

# NOTICES

OF THE

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AMERICAN MATHEMATICAL SOCIETY

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# Calendar of AMS Meetings and Conferences

**This calendar** lists all meetings approved prior to the date this issue went to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have been assigned. *Programs* of the meetings will appear in the issues indicated below. *First and supplementary* announcements of the meetings will have appeared in earlier issues. **Abstracts of papers** presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the *Notices* which contains the program of the meeting, insofar as

is possible. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. The abstract deadlines listed below should be carefully reviewed since an abstract deadline may expire before publication of a first announcement. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of special sessions.

## Meetings

Meeting #	Date	Place	Abstract Deadline	Program Issue
868	* October 12–13, 1991	Philadelphia, Pennsylvania	Expired	October
869	* October 25–26, 1991	Fargo, North Dakota	Expired	October
870	November 9–10, 1991	Santa Barbara, California	Expired	October
871	* January 8–11, 1992 (98th Annual Meeting)	Baltimore, Maryland	October 2	December
872	* March 13–14, 1992	Tuscaloosa, Alabama	January 2	March
873	* March 20–21, 1992	Springfield, Missouri	January 2	March
874	* April 11–12, 1992	Bethlehem, Pennsylvania	January 30	April
875	* June 29–July 1, 1992 (Joint Meeting with the London Mathematical Society)	Cambridge, England	February 28	May-June
876	* October 30–November 1, 1992	Dayton, Ohio	August 3	October
	January 13–16, 1993 (99th Annual Meeting)	San Antonio, Texas		
	March 26–27, 1993	Knoxville, Tennessee		
	April 9–10, 1993	Salt Lake City, Utah		
	May 21–22, 1993	DeKalb, Illinois		
	August 15–19, 1993 (96th Summer Meeting)	Vancouver, British Columbia		
	(Joint Meeting with the Canadian Mathematical Society)			
	October 22–23, 1993	College Station, Texas		
	January 12–15, 1994 (100th Annual Meeting)	Cincinnati, Ohio		
	March 18–19, 1994	Lexington, Kentucky		
	March 25–26, 1994	Manhattan, Kansas		
	January 25–28, 1995 (101st Annual Meeting)	Denver, Colorado		
	March 24–25, 1995	Chicago, Illinois		
	January 10–13, 1996 (102nd Annual Meeting)	Orlando, Florida		

\* Please refer to page 1001 for listing of Special Sessions.

## Conferences

January 6–7, 1992: AMS Short Course on New Scientific Applications of Geometry and Topology, Baltimore, Maryland.

June 13–July 24, 1992: Joint Summer Research Conferences in the Mathematical Sciences, Mount Holyoke College, South Hadley, Massachusetts.

## Deadlines

	December Issue	January Issue	February Issue	March Issue
Classified Ads*	November 7, 1991	December 12, 1991	January 9, 1992	January 30, 1992
News Items	October 24, 1991	December 4, 1991	December 31, 1991	January 21, 1992
Meeting Announcements**	October 28, 1991	December 5, 1991	January 6, 1992	January 23, 1992

\* Please contact AMS Advertising Department for an Advertising Rate Card for display advertising deadlines.

\*\* For material to appear in the Mathematical Sciences Meetings and Conferences section.

# NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

## ARTICLES

### 884 1991 Steele Prizes

The 1991 Steele Prizes were awarded at the Society's ninety-fourth summer meeting in Orono, Maine to Jean-François Treves for expository writing, to Eugenio Calabi for research work of fundamental importance, and Armand Borel for the career award.

### 891 What Every Mathematics Graduate Student Should Know about Looking for a Job (But was too busy to ask) *Stewart Gleason*

Finding a job is on the minds of many today, given the tight academic job market. This timely article provides practical tips on jobhunting in academia as well as pointers for finding a suitable job in business or industry.

## FEATURE COLUMNS

### 900 Computers and Mathematics *Keith Devlin*

This month Silvio Levy of the University of Minnesota Geometry Center discusses some of the merits of symbolic manipulation systems (computer algebra systems). Also, Fernando Gouvêa of Colby College reviews the two number-theoretic packages *PARI* and *GP*, and Herb Holden of Gonzaga University reviews the matrix algebra program *RMT*.

### 906 Inside the AMS

Some new e-MATH services facilitating electronic communication are described; a list of the Society's electronic mail addresses is presented.

### 908 Washington Outlook

Lisa A. Thompson discusses AMERICA 2000, a strategy for achieving the National Education Goals adopted at the education summit undertaken by the Bush Administration and the Nation's Governors in the fall of 1989.

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# NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

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## ADVERTISING

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## From the Executive Director . . .

### Ph.D. EMPLOYMENT—CRISIS?

During the 1980s, the big story was the looming shortage of doctorates in mathematics and the need to improve the pipeline of students in mathematics, and increase the flow through to the Ph.D. level. The big story of the early 1990s tells of departments receiving hundreds of applications for academic positions and of outstanding new doctorates finding themselves without employment as summer ends. Is there a looming shortage of doctorates? Or are we producing too many doctorates?

Such core questions defy easy answers. Statistics show a steady increase in academic employment during the decade of the 1980s, after a decade of no growth during the 1970s. Each year for the past decade the proportion of unemployed among new doctorates has remained under 2%. But many recent stories belie these statements and, indeed, the preliminary statistics for this year indicate severe problems.

Sorting out the facts is not easy. An increased demand for academics in the 1990s is still anticipated, but faculty shortages are not expected to materialize until the late 1990s and early into the next century, when the children of the Baby Boomers reach college age and the large numbers of academics hired in the 1960s reach retirement age. The present, and presumably short-lived, recession was not anticipated and it appears to be having grave effects on state-funded institutions. With the changes in immigration laws and the "opening" of the Soviet Union and Eastern Europe, foreign-born scientists and mathematicians are a significant part of the academic job market. Another issue is that the education and training of Ph.D.s in the U.S. is directed at the academic market. Whether this market can accommodate so many new entrants is unclear.

What has the Society been doing about employment issues in the mathematical sciences and what additionally can the Society do?

The Society operates the Mathematical Sciences Employment Register every January, which serves hundreds of employers and those seeking employment. The Society annually publishes six issues of *Employment Information in the Mathematical Sciences (EIMS)*, containing position listings (primarily academic) and résumés of applicants using the Employment Register. The Society introduced an electronic bulletin board on employment during summer 1989 and now provides a much more sophisticated electronic service over Internet with the Electronic Employment Service on e-MATH. *Notices* lists many classified employment advertisements. (In addition, *Notices* has carried several articles on the subject; for example, see the article by Stewart Gleason in this issue.)

In addition to these services, the Society formed an ad hoc Task Force on Employment early this summer. The charge to this Task Force is to review the current employment situation within the academic community, identify the problems and the severity of the apparent imbalance between mathematicians seeking academic employment and positions available, and make recommendations to the Society, mathematics departments, and to the larger mathematical community.

Representatives from the Task Force reported on some of the issues they face at a session during the Orono Mathfest this past August. They will have a discussion with department chairs as part of the program of the Board on Mathematical Sciences National Department Chairs' Colloquium in October. A preliminary report from the Task Force is expected to be available at the Joint Mathematics Meetings in Baltimore in January 1992.

The current employment situation is an issue of concern for all the mathematics community. Employment problems may only be a symptom of other problems of the community—the way we prepare doctoral students, the lack of a comprehensive and coherent post-doctoral program in mathematics, and our over-dependence on the academic market. Clearly, a solution will require all parts of the community working together.

William Jaco

## Letters to the Editor

### Value of AMS Membership

Thank you for your kind invitation to rejoin the AMS. However, AMS membership may be the least value for the most money of all professional societies.

I began to realize the low benefit/cost ratio of AMS membership after joining the American Society of Heating, Refrigerating, & Air Conditioning Engineers (ASHRAE) and later the Institute of Electrical and Electronics Engineers (IEEE). In both organizations there are local support groups, active lobbying at all levels, a monthly superb Journal of general interest, an at least quarterly newspaper, very low cost subscriptions to technical journals, and other benefits. For example, yearly dues to ASHRAE include a high quality, cloth bound  $9 \times 14$ , 600 page new edition of one of the four handbooks of standard practices. Or with IEEE membership comes subscriptions to prestigious monthly Journals such as *Trans. Auto. Control* plus the monthly *Control Systems Magazine*, together costing only an additional \$15. The AMS *Notices* is amateurish when compared to the IEEE *Spectrum*.

Both ASHRAE and IEEE make a sincere commitment to bettering the professional well-being of the rank and file member. In contrast, the AMS reinforces the present quaint, elitist, and professionally suicidal attitudes within the mathematical community. Much of classical mathematics was developed to compensate for a lack of computing power. Now the computing power exists and mathematics is

forever changed. Yet the AMS, run by troglodytes from the waning disciplines, conducts business as usual. The refereeing system and journal backlogs are a disgrace—of no pressing concern to the entrenched, who belong to preprint closed-loops that guarantee publication, but terminally discouraging to the young researcher. The talent flows elsewhere. Reports such as the COMAP/Exxon survey, *Math outside of math* [see *Notices* April 1990, pages 408–411], show the bulk of advanced mathematics is being taught outside of mathematics departments. No wonder. We insist on teaching what our clients do not need nor want to know. The mathematical workers that will be remembered from this era will be the non-mathematicians (e.g., Hamming, Feigenbaum, Hopfield), for they are working on the relevant.

Therefore, for these and other reasons, I must decline your invitation to rejoin the AMS.

C. R. MacCluer  
Michigan State University  
(Received May 28, 1991)

### Queries Column Missed

“If  $A \subset N$  is infinite, and

$$p_n = \frac{l}{n} \text{card}(A \cap \{1, \dots, n\}),$$

does

$$\sum_{A \ni k \geq n} \frac{1}{k^3} = O(p_n/n^2)?”$$

Queries like this are posted on walls and columns at mathematics meetings for those which are in the mood for solving exercises. Proliferation of such ad hoc posters reveals a symptom seemingly neglected by the headquarters of the AMS. It shows a kind of frustra-

tion from the part of queries’ authors. Perhaps this phenomenon has been potentiated by the cancellation of the Queries Column in *Notices*. Therefore, I think it is the Society’s staff duty to offer the mathematical community alternative service for catching interest which otherwise will continue to be exhibited on pieces of paper stuck on walls and columns at mathematics meetings.

Aurel Spătaru  
Centre of Mathematical Statistics,  
Bucharest  
(Received July 1, 1991)

### Policy on Letters to the Editor

Letters submitted for publication in *Notices* are reviewed by the Editorial Committee, whose task is to determine which ones are suitable for publication. The publication schedule normally requires from one to two months between receipt of the letter in Providence and publication of the earliest issue of *Notices* in which it could appear.

Publication decisions are made by a letters editor who is appointed by the Editorial Committee from among its members and who is accountable to the committee for those decisions. There is provision for discussion among committee members, by mail or at meetings, before decisions are made by the letters editor. Letters requiring collateral correspondence and/or revision may require several months to process. Letters which have been, or may be, published elsewhere will be considered, but the Managing Editor of *Notices* should be informed of this fact when the letter is submitted.

The committee reserves the right to edit letters.

*Notices* does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in *Bulletin of the American Mathematical Society* will be considered for publication. All published letters must include the name of the author.

Letters should be typed and in legible form or they will be returned to the sender, possibly resulting in a delay of publication.

Letters should be mailed to the Editor of *Notices*, American Mathematical Society, P.O. Box 6248, Providence, RI 02940, or sent by email to [notices@math.ams.com](mailto:notices@math.ams.com), and will be acknowledged on receipt.

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# 1991 Steele Prizes Awarded in Orono

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Three Leroy P. Steele Prizes were awarded at the Society's ninety-fourth Summer Meeting in Orono, Maine.

The Steele Prizes are made possible by a bequest to the Society by Mr. Steele, a graduate of Harvard College, Class of 1923, in memory of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein.

Three Steele Prizes are awarded each Summer: One for expository mathematical writing, one for a research paper of fundamental and lasting importance, and one in recognition of cumulative influence extending over a career, including the education of doctoral students. The current award is \$4,000 for each of these categories.

The recipients of the Steele Prizes for 1991 are JEAN-FRANÇOIS TREVES for the expository award; EUGENIO CALABI for research work of fundamental importance; and ARMAND BOREL for the career award.

The Steele Prizes are awarded by the Council of the Society, acting through a selection committee whose members at the time of these selections were Sylvain E. Cappell, Alexander J. Chorin, Charles L. Fefferman, William J. Haboush, Jun-ichi Igusa, Arthur M. Jaffe, Harry Kesten, Joseph J. Kohn, George Lusztig, and Mark Mahowald (chair).

The text that follows contains the Committee's citations for each award, the recipients' responses to the award, and a brief biographical sketch of each of the recipients. The biographical sketches were written by the recipients or were based on information provided by them. Professors Borel and Treves were unable to attend the Summer Meeting to receive the award in person. They did, however, send written responses to the award.

## Expository Writing

### Jean-François Treves

#### Citation

The 1991 Steele prize for an outstanding exposition of mathematics is awarded to Jean-François Treves for *Pseudodifferential and Fourier Integral Operators* (Volumes 1 and 2), Plenum Press, 1980. The theory of pseudodifferential operators arose from the study of the Hilbert transform in one variable and its generalization to singular integral operators in higher dimensions. Roughly speaking, the algebra

of pseudodifferential operators is an algebra generated by: Real powers of the Laplacian, singular integral operators, and linear partial differential operators; under the following operations: Composition, addition, and taking adjoints. The study of these operators has had many applications: Uniqueness of the Cauchy problem, regularity theorems in several complex variables and on CR manifolds, hypoellipticity, study of the oblique derivative problem, subelliptic operators, the index theorem, etc. Fourier integral operators arise naturally from the study of pseudodifferential operators, especially in connection with propagation of singularities, canonical changes of coordinates, and hyperbolic equations. The theory of Fourier integral operators serves as a fundamental tool in analysis on manifolds.



Jean-François Treves

Treves presents the theory with great elegance and lucidity, he gives many examples and a closely reasoned motivation, which enables him to develop the concepts in

full generality and at the same time make them accessible to the non-specialized reader. In fact, one of the great merits of this work is its accessibility, an individual, after mastering a standard first year course in analysis, should be able to follow these volumes. Perhaps the greatest virtue of these volumes is that they fully reflect the author's insight and expertise as a leading researcher in the field as well as an extremely prolific and successful expositor of analysis.

### Response

The progress of PDE theory in the second half of the twentieth century has been propelled by a number of powerful new analytic tools. The first wave of new concepts appeared in the late 1940s and in the 1950s, emerging mainly from the success of the Sobolev spaces and, more generally, from Hilbert space theory, as well as from the brand of functional analysis created by S. Banach. Today we take for granted the availability and the multiple uses of weak solutions and generalized functions. Presenting or handling Fourier transform without distributions does not strike one, any more, as a viable option; it is more likely to appear as a provocative *tour-de-force*.

The second wave arrived around 1960 and was born of the conjunction of Fourier transform and singular integral operators. Its fairly easy acceptance was certainly due to the spectacular success of its first applications: By A. Calderón to the uniqueness in the Cauchy problem and soon after by M. Atiyah and I. Singer to the proof of the index theorem. Of course, both developments—generalized functions, pseudodifferential operators—had strong roots in earlier mathematics. Several of their concepts and results had been anticipated by mathematicians in the first half of the century. Heaviside calculus and Hadamard's finite parts were precursors of distribution theory. The invariance of singular integral operators under diffeomorphism was proved by G. Giraud in 1934. The language of distributions made possible the passage from kernels to symbols (although special types of symbols showed up already in the work of S. G. Mihlin in the late 1930s). The use of symbols allowed the analyst to move from one differential operator to another one by a path through the territory of operators that are not differential, that are pseudodifferential—like deforming one polynomial into another one through smooth functions. It was a great gain, crucial to the proof of the index theorem—in which deformations were an especially attractive option, thanks to the homotopy invariance of the index of an elliptic operator.

Singular integral operators led, circa 1964, to pseudodifferential operators, of which, in their standard form, they constitute the zero-order "level". A limpid article of J. J. Kohn and L. Nirenberg sold them to the "public" (an independent and simultaneous presentation by J. Bokobza and A. Unterberger was less accessible, based as it was on topological tensor products). Soon after, a completely local theory was proposed by L. Hörmander. In the same spirit, but using amplitudes rather than symbols, M. Kuranishi gave an extremely short and elegant proof of the invariance of pseudodifferential operators under a diffeomorphism, in-

variance which is essential to their transfer onto a smooth manifold. At that stage, the core of the theory had found its natural shape—and was ready for a presentation in an expository text. But still more progress ensued, e.g. the adaptation to boundary value problems by L. Boutet de Monvel and, especially, the emergence of Fourier integral operators in the work of V. P. Maslov and, in a more systematic, and at the same time more accessible, guise, in that of L. Hörmander. Fourier integral operators force one to reset the problems in the framework of the symplectic geometry of the cotangent bundle. Through them the link with the classical (old) quantum mechanics becomes apparent. Among their many successes, one ought to mention the asymptotic estimate of the eigenvalue distributions for elliptic equations, the generalized Poisson formula, the applications to hyperbolic (diffraction) theory, and their use in tomography. They have played a crucial role in an endeavor in which I was fortunate to participate, in joint work with L. Nirenberg: The description of the linear partial differential equations (with simple real characteristics) that admit local solutions.

Surely it would be inappropriate for me to argue with the Committee that decided the attribution of the Steele Prize for Expository Writing and to point out the many, glaring shortcomings of the book for which the Prize was given. I believe that the great honor bestowed upon me is really a tribute to the magnificent collective effort of which my book is but an imperfect reflection. It was my great luck to have been present at the creation of the tools of microlocal analysis and to have been the contemporary of brilliant minds.

### Biographical Sketch

Jean-François Treves was born in Brussels, Belgium, on April 23, 1930, of Italian parents. Part of his childhood and adolescence was spent in Belgium and part in Italy. In 1947 the family emigrated to France. In 1948 J.-F. Treves passed the first Baccalaureat examination, in the Latin-Greek section; he was almost completely ignorant of mathematics and remembers having to learn then what a vector was. In 1949 he obtained the second Baccalaureat, in the Philosophy section, but by now he was studying heat transfer in an engineering school in Paris. There he was taught Laplace's method for solving the mixed problem for the heat equation in a metal bar of finite length, using the Gaussian function. Laplace's method made such a strong impression on him that he resolved to study partial differential equations (PDE), which he has been doing ever since. At the time, however, he was thinking of studying them as a physicist. He joined a group of nuclear physicists at the Atomic Energy Agency in France; they directed him towards the Fourier transform and the Boltzman equation. Relief from the Boltzman equation came when Treves, as a resident alien in France, was forbidden to enter the grounds of the atomic reactor at Saclay. Another turn of good luck occurred at the end of his "Licence" studies at the Sorbonne, when a mathematics tutor of his engineering days, met by chance, offered to

introduce him to Laurent Schwartz, who agreed to supervise Treves' thesis work. His doctoral dissertation was defended in June 1958. At that time, it was not possible for an Italian citizen to obtain a permanent position in a French university. On the recommendation of L. Schwartz, Treves was offered a job, to start in September, at the University of California, Berkeley—a place he could not locate on the map, where people spoke a language he could only read in texts that consisted mostly of mathematical formulas. Since then he has lived in the United States; he became a U.S. citizen in 1972.

After leaving Berkeley in 1961, J.-F. Treves taught at Yeshiva University and Purdue University. In 1970, he joined the mathematics department at Rutgers University, where he has been teaching ever since. He has been a member of the American Mathematical Society since 1959 and, in 1971, he received the Mathematical Association of America's Chauvenet Prize. He gave an Invited Address at the International Congress of Mathematicians in Nice in 1970. He is the author of several books on the subject of PDE and functional analysis and of many technical articles. He has lectured extensively in Europe, the Americas, and in Asia. When traveling in Latin America and in Asia, he collects butterflies.

