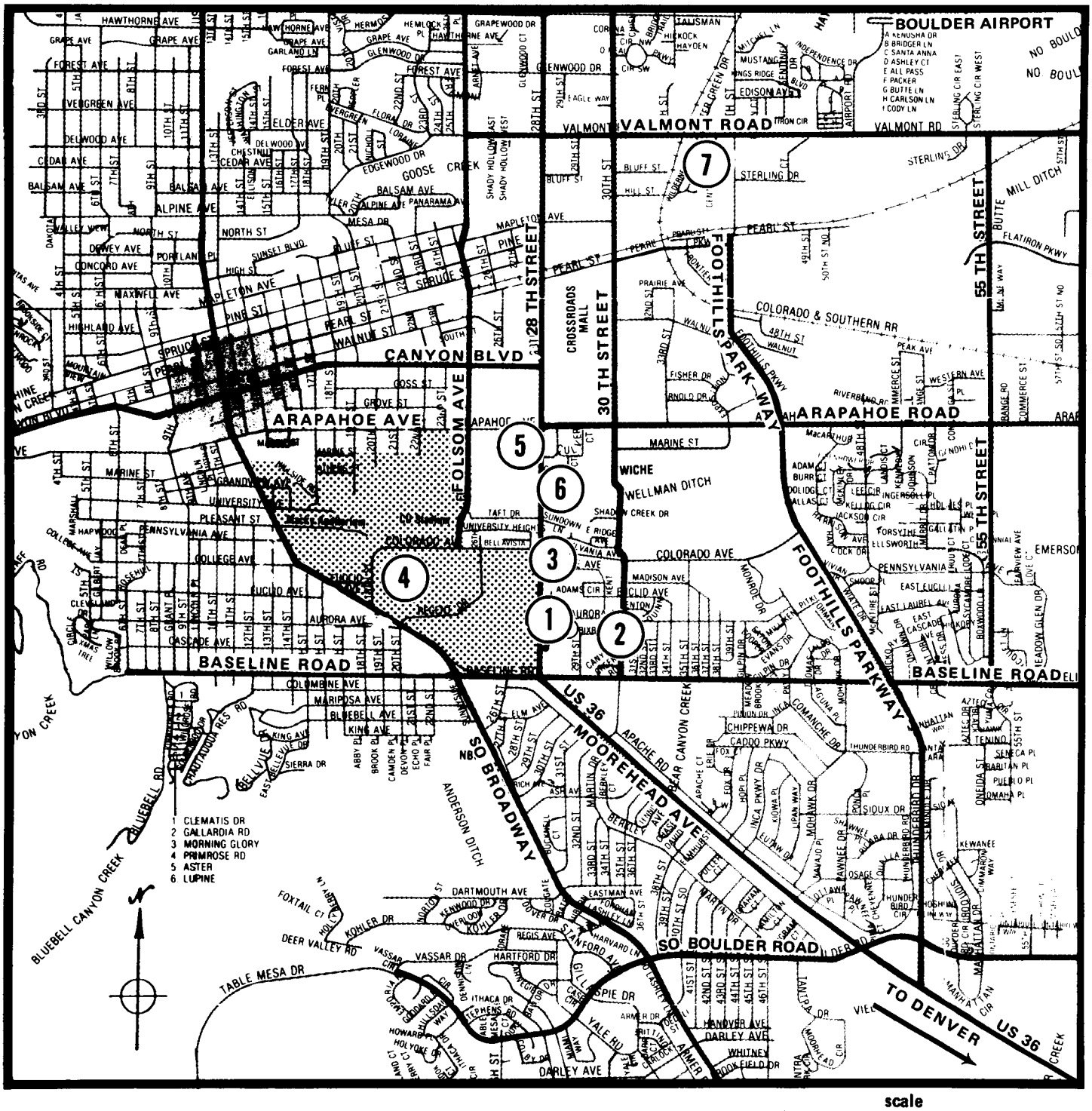
BOULDER MAP: DETAIL





BOULDER MAP: DETAIL

AREA MAP OF BOULDER



DOWNTOWN BOULDER

1 BOULDER INN
2 BROKER INN
3 HOLIDAY INN
4 UNIVERSITY OF COLORADO
5 THE CLARION HARVEST HOUSE
6 HIGHLANDER INN
7 MARRIOTT RESIDENCE INN

Preregistration/Housing Form, Boulder, Colorado

August 7–10, 1989

Must Be Received in Providence No Later Than June 1, 1989

Please complete this form and return it with your payment to
Mathematics Meetings Housing Bureau
P.O. Box 6887, Providence, Rhode Island 02940 – Telephone: (401) 272-9500, Ext. 290-Telex: 797192

DEADLINES:

Preregistration/Dormitory Reservations	June 1, 1989
Housing Changes/Cancellations	July 17, 1989
Preregistration Changes	July 31, 1989
50% Refund on Preregistration	July 31, 1989 (no refunds after this date)
90% Refund on Residence Hall Package	July 17, 1989 (no refunds after this date)
50% Refund on Banquets/Tour/Hoe Down	July 14, 1989 (no refunds after this date)

	REGISTRATION FEES Preregistration by mail by June 1, 1989	At Meeting
JOINT MATHEMATICS MEETINGS		
Member of AMS, CMS, MAA, PME	$ 63	$ 82
Nonmember	98	127
* Student, Unemployed, or Emeritus	18	23
AMS SHORT COURSE		
Member/Nonmember	40	50
* Student or Unemployed	15	20

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

* All full-time students currently working toward a degree or diploma qualify for the student registration fees, regardless of income. The unemployed status refers to any person currently unemployed, actively seeking employment, and who is not a student; it is not intended to include persons who have voluntarily resigned from their latest position. The emeritus status refers to any person who has been a member of the AMS or MAA for twenty years or more and is retired on account of age or on account of long term disability from his or her latest position.