## Fundamental Paper

### Eugenio Calabi

#### Citation

Calabi's work on global differential geometry, especially complex differential geometry, has profoundly changed the landscape of the field. His fundamental contributions heralded in important new directions in diverse areas. His construction of compact non-Kaehler manifolds with Eckmann, now known as the Calabi-Eckmann manifolds, and his construction of 6-dimensional almost complex manifolds shed light on the theory of Kaehler manifolds and the theory of integrability of almost complex structures and serve as important examples for concrete understanding of those theories. His computation with Vesentini of the cohomology groups with coefficients in the tangent bundle for compact locally Hermitian symmetric spaces is an important step in the theory of rigidity of compact complex manifolds. The way the curvature term was analyzed in the computation is instrumental in the later theory of strong rigidity for Kaehler manifolds with nonpositive curvature conditions. The first example of the important twistor program of Penrose in relativistic quantum field theory is due to Calabi who constructed it before the work of Penrose. Calabi constructed all harmonic maps from the standard 2-sphere to the standard  $n$ -sphere by projecting onto the  $n$ -sphere certain holomorphic maps from the Riemann sphere to a complex manifold over the  $n$ -sphere. This complex manifold constructed by Calabi is now known as the twistor space of the  $n$ -sphere.

Among the numerous important contributions of Calabi, the jewel on the crown is his work on the Monge-Ampere equation and the Kaehler-Einstein metric. This general area is now under the umbrella name of the Calabi conjecture. The problem is to construct Kaehler-Einstein metrics on certain class of compact Kaehler manifolds. The sign of the first Chern class is an important condition of the existence of a Kaehler-Einstein metric. For the case of zero first Chern class, Calabi formulated the problem in the form of the complex Monge-Ampere equation. He proved the uniqueness of the solution and set down the program of proving the existence by the method of continuity and pointed out the openness and the need of *a priori* estimates up to order three. By studying the geometry of improper affine hypersurfaces of convex type, he obtained the third-order *a priori* estimate for a real Monge-Ampere equation in terms of a second-order *a priori* estimate. His method for this third-order estimate is the foundation for the third-order estimate for the complex Monge-Ampere equation. Later, the second-order estimate was obtained by Aubin and Yau, yielding the existence of Kaehler-Einstein metrics for the case of the negative Chern class. Coupled with the work of Guggenheimer, this negative Chern class case of the Calabi conjecture gives the conclusion for the equality case of the Chern number inequality due in the algebraic geometric setting to Bogomolov and Miyaoka for surfaces of general type, leading to a characterization of compact quotients of the complex 2-ball (and in general the complex  $n$ -ball) as a compact complex manifold with positive canonical line bundle satisfying that Chern class inequality. This characterization removed the additional condition for the even dimensional case in the result of Hirzebruch-Kodaira on topological characterization of the complex structure of the projective space. It also made possible the construction of 2-ball quotients by branch covers over the complex projective plane by Hirzebruch and his school and the construction of non locally symmetric compact complex manifolds of negative curvature of Mostow's method of complex reflection groups. Finally the zeroth order estimate by Yau completed the solution of the Calabi conjecture for the zero first Chern class case. After that, the need, in string theory, of the construction of compact Ricci-flat Kaehler threefolds with certain topological structures gave rise to a great deal of activities in the explicit construction of such threefolds which are now called Calabi-Yau manifolds. The zero Chern class case of the Calabi conjecture provided the means to finally confirm the missing case of Kodaira's conjecture that a compact complex surface is Kaehler precisely when its first Betti number is even. It also made possible the proof of the smoothness of the local moduli of compact Ricci-flat Kaehler manifolds. Recently the positive Chern class case of the Calabi conjecture is also an active area of research with a number of significant results.

For a holomorphic vector bundle the analog of the Kaehler-Einstein metric is the Hermitian-Einstein metric, alias the Yang-Mills field, with the Chern class condition replaced by the notion of stability. There the work of



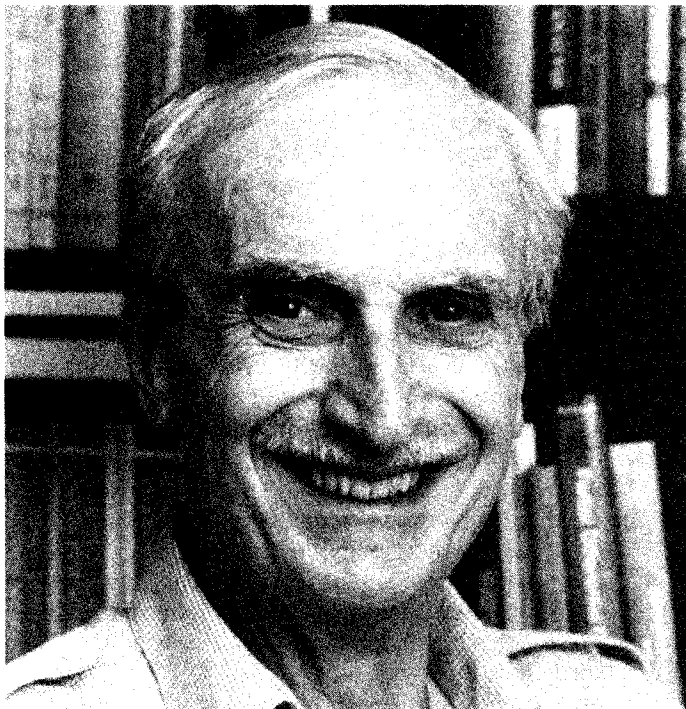
Donaldson, Uhlenbeck-Yau, and other people established an active and very fruitful area of research.

Other settings for the complex Monge-Ampere equations are pseudoconvex domains and quasi-projective manifolds, in which there are results by Bedford-Taylor, Chang-Yau, Lee-Melrose, Cafarelli-Kohn-Nirenberg-Spruch, and others.

Most recently, Demailly used the complex Monge-Ampere equation with some point measures on the right-hand side to obtain results on the Fujiki conjecture which gives the power needed to raise an ample bundle to get a very ample bundle after tensoring with the canonical line bundle. Such results so far have eluded the reach of methods of algebraic geometry.

Calabi also started the program of investigating Kaehler-Einstein metrics as extremal Kaehler metrics and introduced the method of constructing Kaehler-Einstein metrics for special complex manifolds by solving certain ordinary differential equations.

Over the years, there may have been improvements on the technical aspects of *a priori* estimates for the complex Monge-Ampere equation. For example, Evans introduced a simpler method to dispense with the third-order estimate for the solution of the Monge-Ampere equation. Yet the unusually penetrating geometric insight and the brilliant idea of Calabi in the geometric use of the complex Monge-Ampere equation will always remain one of the most important powerful fundamental tools in complex differential geometry and algebraic geometry.



Eugenio Calabi

### Response

There is no instance in my professional life where I can recall a greater sense of surprise, and elation, than when I

first received notice of the great honor being bestowed on me tonight.

While it is usual and fitting, on such a happy occasion, to express one's thanks to teachers, colleagues, assistants, and students, acknowledging their contributions to the work cited in the award, I want to be especially emphatic in doing so now, for the following reason. Having been all my life a slow reader and an awkward writer ("negligent" and "lazy" were some of the more charitable epithets I sometimes got from teachers in school), I have always relied primarily on the spoken word for most of my education. In mathematics too, I think that most of what I know or understand has come through lectures, seminars, conferences, or from the patient attention of many friends when I approached them aggressively with my unsolved problems.

I want to recall, first of all, the early encouragement to pursue study in mathematics during my adolescence from teachers and family, and later from Guido Fubini, Dirk J. Struik, and Norman Levinson. During my graduate training, my natural attraction to geometric subjects was reinforced by the inspired influences of Harry Levy, Don C. Spencer, and my thesis advisor, Salomon Bochner. An especially important role was played, then and since then, in preparing me for the core areas of my subsequent work, by the legendary seminar of deRham and Kodaira of 1949-50 at the Institute for Advanced Study and by the "Nothing" seminars of Kodaira and Spencer in the 1950s. Among the people to whom I feel especially indebted for helping me broaden my views and techniques over the years, I want to recall Emil Artin, Louis Nirenberg, Arthur Erdélyi, Paul C. Rosenbloom, Arthur N. Milgram, René Thom, and Marcel Berger. And then there is S.-T. Yau: Without his contributions, I probably would not be speaking tonight.

For most of my adult life I have often wavered, as I suspect many colleagues do, between positive and negative feelings about the significance of our work, or, more generally, of mathematics as a whole within the framework of human cultural evolution. To explain the negative feelings, we need only to browse through mathematical periodicals of, say, the 1930s or 1940s to notice how many of the topics treated then, that seemed "hot" at the time, are now largely ignored or forgotten: Does this mean that much of what we do today may look, say by the year 2050, as "sonnets in the Etruscan language"? With tonight's activities, I feel far more inclined toward the polar view: it is precisely the constant, unpredictable shift of what are current interests and concerns that makes up the essence of progress; every article published contributes, however imperceptibly, to such a shift, leading to the delimitations of what will turn out to be the "hot" topics in the mid-twenty-first century.

I would like to recall here a cautionary essay of nearly twenty years ago that made a lasting impression on me: It is the 1972 Gibbs Lecture delivered by Freeman J. Dyson, at the annual meeting of the A.M.S., with the title "Missed Opportunities". The written article contains a wealth of information and inspiring ideas, but its main theme is to decry what the author perceived as a "divorce"

between mathematics and theoretical physics, contributing to a “shabby” state of the latter (in 1972!). To back his point, he advanced some examples of current advances in his own area of physics, that could have been made decades earlier, had the physicists only been more aware of developments in mathematics. It may be partly as a result of Dyson’s scolding lecture that we have seen in the years since then a conspicuous turnaround (a “reconciliation”?) between the two fields. Indeed, we have witnessed during the last score of years not only how theoretical physicists are “eating up” such traditionally “pure” subjects as differential topology, algebraic geometry (not to mention functional analysis and calculus of variations), in the development of gauge field theory, string theory, and their outgrowths; we have in fact also seen the reverse flow, whereby mathematicians, working in quantum groups, knot theory, low-dimensional topology, and noncommutative differential geometry, look at ideas from theoretical physics as a heuristic source of intuition. It is not a coincidence that the concept of functional integration, for instance, was first devised by physicists. I am still puzzled by the reason for an advice that Fubini gave me in 1940, “If you want to learn mathematics, you’d better study first a lot of physics!”.

In a lighter vein, it may well be that the time has come to think of a new essay, countering Dyson’s thoughts of 1972, with a title like “Lucky Breaks” or “Narrow Escapes”. We should back it with examples, which I’d like to collect, where the actual timing of the formulation or dissemination of some specific ideas has had a serendipitous effect, whereas if they had occurred earlier the outcome might have been worse. Here is one for a start. Suppose that in the years between the time of Kepler and that of Newton, some enterprising physicist, perhaps trying to estimate a speed of light or maybe whether light transmission was instantaneous, had devised an interference screen (not an inconceivable idea in the seventeenth century) and performed the Michelson-Morley experiment some 250 years ahead of its time. Would the outcome of the experiment not have been a perfect vindication of the ptolemaic view of the universe, confining Copernicus to oblivion for generations to come?

Yes, the development of all sciences is a long history of accidents, a few with negative effect, but the overwhelming majority being “lucky breaks”. In reviewing my own life as a mathematician, I see there too a corresponding preponderance of lucky breaks, more than I am able to recount, and of narrow escapes, from foolish or glaring mistakes caught just in time. For all of these, I am forever thankful to a benevolent Fate that has guided me over the years and to all those people who have so ably and effectively aided Him (or Her?) in that endeavor. Especially to my dear wife Giuliana, who in the process has put up with my swinging moods.

### Biographical Sketch

Eugenio Calabi was born on May 11, 1923, in Milano, Italy to a middle-class Italian Jewish family. They left Italy in 1938 to escape racially discriminatory laws of the Fascist government and, in 1939, immigrated to the United States.

Calabi became a U.S. citizen in 1943. He received his B.S. in chemical engineering from Massachusetts Institute of Technology (1946), his M.A. in mathematics from the University of Illinois (1947), and his Ph.D. from Princeton University (1950).

Professor Calabi was a part-time instructor at Princeton University (1947–1951) and an assistant professor at Louisiana State University (1951–1955). In 1955, he joined the faculty of the University of Minnesota as an assistant professor and progressed to associate professor (1957) and to full professor (1960). Since 1964, he has been a professor at the University of Pennsylvania and served as chairman of the department of mathematics from 1971–1973.

In 1951–1952, Professor Calabi was a Research Fellow at Princeton University and, in 1962–1963, was a J.S. Guggenheim Fellow. He has had visiting positions at the California Institute of Technology (1954–1955), the Institut des Hautes Etudes Scientifiques (1968–1969), Stanford University (spring, 1977), University of Paris-VII (1983), and Princeton University (1988–1989). He has also been a member of the Institute for Advanced Study (1958–1959, fall 1979, and spring 1983). In 1982, he was elected a member of the National Academy of Sciences.

### Career Award

#### Armand Borel

### Citation

The career of Armand Borel has so far spanned four decades and, for the course of that span, his work has been utterly fundamental to the development and formation of modern mathematics: In 1950, he proved with J.-P. Serre the impossibility of fibering a euclidean space with compact fibres, not reduced to a point. This was one of the first striking applications of Leray’s spectral sequence. His subsequent work on the cohomology of classifying spaces and homogeneous spaces demonstrated the effectiveness of spectral sequences in topology. It was a basis for further developments in the theory of characteristic classes, pursued in part in joint work with Serre and with F. Hirzebruch. His recasting of the Smith theory in that framework led to further fundamental developments in transformation group and fixed point theory, based on the “Borel construction”, a first example of “equivariant cohomology”, and, jointly with J.C. Moore, to a new homology theory.

One of his most astonishing achievements at that time was laying the foundations of a theory of linear algebraic groups valid in all characteristics. Together with the work of C. Chevalley, this was the fundamental breakthrough which rendered the theory of algebraic groups susceptible to analysis by the methods of algebraic geometry. Together with J. Tits, he established later the basic properties of the group of rational points of semi-simple groups and determined the representations or homomorphisms of such groups, viewed as abstract groups.

Algebraic groups supplied a framework to the study of arithmetic groups. In 1960, jointly with Harish-Chandra, he generalized to arbitrary groups over number fields and refined the reduction theory known for classical groups. This and infinite dimensional representations supplied the basis of the modern understanding of the theory of automorphic forms. Together with W. Baily, he showed that a specific Satake compactification of the quotient of a bounded symmetric domain by an arithmetic group carries a natural structure of projective variety, a result which is basic in the study of Shimura varieties. Later, Serre and he introduced a compactification of locally symmetric spaces as a manifold with corners and used it to prove basic results on the cohomology of  $S$ -arithmetic groups. It allowed him to determine the stable cohomology of classical groups, the rational higher  $K$ -groups of rings of integers of number fields, further information on "Borel regulators" and to realize the Steinberg representation of a reductive  $p$ -adic group in the space of square integrable harmonic forms on a Bruhat-Tits building, which led to an important contribution to the theory of square integrable, non cuspidal, representations of  $p$ -adic groups. A monograph written jointly with N. Wallach presents a systematic exposition of known and new results on relative Lie-algebra cohomology, continuous cohomology, and cohomology of cocompact discrete subgroups. In 1983-1984, he organized seminars which led to notes on the Goresky-MacPherson intersection homology and on the Beilinson-Bernstein theory of algebraic  $D$ -modules. More recently, jointly with G. Prasad, following Margulis' breakthrough, he proved a generalization in an  $S$ -arithmetic framework of the Oppenheim conjecture.

In each decade, he has played a major role in several of the most important developments of the era and it is reasonable to assume that this will continue. Each of these contributions has been of major importance in shaping the mathematical life that came afterwards. His work provided the empirical base for a great swath of modern mathematics and his observations pointed out the structures and mechanisms that became central concerns of mathematical activity.

In the course of amassing these astounding achievements, he placed the facilities of the Institute for Advanced Study at the service of mathematics and mathematicians, using them to foster talent, share his ideas, and facilitate access to recent developments through seminars and lectures. It is just simply not possible to cite a career more accomplished or fruitful or one more meaningful to the contemporary mathematical community.

### Response

To receive a "career award" brings home the fact that more lies in the past than in the future and makes one look back, notwithstanding the lingering hope that it is not quite all over yet. Doing so gives me first of all the impression of having been very fortunate. For instance, when I went to Paris in 1949, with some trepidation, and some hopes, no doubt, I could hardly anticipate the tremendous benefits I would gain

from Cartan's Seminar, Leray's lectures, my contacts with them and especially with Serre. Combined with a knowledge of Lie groups acquired earlier in Zürich, it provided the framework for my thesis and subsequent work in topology. Similarly, my *Annals* paper on linear algebraic groups could hardly have come about without my stay in Chicago (1954-1955) and the influence of A. Weil, which helped me to get familiar with the algebraic-geometric setting which I eventually used, influenced moreover by earlier results of E. Kolchin and an outlook on compact Lie groups I had learned from H. Hopf and E. Stiefel in Zürich. Then there has been (and is) the privilege of spending the major part of my career under the ideal set up of the Institute. In fact, I have had so many "opportunities" that I cannot help feeling I "missed" too many. But rather than pursuing this melancholy thought, I prefer, without worrying as to whether this honor is really deserved, to express my appreciation to the Steele Prize Committee for this testimony of scientific esteem.



Armand Borel

### Biographical Sketch

Armand Borel was born May 21, 1923 in La Chaux-de-Fonds, Switzerland. He received his *diplôme* from the Federal Institute of Technology in Zürich in 1947 and his *doctorat d'état* from the University of Paris in 1952. He served as an assistant (1947-1949) and professor (1955-1957; 1983-1986) at the Federal Institute. He went to the Centre National de Recherche Scientifique in Paris in 1949, and then to the University of Geneva as a Supplying Professor for Algebra in 1950. From 1952 to 1954, he was a member at the Institute for Advanced Study in Princeton and, in 1957, he was appointed to his current

position of professor at the Institute. He also served as a visiting lecturer at the University of Chicago (1954-1955), and as a visiting professor at the Massachusetts Institute of Technology (1958, 1969), the Tata Institute of Fundamental Research in Bombay (1961, 1983, 1990), the University of Paris (1964), the University of California at Berkeley (1975), the University of Chicago (1976), Yale University (1978), and Tôhoku University in Sendai, Japan (1990).

In 1972, Professor Borel received an honorary doctorate from the University of Geneva and in 1978 was awarded the Brouwer Medal of the Dutch Mathematical Society. A member of a number of scientific societies, he was elected to the American Academy of Arts and Sciences in 1976 and to the National Academy of Sciences in 1987. He is also a foreign member of the Finish Academy of Sciences and Letters, the French Academy of Sciences, and the American Philosophical Society.

Professor Borel was an editor of *Annals of Mathematics* from 1962 to 1979. He has been an editor of *Inventiones mathematicae* since 1979 and of *Commentarii Mathematici Helvetici* since 1984. He presented a Plenary Address at

the International Congress of Mathematicians (ICM) in Stockholm (1962) and an Invited Address at the ICM in Vancouver (1974). In addition, he has given invited lectures at numerous conferences all over the world, including the Invited Address at the AMS Eastern Sectional Meeting in New York (February 1954) and the Colloquium Lectures at the AMS Summer Meeting in University Park (1971).

Professor Borel's professional activities include membership on the Consultative Committee of the ICM held in Moscow in 1966, and the chairmanship of the same committee for the ICM held in Helsinki in 1978. His AMS activities include serving as a Member-at-Large of the Council (1968-1970) and on the following committees: The Committee to Select Hour Speakers for Eastern Sectional Meetings (1962-1963); co-chair of the Invitations and Organizing Committees for the AMS Summer Institutes (1965, 1977); the Nominating Committees for the 1973 and 1976 (chair) elections; and as chair of the Committee on Progress in Mathematics, a newly-established AMS lecture series, for 1988-1990.

# COMBINATORIAL GAMES

RICHARD K. GUY, EDITOR

PROCEEDINGS OF  
SYMPOSIA IN  
APPLIED MATHEMATICS  
Volume 43



■ "The subject of combinatorics is only slowly acquiring respectability and combinatorial games will clearly take longer than the rest of combinatorics. Perhaps this partly stems from the puritanical view that anything amusing can't possibly involve any worthwhile mathematics."—*from the Preface*

■ Based on lectures presented at the AMS Short Course on Combinatorial Games, held at the Joint Mathematics Meetings in Columbus in August 1990, the ten papers in this volume will provide readers with insight into this exciting new field. Because the book requires very little background, it will likely find a wide audience that includes the amateur interested in playing games, the undergraduate looking for a new area of study, instructors seeking a refreshing area in which to give new courses at both the undergraduate and graduate levels, and graduate students looking for a variety of research topics.

■ In the opening paper, Guy contrasts combinatorial games, which have complete information and no chance moves, with those of classical game theory. Conway introduces a new theory of numbers, including infinitesimals and transfinite numbers, which has emerged as a special case of the theory of games. Guy describes impartial games, with the same options for both players, and the Sprague-Grundy theory. Conway discusses a variety of ways in which games can be played simultaneously. Berlekamp uses the theory of "hot" games to make remarkable progress in the analysis of Go Endgames. Pless demonstrates the close connection between several impartial games and error-correcting codes. Fraenkel explains the way in which complexity theory is very well illustrated by combinatorial games, which supply a plethora of examples of harder problems than most of those which have been considered in the past. Nowakowski outlines the theory of three particular games—Welter's Game, Sylver Coinage, and Dots-and-Boxes. A list of three dozen open problems and a bibliography of 400 items are appended.

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**Individual Member \$31**, List Price \$52,  
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# What Every Mathematics Graduate Student Should Know about Looking for a Job (But was too busy to ask)

Stewart Gleason

*Prudential Reinsurance Company*

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The primary thing that every graduate student should know about looking for a job is that it is never too soon to start. After all, the whole point in the end is to find a position which will be rewarding personally and financially (forgot about that, eh?). You should begin by considering whether academia, industry, or government is the most comfortable setting and by becoming aware of what is most attractive to those employers and what actions will be required when the time comes. This will affect many decisions: The courses that you take, your area of specialty and thesis topic, and indeed whether a Master's or a Ph.D. is the best degree for your goals.

Many graduating students have been rudely awakened to the fact that it is very difficult to get a job in the academic world. Though this unfortunate situation may improve over the coming decade, a grim but apt synopsis of the recent outlook is that "there are few or no jobs for the average mathematician, but twenty-five jobs for any potential Fields medalist."<sup>1</sup> While the job market outside of academia may be in an overall sense better, it offers a much broader spectrum of opportunities. What follows is meant to give a brief overview of the tasks and concerns involved in the job search and a few helpful hints for getting through them (from someone who learned the hard way).

## How It Works When Applying to Universities

A student who will successfully defend his or her thesis before September of the new academic year will be considered employable in that year. Whether the degree is actually in hand by the start of the term appears to be largely irrelevant at many schools—what matters is that one should be assured of getting it. However, in business, government, and some smaller schools it is important to have the degree conferred by the time you are offered the position, as it may affect your starting salary and, in some cases, even eligibility for the job.

One should be prepared to send out applications at the beginning of December of the academic year in which one expects to finish and, for some postdoctoral fellowships, even earlier. An application to a university usually consists

of a cover letter, a résumé and a list of publications (if any), a description of one's thesis and other scholarly work, and three or, preferably, four letters of recommendation (more about all of this later). Some academic institutions will require graduate and undergraduate transcripts as well.

A list of suitable employers to which application letters may be sent can be prepared from several good sources, most notably *Notices*, which also publishes a directory of postdoctoral fellowships in the October issue. (See the Stipends for Study and Travel section elsewhere in this issue.) Additionally, there is an AMS periodical devoted entirely to this purpose: *Employment Information in the Mathematical Sciences*. If you can't find the latter publication in your library, try the department chairman's office or interlibrary loan.

For better or worse, the method of most applicants has been to send letters to as many addresses as they have stamps for. This number has traditionally ranged between seventy-five and 200; less than seventy-five seems to be considered inadequate.<sup>2</sup>

Let there be no doubt: Relying on this standard procedure is a really rotten way to look for a job! It looks systematic by is driven entirely by chance and, by itself, is about as effective in producing a job as trying to make a fire with two sticks. You will fare much better if you first figure out what kind of job you want and who has it and then target your efforts to get it. Take advantage of every opportunity to meet and work with people in your field, to attend conferences, etc. Having your advisor help you look for and secure a job by making lots of telephone calls is indispensable. But, whatever you do, the most important idea is to start now. Your résumé will very likely end up in a pile with six hundred others; you must give the hiring committee a reason to hunt through the stack for the one with your name on it!

Another avenue (which I heard nothing about during my own academic job hunt) is the AMS Employment Register held each January during the Joint Mathematical Meetings. Some people I have talked to seem to know a lot about this service, but the majority know very little. This neglected resource, when integrated with email, could be turned into a valuable tool in a field of only two or

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<sup>1</sup>Quoted from, "Hiring and Jobseeking in Academia," Allyn Jackson, *Notices*, December 1989. Read it! A companion article appears in the December 1990 issue.

<sup>2</sup>See "How to find the Right College Position," Keith Devlin, *Focus*, June-July 1991.

three thousand applicants. At the very least, the piles of letters clogging department mail boxes each spring could be reduced substantially. (For more information on the Employment Register of the Baltimore Meetings in January 1992, see the Meetings section of this issue of *Notices*.)

### How It Works Outside Academia

This is a subject that most of the world knows about, and I will leave most of it to them. The essential point is that you will need to emphasize information gathering: Who is hiring mathematicians and for what kind of work? Finding this out can actually be fun, and by far the most efficient method is networking.

The best way to start networking is to call all of your friends and ask them a lot of questions about people they know who are employed in a mathematical capacity and then call *them* and ask more questions. Calling on previous employers and professors can also be extremely helpful. When you track down an open position, follow up by sending a résumé. Even if that employer cannot give you the job, he or she will hopefully be sufficiently impressed to give you more leads. Gradually you'll form a picture of your ideal job and how to get it. You'll send out a lot of résumés in the end, but relying completely on mass mailings is probably a waste of time.

Campus recruiting through the career placement office is another source of opportunities and graduate students may partake of this (it goes on all year, so start early). For information on particular companies, see the *Directory of American Research and Technology* in the library or get their annual report. Also informative are the *Government Research Directory* and the *Research Services Directory*. The *National Business Employment Weekly*, containing job search hints and a week's worth of ads, hits the newsstands on Friday and can be most helpful if you already have a clear idea of what you are looking for.

Recruiters, if you choose to employ them, should be treated with caution. Their value depends entirely on the field in which you are looking, and, since they will collect a fee from your future employer, may do you more harm than good. Good computer programmers are in high demand at every level and many employers are willing to pay this fee to get them. On the other hand, actuarial firms can get all of the entry level employees they need without a fee and will certainly think twice about a candidate offered by a recruiter.

While the timing is about the same, similarities between this and academic job hunting stop there. An application to a business is a cover letter and a résumé. If they want more, they'll ask for it. Prepare these carefully and thoughtfully: Good content is enhanced by details like quality paper and attractive typesetting.

It will be important to keep in mind that positions in the industrial world which directly utilize or pursue research level mathematics are relatively rare. The majority of positions available to mathematicians will be those that require a firm grasp of less sophisticated mathematics

and the ability to apply it or that favor candidates with extensive programming knowledge. For many such positions, particularly in the financial world, a Master's degree may very well be considered ample technical preparation. If you are the recipient of a Master's degree, you will also skirt a hidden obstacle. Few employers will doubt your sincerity or motives and will readily accept an expressed interest in pursuing professional designations or other degrees, such as an M.B.A. As a new Ph.D., on the other hand, you will likely be questioned about your commitment to a non-academic endeavor or further study. Of particular concern is whether or not you are in a holding pattern until the next academic hiring season. If you are, it would be suicide to say so; if you are not, reassure the employer repeatedly.

### Keeping Your Options Open

It is well known that, even in academia, there are fields which are more fashionable than others because of immediate applicability (e.g. numerical analysis and statistics) or because they have only recently been awakened (e.g. graph theory and dynamical systems). Though it is also well known that it is difficult to get through graduate school without doing something you really love, opting to work in a field that is in vogue should not be dismissed out of hand. A notable advantage is that it will be a much shorter journey to the research level and the possibility of publishing a paper before you graduate won't hurt you either. At the very least, you should consider taking a number of courses which are of interest in business and industry, should academia not have a job for you. Indeed, this will also increase your value to small colleges which cannot afford to hire specialists in every area but still need a well rounded faculty.

It is not often mentioned that the principal duty of almost all new Ph.D.s is college level teaching. Many students are encouraged to swallow the notion that the only thing that will get you anywhere is a good thesis and promise as a researcher. While this may be true of large universities and "think tanks" where research is the primary focus, there are many smaller institutions where quality teaching is the goal and building good credentials from your teaching assistantship duties will be essential.

### Mechanics of Job Hunting

What comes next is a few suggestions on the mechanics of job hunting. The first thing you'll want to do is get set up with some computer time and a letter quality printer, if you aren't already. Fortunately,  $\text{T}_{\text{E}}\text{X}$  and  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$  make nice letters, résumés, and mailing labels. You can have your (hopefully free) laser prints photocopied onto fine paper with good results for a few cents. Envelopes are a pain and in the end it's probably easiest to type them. Self-adhesive return address labels help a lot and a lifetime supply is about two bucks.

### Cover Letters

This is your chance to tell the prospective employer exactly what kind of job you are looking for. Be as specific as possible: The more vague you are, the more likely it is that you will be offered a job that you don't want (a bad job can be worse than no job, especially if it is for several years). If nothing else, a letter that sounds too generic will go directly to the file cabinet and will never be seen again.

It should still be possible to appease most employers with minor deviations from the same basic letter. A good trick is to pick a single target, write a letter specifically to them, and then modify it as necessary for each of your other letters. It is best not to use a "Dear Sir or Madame" letter: Find out who to write to and put their name on it. Word processors make these things possible.

### Résumés and Lists of Publications

In short, prepare this as you would when applying for any job. Describe your education, experience, special skills, honors, etc. One thing out of the ordinary that may be included is your country of citizenship and current visa, as this could affect your eligibility for the position.

When applying to a college or university, be thorough in describing your teaching experience. Since teaching will almost certainly be one of the duties of an entry level university position, even limited teaching experience will be of some value. It is of particular value if you can say that you have been in charge of a whole lecture course.

You might consider abbreviating the résumé that you send to large universities, as these schools are frequently overwhelmed by mountains of applications. It is doubtful that such a place will want to know what your hobbies are or whether you painted houses with the same company for ten summers. Ironically, these are precisely the sorts of things that industry and small college employers will want to know. Extracurricular activities, society memberships, and intersecting summer employment will certainly help a business application.

Include with this, on a separate page if necessary, a list of all of your scholarly activity, particularly papers and invited talks. If you don't have any of these, squeeze in anything that is remotely like scholarly activity. Most graduating students will not have much to say in this line anyway, so try not to worry if you can't think of anything. Better yet, think a little harder.

### Description of Thesis and Research

Here you may include summaries of research projects you have worked on, but at the very least you should present a description of your thesis. The paragraph-length abstract contained in your thesis is probably not best for this purpose; it is by nature too brief. A better choice would be a carefully pruned version of the introduction to your thesis as it not only describes the results, but also the background of the problem and its relationship to other fields. This is essential since there is little chance of the first reader of your synopsis being an expert in your field. You must take the opportunity

to point out how important your work really is (even though by the time you are writing applications you will think that your thesis is the biggest waste of time in the history of the universe). End with an indication of your plans for future work.

### Reference Letters

A minimum of three letters will need to accompany most collegiate applications. One should be written by your advisor, of course. Another should come from a professor familiar with your teaching record. If English is not your first language, letters to American schools should address the matter of fluency.

The third letter should probably come from a professor with first hand knowledge of your thesis and the field it's in. With this in mind, it is a good idea to find someone who will serve as a "second advisor." This way you will not have trouble requesting a letter from this person, and they can do better than a letter saying what a nice person you are. A bad situation is to find that, one week before mailing, you don't know who your letters are going to come from. It is a good idea, since your applications are going out in December, to supply your letter writers with mailing labels *before* Christmas recess begins.

### Security Clearance

In some jobs, particularly with government agencies, a security clearance will need to be obtained. This may amount to nothing more than being assigned routine projects until you are cleared. For sensitive government positions, however, you must be prepared for a thorough background check, including a polygraph test or an F.B.I. interview. If drugs are an uncomfortable topic, you might consider avoiding this route. Drug use is the current no-no in government jobs, and, surprisingly, a history of alcohol abuse would be far less damaging.

### In Closing

We have all heard that the nation faces a shortage of mathematicians and, indeed, of scientifically trained people of every discipline. With an expected "wave of retirements" in the universities, one might assume that the need lies mostly in academia and that such jobs will shortly be easy to find. The situation is not as simple as this. Much of the need arises simply from advancing technology and often what is called for is the analytical and research skills that one develops in a graduate education, rather than a mastery of a particular subject. Laboratory and other "hands on" experience are a plus and mathematicians are at a big disadvantage here. Worse yet, with the currently sluggish economy and wavering defense dollars, many companies are cutting their staffs rather than enlarging them.

This trend has appeared in academia as well. Tight university budgets and the uncertainty of student populations make it difficult to hire freely, and very often departments make tenure-track offers to only the most promising candidates, hiring no one if they are not accepted. Landing a

tenure-track job straight out of graduate school is becoming a thing of the past.

Hopefully, this essay has been presented in time to be of some use to this year's graduates. Its real value, however, lies in proving a head start to those of you who will finish in the next few years: If you start thinking about it now, you

will be much better equipped to cope with the chore when the time comes. Furthermore, it was not the intention of this rather pessimistic discourse to say that interesting jobs are not to be had, only that you will have to look hard to find them. Good luck and get busy!

## MATHEMATICS OF RANDOM MEDIA

**Werner E. Kohler • Benjamin S. White,  
Editors**

**Lectures in Applied Mathematics  
• Volume 27 •**

In recent years, there has been remarkable growth in the mathematics of random media. The field has deep scientific and technological roots, as well as purely mathematical ones in the theory of stochastic processes. This collection of papers by leading researchers provides an overview of this rapidly developing field.

The papers were presented at the 1989 AMS-SIAM Summer Seminar in Applied Mathematics, held at Virginia Polytechnic Institute and State University in Blacksburg, Virginia. In addition to new results on stochastic differential equations and Markov processes, fields whose elegant mathematical techniques are of continuing value in application areas, the conference was organized around four themes:

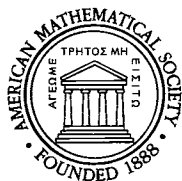
*Systems of interacting particles* are normally viewed in connection with the fundamental problems of statistical mechanics, but have also been used to model diverse phenomena such as computer architectures and the spread of biological populations. Powerful mathematical techniques have been developed for their analysis, and a number of important systems are now well understood.

*Random perturbations of dynamical systems* have also been used extensively as models in physics, chemistry, biology, and engineering. Among the recent unifying mathematical developments is the theory of large deviations, which enables the accurate calculation of the probabilities of rare events. For these problems, approaches based on effective but formal perturbation techniques parallel rigorous mathematical approaches from probability theory and partial differential equations. The book includes representative papers from forefront research of both types.

*Effective medium theory*, otherwise known as the mathematical theory of homogenization, consists of techniques for predicting the macroscopic properties of materials from an understanding of their microstructures. For example, this theory is fundamental in the science of composites, where it is used for theoretical determination of electrical and mechanical properties. Furthermore, the inverse problem is potentially of great technological importance in the design of composite materials which have been optimized for some specific use.

*Mathematical theories of the propagation of waves in random media* have been used to understand phenomena as diverse as the twinkling of stars, the corruption of data in geophysical exploration, and the quantum mechanics of disordered solids. Especially effective methods now exist for waves in randomly stratified, one-dimensional media. A unifying theme is the mathematical phenomenon of localization, which occurs when a wave propagating into a random medium is attenuated exponentially with propagation distance, with the attenuation caused solely by the mechanism of random multiple scattering.

Because of the wide applicability of this field of research, this book would appeal to mathematicians, scientists, and engineers in a wide variety of areas, including probabilistic methods, the theory of disordered materials, systems of interacting particles, the design of materials, and dynamical systems driven by noise. In addition, graduate students and others will find this book useful as an overview of current research in random media.



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### **Reform in Mathematics Education: Opportunities and Challenges for All**

*Joan Ferrini-Mundy*  
*University of New Hampshire*  
and  
*Glenda Lappan*  
*Michigan State University*

#### **Introduction**

Mathematics education is in the enviable and challenging situation of having the attention of the American public and of policy makers in an unprecedented way. In his report "America 2000," President Bush chooses to highlight mathematics; Goal 6 demands that "By the year 2000, U.S. students will be first in the world in science and mathematics." [4] (p. 9). A series of reform documents, including "Everybody Counts" [18], "National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards" [16], "Project 2061" [2], "Reshaping School Mathematics" [14], *On the Shoulders of Giants* [22], "NCTM Professional Standards for Teaching Mathematics" [17], "A Call for Change" [11], "Counting on You" [13], and "Moving Beyond Myths" [19] develops a consensus of the professional organizations concerned with mathematics. This vision is focused on providing quality mathematics education for all students, as a necessity for the functioning of American society in a quantitative and technological age. It offers both opportunities and challenges for all who have interests and are stakeholders in the mathematical development of children

and young adults. In particular, the mathematics research community can play an important role.

#### **New Structures and Collaborations for New Activities**

Another circumstance of the current era is the existence of new structures to facilitate reform. The Mathematical Sciences Education Board, as an arm of the National Academy of Sciences, was created to stimulate and coordinate national reform. MSEB's State Mathematics Coalitions exist in all states as mechanisms for facilitating change more locally. The National Science Foundation's Statewide Systemic Initiatives program is providing substantial funding to states for the improvement of mathematics and science education. The U.S. Department of Education's Office of Educational Research and Improvement supports a number of centers engaged in research and development related to mathematics education reform, with the National Research Center on Mathematics Teaching and Learning at the University of Wisconsin designated solely for mathematics. The National Council of Teachers of Mathematics, the 80,000-member organization devoted to precollege mathematics education, is launching major efforts to provide inservice and curricular support to teachers engaged in change, and to study the reform process.

The complexity of the educational enterprise is reflected in that of the reform process: At all levels, collaborative efforts are emerging among funding agencies, state and local policy makers, university faculty in mathematics and mathematics education, curriculum developers and publishers, assessment experts, and school personnel and classroom teachers. Such collaboration may be critical to the lasting implementation of sustained change and innovation in schools, and may represent relatively new ways of functioning for research mathematicians and mathematics educators who are committed to working on the problems of improving mathematics education. This activity now includes major new mathematics curriculum development for students in kindergarten through college, the revision and enhancement of preservice and inservice mathematics teacher education, and exciting new efforts to better assess student learning in mathematics.

**Mathematics and Mathematics Education: Tangled Roots**  
Research mathematicians have a long and distinguished

history of leadership and contribution to the precollege mathematics enterprise. G.D. Birkhoff co-authored a secondary school geometry text with the mathematics educator Ralph Beatley in 1941 [1]. In his 1902 address as retiring president of the AMS, E.H. Moore addressed the problems of the secondary school, and argued for integration of algebra and geometry, as well as strong articulation between mathematics and science [15]. The School Mathematics Study Group (SMSG), directed by Edward Begle, grew out of recommendations by conferences of mathematicians, and the original Committee of Eight was actually appointed by AMS president Richard Brauer [15]. The major curricular reform efforts of the sixties and seventies were led by mathematicians such as Suppes, Davis, Page, Kemeny, Tucker, Moise, Gleason, Mac Lane, Rees, Rosenbloom, and others. Mathematicians also have long-standing interest and success in working with teachers and with talented children. The vigorous involvement of mathematicians in the reforms of the fifties and sixties has contributed in some ways to the rapid emergence of mathematics education as a profession. The big curriculum projects of that era opened new opportunities in research concerning questions of teaching and learning, and created the need for massive efforts in teacher education and enhancement.