PREREGISTRATION SECTION: Please check the function(s) for which you are preregistering:

Joint Meetings ☐ AMS Short Course (August 6–7) ☐ (A separate form for MAA Minicourses appears in this issue)

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

2) _____
(Mailing address)

3) Badge information: a) Nickname (optional): _____ b) Affiliation _____ c) City&State _____

4) I am a student at _____ City&State _____ 5) Emeritus member ☐ Unemployed ☐

6) Accompanied by spouse _____ Number of children _____ (Enumerate only if accompanying to meeting)
(name)

7) Member of AMS ☐ CMS ☐ MAA ☐ PME ☐ Nonmember ☐ (Member discount applies only to members of AMS, CMS, MAA, and PME) Member of other organizations: AWM ☐ NAM ☐ **MR Classification #** _____

8) Joint Meetings fee $ _____ 9) **AMS** Short Course fee $ _____ 10) Dormitory payment $ _____

11) _____ MAA 25-Year Banquet ticket(s) @ $21 each = $ _____ 12) _____ PME Banquet ticket(s) @ $9 each = $ _____

13) _____ Rocky Mtn. Nat'l. Park Tour tkt(s) @ $12 each = $ _____ 14) _____ Western Hoe Down Adult tkt(s) @ $19 each = $ _____
_____ Western Hoe Down Vegetarian tkt(s) @ $16 each = $ _____ _____ Western Hoe Down Child (5–12 yrs.) tkt(s) @ $9 each = $ _____
I will bring _____ children under 5 years of age to the Western Hoe Down.

15) TOTAL AMOUNT ENCLOSED FOR 8 through 14 $_____ NOTE: May be paid by check payable to AMS (Canadian checks must be marked "U.S. Funds") or VISA or MasterCard credit cards.

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

_____
(Printed name) (Signature)

Please complete the Housing Section on the reverse if you will require dormitory accommodations.

If housing is not needed, please indicate arrival/departure dates in Travel Section on the reverse.

For office use only:

Codes: Options: Hotel: Dorm: Room type:

Dates: Hotel Deposit Room/Board Pmt Total Amt. Paid:

Special Remarks:

$ _____ room/board paid; $ _____ room/board due

PREREGISTRATION AND HOUSING FORMS

HOUSING SECTION:

☐ PLEASE CHECK HERE IF YOU WILL **NOT** BE STAYING IN ANY HOTEL, MOTEL, OR DORMITORY

☐ PLEASE CHECK HERE IF YOU WILL BE STAYING IN ONE OF THE HOTELS/MOTELS LISTED IN THE TEXT

UNIVERSITY HOUSING

NOTE: Full prepayment for room and board is required. Please make checks payable to AMS. Canadian checks must be marked "In U.S. Funds'; VISA and MasterCard credit cards will also be accepted. Acknowledgements of your residence hall reservations will be sent to address indicated on reverse. **The University's Kittredge Commons Office will assign ALL rooms. Purchase of meal tickets is mandatory, and the price is included in the rates below.**

Please circle applicable rates listed below for each day and enter totals in column at far right. Rates listed below are PER PERSON.

	Adults	Children 6–13 yrs. in bed	Children 6–13 yrs. in rollaway	Children under 6 yrs.*	**Enter total rate per day**
8/4 (no meals)	$29.00 single $19.00 double	$14.00 single $9.00 double	$3.00	$3.00	
8/5	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
8/6	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
8/7	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
8/8	$34.00 single $23.00 double	$18.00 single $12.00 double	$6.00	$3.00	
8/9	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
8/10	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
Total for Residence Hall Package = (Please insert this amount in #10 on the reverse.)					$

*There will be a $3.00 rollaway or crib charge for all children under 6 years of age. Meals are free. Smoking and nonsmoking rooms are available upon request.

Please list other room occupants; indicating ages of children.

FULL NAME ARRIVAL DATE DEPARTURE DATE

_____

_____

☐ I am **not** going to the Western Hoe Down, but plan to eat dinner on campus on Tuesday, August 8. I will purchase a ticket at the Meetings Registration Desk for this meal.

TRAVEL SECTION: (Arrival/Departure dates are mandatory.)

I plan to arrive by on _____ (date) am/pm and depart on _____ (date) am/pm

☐ I plan to drive to the meeting. ☐ I will need a parking sticker for the University of Colorado campus.

MAA Minicourse Preregistration Form, Boulder, Colorado

August 7–10, 1989

NOTE: This is not an AMS Short Course Form. Please use the Boulder, Colorado Pregistration/Housing Form to preregister for the AMS Short Course.

To preregister for MAA Minicourse(s), please complete THIS form and return it with your payment to:

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

_____ Telephone: _____
(Please print) Surname First Middle

_____
Street address City State Zip

- Deadline for MAA Minicourse preregistration: June 1, 1989 (After this date, potential participants are encouraged to call the MAA headquarters at 800-331-1622.)
- Deadline for cancellation in order to receive a 50% refund: July 31, 1989
- Each participant must fill out a separate Minicourse Preregistration form.
- Enrollment is limited to two Minicourses, subject to availability.
- Please complete the following and send both form and payment to Susan Wilderson at the above address:

  I would like to attend ☐ 1 Minicourse ☐ 2 Minicourses

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

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

- PAYMENT

  Check enclosed: $ _____

  Credit card type: ☐ MasterCard ☐ Visa

  Credit card # _____ Expiration date: _____

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

Minicourse Number and Name	Organized by	Fee
1. The use of personal computers in an introductory linear algebra course	Homer Bechtell	$30
2. Combinatorics via functional equations	Donald R. Snow	$30
3. Chaotic dynamical system	Robert L. Devaney	$30
4. Faculty-managed programs that produce minority mathematics majors	Uri Treisman & Ray Shiflett	$30
5. Starting, funding and sustaining mathematics laboratories	Stavros N. Busenberg	$30
6. Group theory through art	Thomas Brylawski	$30
7. HP-28S short course for nearly inexperienced users	Jerold Mathews	$30
8. Applications of the HP-28S for experienced users	Thomas W. Tucker	$30
9. A seminar on women in mathematics	Miriam P. Cooney	$30

☐ I plan on preregistering for the Boulder, Colorado meetings **ONLY** in order to attend the MAA Minicourse(s) indicated above. It is my understanding that, should the course(s) of my choice be filled, full refund of the Boulder meetings preregistration fee will be made.

MAA MINICOURSE REGISTRATION FORM — SEND TO THE MAA IN WASHINGTON

FOCUS EMPLOYMENT ADVERTISEMENTS

FOCUS advertisements reach the MAA's 28,000 members, most of whom are college and university mathematicians. FOCUS now offers a new line of advertisement formats; for these new formats we have adjusted our rates per inch accordingly. FOCUS ads now costs approximately 60 cents per word for solid text; such text will yield roughly sixty-six words for each eight lines and slightly more than eight lines per inch.

Rates for FOCUS Employment Ads are:

- 50 words or less: $37.50
- More than 50 words: $40.00 per column inch

There is a 15% discount for the same ad in more than two consecutive issues (with contract in advance). An insertion order on institutional letterhead will be considered a contract. Charges will be billed after the **first** occurrence specified in the contract.

Anyone wishing to place an employment advertisement in FOCUS should write to: Siobhán B. Chamberlin, FOCUS Employment Advertisements, The Mathematical Association of America, 1529 Eighteenth Street, N.W., Washington, D.C. 20036. For more information, call the MAA Washington office at (202) 387-5200.

The deadline for submission in the September 1989 issue is July 1, 1989.

AUGSBURG COLLEGE

Department of Mathematics and Computer Science
Position in Mathematics

ARE YOU DEDICATED TO QUALITY MATHEMATICS TEACHING IN A PRIVATE, LIBERAL ARTS COLLEGE NEAR THE HEART OF MINNEAPOLIS? We are. Continuing, non-tenure track position begins 9/89. Ideal candidate would be an excellent, creative teacher holding a doctorate, with general mathematical interests. Some teaching assignments in our Weekend College likely. Applications from high-quality teachers with master's degrees in mathematics are encouraged too. Please send letter of intent, vita, three letters of recommendation, and evidence of creative, innovative teaching to Kenneth Kaminsky, Chair, Department of Mathematics & Computer Science, Augsburg College, Minneapolis, MN 55454. Applications accepted until position is filled. Augsburg College is a college of the Evangelical Lutheran Church of America and is an Equal Opportunity Employer.

SALISBURY STATE UNIVERSITY

Mathematical Sciences Position

The Department of Mathematical Sciences of Salisbury State University has an opening for the Fall of 1989. A strong commitment to the mathematical sciences point of view (a blending of pure and applied mathematics, statistics, and computer science) and good teaching recommendations are essential. Candidates must be able to teach students with diverse backgrounds (this includes the ability to communicate effectively in English, both orally and in writing). Rank and salary will be commensurate with credentials and experience. A PhD in one of the mathematical sciences is required for a tenure-track position. Applicants not possessing a PhD will be considered for a one-year contractual position. Non-US citizens must have US Immigration and Naturalization authorization to accept employment in this country.

Initial screening will be based on each applicant's academic background and teaching experience supported by recommendations. Final selection will be made on the basis of the foregoing, a personal interview, and a formal lecture on a topic of the candidate's choice.

Salisbury is a small city in a rural area, close to ocean beaches and the Chesapeake Bay.

Send letter of application, resumé, and three letters of recommendation to:

Search Committee
Department of Mathematical Sciences
Salisbury State University
Salisbury, Maryland 21801

Screening of applications will begin on March 15 and continue until the position is filled.

Salisbury State University is an Affirmative Action/Equal Opportunity Employer. Women, minorities, and the disabled are encouraged to apply.

TRENTON STATE COLLEGE

Department of Mathematics and Statistics
Faculty Vacancies for Fall, 1989

Assistant Professor of Mathematics. Tenure-track. Req'd: PhD (or within one year of completion); demonstrated commitment to quality teaching; ability to teach applied mathematics courses; strong research potential.

Assistant Professor of Statistics. Tenure-track. Req'd: PhD in Statistics; demonstrated commitment to quality teaching and strong research potential. Pref'd: ability to provide leadership to a developing program.

Send vita and three letters of recommendation to:

Dr. Aigli Papantonopoulou, Chair
Search Committee
Dept. of Mathematics and Statistics
Hillwood Lakes, CN 4700
Trenton, NJ 08650-4700

Application deadline is March 1, 1989, or until positions are filled. Non US citizens must include statement of current visa status.

Trenton State College has earned national recognition as an undergraduate institution of exceptionally high quality. TSC is located on 225 acres in Ewing Township, within seven miles of Central New Jersey's thriving high-tech and research corridor.

To enrich education through diversity, TSC is an AA/EOE.

BOARD ON MATHEMATICAL SCIENCES

Senior Program Officer

The BOARD ON MATHEMATICAL SCIENCES is preparing a project to update the 1984 David Report, "Reviewing US Mathematics: Critical Resource for the Future," for the National Science Foundation. The update will analyze the current state of support for research in the mathematical sciences and assess progress against the recommendations of the original David Report. It will go further to briefly scientifically assess the field and identify promising opportunities for interdisciplinary research.

Incumbent will be responsible for organizing and supporting the work of the committee, chaired by Dr. Edward E. David, Jr., former presidential science advisor. Requires excellent organizational, writing, and interpersonal skills and familiarity with mathematical sciences research and issues. A PhD or equivalent experience in a mathematical science is required. The National Research Council is an Equal Opportunity/Affirmative Action Employer.