The mathematics education profession has matured in substantial ways in the past forty years. Professionals with backgrounds in mathematics and education now work in university departments of mathematics, mathematics education, and curriculum and instruction; they also are situated as policy makers in state departments of education and schools. These individuals function as teacher educators, curriculum developers, and instructional leaders. The community reports research findings about the teaching and learning of mathematics in publications such as the *Journal for Research in Mathematics Education*, *Educational Studies in Mathematics*, and the *Journal of Mathematical Behavior*. It meets to discuss research in teaching and learning at conferences of the American Educational Research Association (which has a Special Interest Group for Research in Mathematics Education), the North American Section of the Psychology of Mathematics Education, and at the Research Pre-session of the NCTM Annual Meeting.

A base of knowledge, through research, development, and practice, about the complexity of the mathematics teaching and learning process is developing as a result. This knowledge base is influencing major reform activities. For example, the accumulation of insights from research in children's learning of early arithmetic is serving as the base for large-scale inservice teacher education activity in the University of Wisconsin's Cognitively Guided Instruction Project, under the direction of Thomas Carpenter and Elizabeth Fennema. In particular, the striking findings of Carpenter and Moser [5] concerning the relatively sophisticated problem solving ability of children upon beginning school, and the deterioration of this ability following the introduction of the traditional curriculum in arithmetic, has influenced this work.

Knowledge of how young children learn mathematics is shaping the major elementary school mathematics curriculum work underway at Technical Education Research Centers in the Investigations project, directed by Susan Jo Russell. At the middle school and secondary school levels, curriculum and instruction in geometry teaching has been influenced by research about the development of proof [21] and by study of the developmental scheme offered in the Van Hiele levels [3]. A great deal of research concerning students' understanding of the function concept has been undertaken [24] and the results can be of assistance in the development of curriculum and instructional strategies at the secondary as well as college levels.

On a different scale, researchers-teachers Deborah Ball and Magdalene Lampert at Michigan State University are engaged in the process of studying their own teaching, and working to build elementary school mathematics classrooms which foster rich mathematical discourse and genuine problem formulation and solving [10]. These are efforts to enhance the mathematical education at particular sites, through teacher inservice, through enhanced resources and attention to the schools, and then to study what happens in terms of children's learning.

At the same time, as teachers and schools begin to make changes in the practices of mathematics teaching and learning, mathematics educators are engaged in studying and facilitating those innovations. The QUASAR Project at the University of Pittsburgh's Learning Research and Development Center, under the direction of Edward Silver, and the University of Maryland's Project IMPACT, led by Patricia Campbell, are examples of intervention efforts coupled with elaborate research and documentation, designed to study how reform and change can best occur in mathematics education. As current mathematical research and practice grows out of previous research, increasingly so does research and practice in mathematics education. Syntheses of this research and its implications for practice are underway [9].

Efforts of this sort help the mathematics education community to understand the enormous complexity of the change process, and they teach us about potential pitfalls and opportunities for progress. David Cohen, a well-known researcher in educational policy, cautions [6] that we must recognize that the sort of reform being promoted in mathematics education represents truly revolutionary change for teachers, and that what seems like a small change to a "reformer" can be an enormous change for a classroom teacher. The point is that the education community can bring wisdom and important knowledge to the process of change.

### **Involvement of the Mathematics Community**

Likewise, the mathematics community can bring important knowledge and wisdom to the process of reform in mathematics education. The pages of *Notices* have included some lively discussion of the ways in which this might occur [7, 8, 12, 20, 23]. In our view, it is most likely to occur productively through interesting collaborative efforts. For example, mathematics educators are interested in studying

how children learn mathematical ideas; research mathematicians can provide valuable insights in helping define the sorts of mathematical ideas and concepts that are important and should be studied. As new curricular frameworks and materials are being developed at the local, state, and federal level, mathematicians should have an important voice in helping to determine what mathematical areas, ideas, and processes should undergird those materials. By providing attention to the ways in which the undergraduate mathematics curriculum actually influences and drives the secondary school mathematics curriculum, mathematicians can work with mathematics teacher educators to provide more sensible transitions and articulation. The future precollege teachers of mathematics pass through mathematics courses taught by practicing mathematicians. This provides a wonderful opportunity to model for these preservice teachers powerful ways of understanding and sharing mathematics. The reform documents call for the inclusion of mathematical ideas in the precollege curriculum that are relatively new to that curriculum, in areas such as probability, statistics, mathematical modelling, and applications of many types. Inservice teachers need support and materials to help incorporate these new directions in their teaching, and mathematicians can play an important role.

Many mathematicians are already fully engaged in thinking about educational problems of the type mentioned here, and in conducting educational projects. Such people as Alan Schoenfeld, Paul Sally, Herb Clemens, Ronnie Wells, Karen Uhlenbeck, Bob Devaney, Don O'Shea, and many others are engaged in important educational efforts. The organization Mathematicians and Education Reform (MER), directed by Harvey Keynes and Phil Wagreich, was established to encourage and facilitate the involvement of mathematicians in the improvement of precollege education. Organizations such as MER, as well as provocative statements by the likes of Thurston ("It is dumb to measure mathematicians against the single scale of research," *Notices*, 1990, p. 850) offer context and support for mathematicians interested in directing their talents to educational improvement.

Our recent experience as program directors in the National Science Foundation's Directorate for Education and Human Resources has been enlightening in terms of the challenges that accompany the sorts of collaboration and research-based endeavors discussed earlier. In particular, for mathematicians who become involved in educational projects, it is important that they anticipate the "culture" in which precollege educational projects are developed, reviewed, and funded. Projects that are not sensitive to the needs of teachers and schools, and that have not involved cooperation with school personnel, generally do not fare well. The "negotiation" process for a proposal that has done well in the merit review process can be substantial. Agency staff may ask for clarification and focus, additional detail and revision, program plans, timelines, materials, and discussion of pedagogical perspective. These realities should not deter mathematicians from making contributions and becoming involved.

## Conclusion

Clearly, the intensity of the interest in reform, the abundance of opportunities for involvement, and the high levels of federal funding available are strong forces for participation by a wide range of individuals. Collaborative efforts involving mathematicians, mathematics educators, policy makers, and classroom teachers are not only obviously practical, but are in fact becoming a mandate within many funding programs. This will challenge all of these communities to find mechanisms for interacting, sharing knowledge, and respecting one another's expertise.

Thurston (*Notices*, 1990) calls for the mathematics community to "create better channels of communication between the compartments of the educational system" (p. 850), and argues that "needed reforms will take place through collegial, cooperative efforts." We believe that cooperation between mathematicians and mathematics educators can be especially fruitful as a means for improving the teaching and learning of mathematics for young people.

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## A Computer Classroom for Learning Mathematics\*

Herbert I. Brown

State University of New York at Albany

Some mathematics departments have been experimenting with the use of computers in a laboratory as a supplement to lectures. At The State University of New York at Albany, the Department of Mathematics designed a Computer Classroom where we offer a full range of courses from calculus for non-science/math majors to junior/senior analysis and algebra. Students learn mathematics by simultaneously interacting with their computer, with the instructor's computer, with the instructor at the blackboard, and with fellow students. They are encouraged to collaborate among themselves at all times during the course. It is an extraordinarily rich learning environment whose power and potential have not yet been fully realized.

In addition to teaching the traditional courses found in a mathematics curriculum, the Classroom is also being used to pilot-test two NSF-supported calculus projects: The "lean & lively" Calculus course currently under development at Oregon State University and the Purdue Calculus Project.

Teaching in this atmosphere provides a fresh approach to the study of mathematics by incorporating personal computers and sophisticated Computer Algebra Systems (CASs) into the curriculum, thereby enhancing a student's understanding of the fundamental concepts of the discipline through the exploration of complex examples and applications.

\*The Classroom, an additional user room, and machines for faculty offices were made possible by a grant from Commodore Business Machines, Inc., with additional funding from the University at Albany.

Some see computers as transforming education the way they transformed industry: Teaching more students more quickly and more efficiently. Although this is certainly possible, our experience so far indicates that it is better to think of the computer as "Doing something different" rather than "Doing the same thing faster." The intent is to realize the vision of a "lean and livelier" approach to the teaching of mathematics by taking appropriate advantage of computers and CASs to allow students and instructors unprecedented access to numeric, symbolic, and graphic tools that are usually difficult to get hold of in the classroom; thereby changing the current manner by which mathematics is taught.

The best words to describe our Computer Classroom experience are "interaction" and "collaboration". The course is taught in its entirety in this Classroom and often combines lectures (utilizing the blackboard) and computer demonstrations by the instructor with individual and/or collaborative in-class activities by the students. This inevitably leads to spirited interaction between instructor and student. The spontaneous and simultaneous nature of this interaction is exciting and mathematically stimulating to students. Quite often a student will lean over to another student's computer to point out a syntax error or to make a helpful observation; thereby changing a frustrating experience into a positive one. Recent research indicates that collaborative learning is extremely effective. We encourage collaboration at all times. The reward is the realization that weaker students, who might ordinarily drop the course, become engaged by the stronger students and respond by completing the material, while the stronger students are able to advance beyond the current level of the material through the spirit of exploration that until now was virtually inaccessible in the classroom.

An important concept in mathematics is that of "reversing" a function process. That is, beginning with a function's output, attempt to recover the original input. This is a difficult concept for a beginning calculus student to grasp because it is too difficult to illustrate on the blackboard in any way other than an elementary one. The difficulty lies in having to solve a non-trivial algebraic equation. I usually avoid this difficulty by presenting simple examples which generally leave students unimpressed and uninformed as to the true importance of the concept. This semester, however, I was able to take advantage of the powerful CASs by using a cubic to illustrate the concept. After "looking" at its graph on the monitor and observing that an inverse function existed, the class was asked to solve for the inverse function. This required them to solve a cubic equation, which no one knew how to do. Since no one offered a solution, I suggested we turn to the CAS for help. Lo and behold, it gave us three solutions, two of which we quickly discarded because they were complex (conjugate) solutions. (By the way, an important by-product of this was the student's reinforcement of the Fundamental Theorem of Algebra from High School.) By plotting the resulting solution along with the original function on the computer, the students were now able to "see" and understand the concept of an inverse in a non-trivial manner.

Students use the computer to verify and expand on statements made by the instructor at the blackboard. For example, in a course called Basic Analysis, students come face-to-face with difficult mathematical concepts: Continuity, differentiability, integration, etc. When they study the derivative, it is valuable for them to "see" that being differentiable at a point is a local phenomenon. The computer presents an ideal way for them to learn this. By zooming in closer and closer in a vicinity of the point in question, the students see the local behavior on the screen. In this class, I used a common example from the literature which involved an expression depending on a variable  $x$ . By using the CAS's plotting routines, the students were able to zoom in close to the point in question and look at the results on the screen. I noticed that one student's screen was different. Indeed, this student had replaced every occurrence of the variable  $x$  by the square of that variable. That was remarkable. I casually remarked that his screen looked different and wondered whether he replaced the variable  $x$  by the square of that variable. The student, not sure if he did something wrong, was slow to respond, but eventually admitted doing precisely that. At which point I exclaimed (loud enough to be heard by every student) that that was great! Not only did he sit up straight, but was proud to let straining necks see his display on the screen. I dare say that this student will

continue to explore; not only in mathematics, but in every discipline that he studies. If only all students learned to do this!

The Classroom is designed so that no computer is physically situated between the instructor and the student. Moreover, each screen is visible to the instructor from the front of the room. The students sit on (comfortable) swivel chairs that permit easy movement between work area and computer area. When the student is at his/her work area, he/she is turned toward the instructor. Most of the computers are placed along the perimeter of the room in the shape of a wide "U" with its open end towards the front of the room. Inside this "U" is a wide "E" with its open end also towards the front of the room. The instructors' computer is at the end of the middle leg of the wide "E". This configuration allows the instructor to see at a glance every student's response to a question involving the computer. More importantly, it forces that alluring screen out of sight when blackboard work and note taking or other written work is necessary.

Our results so far exceeded our expectations, and we plan to employ this technology more aggressively in upcoming semesters at all levels of mathematics. Our surprise at the room's apparent effectiveness underscores the need to expose instructors to this environment; it is literally a case of needing to see it to believe it.

## COMPUTER-AIDED VERIFICATION '90

E. M. Clarke and R. P. Kurshan, Editors

### Proceedings of a DIMACS Workshop, Volume 3

This volume, published jointly with the Association for Computing Machinery, contains the proceedings of the second workshop on Computer-Aided Verification, held at DIMACS at Rutgers University in June 1990. The motivation for the workshop was to bring together researchers working on effective algorithms or methodologies for formal verification (as distinguished from, for example, attributes of logics or formal languages). The theoretical results leading to new or more powerful verification methods include advances in the use of binary decision diagrams, dense time, reductions based on partial order representations, and proof-checking in controller verification.

The general focus of this volume is on the problem of making formal verification feasible for various models of computation. Specific emphasis is on models associated with distributed programs, protocols, and digital circuits. The general test of algorithm feasibility is to embed it into a verification tool and to exercise that tool on realistic examples. This volume provides a look at the latest theoretical advances in this exciting and important area of research.



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# Computers and Mathematics

*Edited by Keith Devlin*

## **This month's column**

There can surely be very few mathematicians, and no regular readers of this column, who are not aware of the many uses of computers in mathematics these days. In particular, the impact of computer technology in the mathematics classroom has been well chronicled. Then there are the famous "computer results" that everyone has heard of, such as the Four Color Theorem and Mertens Conjecture. Less certain is how many mathematicians are familiar with the extent of the use of computers in research, other than perhaps applications in dynamical systems and number theory. For instance, how many mathematicians know much about recent work in computational geometry? From conversations I have with my fellow mathematicians around the country, it seems that the "word" still has a long way to go before it spreads to everyone in the mathematics business. This month's feature article should help matters along that path. It comes from Silvio Levy, a research associate at the Minnesota Geometry Center and editor of *The Mathematica Journal*.

Following Levy's article, number-theorist Fernando Gouvêa reviews the two number-theoretic packages *PARI* and *GP*, and Herb Holden takes a look at the matrix algebra program *RMT*.

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## **Symbolic vs. Numerical Computations in Mathematical Research**

**Silvio Levy\***

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On the whole, mathematicians have been slower than practitioners of other sciences to embrace computers as a work tool. There is still a lot of truth to the joke that

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mathematics is the second-cheapest profession, requiring only paper and pencil and a wastebasket (I'll leave unnamed the profession that makes do without the wastebasket . . .).

Yet it is now relatively common for research mathematicians to have a personal computer or workstation on their desks. Although this is often for reasons that have nothing to do with research—a significant percentage of these computers is used mostly for typesetting and electronic mail—it is fair to say that the use of computers in mathematical research is finally coming into its own. In my view, the main factor in this change is the increasing ease with which computers can handle symbolic computations, as opposed to arithmetical computations, a.k.a. number crunching.

I'm not knocking number crunching—not only does it have a central place in applied mathematics, but it can benefit even decidedly "pure" mathematics. For example, computer experimentation was a key factor in reviving the study of complex rational maps, which, having been inaugurated by Fatou and Julia in 1918–1920, had lain essentially dormant until the seventies (notwithstanding important results by Siegel in 1942 and by Hermann in the sixties; for references on all of this, see Paul Blanchard, "Complex Analytic Dynamics on the Riemann Sphere," *Bulletin of the AMS*, **11**, 85–141 (1984)). The theoretical breakthroughs that have since been achieved, notably by Douady and Hubbard, Milnor, Sullivan, and Thurston, were motivated, and perhaps in some sense made possible, by computer experiments.

Likewise, numerical experimentation has been widespread in fields such as dynamical systems, partial differential equations, etc. But the fact remains that there are many areas of mathematics where purely numerical calculations are essentially irrelevant.

Symbolic computations are another story. Just about every mathematician has, on occasion, performed essentially mechanical manipulations in the course of doing research—to compute a curvature tensor from a metric, for example, or the invariant polynomials of a knot, or a Kloosterman sum. And many of them have wished that they could delegate the task to someone or something. Increasingly, they can.

Mathematically oriented symbolic manipulation systems (or computer-algebra systems, or systems "for doing mathematics by computer," in the catchy shorthand used by the creator of one of them) have been around for a while.

The ACM's Special Interest Group on Symbolic and Algebraic Manipulation (SIGSAM) was formed in 1965, and by the early seventies there were already several such systems available or under development (see D. Barton and J. P. Fitch, "A Review of Algebraic Manipulation Programs and their Applications," *Comput. J.* **15**, 362–381 (1972)). But mostly, these early systems (except perhaps for *Scratchpad*, which already had an essentially modern look) tended to be clumsy to program, being reminiscent of the language they themselves were written in, and the range of mathematics that they knew about was limited.

Even when a problem could be expressed in a natural way in these early systems, memory and speed limitations were such that only fairly small instances of the problem could be solved. In the late seventies, as a physics graduate student working on statistical mechanics, I developed with my advisor, Constantino Tsallis, an algorithm to recursively find a certain rational fraction associated with an arbitrary graph, in terms of the fractions associated with subgraphs. Because of branching, the algorithm was exponential. We tried implementing it using one available computer-algebra system, and found that it could cope only with very simple graphs. Eventually, Georges Schwachheim wrote a special-purpose program in PL/I and we were able to deal with examples several times as big.

Of course, this type of trade-off will always have to be made. But the boundary between computations that can be tackled in a casual manner and those requiring a skillful and determined programming effort has been pushed far indeed: One no longer needs to be an accomplished programmer, always mindful of squeezing the most results from the last kilobyte of memory, in order to profit from computers. Most of today's symbolic manipulation systems—and especially the three *M*'s (*Macsyma*, *Maple*, and *Mathematica*)—incorporate a large number of built-in mathematical functions, graphics ranging from adequate to excellent, and, perhaps most importantly, a programming language of high expressive power.

There are also a multitude of specialized symbolic programs that bridge the gap between general-purpose symbolic manipulation programs and user-written, special-purpose software: *Cayley* for group theory, *Macaulay* for commutative algebra, and so on. Such specialized programs generally require far fewer resources than general-purpose systems to solve the same problem, and they have far more complete libraries in their area of specialization. On the other hand, the time that you must invest in learning how to use such a program (not to mention obtaining and installing it, if it's not there already) generally makes sense only if you're going to be using it a lot.

The programming-language aspect of symbolic manipulation systems cannot be overemphasized: The sorts of things that mathematicians like to do can often be expressed much more briefly and cleanly (and sometimes more efficiently as well) in a functional or declarative programming language than in a procedural one, such as *C* or *Fortran*. The advantages of using a highly expressive language go beyond the

fact that programming time and program size may easily be cut by an order of magnitude; they extend to the equally important issues of modularity, portability, robustness, and documentation. Traditionally, these principles of software engineering have largely been ignored by mathematicians, who typically write programs in a rough-and-ready fashion, without much thought for the future. This haphazard approach becomes harder to justify as it becomes easier to write modular, robust, and well-documented programs in languages that are available on a variety of hardware platforms.

Of course, there are also many systems, such as *Derive* and *The Theorist*, that do not aim at offering full programmability, being essentially interactive in nature. These tools can be very useful, especially because they require fewer resources than the three *M*'s. But even murine enthusiasts sometimes wish that they could program a loop, instead of clicking on the same menu item ten times in a row at five-minute intervals. Mathematicians are well-equipped to master programming—it seems to go with being "good at mathematics," especially when the programming language mirrors mathematical concepts.

The following story, told by David Epstein, from the University of Warwick, illustrates well the progression that many mathematicians undergo from an interactive to a programming mode. The work described here was done in 1985; primarily because of it, in June 1988, Epstein was awarded the London Mathematical Society's Senior Berwick Prize "for innovative applications of computers to mathematical research." By way of introduction, I should say that *bc* is a calculator program available under Unix, with simple *C*-like programming capabilities. It is not a symbolic manipulation program at all. Nonetheless, the story does point out some unexpected ways in which even simple computer tools can be helpful in mathematics research. Epstein says:

During the past two years, I have been working with Albert Marden of the University of Minnesota on Sullivan's Theorem. Given an open topological disk  $P$  on the unit sphere, form its complement and let  $C$  be the complement's convex hull in the unit ball, looked at as the Poincaré model of hyperbolic space. The boundary of  $C$  in the open ball is a topological disk  $D$ , and is isometric to the hyperbolic plane;  $P$  is also isometric to the hyperbolic plane by the Riemann mapping theorem. Sullivan's Theorem says that there is a natural bilipschitz homeomorphism between  $P$  and  $D$  (natural in the sense that it commutes with isometries of hyperbolic space), extending the identity map between their point-set boundaries in the closed ball. The bilipschitz constant is bounded above by a universal constant, which I have shown to be no more than 66.25. Bill Thurston conjectures that the best bound is 2; it is known that it cannot be better than 2.