The closing date is March 15, but applications will be accepted until a suitable candidate is identified. Please submit a resumé or cv with salary history and the names of three references to:

NATIONAL RESEARCH COUNCIL
Board on Math Sciences NAS 312 (LC)
2101 Constitution Ave., NW
Washington, DC 20418 EOE

ARKANSAS COLLEGE

Mathematics

Duties include teaching freshmen core mathematics courses, management of a mathematical skills laboratory, and advising of freshmen. Opportunities to teach upper level courses. Master's required. Three years college teaching experience desired. Salary, rank negotiable. Arkansas College is a four-year, liberal arts, Presbyterian college with a $37 million endowment. Send resumé and names of three references to Professor Ed Mosley, Chair, Mathematics Search Committee, Arkansas College, Batesville, Arkansas 72501. AA/EEO.

MATHEMATICS FACULTY POSITION

Master's degree or equivalent in Mathematics. Applicant must be enthusiastic, versatile, and possess the ability to teach a wide range of Mathematics courses from the remedial through college level offered by a comprehensive community college. Previous community college teaching experience preferred. Review of applications will begin immediately and continue until the position is filled. Send letter of application and resumé to:

Dean of Human Resources
MOHAWK VALLEY COMMUNITY COLLEGE
1101 Sherman Drive
Utica, New York 13501

Mohawk Valley Community College is an Affirmative Action/Equal Opportunity Employer who invites and encourages women and minorities to apply.

DEPARTMENT OF MATHEMATICS

University of Alberta

Applications are invited for a tenure-track position, in Approximation Theory (File AP-2) at the Assistant or Associate Professor level, beginning July 1, 1989. Requirements are a PhD and proven ability or demonstrated potential for research and teaching. Current salary range is from $33,144 (Canadian) per annum depending upon qualifications. Send vitae and arrange for three letters of reference to be sent to: Professor L.H. Erbe, Chairman, Department of Mathematics, University of Alberta, Edmonton, Canada, T6G 2G1. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. Closing date for applications is April 30, 1989. Please quote file number when responding to this advertisement. The University of Alberta is committed to the principle of equity in employment.

MONTCLAIR STATE COLLEGE

Faculty Position V-10

The Department of Mathematics and Computer Science invites applications for a tenure-track position at the Assistant Professor rank in Applied Mathematics—Operations Research or Combinatorics.

Applicants should have a PhD in Applied Mathematics or a related field. Applicants at the ABD stage will also be considered. Starting date is September 1, 1989.

Submit resumé with V number and the names, addresses, and phone numbers of three references to Dr. Kenneth C. Wolff, Department of Mathematics and Computer Science, Montclair State College, Upper Montclair, NJ 07043, (201) 893-5132. Review of applications and resumés will begin on February 3, 1989.

Montclair State College has a long history of commitment to cultural diversity in its programs, faculty, and students. To foster this multicultural environment, the College encourages applications from minority group members for its faculty openings. Candidates whose qualifications and experience are directly relevant to complementary college priorities (e.g., urban and multicultural concerns) may be considered for a higher rank.

Montclair State College is an Equal Opportunity/Affirmative Action Employer.

MONTCLAIR STATE COLLEGE

Faculty Position V-12

The Department of Mathematics and Computer Science invites applications for a tenure-track position at the Assistant Professor rank in Mathematics Education—supervisory experience, secondary teaching experience, experience with the use of computers in the Mathematics classroom.

Applicants should have a PhD in Mathematics Education or a related field. Applicants at the ABD stage will also be considered. Starting date is September 1, 1989.

Submit resumé with V number and the names, addresses, and phone numbers of three references to Dr. Kenneth C. Wolff, Department of Mathematics and Computer Science, Montclair State College, Upper Montclair, NJ 07043, (210) 893-5132. Review of applications and resumés will begin February 3, 1989.

Montclair State College has a long history of commitment to cultural diversity in its programs, faculty, and students. to foster this multicultural environment, the College encourages applications from minority group members for its faculty openings. Candidates whose qualifications and experience are directly relevant to complementary college priorities (e.g., urban and multicultural concerns) may be considered for a higher rank.

Montclair State College is an Equal Opportunity/Affirmative Action Employer.

ROCKFORD COLLEGE

Rockford, Illinois
Computer Science/Mathematics

Rockford College, a small liberal arts college in northern Illinois, invites applications for a tenure-track position in computer science/mathematics. Responsibilities will include teaching approximately twelve hours a week per semester, student advising, and committee work.

Qualified applicants must have a master's degree with post-graduate level work in computer science and mathematics (a PhD is preferred), be qualified to teach upper division computer science and post-calculus mathematics, and present excellent teaching recommendations.

The computer science and math departments collectively consist of six faculty using an IBM 4381 VM, operating under CMS with 30 terminals and a lab of 16 IBM PC's and XT's. Curriculum is ACM-based.

Rank and salary are commensurate with qualifications, and there is an attractive benefits program. Send resumé and three letters of teaching recommendations to Dr. Gerald Caton, Computer Science Department Chair, Rockford College, 5050 E. State Street, Rockford, Illinois 61108-2393.

AA/EOE.

WAKE FOREST UNIVERSITY

Department of Mathematics and Computer Science

Applications are invited for a position at the instructor level in both mathematics and computer science beginning in August 1989. The primary duty is teaching freshman and sophomore level courses. An MA, MS, or equivalent is required for each position. Send letter of application and resumé to Richard D. Carmichael, Chairman, Department of Mathematics and Computer Science, Wake Forest University, P.O. Box 7311, Winston-Salem, NC 27109. AA/EOE Employer.

MATHEMATICS

Two faculty positions in mathematics are anticipated beginning August 1989, with one position requiring a background in statistics. A master's degree is required with the doctorate preferred. ABD's will be considered with a commitment to completion of the doctorate required. Primary responsibilities will include quality teaching of lower division and upper division courses. Salary and rank commensurate with education and experience. Closing deadline for accepting applications is April 17, 1989, or until filled. Send letter, vita, transcripts, and at least three letters of reference to Dr. John Watson, Head, Department of Mathematics, Arkansas Tech University, Russelville, AR 72801. AA/EOE.