The computer entered into the work as follows. In the original idea of the proof, about twenty-five universal constants had to be chosen, each depending

on certain of the others. Unfortunately, the order in which they had to be chosen was very different from the natural progression of the mathematics. This is of course typical of complicated epsilon-delta proofs.

I tried a large number of drafts and each eventually turned out to be flawed, in that the constants did depend on the particular choice of  $P$ . Eventually I decided that the only way to be sure was to include actual numerical constants, so that I obtained theorems like “If one travels along a path of length .11 in the surface  $D$ , the sum of bending angles met on the surface is at most 3.84 radians.”

In order to find these constants, I used a Unix calculator program called *bc*. I started from the first theorem, working through the paper, putting the constants in. When I hit a snag, I had to go back to the beginning again, changing the constants at an earlier point, where a choice was possible. The process took over a hundred iterations. At first I performed the computations one by one, using *bc*. I soon realized this was inefficient and incorporated the computations into a *bc* program, which worked out the effects of choices on the various constants which were to appear in each lemma. Thus, I could change a single choice of constant with very little labor, and see how this caused other constants to change.

The effect on the pure mathematics was dramatic. First of all, there were a large number of places where numerical estimates were impossible, although one could prove that some constant existed. This threw up a number of problems in pure mathematics, including several suitable for Ph.D. students. One example is to compute the geodesics in the tangent bundle to hyperbolic space, using the standard Riemannian metric.

By pinpointing places where numerical estimates were impossible or produced huge numbers, I also found the intellectually weak points in the proof. By working on these, the proof became shorter, easier to comprehend and more elegant.

Eventually, I was able to get right through the proof with reasonable numerical estimates. As this process neared the end, I realized that the *bc* program, which had been continually modified and improved, now actually contained formulas so that the mathematics could be rewritten in conventional mathematical form, along the lines of “If one travels a distance  $t$  on the surface  $D$ , the sum of bending angles met on the surface is at most

$$(\pi + t)(1 + \cos^2 t - 1/\cos t).”$$

At the end of the paper, an estimate for the bilipschitz constant was found by minimizing a certain expression over a range of possible choices. This program was written in *C* and took a week to write and debug and fourteen hours to run.

One of the steps forward that made a major difference to the computation was the proof of a formula for approximate solutions of differential equations on Riemannian manifolds. The formula, when applied to Euclidean space, gives a standard result, but the proof in our paper is simpler than that in, say, Coddington and Levinson. Before formulating this result, it was necessary to decide how one should define the Lipschitz constant of a non-differentiable vector field on a Riemannian manifold. All this work on elementary but important material was stimulated by the desire to make computations.

More recently, Epstein has made substantial use of computers in developing the theory of automatic groups, in collaboration with Jim Cannon, Derek Holt, Mike Paterson and Bill Thurston. This theory, described in detail in their forthcoming book *Word Processing and Group Theory*, provides practical ways to approach tasks such as solving the word problem and enumerating group elements without repetition, for large classes of groups. It also has important consequences in areas such as hyperbolic geometry and ergodic theory, whose links to the theory of automata have been used by mathematicians for decades, sometimes without their being fully aware of it.

The crucial use of computers came in adding refinements to the basic theory, and especially in the form of a suite of programs, collectively known as *automata* and written in *C* by Epstein, Holt and Sarah Rees, which try to compute an automatic structure for a finitely presented group, given its presentation. The program’s development generated a number of new theoretical insights, often as a direct consequence of procedures initially not having worked as expected, or of the search for speedups.

My own small contribution to this venture came recently, when I proofread and edited the manuscript of *Word Processing and Group Theory*. On several occasions, I was stumped by a proof and ran to the computer to experiment with particular cases, trying to gain insight. I couldn’t use the *automata* program, because the information I wanted was about how the program does (or might do) its work, rather than the result of the work itself. I therefore used *Mathematica* to emulate very small subsets of *automata*’s functions. It was particularly gratifying to see that the Knuth–Bendix algorithm, which accounts for a few pages of *automata* source code, can be implemented in some twelve lines in *Mathematica*, thanks to pattern matching. (One pays a price in speed, but I just wanted to “prototype.”) As a consequence, I was able to clarify several proofs and even extend some of the results, answering questions posed by Epstein in the manuscript.

I have tried to give an idea of sometimes non-obvious ways in which symbolic manipulation systems, and programmable tools in general, can be useful to the research mathematician. I haven’t tried to be exhaustive or balanced in this discussion; there are simply too many areas of mathematics, and too many programs, about which I know virtually nothing. But I would be interested in hearing from



people who have had similar experiences, even in very different fields; perhaps a future article might summarize these.

## Reviews of Mathematical Software

### A Look at *PARI* and *GP*

Reviewed by Fernando Q. Gouvêa\*

*PARI* and *GP* are the two sides of a very impressive package of programs for fast infinite-precision arithmetic and high-precision floating-point calculation developed in France by H. Cohen, C. Batut, D. Bernardi, and M. Olivier. The package is built with special attention to its use for number-theoretic computations. It includes *GP*, which is an interactive "calculator," and library of programs and functions to be used with the *C* programming language, usually referred to as "the *PARI* library." Though the package has number-theoretic computations as its primary goal, it should be useful in many contexts.

The programs were originally written for computers using the Motorola 68020/68030/68040 processors (notably SUN/3, NeXT, and Macintosh II workstations); to increase the speed, much of the program code was written in assembly language. The programs have since been modified for a variety of computers including SPARCstations and the Amiga. The SPARC version also includes some assembly language code and is faster than the SUN/3 version (though perhaps not as much faster as one might have expected). The distribution also includes a "generic 32-bit" version that should compile on many different machines, but the authors provide few guarantees for this version. There is no "generic" MS-DOS version (due to the infamous "640K barrier"), but the package has recently been ported (by David Carlisle of Manchester, via the new *gcc* compiler) to PC-compatibles using the Intel 386 processor. This review is based exclusively on experience with the SUN/3 version.

Assuming *GP-PARI* is already installed on her machine, the typical user will probably first get to know the *GP* calculator (see below for the installation process). This is an interactive program much like the various symbolic manipulation programs. The authors take pains to point out that it is really a "calculator," though it will compute with various kinds of objects, including polynomials and matrices. One should not view *GP*, then as competing with programs for symbolic manipulation such as *macsyma*, *maple*, or *mathematica*. I have not explored *GP*'s graphical capabilities at all; though they exist, they are quite limited.

\*Fernando Gouvêa obtained his Ph.D. at Harvard in 1987 with Barry Mazur, with whom he continues to collaborate. Since September, he has been on the faculty at Colby College in Maine. He can be reached by email at fgouvea@colby.edu.

Playing around with *GP*, one is first of all impressed by its speed. Factoring (both numbers and polynomials), for example, is very quick, especially in comparison to the symbolic manipulators. I recently had the experience of walking into a computer room where a colleague was patiently waiting for *macsyma* to factor a 25-digit integer. I logged in at another terminal, started *GP*, and gave her the factorization almost immediately.

The second impressive thing about *GP* is that it is built to handle various "types" of numbers with equanimity. The first page of the manual lists all of these types, and they include integers, rational numbers, real and complex numbers (as might be expected), but also integers modulo  $n$ ,  $p$ -adic numbers, algebraic numbers, polynomials, polynomials modulo  $P(X)$ , rational functions, finite Laurent series (including power series) in one variable, and matrices. The formation of such objects is recursive, so that one can have, say, polynomials with  $p$ -adic coefficients, matrices of integers modulo  $n$ , and power series with polynomial coefficients. As one moves toward "symbolic manipulation," *GP* becomes less effective; polynomials in two variables, for example, can be handled as polynomials with polynomial coefficients, but this is a bit unwieldy and the routines are less efficient.

Finally, *GP* has a great many functions built in, many relating to number theory: Factoring, functions for handling primes, elementary arithmetic functions, functions for computing class numbers, many functions for handling elliptic curves, etc. There is also an extensive list of transcendental functions (including such animals as Weber functions), many functions for handling polynomials and power series and for doing linear algebra (including an implementation of the Ill algorithm). These are all carefully described in the *User's Guide* that is included with the program.

If *GP* lacks anything, it is a bit more user-friendliness and a bit more programmability. As for the first, there seems to be no way to edit your input. Hence, for example, a long command with a typing mistake in it must be re-typed after *GP* has greeted us with an error message. For *emacs* users, this can be alleviated by running *GP* from within *emacs*; a `pari.el` file is provided with the UNIX distribution. As for programmability, it is possible to run commands from a file, but it seems not to be possible to run *GP* from a shell script (which would allow the user to log off and let the computer compute by itself). Hence, if your process is going to take several days or involves several million repetitions of the same computation, *GP* is probably not the way to go. On its own turf, however, I find this package hard to beat.

The most likely reason for the lack of programmability in *GP* is the existence of the *PARI* library. In fact, it is this library which is the core of the *GP-PARI* package, since *GP* is compiled from a *C* program that calls it for all its special routines. The library may be "#included" in a *C* program, and therefore be available for specific tasks. This certainly seems like the thing to do for repetitive or lengthy processes.

My experience with the *C* programming language and with the *PARI* library are limited. Recently, however, with the

help of Imin Chen, an undergraduate at Queen's University in Canada, I went through the process of constructing a simple program using the library. Our reaction is that this is a powerful set of routines, but they require very careful use. The main reason for this is that *PARI* requires very careful use of memory, and, in particular, has no built-in garbage collection. As the manual says, "you must do your own cleaning up as soon as the intermediate results are not needed." Our program, as an example, involves repeated computations, and cleanup must be done after each one; this is probably not very hard for experienced *C* programmers, but we found it a little daunting.

Our second observation is that it is often better to call the low-level *PARI* routines rather than the ones listed in the manual. This is because the library function **gmul**, for example, is a *general* multiplication function: It knows how to multiply integers, reals, *p*-adics, integers mod *n*, polynomials, etc. In a program where speed is of the essence, and where huge numbers of multiplications are performed, this is excess baggage, and we found it better to use a lower-level routine. Since source is available, one can even take the "integer part" of the definition of **gmul** and use that...

This leads to the final comment: Since everything is distributed as *C* source, the user has great flexibility in using the package. If she wishes to, it is possible to root through the source and write a program based directly on the assembly language routines underlying the system. Thus, while using the *PARI* library requires some *C* wizardry, it provides quite a powerful tool.

*GP* and *PARI* are distributed free. They are available by anonymous ftp from math.ucla.edu (internet address 128.97.64.16). The current version (for UNIX) is the file pari-1.35a.tar.Z in the /pub/pari directory; this is a compressed **tar** archive. Versions for the NeXT and for the Macintosh are available in the same directory (the Macintosh distribution comes as either a stand-alone application or as source). One can also obtain a copy of the current version by anonymous ftp from France (internet address 192.33.148.32); according to Henri Cohen, this machine always contains the latest version (with old bugs corrected, but perhaps with new bugs still undetected!). Updates are frequent, and are announced to the UNIX community via the usual sources. Once obtained, the program must be compiled; I have had little trouble with the compilation (the one time things didn't seem to want to work, a brief email message to Henri Cohen resolved the issue very quickly). Also included in the distribution is the *User's Guide to PARI-GP*, in  $\text{\TeX}$  format. Printing the guide should be easy to do (provided  $\text{\TeX}$  is available). The guide is well-written, and only lacks information about the low-level routines underlying the library functions; perhaps this can be added in later versions.

To summarize, *PARI* and *GP* are a very useful and impressive contribution to the mathematical community. This package deserves to be better known and very widely used.

## ***RMT* - A Matrix Algebra Software Package**

Reviewed by Herbert L. Holden\*

First of all, this software package is easy to use! (My definition of "easy to use" is: It takes less than five minutes to relearn after not using the software for a month.) *RMT* is an interactive program which performs computations with real matrices on an IBM PC. The source language was TURBO C and the object code occupies 163K bytes. The program does not do graphics so there are no special monitor requirements and a coprocessor is not required. All real arithmetic is done in double precision and if a coprocessor is present *RMT* will detect this and take advantage of it. The program and associated files come on one diskette and are accompanied by a 58 page loose-leaf 8 1/2 by 11 manual. This is a refreshing change from the current trend in juggernaut applications.

The program is easy to install and a parameter file provides modest capabilities for customizing the colors on the screen, a desirable feature since information on color schemes known to people in art and advertising has clearly been withheld from software developers.

There are 11 main menu commands each of which has a submenu. The submenus do not have submenus. I like that. It eliminates the labyrinth effect which occurs in other notable menu happy applications which provide the user with a game rather than an efficient way to get work done.

The main menu commands are:

**MAKE** and **ALTER** - Create and edit matrices and vectors.

**FILE** - File maintenance. Store, retrieve, and examine disk files. All data files are expected to be plain vanilla ASCII.

**STACK** - Each matrix and vector in use by the program is numbered, named, and stored in a stack. This command provides stack maintenance.

**UNARY, BINARY, ROW&COL** - Operations on matrices.

**LINSYS** - Algorithms related to solving linear systems.

**POLY** - Operations with polynomials. (Polynomials are stored as vectors.)

**EIGEN** - Operations related to finding eigenvalues and eigenvectors.

**ORTHO** - Operations related to orthogonal matrices.

The display is organized as follows. The top line contains status information. This is followed by 21 lines for matrix display and the user can pan left, right, up, and down. The user may specify the number of decimal places shown or select scientific notation. The last three lines are the main menu and submenus. Options on the main menu are selected by using either a highlight bar and ENTER or keyletter. The

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submenu lines reflect the current main menu choice.

Noteworthy editing features are the ability to create augmented matrices and extract submatrices.

There is the capability of defining a single resident macro consisting of three lines of text (displayed when the macro is activated) and a sequence of keystrokes. A macro can be saved to or loaded from disk.

Some commands work in a demonstration or single step mode so that the user can see the result of each iteration. This feature works with reduction to triangular form, the sweep of Jacobi rotations, reduction to Schur form, and Newtons method for the root of a polynomial.

The program is quite versatile and it is difficult to give the reader an appreciation of the full scope without replicating the users manual. However, here is a partial list of some of the computational options.

**UNARY:** Transpose, Scale,  $A^n$ , Determinant, Frobenius condition number, Signature, Make Vandermonde matrix,  $e^A$

**BINARY:** Dot( $B^T A$ ), Blocksum, Join, Conjugate,  $[A, B] = AB - BA$ ,  $BAB^T$ , evaluate the polynomial  $p(A)$ , find the annihilator polynomial

**LINSYS:** Rank, Nullity, Nullspace, Inverse, Solve, Basis for column space, LU decomposition, Cholesky decomposition

**EIGEN:** Characteristic polynomial, Minimal Polynomial, Hessenberg form, Companion block form, perform Jacobi rotation, perform a QR step or double QR step, Schur form, find all eigenvalues (the result is a  $n$  by 2 matrix of the real and imaginary parts), find eigenvector

**ORTHO:** Project the columns of  $A$  onto the column space of  $B$  or the orthogonal space, Hausholder matrix for column 1 of  $A$ , Reduce to tridiagonal form, Normalize the columns of  $A$ , QR factorization, Gram-Schmidt on the columns of  $A$

**POLY:** +, -, \*, /, gcd, lcm, nth power, evaluate, derivative, Newton imaginary parts

The procedures in LINSYS and EIGEN were tested with a variety of examples from "A Collection of Matrices for Testing Computational Algorithms" by Robert T. Gregory and David L. Karney and the program in fact produced

correct results to within the expectations of double precision arithmetic.

The current philosophy in computer applications is that it is better to have one program with ten computational options than ten programs with one computational option each and the possibility of redundant data processing features. (Contrast the statistical packages *SPSS* and *BMDP*.) Given the facility for sharing results via disk files, I prefer compartmentalization and redundancy.

I suppose, one day, all applications will be rolled up in one program with a menu structure which can only be traversed with a forty button power mouse and an array of foot pedals exceeding even the standards of the American Guild of Organists.

*RMT* provides a modest number of computational procedures in the area of linear algebra. It also provides the user good facilities for editing data, maintaining files, and performing analyses. With fewer analyses, it would still be a good package.

**Odds and ends:** An analysis which was not an option was the singular value decomposition. The screen format was a little cluttered for my taste. The method of specifying "which eigenvalue" for the eigenvector procedure was awkward. An arithmetic fault such as an overflow will terminate the program.

**Overall impression:** I liked it. It would take less than one hour to show students how to use the data processing features and one or two numerical procedures.

This software is marketed by Saunders College Publishing. It is provided free with their linear algebra text and can be purchased separately for \$34.95. Further information can be obtained from:

Denise Watrobsky  
(215) 238-8423  
Marketing Department  
Saunders College Publishing  
The Curtiss Center  
Independence Square West  
Philadelphia, PA 19106-3399

# Inside the AMS

## Electronic Communication on e-MATH

In the coming weeks, four separate tools that facilitate electronic communication will be made available on the e-MATH system. These tools provide bulletin board, discussion list, and conferencing capability that can be moderated or unmoderated.

### LISTSERV

A discussion list mechanism for maintaining subscriber mail addresses to which copies of every item posted to a specific list are automatically remailed. All transactions (e.g., joining a list, posting items to a list, determining which lists are available, resigning from a list) are conducted by processing email messages sent to the LISERV. Discussion groups, newsletters, and journals can be maintained by LISERV. Indexes to available lists as well as purposes of lists can be maintained.

### NETLIB

A bulletin board mechanism that archives material for demand distribution. Items are posted to and retrieved from NETLIB by processing email messages. NETLIB requires that an administrator actually post each submitted item. Dependencies among items can be specified; for example, a subset of modules required to successfully install a particular software routine can be retrieved. NETLIB can also be used to store archive material collected by LISERV applications.

### NETNEWS

A bulletin board list mechanism popular in the UNIX community for establishing open or unstructured discussion groups, or moderated conferences. Items posted to NETNEWS groups can be read on the host machine or exported as news "feeds" to local hosts that support NETNEWS. A login to some NETNEWS host machine and use of a NETNEWS reader is required. e-MATH's use of NETNEWS will be restricted to discussion groups of research or profes-

sional interest to mathematicians. Discussion groups on the e-MATH machine will be available for export.

### CONFER

An online conferencing environment designed to support structured group discussion. CONFER users can join conferences as formal participants, auditors, or temporary observers. Individuals can start discussions in a conference by entering an item to which other users can respond. Items and responses that are entered are immediately available to other members of a conference. Conferences can be public or private. Each conference is established by a conference organizer who serves as a facilitator. CONFER requires a login to the e-MATH machine and use of an editor. Logins to the e-MATH machine will be created under software control; the EMACS and VI editors will be supported.

Care needs to be taken to match tools to purpose. LISERV, NETLIB, and NETNEWS are particularly well-suited to communities with large numbers (several hundred to thousands) of participants. LISERV involves very little administrative overhead. CONFER is best-suited to structured discussions involving fewer numbers of participants. Export of NETNEWS discussion groups is suited to UNIX sites. LISERV and NETLIB work when BITNET sites are involved while CONFER will not work for purely BITNET sites. CONFER assumes that participants have familiarity with EMACS or VI. And so on.

If you are interested in using one of the above services on the e-MATH system for electronic communication, please send a description of your needs or ideas to e-MATH support ([support@e-math.ams.com](mailto:support@e-math.ams.com)). A subcommittee of an AMS standing committee (COMCOM) responsible for overseeing e-MATH operations will review and approve proposals. e-MATH support staff will provide assistance in implementing suitable solutions.

### Accessing e-MATH

e-MATH can be accessed via telnet (**telnet e-math.ams.com** or **telnet 130.44.1.100**). Login and password are **e-math**. The requirements for a successful connection to e-MATH are:

- a connection to an INTERNET host.

- VT100 connectivity in communications software and host operating system.
- terminal tabs set at every eight columns.