THE UNIVERSITY OF SCRANTON

Departments of Mathematics and Computing Sciences

The University of Scranton is a Jesuit university with over 3,500 undergraduates. At least one tenure-track position is available in Fall 1989 for faculty interested in a teaching environment. Individuals with expertise in any area of mathematics or computer science will be considered. Research is encouraged and supported through a strong faculty development program. Rank and salary are open and competitive. The two departments currently have 22 full-time faculty and 300 majors. The University has a campus-wide commitment to computing including a faculty PC purchase program. Submit a vita, transcripts, and three references to Mathematics/Computing Sciences Search Committee, University of Scranton, Scranton, PA 18510; or phone (717) 961-7774.

An AA/EO Employer and Educator

MATHEMATICIAN

The University of Pittsburgh at Greensburg invites applications for a full-time faculty position in mathematics at the Instructor/Assistant Professor level. PhD preferred, MS required. Candidates must have a strong background in statistics and provide documentation of teaching excellence. Normal teaching load includes 12 credit hours of instruction per Fall and Winter Terms with associated academic duties. Appointment starts September 1, 1989 contingent on funding. Applicants selected for interview must pay all costs. Successful applicant fully reimbursed. Send curriculum vitae, transcripts, three letters of recommendation, and a letter of interest/teaching philosophy to: Dr. Estrella Z. Ang, Chair, Division of Natural Sciences & Engineering, University of Pittsburgh at Greensburg, Greensburg, PA 15601 on or before March 1, 1989. Women and minorities are encouraged to apply. UPG is an Affirmative Action/Equal Opportunity Employer.

MATHEMATICS FACULTY

Winona State University invites applications for this tenure-track position with negotiable appointment date. Rank and salary dependent on qualifications. Competitive salaries and excellent benefits. Primary duty is to teach undergraduate mathematics and service mathematics courses. Minimum requirement is ABD (with PhD completion by 1992 in Mathematics of Applied Mathematics). Experience and excellence in teaching. POSSIBLE VACANCY: Fixed term appointment with the same duties but with a requirement of a master's degree in mathematics or applied mathematics. Send a resumé, three letters of reference, and transcripts to: MATH SEARCH (Indicate tenure-track *or* fixed term), Office of Human Resources , Winona State University, Winona, MN 55987. Open until filled. Women and minorities are encourage to apply.

HAMILTON COLLEGE

Dept. of Mathematics & Computer Science
Clinton, NY 13323

Temporary leave replacement position; 1 or 2 positions open. Rank and specialty open, but PhD and prior teaching experience desirable. Excellence in teaching required. Duties involve teaching six courses per year at a small, highly selective, 4-year liberal arts college; a part time arrangement may be possible. To apply send curriculum vitae and three letters of reference (at least one about teaching) to Larry Knop, Chair. Women and members of minorities are encouraged to apply; Hamilton College is an Equal Opportunity Employer.

MATHEMATICS

Assistant or Associate Professor. Tenure-track. PhD required. Teaching experience preferred. Ability to prepare secondary school mathematics educators. To teach upper-division mathematics. Reporting date August 21, 1989. Please send letter of applications, resumé, list of graduate courses taken, and three current references to: Dr. Daniel Jaeckle, Chair, Division of Arts and Sciences, University of Houston-Victoria, 2302-C Red River, Victoria TX 77901. Review process begins March 1, 1989. An Affirmative Action/Equal Opportunity Employer.

CHAIR OF MATHEMATICS

University of Mississippi

The Department of Mathematics seeks applications and nominations for the position of professor and chair of the Department of Mathematics. The Department consists of 16 full-time professors, and offers the PhD degree. Applicants must possess a PhD in Mathematics or a Mathematical Science, a research record appropriate for leadership in a research institution, evidence of administrative ability, and a commitment to quality teaching. Salary is open. To insure consideration, respond by May 1, 1989. Desired appointment date is July 1, 1989. Send application, curriculum vita, and three letters of recommendation to: Dr. Alan Paterson, Department of Mathematics, University of Mississippi, University, MS 38677.

The University of Mississippi is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF GUAM

College of Arts & Sciences
Division of Science & Mathematics
Department of Mathematics

The Department of Mathematics at the University of Guam announces six (6) vacancies for the 1989/90 academic year. All positions are at assistant to associate professor level for a 3 year contract, leading to a tenure-track position. Teaching load 12 hours per semester. An earned doctorate is required. Multicultural experience is desirable. Salary $20,374–$42,356. Completed application consists of (1) resumé; (2) transcripts; (3) three letters of recommendation; (4) completed application form. Further information and letters of application to:

Chair, Mathematics Search Committee
College of Arts & Sciences
UOG Station
Mangilao, Guam 96923 USA

Applications completed before March 15, 1989 will receive first consideration,

BARD COLLEGE

Tenure-track Position in Mathematics

Applications are invited for a tenure-track position in Mathematics at Bard College for the Fall of 1989. Bard is a Liberal Arts College with a young and expanding Mathematics Department. We are seeking someone with a strong interest in building an innovative mathematics program in a liberal arts context. Candidates must have a PhD by the Fall of 1989, and a commitment to teaching and continued mathematical activity. Salary and rank depending on experience. To apply, submit a resumé, a statement of teaching and research interests, and 3 letters of recommendation (at least one concerning teaching) to Prof. Ethan Bloch, c/o Dean's Office, Bard College, Annandale-on-Hudson, NY 12504. Deadline for applications is 1/1/89; late applications will be considered until the position is filled. For more information, call (914) 758-6822, exts. 266, 267. Bard College is an AA/EOE.

MATHEMATICS/SCIENCE EDUCATION COORDINATOR

Professional Development Program
University of California at Berkeley
Academic Coordinator II – $31,680–$43,992

Responsible for administration of educational and research programs in the area of science and math education at the high school and undergraduate level. Organizes publication and conference presentations of research findings. Advocates for increased opportunity for minorities at all educational levels in science and mathematics. Solicits increased professional participation and involvement in the construction of department-based programs for minority education. Coordinates curriculum development for program staff of experimental programs at the high school and undergraduate level. Evaluates instructional materials for science and mathematical content. Designs and carries out research on innovative science and mathematics programs and curriculum. Some travel within US is required.

Minimum Qualifications: Demonstrated education or experience equivalent to a master's level in a mathematics or science field. Education and experience demonstrating three to five years directing research and programs in science and math education, especially in multi-cultural settings. Professional activities in related areas. Demonstrated university and public service in related areas. PhD desirable.

Submit letter of application, describing qualifications, resumé, and names/addresses of three references to:

Uri Treisman, Director–Dana Center
Academic Coordinator Search
Professional Development Program
University of California, Berkeley
Berkeley, California 94720

Application deadline April 30, 1989. Approximate starting date is June 1, 1989.

The University of California is an Equal Opportunity/Affirmative Action Employer

MATHEMATICS DEPARTMENT

Kennesaw State College
P.O. Box 444, Marietta, GA 30061

Two tenure-track positions in mathematics at the level of Assistant Professor or above beginning in September 1989. A PhD is required with a strong commitment to undergraduate teaching as well as an interest in scholarly activities. Salary and rank are competitive and commensurate with credentials and experience. The College is located in Northwest Metro Atlanta, and enrolls approximately 8,500 day and evening students in undergraduate and graduate programs. The Department of Mathematics has 15 full-time faculty and shares 6 others with the Department of Computer Science. Send resumé and a list of three references to Dr. Thomas R. Thomson, Chair, Search Committee. Application deadline is March 15, 1989 or until filled.

Kennesaw State College is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF MICHIGAN-DEARBORN

Univ. of Michigan, Dearborn, Dept. of Math & Stat., Dearborn, Michigan 48128. Search Co-chairs James Brown and Ronald Morash. The U of M-Dbn plans to fill a tenure-track position starting in Sept. 1989. It is at the Asst. Prof. level and requires a PhD in Mathematics. A research interest in an applied area is preferred. Teaching capability in an applied area of mathematics or in statistics is also a plus for this position. The teaching load is 9 credit hours per term. To apply, send resumé and have 3 letters of recommendation sent to James Brown, Co-Chair, Search Committee. The Univ of Mich-Dbn is an Equal Opportunity Employer and specifically invites and encourages applications from women and minorities.

MISSOURI WESTERN STATE COLLEGE

St. Joseph, Missouri

The Department of Computer Science, Mathematics, and Physics seeks to fill a tenure-track position in the areas of math and/or physics. Qualified candidates must have at least a master's degree in math or physics and demonstrated ability to teach introductory courses in math and physics. Competence to teach upper-level courses in one or both of these areas is desirable. Responsibilities include teaching 24 semester hours per academic year and service on department and institutional committees. Candidates should submit letter of application, curriculum vita, transcripts, and three letters of reference (one of which should address the candidates teaching abilities) to: Dr. Christopher Godfrey, Department of Computer Science, Mathematics, and Physics, Missouri Western State College, 4525 Downs Drive, St. Joseph, MO 64507.

Applications will be taken until May 1, 1989, or until position is filled.

MWSC is an AA/EOE.

MATHEMATICS

Two positions teaching lower division and/or developmental mathematical courses, assisting in curriculum development, student advising, and professional activity. Requires minimum master's degree. Teaching experience preferred. Position available: August 1989. Application deadline: March 15, 1989, or until filled. Send letter of application, resumé, transcripts, and three letters of reference to: Director of Human Resource Management, Northwest Missouri State University, Maryville, MO 64468. Affirmative Action/Equal Opportunity Employer. Northwest encourages women and minorities to apply.

PRESTONBURG COMMUNITY COLLEGE

Faculty Positions
1989–1990 Academic Year

MATHEMATICS–2 positions: Bachelor's and Master's degrees in Mathematics required. Total of 36 graduate hours in Mathematics or PhD preferred.

COMPUTER SCIENCE: Bachelor's and Master's degrees in Computer Science required. 18 hours beyond Master's preferred.

SALARY FOR POSITIONS: Commensurate with education and experience.

PROCEDURE: Send (1) letter of application, (2) resumé with list of references, and (3) transcripts to:

Dean Robert R. Allen
Prestonburg Community College
University of Kentucky
Community College System
One Bert T. Combs Drive
Prestonburg, KY 41653

An Equal Opportunity Institution

SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE

Department of Mathematics
Carbondale, IL 62901

Temporary positions are anticipated starting on August 16, 1989 as Lecturer. Master's degree in mathematics or admission to candidacy required: PhD preferred. Applicants should provide evidence of excellence in teaching and foreign applicants must provide evidence of ability to speak English effectively. Preference given to applicants with research interest compatible with those of our faculty. The duties will consist of 12 hours of undergraduate mathematics instruction each semester. Closing date May 1, 1989 or until positions are filled. Send applications (including transcripts) to: Temporary Positions, c/o Ronald Kirk, Chairman, Department of Mathematics, Southern Illinois University, Carbondale, IL 62901. SIU-C is an Equal Opportunity/Affirmative Action Employer.

MENLO SCHOOL

Mathematics Department Chair

Highly competitive college prep school 7–12, located on San Francisco Peninsula. Duties include teaching four classes in mathematics through calculus and overseeing operation of department's faculty

and curriculum. Master's degree in mathematical sciences with background in computer science preferred. Several years of teaching experience and some administrative experience desirable. Inquiries accompanied by vita and three letters of recommendation to:

Tony Paulus, Headmaster
Menlo School
50 Valpariso Avenue
Atherton, CA 94025
(415) 323-6141, ext. 332

Menlo School is an Equal Opportunity/Affirmative Action Employer.