To access the e-MATH *CML* name look-up service, type the following:

telnet 130.44.1.100 2050 (UNIX hosts)  
telnet 130.44.1.100/port=2050 (VMS hosts)

At the "Enter Name" prompt, enter the last name of the person you would like to look up in the *CML* database. First names may be given in the following manner: "Last:First", with no spaces around the ":". The search wildcard "\*" may be used in the name string.

For further information, or for assistance accessing and using e-MATH services, send email to:

**support@e-math.ams.com.**

### AMS Electronic Mail Addresses

When the AMS first connected to the Internet, a number of non-user-specific electronic addresses were established to contact the AMS and *Mathematical Reviews* staff. The following is an updated list of those addresses together with a description of the types of inquiries that should be made through each address.

#### **EXDIR@MATH.AMS.COM**

to contact the administrative offices in Providence.

#### **MEET@MATH.AMS.COM**

to send requests for general information about Society meetings and conferences and for submission of electronic preregistration for the annual and summer meetings.

#### **AMSMEM@MATH.AMS.COM**

to request information about individual or institutional membership in the AMS, about dues payment, about membership privileges, or to ask any general membership questions; may also be used to submit address changes.

#### **CUST-SERV@MATH.AMS.COM**

to send address changes, place credit card orders for AMS products, or conduct any general correspondence with the Society's Customer Services Department.

#### **NOTICES@MATH.AMS.COM**

to send correspondence to the Managing Editor of *Notices*, including letters to the editor, contributed articles, and information for the meetings and conferences listing.

#### **SECRETARY@MATH.AMS.COM**

to communicate with the Secretary of the Society.

#### **SUPPORT@e-MATH.AMS.COM**

for information or for assistance in accessing and using e-MATH (the Society's new bulletin board) services.

#### **MATHREV@MATH.AMS.COM**

to submit reviews to *Mathematical Reviews* and to send related correspondence.

#### **MATHDOC@MATH.AMS.COM**

for users of *Current Mathematical Publications*, *MR*, and MathSci who wish to order a copy of an original item from the MathDoc document delivery system.

#### **MATHSCI@MATH.AMS.COM**

for information or questions regarding MathSci. If requesting an information package for MathSci or the  $\TeX$  Library, please include a complete mailing address.

#### **GUIDE-ELEC@MATH.AMS.COM**

to request a copy of the Society's *Guidelines for Preparing Electronic Manuscripts*. Please specify  $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{T}\mathcal{E}\mathcal{X}$  or  $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$  version.

#### **AMS-TEX@MATH.AMS.COM**

to request an  $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{T}\mathcal{E}\mathcal{X}$  style file for a particular AMS book series.

#### **AMS-LATEX@MATH.AMS.COM**

to request the  $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$  style files.

#### **ABS-REQUEST@MATH.AMS.COM**

to request style files for submission of abstracts for AMS meetings and for MAA programs at January and August Joint Mathematics Meetings.

#### **ABS-SUBMIT@MATH.AMS.COM**

to submit abstracts for AMS meetings and for MAA programs at January and August Joint Mathematics Meetings.

#### **ABS-MISC@MATH.AMS.COM**

for questions regarding a particular abstract.

#### **PUB-SUBMIT@MATH.AMS.COM**

to submit accepted manuscripts to AMS publications (other than *Abstracts*).

#### **PUB@MATH.AMS.COM**

to send correspondence to the AMS Publications Division.

#### **TECH-SUPPORT@MATH.AMS.COM**

to contact the Society's Typesetting Technical Support group.

When requesting the files on diskette, please specify whether IBM or Macintosh diskettes are required and give a complete mailing address.

## Washington Outlook

This month's column is written by Lisa A. Thompson, who is the Assistant for Governmental Affairs of the Joint Policy Board for Mathematics (JPBM).

### **America 2000: The Education President's Education Strategy**

With the words, "dollar bills don't educate students; education depends on committed communities determined to be places where learning will flourish," President Bush introduced in April a grand plan to reform precollege education in the United States and transform the country into a nation of learners. AMERICA 2000 is a strategy for achieving the goals adopted at the education summit undertaken by the Bush Administration and the Nation's Governors in the fall of 1989. Secretary of Education Lamar Alexander calls AMERICA 2000, not just another federal program, but a nine-year crusade to transform American education state by state, community by community, school by school, and family by family.

The National Education Goals state that by the year 2000: 1) All children in America will start school ready to learn; 2) The high school graduation rate will increase to at least 90 percent; 3) American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter including English, mathematics, science, history, and geography, and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy; 4) U.S. students will be first in the world in science and mathematics achievement; 5) Every adult American will be literate and possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship; 6) Every school in America will be free of drugs and violence and will offer a disciplined environment conducive to learning.

A legislative package authorizing many of the AMERICA 2000 proposals was introduced in May amid a spirit of bipartisanship and an expectation that at least portions of the package would be expedited. Both Houses of Congress have held a number of hearings on various aspects of the

bill, but no action had been taken on the most sweeping proposals prior to the August Congressional recess.

The first part of the AMERICA 2000 blueprint involves establishing better and more accountable schools. The proposal calls for defining World Class Standards for student performance at the fourth, eighth, and twelfth grade levels in five core subjects, including mathematics, and developing a system of voluntary tests, the American Achievement Tests, that would measure student knowledge of the five core subjects. The plan suggests that universities and colleges use the results of these examinations in the admissions process and that employers use them when making hiring decisions.

President Bush also asks that the National Assessment of Educational Progress be expanded to include assessment of three grade levels in all five core subjects, as an interim measure until the American Achievement Tests can be designed and implemented. Congress, more wary of the viability of this approach, created a National Council on Education Standards and Testing to study the feasibility and desirability of standards and testing. It is to report to the Nation before the end of the year.

By far the most controversial aspect of AMERICA 2000 is its provision encouraging states to allow parents to choose the schools their children attend and directing federal dollars to "follow" the students to the chosen schools, even private schools. The President believes strongly that this approach will create a competitive climate that stimulates excellence in education.

But serious questions concerning the merits of school choice have been raised in Congressional hearings and in press coverage of the President's plan. Education leaders are troubled by the consequences for children left behind at substandard and underfunded schools, a concern the Administration has not addressed. It has been noted that parents might choose schools for reasons other than academics. And the constitutionality of providing funds to parochial schools is the subject of fierce debate.

National testing has also engendered controversy: An education expert testifying before Congress noted that applying universal standards to students in a given grade level is problematic because children learn at different rates. Minority and other groups have spoken out against testing because, among other things, it could hinder education and

job advancement for minority and female students, who traditionally have scored lower on standardized tests.

Rounding out the strategy for improving existing schools are provisions for federal seed money for Governors' Academies for Teachers and similar institutions for school leaders and the encouragement of local education agencies to implement alternative certification of teachers and principals.

Part II of the AMERICA 2000 strategy outlines a plan to invent and establish a New Generation of American Schools. President Bush is working with corporate leaders to endow and operate a private sector research and development fund—the New American Schools Development Corporation—to finance innovation in education. He has asked Congress to authorize the establishment of 535 experimental schools, at least one in every Congressional district. Communities would draw on the assistance of the research and development teams to create schools that will achieve the National Education Goals.

Parts III and IV focus on adult education and on the importance of community involvement in the success of AMERICA 2000. In July, the President signed a bill, initiated by Democrats before AMERICA 2000 was unveiled, expanding the Department of Education's literacy programs. Communities are being encouraged to adopt the National Education Goals as their own, develop a community-wide strategy for reaching those goals, devise a report card for publicizing its progress toward those goals, and agree to create and support a New American School. Those that do can be designated by the state Governors as AMERICA 2000 Communities.

Despite the Administration's emphasis on the strategy, AMERICA 2000 has company on Congress's education

agenda. Shortly before the President's plan was unveiled, the Senate passed a bill that would establish literacy programs, model schools, a pilot program to test school-based management, and increased funding for science and mathematics education. Congress is also involved this year in reauthorizing the Higher Education Act, generating much debate on the appropriate structure of federal student aid.

Congress is still working on the Fiscal Year 1992 budget, which includes a proposal from the FCCSET Committee on Education and Human Resources to increase support for federal programs in mathematics, science, and engineering education 13 percent, to a level of nearly two billion dollars; much of that increase would be spent at the precollege level. The National Science Foundation's Education and Human Resources programs and the Department of Education have been singled out for generous treatment in the Congressional budget process, though not in ways conforming to the President's priorities.

While AMERICA 2000 is still evolving and it remains to be seen how it is implemented by the schools, there is clearly a role for the mathematical sciences community. Recent activities in support of improved mathematics education—the National Council of Teachers of Mathematics efforts in preparing standards for curriculum and teaching, the Mathematical Sciences Education Board work in assessment, and the Mathematical Association of America's curriculum action and teacher preparation projects to name a few—give mathematics a head start among the five school subject areas emphasized by the strategy. AMERICA 2000 is another opportunity to contribute to the improvement of mathematics education and encourage a continuing supply of teachers, researchers, and workers who are mathematically literate.

## LIE GROUPS I, II

Mikio Ise and Masaru Takeuchi

Translations of Mathematical Monographs, Volume 85

The first part of this book, which is the second edition of the book of the same title, is intended to provide readers with a brief introduction to the theory of Lie groups as an aid to further study by presenting the fundamental features of Lie groups as a starting point for understanding Lie algebras and Lie theory in general. In the revisions for the second edition, proofs of some of the results were added.

The second part of the book builds on some of the background developed in the first part, offering an introduction to the theory of symmetric spaces, a remarkable example of applications of Lie group theory to differential geometry. The book emphasizes this aspect by surveying the fundamentals of Riemannian manifolds and by giving detailed explanations of the way in which geometry and Lie group theory come together.

1980 *Mathematics Subject Classifications*:

Part I: 22, 17; Part II 53

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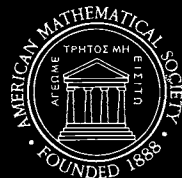
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## News and Announcements

### Andreas Floer 1956–1991

Andreas Floer died on May 15th, 1991 in Bochum, Germany. He was in his first year as a Professor of Mathematics at the Ruhr-Universität Bochum, while still on leave from a professorship at the University of California, Berkeley.

Andreas was born on August 23rd, 1956 in Duisburg, Germany. He studied with R. Stöcker and E. Zehnder at Bochum, where he received the degree of Diplom in Mathematics in 1982, specializing in algebraic topology. In fall 1982, he came to Berkeley as a doctoral student, working with C. Taubes on gauge theory and A. Weinstein on symplectic geometry. He returned to Germany in the summer of 1984 and resumed work with Zehnder, completing a thesis on V.I. Arnol'd's symplectic fixed point conjecture to earn the degree of Doctor in December 1984.

In Spring 1985 he returned to Berkeley as a research associate, where he began his work leading to what is now called Floer homology. Without finishing his Berkeley thesis, which was to be on work with Taubes on monopoles on 3-manifolds, Andreas obtained a postdoctoral fellowship in mathematical physics at SUNY Stony Brook on the strength of his German doctorate. After a year at Stony Brook he spent two years as a Courant Instructor at NYU and completed some of his seminal work. In 1988 he took up an assistant professorship in Berkeley.

During the last two years, Andreas received many honors: visiting invitations from all over the world (Moscow, Oxford, Paris, Zürich), a Sloan Fellowship (1989), and an invitation as

plenary speaker at the ICM in Kyoto (1990). By 1990 he was promoted to Professor at Berkeley while considering offers from other universities, including Bochum, where he returned in the fall of 1990 as a Full Professor.

The notion of Floer homology arises from some ideas of C. Conley (who proved the Arnol'd conjecture for symplectic tori with Zehnder in 1982). Many problems in symplectic geometry had been known to be equivalent to critical point problems for "action" functionals on path or loop spaces in symplectic manifolds. Unfortunately, these functionals lacked some nice properties thought to be necessary for a theory of Morse or Lusternik-Schnirelman type relating critical points to topology: their critical points had infinite index and coindex, and the crucial Palais-Smale condition could be expected only in the space of curves with "half a derivative" in  $L^2$ , which just fails to carry the structure of a Hilbert manifold. For this reason the variational principle was considered to be only of formal interest.

In an early breakthrough, P. Rabinowitz in 1978 used the action functional to study the existence of periodic orbits for hamiltonian systems in  $\mathbb{R}^{2n}$ . His crucial observation was that the functional looks like a finite dimensional map suspended by an infinite dimensional quadratic form with infinite dimensional stable and unstable directions. Rabinowitz's idea of isolating the finite dimensional part was fundamental in Conley and Zehnder's proof of the Arnol'd conjecture for tori. There, the infinite dimensional part was completely removed, and the complexity of the remaining finite dimensional

part was measured by the so called Conley index.

The Conley index is a homotopy invariant for an isolated set of bounded trajectories of a flow on a locally compact space. Conley also realized that an isolated locally compact invariant set within an infinite dimensional space could be at least partially described by some kind of Morse decomposition, including the connecting orbits between the invariant subsets of this decomposition. This led him to the idea of the so called connection matrices for general continuous flows, but his theory worked only for locally compact spaces.

Through an influential 1982 paper by Witten, Andreas also became aware of the fact known already to Smale and Milnor that, in finite dimensional Morse theory, the connecting gradient orbits between critical points of adjacent Morse index suffice to determine the homology of the underlying manifold. A knowledge of the entire gradient flow is not necessary. For the action integral, the connecting orbits are solutions of an elliptic PDE which is essentially the one considered by Gromov in his theory of pseudoholomorphic curves in symplectic geometry.

One of Andreas' fundamental observations was that, though the Morse indices are always infinite, their difference has a well defined meaning as the Fredholm index of the elliptic system describing the connecting orbits. (This difference was also analyzed by C. Viterbo.) Homology spaces can then be constructed from the chain complex in which the critical points are the generators, with boundary operator given by the algebraic number of connecting



orbits between critical points whose index difference is 1. Proving that the square of the boundary operator is zero and that the resulting homology is, like the Conley index, invariant under homotopy, required a lot of hard analysis involving a variant of Taubes' "gluing procedure".

Floer's homology construction led to new estimates for the number of solutions of problems in symplectic geometry (fixed points, periodic orbits and lagrangian intersections). In joint work with H. Hofer, a combination of Floer's theory and the Ekeland-Hofer symplectic capacity theory has led to new symplectic invariants and a symplectic homology theory.

Floer's ideas spread quickly thanks to his work in low dimensional topology. In 1986, Taubes had interpreted Casson's invariant for homology 3-spheres as the index of a vector field on an infinite dimensional manifold. This vector field can be considered as the gradient of the so called Chern-Simons functional. Floer was able to interpret Casson's invariant as the Euler number of an "instanton homology" for three manifolds. In some of his last work, he defined Yang-Mills type invariants for knots and gave an axiomatic characterization of his three-manifold and knot invariants.

Andreas Floer's life was tragically interrupted, but his mathematical visions and striking contributions have provided powerful methods which are being applied to problems which seemed to be intractable only a few years ago.

Helmut Hofer  
Alan Weinstein  
Eduard Zehnder

### Elections to the American Academy of Arts and Sciences

The American Academy of Arts and Sciences has announced the election of 195 new fellows and twenty-one honorary members. Among the elections were several that are likely of interest to the mathematical sciences community:

MICHEL BOUDART, Stanford University; ALEXANDRE J. CHORIN, University of California at Berkeley; EDWARD A. FEIGENBAUM, Stanford Uni-

versity; WALTER M. FITCH, University of California at Irvine; GRACE HOPPER, U.S. Navy; GEORGE W. HOUSNER, California Institute of Technology; GEORGE LUSZTIG, Massachusetts Institute of Technology; WALTER E. MASSEY, National Science Foundation; O. T. O'MEARA, University of Notre Dame; DONALD S. ORNSTEIN, Stanford University; DONALD O. PEDERSON, University of California at Berkeley; MARY ELLEN RUDIN, University of Wisconsin at Madison; DAVID E. RUMELHART, Stanford University; PETER C. SARNAK, Stanford University; SYLVAN SCHWEBER, Brandeis University; L. E. SCRIVEN, University of Minnesota; JOHN SEINFELD, California Institute of Technology; DANIEL W. STROOCK, Massachusetts Institute of Technology; DENNIS P. SULLIVAN, Queens College of the City University of New York; HARRY L. SWINNEY, University of Texas at Austin; CLIFFORD A. TRUESDELL, III, Johns Hopkins University; and MARVIN ZELEN, Harvard University. SAHARON SHELAH, Hebrew University, was elected as a foreign honorary member.

### Prizes from the Parisian Academy

The Académie des Sciences, Paris has announced a number of prizes to researchers in the mathematical sciences.

The 1991 Grand Prix de Mathématiques of 50,000FF was awarded to JEAN-CHRISTOPHE YOCOZ of the Université de Paris-Sud, Orsay.

The recipients of other Academy prizes in mathematics are: JACQUES FARAUT, Université de Paris VI; FREDERIC HELEIN, Ecole Normale Supérieure de l'Enseignement Technique, Cachan; FRANÇOIS MURAT, Centre National de la Recherche Scientifique, Université de Paris VI; and LAURENT CLOZEL, BERNARD HELFFER, PIERRE PANSU, and CLAUDE VITERBO, all of Université de Paris-Sud, Orsay.

### Rollo Davidson Prize

The Trustees of the Rollo Davidson Trust have announced the presentation of the Rollo Davidson Prize for 1991 to ALAIN-SOL SZNITMAN of

the Eidgen Technische Hochschule in Zurich, Switzerland. The prize recognizes Sznitman's work on the development of chaos in stochastic systems.

### American Team Places Fifth in Olympiad

The U.S. team of six students placed fifth in the 32nd Annual International Mathematical Olympiad (IMO), held July 17-18, 1991 in Sigtuna, Sweden. With a score of 212 out of a possible 252, the U.S. followed the USSR, which had a score of 241; China, 231; Romania, 225; and Germany, 222.

Each of the U.S. team members won individual medals. A gold medal went to JOEL ROSENBERG (Hall High School, West Hartford, CT), and silver medals to KIRAN KEDLAYA (Georgetown Day High School, Washington, DC), ROBERT KLEINBERG (Iroquois High School, Elma, NY), LENHARD NG (Chapel Hill Senior High School, Chapel Hill, NC), and MICHAEL SUNITSKY (Stuyvesant High School, New York City). RUVIM BREYDO (Stuyvesant High School, New York City) received a bronze medal.

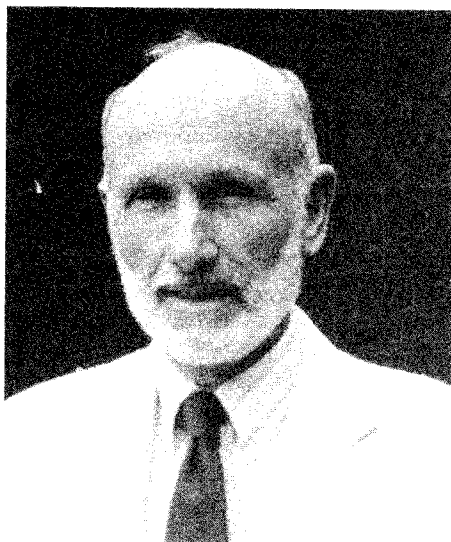
The fifty-five IMO teams competed by working on solutions to six challenging mathematical problems in two, 4 1/2-hour sessions. A sample problem from this year's IMO is the following. Let  $S = \{1, 2, 3, \dots, 280\}$ . Find the smallest integer  $n$  such that each  $n$ -element subset of  $S$  contains five numbers which are pairwise relatively prime.

The U.S. IMO team coach was Cecil Rousseau of Memphis State University. The team was chosen on the basis of performance in the Twentieth Annual United States of America Mathematical Olympiad, held on April 23, 1991 and on an evaluation of prospective team members' work during a rigorous, four-week training session held June 11-July 11, 1991 at the U.S. Military Academy at West Point, NY.

The Mathematical Olympiad activities are sponsored by eight national associations in the mathematical sciences (including the AMS and the Mathematical Association of America (MAA)), with arrangements made by MAA.

### Bradley and Rankin Join AMS Staff

The Society is pleased to announce that John S. (Spud) Bradley and Samuel M. Rankin III have joined the AMS executive staff.



Spud Bradley

Bradley just finished a tour of duty as program director for the calculus curriculum development program at the National Science Foundation, a position he held for the past two and a half years. At the AMS, Bradley will be associate executive director for projects, which involves the development and coordination of a wide range of programs, particularly those involving other organizations, educational matters, relations with the legislative and executive branches of the federal government, and public awareness of the role of mathematics in today's world. In addition, he will serve as managing editor of *Notices*. (Donovan Van Osdol, who was managing editor for the past two years, has returned to the University of New Hampshire.)

"The new directions for the Society suggested by the Strategic Planning Task Force in its recent report open up some exciting possibilities," Bradley says. "The time is right for the AMS to find new ways to use its resources and leadership position to advance the cause of mathematics education and research and to promote awareness in government and the public of the importance of mathematics in all its man-

ifestations. Such efforts must be made in cooperation with other organizations that share with the AMS an interest in these issues."

Bradley grew up in Mississippi and received his early education there, including a B.S. degree at the University of Southern Mississippi. He received a Master's degree from Peabody College, now part of Vanderbilt University, and, after teaching at Southern Mississippi and Peabody, he received a Ph.D. from the University of Iowa in 1964. He then joined the faculty at the University of Tennessee, where he was head of the mathematics department from 1980 until 1989.



Samuel M. Rankin III

Rankin will serve as associate executive director for publications for the AMS. In this capacity, he will oversee the AMS publications operation and will work on acquisitions and the development of new kinds of AMS publications. "I want to continue the level of quality of publications the AMS has established," Rankin says, "and I would also like to expand our horizons to new kinds of publications, possibly moving into the area of expository writings and works dealing with educational reform issues. In addition, we hope to establish interdisciplinary institutes with the idea of generating proceedings volumes that will be of value to other scientific communities, as well as to the mathematical community." Rankin also notes that the AMS

publications program will be changing as a result of new technologies. "With increased access to electronic mail and the continuing pressure for libraries to keep costs down, electronic publishing, especially of journals, will be one of the important publishing developments of the 1990s. The AMS, with its development of e-Math, is positioning itself to be in the forefront of electronic publishing."

Rankin received his A.B. from Elon College and his Ph.D. from Vanderbilt University. He was professor of mathematics at West Virginia University (1977–1987) and spent the academic year 1981–1982 at the Mathematics Research Center at the University of Wisconsin. From 1982 to 1984, he was associate chair of the Department of Mathematics at West Virginia University. During the period August 1, 1985 through July 31, 1987, he served as a program advisor for optimization and discrete mathematics in the Directorate of Mathematical and Information Sciences of the Air Force Office of Scientific Research. Rankin is professor and department head at Worcester Polytechnic Institute. His areas of research are differential and integral equations and nonlinear analysis. Active in the mathematics education reform movement, Rankin has taken part in the development of a state mathematics coalition in Massachusetts, sponsored by the Mathematical Sciences Education Board of the National Research Council, and has been a proponent of reform in undergraduate education, particularly calculus reform.

### Staff at the NSF's Division of Mathematical Sciences

Listed below are the Program Directors for the coming academic year in the Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF).

#### Classical Analysis

John V. Ryff  
202-357-3455

#### Modern Analysis

Joe Jenkins  
202-357-3697

**Geometric Analysis**

Robert Molzon  
202-357-3451

**Topology and Foundations**

Ralph M. Krause  
202-357-3457

**Algebra and Number Theory**

Ann K. Boyle  
Gary Cornell  
202-357-3695

**Applied Mathematics**

Jerrold Bebernes  
Rouben Rostamian  
Michael Steuerwalt  
202-357-3686

**Computational Mathematics**

Michael Steuerwalt  
Alvin Thaler  
202-357-3691

**Statistics and Probability**

Keith Crank  
Nell Sedransk  
202-357-3693

**Office of Special Projects**

Bernard R. McDonald (Head)  
Peter Arzberger  
Deborah F. Lockhart  
202-357-3453

The administrative staff includes:

**Division Director**

Judith S. Sunley  
202-357-9669

**Deputy Division Director**

Bernard R. McDonald  
202-357-9669

**Administrative Officer**

Tyczer Henson  
202-357-3683

The permanent staff consists of Arzberger, Boyle, Krause, Lockhart, McDonald, Ryff, Sunley, and Thaler. Those starting this year as visiting scientists are Jenkins, from the State University of New York at Albany; Bebernes, from the University of Colorado; Rostamian from the University of Maryland, Baltimore County; and Crank, from Worcester Polytechnic Institute.

Many thanks to outgoing visiting scientists Ira Herbst, University of Virginia; Alfonso Castro, University of North Texas; Frederick Howes, now at the Department of Energy; and Anne

Steiner, Iowa State University.

All NSF staff can be reached through electronic mail. To form an individual's address, take the first initial and last name, and append @nsf.gov for Internet, or @nsf for Bitnet. For example, to contact John Ryff through Internet, use the address jryff@nsf.gov. The mailing address is Division of Mathematical Sciences, Room 339, National Science Foundation, 1800 G Street, NW, Washington, DC 20550.

**Staff at DoD Agencies**

Five agencies of the Department of Defense fund research in the mathematical sciences. The names, addresses, and telephone numbers of the pertinent staff members are listed below.

**Air Force Office of Scientific Research**

Directorate of Mathematical and Computer Sciences  
AFOSR/NM  
Building 410  
Bolling AFB, DC 20332-6448  
Charles J. Holland, Director  
202-767-5025

*Optimization and Discrete Mathematics*

Neal D. Glassman  
202-767-5026

*Physical Mathematics and Applied Analysis*

Arje Nachman  
202-767-4939

*Electromagnetics*

Arje Nachman  
202-767-4939

*Artificial Intelligence*

Abraham Waksman  
202-767-5028

*Signal Processing, Probability, and Statistics*

Jon Sjogren  
202-767-4940

*Computational Mathematics*

Marc Jacobs  
Arje Nachman  
202-767-4939

*Software Systems*

Charles J. Holland (acting)  
202-767-5025

*Dynamics and Control*

Marc Jacobs  
202-767-5027

*Neural Computation Systems*

Steven Suddarth  
202-767-5028

Steven Suddarth joins the AFOSR mathematics staff from the Electronics and Materials Sciences Directorate of AFOSR.

**Army Research Office**

Mathematical and Computer Sciences Division  
P.O. Box 12211  
Research Triangle Park, NC 27709  
Jagdish Chandra, Director  
Gerald Andersen, Associate Director  
919-549-0641

(Program managers may be contacted at the extensions listed below.)

*Applied Analysis and Physical Mathematics*

Julian Wu  
Ext. 4332

*Computer Science and Artificial Intelligence*

David Hislop  
Ext. 4255

*Infrastructure, Support Programs for Army High Performance Computing Center*

Bruce Henriksen  
Ext. 4324

*Numerical Analysis, Scientific Computing, Optimization, and Symbolic Methods*

Kenneth D. Clark  
Ext. 4256

*Probability and Statistics*

Gerald Andersen  
Ext. 4253

*Systems and Control; Centers of Excellence*

Jagdish Chandra  
Ext. 4254

*Workshops, Army-wide Conferences, Tutorials, and Special Projects*

Francis Dressel  
Ext. 4319

**Defense Advanced Research Projects Agency**

Applied and Computational Mathematics Program  
3701 North Fairfax Drive  
Arlington, VA 22203-1714  
James Crowley, Program Manager  
703-696-2287

Prior to coming to DARPA this year, James Crowley served as the Assistant Chief Scientist at Headquarters Air Force Systems Command and, before that, he was director of the Directorate of Mathematical Sciences at Air Force Office of Scientific Research. Crowley says he would be happy to discuss ideas with researchers from the applied and computational math community. He succeeds Louis Auslander, who is now at the Graduate School and University Center, City University of New York.

**National Security Agency**

Mathematical Sciences Program

Attn: RMA

Ft. George G. Meade, MD 20755-6000

Charles Osgood, Director

301-859-6659

email: msp@titan1.math.umbc.edu

Charles Osgood has moved from other duties at NSA to head the Mathematical Sciences Program. He succeeds Marvin Wunderlich, who headed the program for the past two years and has now assumed other duties within NSA.

**Office of Naval Research**

Mathematics Division

Code 1111

800 North Quincy Street

Arlington, VA 22217

Neil Gerr, Director

703-696-4321

*Signal Analysis*

Neil Gerr

703-696-4321

*Operations Research*

Don Wagner

703-969-4313

*Probability and Statistics*

Julia Abrahams

703-969-4320

*Discrete Mathematics*

Marc Lipman

703-696-4310

*Numerical Analysis*

Richard Lau

703-696-4316

*Applied Analysis*

Neil Gerr (Acting)

703-696-4321

**News from the  
Mathematical Sciences Institute  
Cornell University  
and the  
State University of New York  
at Stony Brook**

Mathematical Sciences Institute (MSI) Director Anil Nerode will help organize a three-day session on Hybrid Systems to be held in conjunction with the Second International Symposium on Artificial Intelligence and Mathematics, January 5-8, 1992, at Fort Lauderdale, Florida. This session will expand upon work begun at the June 1991 MSI Workshop on Hybrid Systems organized by Nerode and R. Grossman. Hybrid systems are feedback networks that consist of continuous physical devices controlled by discrete digital programs, requiring digital-analogue transfers of information for their control. The meeting is intended to bring together a small group of scientists and engineers from university, industry, and government laboratories who recognize the importance of developing the underlying science, mathematics, and algorithms of hybrid systems. For more information, contact J.-L. Lassez at IBM, Yorktown Heights, or F. Hoffman, Florida Atlantic University, hoffman@acc.fau.edu.

R. Shore of Cornell is organizing a conference on Logical Analysis in Mathematics and Computer Science to be held on the occasion of MSI Director Anil Nerode's 60th birthday. The conference is scheduled for early June 1991 in Ithaca, New York and will be preceded by a three-day Workshop on Feasible Mathematics to be organized by J. Remmel of UCSD and P. Clote of Boston College. For more information, contact J. Chiment, MSI, 409 College Ave., Ithaca, NY 14850, jjc@msiadmin.cit.cornell.edu, 607-255-8911.

The MSI/Stony Brook Center for the Mathematics of Nonlinear Systems will host a period of concentrated activity during the Fall '91 term on nonlinear hyperbolic waves. This will include an extended visit by L. Henderson from Australia and a two-day Workshop on Computational Geometry (October 25 and 26, 1991) organized by J. Mitchell. Invited speakers include: P. Chew, D.

Dobkin, D. Huttenlocher, M. Karasick, D. Mount, and S. Suri. Contact J. Mitchell at SUNY Stony Brook's Department of Applied Mathematics or S. Skiena at the Department of Computer Science for information. On November 21 and 22, 1991, B. Plohr, J. Glimm, and J. Grove will host a Workshop on Nonlinear Analysis and Computation. Invited speakers include H. Glaz, M. Gurtin, L. F. Henderson, D. Hoff, and R. Menikoff. Contact James Glimm, glimm@ams.sunysb.edu for more information.

ACSyAM, the MSI Center for Symbolic Methods in Algorithmic Mathematics at Cornell University, is planning to emphasize Real Closed Fields during academic year 1992-1993. In announcing "Real Year 1992-1993," Center Director M. Sweedler listed topics to receive special attention. These include: Cell decomposition, computable topological invariants, decision methods and quantifier elimination, effective real nulstellensatz, generalized mover's problems and robotics applications, Macaulay resultants, real algebraic geometry, representation of algebraic numbers and field extensions, root finding, sparseness and complexity issues, Sturm sequences, trace forms, and signatures.

Cornell's M. Stillman and B. Sturmfels are on the organizing committee for the Regional Institute in Geometry/Computational Algebraic Geometry scheduled to meet July 6-13, 1992 at Amherst College. For more information, contact D. Cox at dac@cs.amherst.edu. The conference is cosponsored by MSI/ACSyAM and NSF.

ACSyAM Director M. Sweedler is coordinating publicity for the International Symposium on Symbolic and Algebraic Computation (ISSAC), sponsored by ACM, to be held on the campus of UC, Berkeley. For information, contact Sweedler at jc5j@cornell.cit.cornell.edu. or J. Chiment at jjc@msiadmin.cit.cornell.edu.

The late spring and early summer of 1992 will see three conferences at the MSI Center for Stochastic Analysis at Cornell University. S.R.S. Varadhan of the Courant Institute will or-

ganize a Workshop on Hydrodynamic Limits; D. Griffeth from the University of Wisconsin, Madison will organize a Workshop on Cellular Automata; and C. Mueller from the University of Rochester will direct a period of concentrated activity on Stochastic Partial Differential Equations. For further information, contact the Center's Director, R. Durrett, rtd@cornell.cit.cornell.edu.

An abstracts volume from the July 1991 MSI Workshop on Combinatorics and Discrete Geometry, organized by N. White, is available. For a copy of this volume, for copies of MSI Technical Reports, or for more information on MSI-sponsored workshops, please write: Mathematical Sciences Institute, 409 College Ave., Ithaca, NY 14850, msi@msiadmin.cit.cornell.edu, 607-255-8005.

### Increase in Cost-of-Education Allowance

The National Science Foundation (NSF) has approved an increase in the Cost-of-Education allowance for its Graduate Fellowship program from \$6000 to \$7500 per year, beginning with the 1991-1992 academic year. In addition, the NSF will now allow institutions the option of assigning teaching and research duties to Graduate Fellows.

The Cost-of-Education allowance has in the past been provided to institutions on behalf of Graduate Fellows in lieu of all tuition and fees. However, the allowance has not kept pace with rising educational costs. Therefore, the National Science Board, the governing body of NSF, has approved an alternative to the traditional arrangement for institutions that are no longer able to make up the difference between the allowance and the tuition.

This alternative permits institutions to assign teaching or research duties to Graduate Fellows. A notice sent by the NSF to university and college presidents says, "The NSF expects that any such duties will be acceptable to the Fellow and consistent with the

Fellow's educational goals. Any such required duties should contribute to the timely progress of the Fellow toward an advanced degree. The NSF anticipates that any additional duties in lieu of tuition will be assigned judiciously, to enhance the overall educational experience of the Fellow." The notice goes on to say that the NSF will closely monitor the use of this new option.

### Booklets for Women Students Available

Two booklets aimed at encouraging young women to pursue careers in mathematics and science are now available.

"Careers that Count: Opportunities in the Mathematical Sciences," produced by the Association for Women in Mathematics, presents profiles of fifteen women who have earned degrees in mathematics and have gone on to interesting and rewarding careers. The degrees range from bachelor's to doctorate, and their areas of work include mathematics teaching, biological applications of mathematics, cryptography, finance, and space science. Aimed primarily at the high school and early college level, the booklet has an attractive design and many pictures that make it especially appealing. The booklets are available for \$1.50 apiece or \$1 each for more than ten copies from: Association for Women in Mathematics, Box 178, Wellesley College, Wellesley, MA 02181.

"Graduate School and Beyond" is based on a panel discussion from a conference on women and scientific careers held annually at Argonne National Laboratory. The panelists offered personal experiences and guidance on selecting a graduate school, supporting one's graduate study, choosing a thesis advisor, combining career and family, and planning for the future. "Unspoken" requirements, such as attendance at seminars and conferences and preparing and giving seminar talks, were also discussed. The panel included a physicist, a biologist, a mathematician, an

environmental scientist, a government science administrator, and a graduate student in statistics. The booklet is available free of charge while supplies last from: "Graduate School and Beyond," Division of Educational Programs, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439.

### Genentech Support for AMS Short Course

Genentech, Inc. has made a contribution in support of the AMS Short Course, "New Scientific Applications of Geometry and Topology," to be held at the Joint Mathematics Meetings in Baltimore, January 6-7, 1992. The Short Course will focus on the uses of geometry and knot theory in DNA research, chemistry, and physics. Genentech's contribution of \$5000 toward supporting the Short Course marks the first time a private corporation has contributed funds to support this type of AMS activity.

### Erratum

There was a typographical error in one of the tables accompanying the article "The Past, Present, and Future of Academic Women in the Mathematical Sciences" by Lynne Billard, which appeared in the September issue of *Notices*, pages 707-714. The error occurred in the headings on Table 4, which appeared on page 710. The corrected table appears below.

Table 4: Rank and status of men and women in mathematics - 1987

% in Rank			
	Full Professor	Associate Professor	Assistant Professor
Men	51.7%	23.7	16.9
Women	25.0	33.3	33.3

% in Tenure Status			
	Tenure Track Tenured	Tenure Track Not Tenured	Nontenure Track
Men	70.3%	14.4	4.2
Women	50.0	25.0	8.3

Source: NSF (1990)



## Funding Information for the Mathematical Sciences

### AMS Centennial Fellowships Invitation for Applications, 1992-1993

**Deadline December 1, 1991**

These fellowships are intended to provide enhanced research opportunities to mathematicians who are several years past the Ph.D., who have a strong research record, but who have not had extensive postdoctoral research support in the past. Applicants should have received the Ph.D. degree between January 1, 1980, and December 31, 1985, and should not have had the equivalent of more than two years of full-time postdoctoral support.

The stipend for fellowships awarded for 1992-1993 has been set by the Trustees of the Society at \$40,000 for nine months. In addition, there will be an expense allowance of \$1,300. Applicants must be citizens or permanent residents of a country in North America. The fellowship may be combined with other stipends and/or part-time teaching; this option can be used to extend the award to cover a period of up to two years. For further information about the acceptability of such arrangements, individuals should contact the Secretary of the Society.

The number of fellowships to be awarded is small and depends on the amount of money contributed to the program. The Trustees have arranged a matching program from general funds in such fashion that funds for at least one fellowship are guaranteed. Because of the generosity of the AMS membership it was possible to award three fellowships a year for the past four years.

The deadline for receipt of applications is **December 1, 1991**. Awards

will be announced in February 1992, or earlier if possible.

For application forms, write to the Executive Director, American Mathematical Society, P.O. Box 6248, Providence, RI 02940. (It should be noted that completed application and reference forms should **NOT** be sent to this address, but to the address given on the forms.)

### Changes in NSF's Calculus Program

As part of an overall plan to strengthen science, engineering, and mathematics education, the National Science Foundation (NSF) initiated five years ago a program entitled Curriculum Development in Mathematics: Calculus. Coming in response to calls for revision and renewal of the calculus curriculum, this program has provided support for projects that deal with all of the topics of one- and two-year calculus sequences, including linear algebra and differential equations. To meet the challenge of increasing significantly the percentage of students studying calculus under renewed approaches, some changes in the program are expected.

Although large scale projects were funded last year, the emphasis of the program is expected to be more significantly shifted this year from the development of pilot projects to the revitalization of calculus instruction on a large scale, involving students at the collegiate or secondary levels. This emphasis is expected to continue. In addition, it is anticipated that conferences and workshops to consider student preparation for the renewed cal-

culus will be supported. The program will continue to support particularly promising new pilot projects, including major comprehensive curriculum development projects and highly focused entrepreneurial efforts. Assessment and evaluation activities should form an important component of all projects. The program will be managed by the Division of Undergraduate Science, Engineering, and Mathematics Education, with the cooperation of the Division of Mathematical Sciences and the Division of Materials Development Research and Informal Science Education.

Prospective proposers may wish to consult the MAA report "Priming the Pump: Innovations and Resources" (known as the CRAFTY report), which contains information about more than seventy calculus reform projects. Additional reports have appeared in *UME Trends* and have been presented at conferences and sessions of meetings of professional societies.

The closing date for proposals is anticipated to be **early February 1992**. The program announcement is expected to be available in late October. For more information, contact the program director, James Lightbourne, USEME, Room 639, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-7051; electronic mail [jlightbo@nsf.gov](mailto:jlightbo@nsf.gov) (Internet) or [jlightbo@nsf](mailto:jlightbo@nsf) (Bitnet).