COE COLLEGE

A one-year position with the possibility of continuance is available at Coe College beginning in Fall 1989. The candidates is expected to teach courses in undergraduate physics and the mathematical sciences. The college is eager to support research with undergraduates in the context of a liberal arts institution. Candidates should have an advanced degree (PhD preferred) in physics, mathematics, or a related discipline. Applicants should send a resumé and should arrange to have three letters of recommendation sent to: Dr. James Phifer, Dean of the Faculty, Coe College, Cedar Rapids, IA 52402. Review of applications will begin May 15, 1989. AA/EOI.

LECTURER

One or two lecturer positions, non-tenure accruing, but continuing, full-time, teaching undergraduate statistics courses, starting August 1989. Requires MS training in statistics and commitment to quality teaching, experience desirable. Apply by April 17. Send curriculum vita, graduate transcripts, and three letters of recommendation to: R. Randles, Dept. of Statistics, 496 Little Hall, University of Florida, Gainesville, FL 32611. AA/EOE.

UNIVERSITY OF VERMONT

Positions in Applied Mathematics

All ranks, also visiting positions. Established excellence in research and teaching. As Mathematics at UVM is in the College of Engineering and Mathematics, successful interaction with other scientists/engineers/medical researchers and leadership in an interdisciplinary setting are essential. Applications must include detailed resumé, description of research, and at least three letters of reference. Address inquiries and applications to Kenneth I. Gross, Department of Mathematics and Statistics, University of Vermont, Burlington, VT 05405. UVM is an Affirmative Action/Equal Opportunity Employer.

COLLEGE OF BASIC STUDIES

University of Hartford

The College of Basic Studies of the University of Hartford, invites applications for two (2) full-time, tenure-track Assistant Professorships in Mathematics for Fall 1989. PhD or EdD required, as well as evidence of successful teaching and research. Of particular concern will be the ability to teach Freshman Foundations, Analytic Geometry, and Calculus. Salary and rank are dependent upon qualifications and experience.

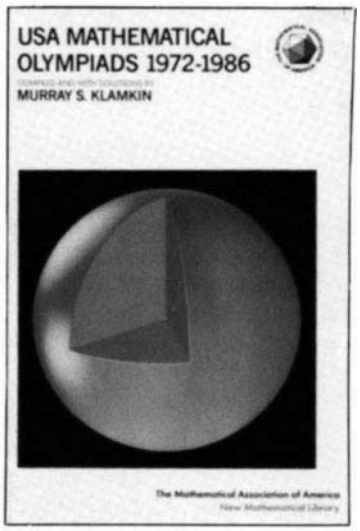
All positions involve instruction at the undergraduate level. Faculty of the College normally teach four (4) courses each semester and participate in student advising. Tenure decisions are based upon the demonstration of excellence in teaching and advising, noteworthy scholarly activity, and participation on departmental, College, and University committees.

TO APPLY: Please send a letter of intent, curriculum vitae, three current letters of recommendation, and official transcripts of course work to: Mathematics Search Committee, College of Basic Studies, University of Hartford, 200 Bloomfield Avenue, West Hartford, CT 06117. The deadline for applications is *March 24, 1989 or until the position is filled.* The University of Hartford is an Equal Opportunity/Affirmative Action employer and specifically invites and encourages applications from women and minorities.

MATHEMATICS

Applications are invited for a full-time, 9-month, tenure-track position beginning Fall 1989. To teach across the undergraduate Mathematics curriculum beginning Fall of 1989. A PhD in mathematics is preferred; candidates with a master's plus other graduate work will be considered. Salary and rank will depend upon qualifications and experience. Send letter of application and vita to the Southern Utah State College Personnel Office, 351 West Center, Cedar City, UT 84720. Applications will be accepted until May 1, 1989. Candidates will visit campus at their own expense.

NEW FROM THE MAA



USA MATHEMATICAL OLYMPIADS, 1972-1986, PROBLEMS AND SOLUTIONS

Compiled by Murray S.Klamkin

Murray Klamkin includes many improvements and extensions to the original USAMO problems. The problems are coded by subject and solutions are arranged by subject as an aid to those interested in a particular field. Contains a glossary of frequently used terms and theorems, and a comprehensive bibliography with items numbered and referred to in brackets in the text. A collection of intriguing problems and elegant solutions.

180 pp., l988, ISBN-0-88385-634-4

List: $13.50 MAA Member: $12.50

RESPONSES TO THE CHALLENGE: KEYS TO IMPROVED INSTRUCTION BY TEACHING ASSISTANTS AND PART-TIME INSTRUCTORS

The Committee on Teaching Assistants and Part-Time Instructors

The committee that prepared this volume has been gathering information on policies, practices, successes, failures, and goals connected with the use of teaching assistants and part-time instructors. In this volume the committee presents and analyzes data showing who these teachers are, the extent and nature of their teaching duties, and the efforts made to assimilate them into the faculties. This volume will help you to see how your department compares nationally, to decide what steps you and your school should take, and to understand what additional resources might be needed.

280 pp., l988, ISBN-0-88385-061-3

List: $15.00

Catalog Number NTE-11

THE USE OF CALCULATORS IN THE STANDARDIZED TESTING OF MATHEMATICS

John W. Kenelly, Editor

This symposium, jointly sponsored by the MAA and The College Board, sets out clearly the theoretical and practical issues that must be addressed as calculators are brought more fully into the mathematics curriculum. This is a practical group concerned with specific tests and test items. General theoretical considerations are set off by the specifics of individual test items and students' success rates on them. The Ohio Early College Mathematics Placement Test is reported on in detail by Joan R. Leitzel and Bert K. Waits. James W. Wilson and Jeremy Kilpatrick examine the theoretical issues in the development of calculator-based tests. John Harvey, now Chair of the MAA's Committee on Placement Examinations looks at the issues surrounding calculator use on placement examinations, as well as giving an overview of the symposium and a survey of developments through 1988.

vi + 50 pp., 1989, Copublished by the Mathematical Association of America and The College Board LC No. 86-064-100

List: $6.50

Calendar

National MAA Meetings

August 7–10, 1989 65th Summer Meeting, Boulder, CO (Board of Governors, August 6, 1989)
January 17–20, 1990 73rd Annual Meeting, Louisville, KY (Board of Governors, January 16, 1990)

Sectional MAA Meetings

Illinois Western Illinois University, Macomb, Illinois, April 28–29, 1989
Kansas Hutchinson Community College, Hutchinson, Kansas, April 21–22, 1989
Metropolitan New York SUNY at Farmingdale, Farmingdale, New York, May 6, 1989
Michigan Hope College, Holland, Michigan, May 12–13, 1989
Nebraska Doane College, Crete, Nebraska, April 14–15, 1989
New Jersey St. Peter's College, Jersey City, New Jersey, April 22, 1989
Northeastern Keene State College, Keene, New Hampshire, June 2–3, 1989; College of the Holy Cross, Worcester, Massachusetts, November 17–18, 1989
Pacific Northwest Gonzaga University, Spokane, Washington, June 15–17, 1989
Rocky Mountain Fort Lewis College, Durango, Colorado, April 21–22, 1989
Seaway Union College, Schenectady, New York, April 28–29, 1989; Utica College, Utica, New York, Fall, 1989; Colgate University, Hamilton, New York, Spring, 1990
Southwestern Western New Mexico University, Silver City, New Mexico, April 21–22, 1989
Wisconsin University of Wisconsin–Parkside, Kenosha, Wisconsin, April 21–22, 1989

Other Meetings

May 4–7 Second Workshop of the Mathematicians and Education Reform Network at the University of California, Berkeley. Directed by Philip D. Wagreich of the University of Illinois, Chicago and Harvey B. Keynes of the University of Minnesota. It aims to strengthen ties among mathematicians involved in precollege educational activities and to encourage more mathematicians to become involved in such activities. For information, contact: Naomi Fisher, Associate Director, MER Network, University of Illinois at Chicago, Office of Mathematics and Computer Education (M/C 249) Box 4348, Chicago, IL 60680; (312) 996-2439.

May 14–16 Markov Processes in Functional Spaces held at Cornell University by the Mathematical Sciences Institute there. For information on scientific program, contact: E. B. Dynkin at (607) 273-1071. To attend, contact: MSI, 201 Caldwell Hall, Cornell University, Ithaca, NY 14853; (607) 255-7740.

May 22–26 Capital City Conference on Combinatorics and Theoretical Computer Science, The George Washington University, Washington, DC. Principle speakers: Richard Karp, László Lovász, and Richard Stanley, each to give three one-hour talks surveying areas of algorithms and complexity, graph theory, and algebraic combinatorics. For information, contact Dan Ullman at (202) 994-6343, dullman@gwuvm.bitnet.

June 5–9 Chaos and the Microcomputer, a workshop sponsored by the Maryland-Virginia-District of Columbia Section. See MAA Workshops on page 6 of the January-February 1989 FOCUS.

June 12–16 Decision Making and the Microcomputer, a workshop sponsored by the Maryland-Virginia-District of Columbia Section. See MAA Workshops on page 6 of the January-February 1989 FOCUS.

June 13–15 Third Chico State Western States Topology Conference. For information, contact: Professor Eldon Vought, Department of Mathematics and Statistics, California State University-Chico, Chico, CA 95929; (916) 895-5113 or 6111.

June 13–17 Maurice Weir and Frank Giordano conduct the Illinois Section Workshop, Teaching Mathematical Modeling, at Northern Illinois University. Techniques of building a mathematical model, team approaches to problem-solving, and interactive use of microcomputers. For information, contact: Dr. Robert Wheeler, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL , 60115; (815) 753-6738.

June 15–18 Third Boston Workshop, Wellesley College, Wellesley, MA. Undergraduate teaching, renewal of calculus, applied linear algebra, differential equations, and algorithms. For information, contact: Gilbert Strang, Room 2-240, MIT, Cambridge, MA; (617) 253-4383.

June 17–21 Workshop on Computers in the Classroom, Meredith College, Raleigh, NC. David Kraines and Vivian Kraines discuss computers in classroom instruction. Includes sample lessons in Calculus, Linear Algebra, and other areas. For information, contact: Dr. Vivian Y. Kraines, Department of Mathematics and Computer Science, Meredith College, Raleigh, NC 27607–5208; (919) 829-8477.

June 19–23 Workshop in Mathematical Modeling sponsored by the Allegheny Mountain Section. See MAA Workshops on page 6 of the January-February 1989 FOCUS. See also Illinois Section Workshop above (June 13–17).

June 20–22 1989 National Educational Computing Conference (NECC), Boston, MA. For information and registration forms, contact: NECC '89, International Council for Computers in Education, University of Oregon, 1787 Agate Street, Eugene, OR 97403-9905.

June 25–30 North Central Section Biennial Summer Seminar, The Mathematics of Computer Graphics, at Carleton College. Short course plus invited addresses and contributed papers. For information, contact: Steve Galovich, Department of Mathematics and Computer Science, Carleton College, Northfield, MN 55057-4025; sgalovic@carleton.edu.

June 26–28 The Mathematical Sciences Institute (MSI) at Cornell University workshop on Feasible Mathematics. The theory and practice of complexity analysis. For information on the scientific program, contact: S. Buss, Department of Mathematics, UCSD, La Jolla, CA 92093, (619) 534-6455, subss@ucsd.edu; or Philip Scott, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5. To attend, contact: MSI, 201 Caldwell Hall, Cornell University, Ithaca, NY 14853; (603) 255-7740.

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