### Deadline for Laboratory Equipment Program

The Instrumentation and Laboratory Improvement (ILI) program is housed in the Education and Human Resources

## Funding Information

directorate of the National Science Foundation. ILI is designed to improve the quality of the undergraduate curriculum by supporting projects to develop new or improved instrument-based undergraduate laboratory and/or field courses. The deadline for proposals to ILI is **November 15, 1991**. For more information, contact William Haver, 202-357-7051. His mailing address is Instrumentation and Laboratory Improvement, Room 639, National Science Foundation, 1800 G Street, NW, Washington, DC 20550. He can also be reached through electronic mail, whaver@nsf.gov on Internet and whaver@nsf on Bitnet.

### Call for Proposals to Improve Teaching Preparation

Last year, the Fund for Improvement of Postsecondary Education of the Department of Education awarded a three-year grant to the AMS-MAA-SIAM Committee on Preparation for College Teaching. The grant, administered by the Mathematical Association of America, has supported projects in six university departments to help their ad-

vanced graduate students prepare for teaching responsibilities they will assume in academic positions. Continuation of this grant is anticipated, allowing two or three new sites to begin receiving support in the spring or summer of 1992.

The institutions already receiving support are the University of Cincinnati, Clemson University, the University of Delaware, Oregon State University, Dartmouth College, and Washington University. The support went toward such expenses as materials, travel, and faculty mentor summer salary supplements.

The goal of this project is to expand the training of graduate students to include a specific resource base needed for their future responsibilities as teachers of mathematics in academia, including: Teaching methods and learning modes; sources of and criteria for recognizing good research about teaching; the impact of the technological revolution and resulting implications for changes in mathematical training; services available from the professional societies through their activities and publications; and the current dialogue

about reform in mathematics education.

All of the projects supported have included development of a "professional seminar" to provide students with much of this information and experience; however, proposals for the new grants need not follow this model. Proposers should address a diversity of graduate student needs with ideas appropriate to their institutions.

Proposals for projects beginning planning in the summer of 1992 should be submitted by **November 30, 1991**. Proposals should be sent to the Committee Chair, Bettye Anne Case, Mathematics B-154, Florida State University, Tallahassee, Florida, 32306; fax 904-644-4053. Details about the current projects and ideas which the Committee feels should be implemented are available by contacting Case (electronic mail case@math.fsu.edu).

To further disseminate the ideas developed in the existing projects, the Committee will sponsor a Special Session of invited and contributed 20-minute papers, "Preparing the college mathematics teachers of the future," at the Joint Mathematics Meetings in Baltimore in January 1992.

# STRUCTURAL PROPERTIES OF POLYLOGARITHMS

Mathematical Surveys and Monographs, Volume 37 • Leonard Lewin, Editor

About ten years ago, the handful of peculiar numerical dilogarithmic identities, known since the time of Euler and Landen, gave rise to new discoveries concerning cyclotomic equations and related polylogarithmic ladders. These discoveries were made mostly by the methods of classical analysis, with help from machine computation. About the same time, starting with Bloch's studies on the application of the dilogarithm in algebraic  $K$ -theory and algebraic geometry, many important discoveries were made in diverse areas.

This book seeks to provide a synthesis of these two streams of thought. In addition to an account of ladders and their association with functional equations, the chapters include applications to volume calculations in Lobatchevsky geometry, relations to partition theory, connections with Clausen's function, new functional equations, and applications to  $K$ -theory and other branches of abstract algebra. This rapidly-expanding field is brought up to date with two appendices, and the book concludes with an extensive bibliography of recent publications. About two-thirds of the material is accessible to mathematicians and scientists in many areas, while the remainder requires more specialized background in abstract algebra.

1991 *Mathematics Subject Classification*: 39  
ISBN 0-8218-1634-9, LC 91-18172. ISSN 0076-5376  
419 pages (hardcover), July 1991

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# 1991 AMS Elections

## Candidates

### OFFICERS

#### President-Elect (one to be elected)

Ronald L. Graham                      Stephen Smale

#### Vice-President (one to be elected)

Avner Friedman                      Robert Osserman  
Linda Keen

#### Member-at-Large of the Council (five to be elected)

Ruth M. Charney                      Joshua A. Leslie  
Carl C. Cowen, Jr.                      Elliott H. Lieb  
Jacob E. Goodman                      De Witt L. Sumners  
Alfred W. Hales                      Gunther A. Uhlmann  
Rebecca A. Herb

#### Board of Trustees (one to be elected)

Maria M. Klawe                      Charles C. Sims

### NOMINATING COMMITTEE FOR 1992

(Preferential Ballot, three to be elected)

Daniel M. Burns, Jr.                      Joseph Lipman  
Hermann Flaschka                      Birgit Speh  
John B. Friedlander                      Carol S. Wood

### EDITORIAL BOARDS COMMITTEE FOR 1992

(Preferential Ballot, two to be elected)

Eugene B. Fabes                      Bhama Srinivasan  
John Fornaess                      Robert J. Zimmer

### Election Information

The ballots for election of members of the Council and Board of Trustees of the Society for 1992 will be mailed on or shortly after September 10, in order for members to receive their ballots well in advance of the November 10 deadline. Prior to casting their ballots members are urged to consult the following articles and sections of the Bylaws of the Society: article I, section 1; article II, sections 1, 2; article III, sections 1, 2, 3; article IV, sections 1, 2, 4; article VII, sections 1, 2, 5. The complete text of the Bylaws appears on pages 1261-1266 of the November 1989 issue of *Notices*, with the amendments passed in the 1990 election appearing on pages 249-250 of the March 1991 issue of *Notices*. A list of the members of the Council and Board of Trustees serving terms during 1991 appears in the **AMS Reports and Communications** section of the September 1991 issue of *Notices*.

### REPLACEMENT BALLOTS

This year ballots for the AMS election will be mailed September 10, 1991, or within a day or two thereafter. The deadline for receipt of ballots in Providence is November 10, 1991.

There has been a small but recurring and distressing problem concerning members who state that they have not received ballots in the annual election. It occurs for several reasons, including failure of local delivery systems on university or corporate properties, failure of members to give timely notice of changes of address to the Providence office, failures of postal services, and other human errors.

To help alleviate this problem, the following replacement procedure has been devised: A member who has not received a ballot by October 10, 1991, or who has received a ballot but has accidentally spoiled it, may write after that date to the Secretary of the AMS, Post Office Box 6248, Providence, RI 02940, asking for a second ballot. The request should include the individual's member code and the address to which the replacement ballot should be sent. Immediately upon receipt of the request in the Providence office, a second ballot, which will be indistinguishable from the original, will be sent by first class or air mail. It must be returned in an inner envelope, which will be supplied, on the outside of which is the following statement to be signed by the member:

The ballot in this envelope is the only ballot that I am submitting in this election. I understand that if this statement is not correct then no ballot of mine will be counted.

\_\_\_\_\_ signature

Although a second ballot will be supplied on request and will be sent by first class or air mail, the deadline for receipt of ballots will not be extended to accommodate these special cases.

### SUGGESTIONS FOR 1992 NOMINATIONS

Each year the members of the Society are given the opportunity to propose for nomination the names of those individuals they deem both qualified and responsive to their views and needs as part of the mathematical community. Candidates will be nominated by the Council to fill positions on the Council and Board of Trustees to replace those whose terms expire January 31, 1993. See the **AMS Reports and Communications** section of the September 1991 issue of *Notices* for the list of current members of the Council and Board of Trustees. Members are requested to write their suggestions for such candidates in the appropriate spaces below.

### SUGGESTIONS FOR 1992 NOMINATIONS

Council and Board of Trustees

Vice-President (1)

\_\_\_\_\_

Members-at-large of the Council (5)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Member of the Board of Trustees (1)

\_\_\_\_\_

The completed form should be addressed to AMS Nominating Committee, Post Office Box 6248, Providence, RI 02940, to arrive no later than **November 10, 1991**.



**Philadelphia, Pennsylvania**  
**Temple University,**  
**Philadelphia**  
**October 12–13**

*Program*

The eight-hundred-and-sixty-eighth meeting of the American Mathematical Society will be held at Temple University, Philadelphia, Pennsylvania on Saturday and Sunday, October 12 and 13, 1991. All special sessions will be held in the Temple University Center City campus (TUCC) building located at 1616 Walnut Street in downtown Philadelphia. The invited addresses will be in room 501 of the TUCC building located at 1619 Walnut Street.

**Invited Addresses**

By invitation of the Eastern Section Program Committee, there will be four invited one-hour addresses. The speakers, their affiliations, and the titles of their talks where available are:

**Abbas Bahri**, Rutgers University, New Brunswick, *Critical points at infinity in some variational problems.*

**Michael T. Anderson**, SUNY at Stony Brook, *Hyperbolization and metrics of least curvature on 3-manifolds.*

**Marjorie Senechal**, Smith College, *Tilings, quasicrystals, and Hilbert's 18th problem.*

**Panagiotis E. Souganidis**, Brown University, *Phase transitions and front propagation.*

**Special Sessions**

By invitation of the same committee, there will be twelve special sessions of selected twenty-minute papers. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

*Recent progress in Ricci curvature and related topics*, **Michael T. Anderson**, and **Jeff Cheeger**, NYU-Courant Institute.

*Nonlinear partial differential equations*, **Abbas Bahri**.

*Modular forms, arithmetic algebraic geometry*, **Boris A. Datskovsky** and **Marvin I. Knopp**, Temple University.

*Surgery theory and singular spaces*, **James F. Davis**, Indiana University at Bloomington, **Ronnie Lee**, Yale University, and **Julius L. Shaneson**, University of Pennsylvania.

*Geometric analysis*, **Leon Ehrenpreis** and **Eric L. Grinberg**, Temple University.

*Extreme value theory*, **Janos Galambos**, Temple University.

*Applications of microlocal analysis to partial differential equations*, **Nicholas Hanges**, CUNY, Herbert H. Lehman College, and **A. Alexandrou Himonas**, University of Notre Dame.

*Variational problems in low dimensional geometry*, **Bruce A. Kleiner**, University of Pennsylvania, and **Robert B. Kusner**, University of Massachusetts, Amherst.

*Rings and representations*, **Martin Lorenz** and **Shari A. Prevost**, Temple University.

*Tilings*, **Doris Schattschneider**, Moravian College, and **Marjorie Senechal**.

*Phase transitions and/or front propagation*, **Halil Mete Soner**, Carnegie Mellon University, and **Panagiotis E. Souganidis**.

*Numerical linear algebra*, **Daniel B. Szyld**, Temple University.

Abstracts for consideration for these sessions should have been submitted by the **July 11, 1991** deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of *Notices*.

**Contributed Papers**

There will also be sessions for contributed ten-minute papers. Late papers will not be accommodated.

**Registration**

The meeting registration desk will be located in room 5B of the TUCC building located at 1616 Walnut Street and will be open from 8:30 a.m. to 4:30 p.m. on Saturday, October 12, and from 8:00 a.m. to noon on Sunday, October 13. The registration fees are \$30 for members of the AMS, \$45 for nonmembers, and \$10 for students or unemployed mathematicians.

### Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Baltimore meeting announcement in this issue of *Notices*.

Telephone: 215-963-2222 (Participants should ask for Keith Rist)

**Deadline for reservations is September 28, 1991.**

Flat rate \$80      Single or Double

### Accommodations

Rooms have been blocked for participants at the Holiday Inn - Center City and the Radisson Suite Hotel. Participants should make their own reservations and directly mention the AMS meeting to obtain the rates listed below. All rates are subject to a room tax. **The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.**

#### Holiday Inn - Center City (A five-minute walk from the TUCC)

1800 Market Street, Philadelphia, PA  
Telephone: 215-561-7500

**Deadline for reservations is September 11, 1991.**

Flat rate \$75      Single or Double

#### Radisson Suite Hotel (approximately a 15-minute walk from TUCC)

18th Street and Benjamin Franklin Parkway, Philadelphia, PA

### Food Service

A complete listing of local restaurants will be available at the meeting registration desk.

### Travel and Local Information

Philadelphia International Airport is served by most major airlines. Taxi and limousine service can be arranged from the airport to the downtown area. The meeting site is located in the Temple University Center City (TUCC) on Walnut Street which is south of Market Street at 16th Street. For precise driving instructions, participants may call Keystone AAA at 215-864-5000.

### Weather

Philadelphia tends to be rather dry in October. The average minimum temperature is 49°F and the average maximum temperature is 66°F. Average total precipitation is 2.82 inches. Up to the minute weather information can be obtained by calling 215-627-5575.

## Several Complex Variables and Complex Geometry

Eric Bedford, John P. D'Angelo, Robert E. Greene, and Steven G. Krantz, Editors

(Proceedings of Symposia in Pure Mathematics, Volume 52)

This three-volume set contains the proceedings of the Summer Research Institute on Several Complex Variables and Complex Geometry, held at the University of California at Santa Cruz in July 1989. The institute explored recent developments in the geometry and function theory of several complex variables. An attempt was made to stimulate interactions among the different methodologies in the subject, such as differential geometry, algebraic geometry, partial differential equations, harmonic analysis, and classical methods. The topics covered include function theory, complex geometry, partial differential equations, functional analysis, and analysis in manifolds. With contributions by some of the world's top experts in several complex variables and complex geometry, this book provides readers with insight into the current state of this field.

1991 *Mathematics Subject Classification*: 32 (Part 1), 32, 53 (Part 2), 32, 35, 53 (Part 3)  
ISBN (Set) 0-8218-1488-5; ISBN (Part 1) 0-8218-1489-3; ISBN (Part 2) 0-8218-1490-7; ISBN (Part 3) 0-8218-1491-5, LC 91-11227,  
ISSN 0082-0717; 262 pages (Part 1); 625 pages (Part 2); 368 pages (Part 3), (hardcover), July 1991

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# Program of the Sessions

The time limit for each contributed paper in the sessions is ten minutes. In the special sessions, the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

Abstracts of papers presented in the sessions at this meeting will be found in the October 1991 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

## Saturday, October 12

### Special Session on Variational Problems in Low Dimensional Geometry, I

8:30 a.m.–10:55 a.m. Room 8B, 1616 Walnut Street

- 8:30 a.m. (1) *Foliations of Euclidean 3-space by constant mean curvature surfaces.* Preliminary report.  
**Wayne F. Rossman**, University of Massachusetts, Amherst (868-53-175)
- 9:10 a.m. (2) *Constant mean curvature hypersurfaces foliated by spheres.* Preliminary report.  
**William C. Jagy**, Midwestern State University (868-53-79)
- 9:45 a.m. (3) *Minimal surfaces and the squared-mean-curvature functional.*  
**Nicholas Schmitt**, University of Massachusetts, Amherst (868-53-89)
- 10:25 a.m. (4) *Construction of genus two doubly-periodic embedded minimal surfaces in  $R^3$ .*  
**Fusheng Wei**, University of Massachusetts, Amherst (868-53-151)

### Special Session on Recent Progress in Ricci Curvature and Related Topics, I

9:00 a.m.–10:50 a.m. Room 4B, 1616 Walnut Street

- 9:00 a.m. (5) *Hyperbolic Cartan connections and the Ricci flow.* Preliminary report.  
**Maung Min-oo**, McMaster University (868-53-132)
- 9:40 a.m. (6) *Nonnegative Ricci curvature and the fundamental group.* Preliminary report.  
**Detlef Gromoll**, State University of New York, Stony Brook (868-53-185)
- 10:20 a.m. Informal Discussion

### Special Session on Modular Forms, Arithmetic Algebraic Geometry, I

9:00 a.m.–10:50 a.m. Room 503, 1616 Walnut Street

- 9:00 a.m. (7) *Application of Dedekind sums to invariants of modular equations.* Preliminary report.  
**Harvey Cohn\***, City College, City University of New York, and **Marvin I. Knopp**, Temple University (868-11-52)
- 9:30 a.m. (8) *Rational period functions with irrational poles are not Hecke eigenfunctions.*  
**Ellen Gethner**, Ohio State University, Columbus (868-11-137)
- 10:00 a.m. (9) *Rational period functions, modular integrals, and indefinite binary quadratic forms.* Preliminary report.  
**L. Alayne Parson**, Ohio State University, Columbus (868-11-136)
- 10:30 a.m. (10) *Periods of modular forms.*  
**Don Zagier**, Max-Planck Institute for Mathematics, Germany (868-11-147) (Sponsored by Walter D. Neumann)

### Special Session on Surgery Theory and Singular Spaces, I

9:00 a.m.–10:50 a.m. Room 3B, 1616 Walnut Street

- 9:00 a.m. (11) *Formulae for generalized Casson's  $SU(2)$ -invariant of 3-manifolds.* Preliminary report.  
**Sylvain Cappell**, Courant Institute of Mathematical Sciences, New York University, **Ronnie Lee\***, Yale University, and **Edward Miller**, Polytechnic Institute of New York (868-20-138)
- 9:30 a.m. (12) *Algebraic homotopy.*  
**Justin R. Smith**, Drexel University (868-55-159)
- 10:00 a.m. (13) *Inductive detection for homotopy equivalences of manifolds.* Preliminary report.  
**Slawomir Kwask\***, Tulane University, and **Reinhard Schultz**, Purdue University, West Lafayette (868-57-78)
- 10:30 a.m. (14) *Algebraic  $G$ -vector bundles.*  
**Ted Petrie**, Rutgers University, New Brunswick (868-14-75) (Sponsored by Ronnie Lee)

## Saturday, October 12 (cont'd)

### Special Session on Geometric Analysis, I

9:00 a.m.–10:50 a.m. Room 7B, 1616 Walnut Street

- 9:00 a.m. *Radon and Riesz transforms in real hyperbolic spaces.*  
(15) Preliminary report.  
**Carlos A. Berenstein\***, University of Maryland, College Park, and **Enrico Casadio Tarabusi**, Università di Trento, Povo, Italy (868-44-09)
- 9:30 a.m. *Support properties of the spherical Radon transform.*  
(16) Preliminary report.  
**Paul Goodey\***, University of Oklahoma, and **Wolfgang Weil**, Universität Karlsruhe, Germany (868-52-06)
- 10:00 a.m. *Microlocal analysis of the 2-plane transform.*  
(17) Preliminary report.  
**Allan Greenleaf\***, University of Rochester, and **Gunther Uhlmann**, University of Washington (868-58-116)
- 10:30 a.m. *Explicit non-local formulas in real integral geometry.*  
(18) Preliminary report.  
**Simon Gindikin**, Rutgers University, New Brunswick (868-44-85)

### Special Session on Extreme Value Theory, I

9:00 a.m.–10:50 a.m. Room 502, 1616 Walnut Street

- 9:00 a.m. *Regularly varying expected residual life and the domain of attraction of  $\exp(-\exp(-x))$ .*  
(19) **Janos Galambos\***, Temple University, Philadelphia, and **Yuan Xu**, University of Texas, Austin (868-60-69)
- 9:30 a.m. *Tail behaviour of quantile processes.*  
(20) **Miklós Csörgő**, Carleton University (868-60-97)
- 10:00 a.m. *Extremes of interarrival times under a variety of conditioning.*  
(21) **Abera Abay**, Temple University, Philadelphia (868-60-45)
- 10:30 a.m. *Tail empirical and sums of extreme value processes.*  
(22) **David M. Mason**, University of Delaware (868-60-121) (Sponsored by Janos Galambos)

### Special Session on Applications of Microlocal Analysis to Partial Differential Equations, I

9:00 a.m.–10:50 a.m. Room 6B, 1616 Walnut Street

- 9:00 a.m. *A nonsolvable complex vector field with Hölder coefficients.*  
(23) **Howard Jacobowitz**, Institute for Advanced Study (868-35-62)
- 9:35 a.m. *Local solvability and estimates for the tangential Cauchy-Riemann equations.*  
(24) **Mei-Chi Shaw**, University of Notre Dame (868-35-123)
- 10:10 a.m. *On the integrability of first-order complex PDE.*  
(25) **Francois Trèves**, Rutgers University, New Brunswick (868-35-162)

### Special Session on Rings and Representations, I

9:00 a.m.–10:50 a.m. Room 5B, 1616 Walnut Street

- 9:00 a.m. *The Jacobi identity for vertex operators and the representations of the twisted parafermion algebra.*  
(26) **Cristiano Husu**, University of Connecticut, Stamford (868-17-139)
- 9:30 a.m.  *$p$ -structure of the Moonshine modules.*  
(27) **Chongying Dong\*** and **Geoffrey Mason**, University of California, Santa Cruz (868-17-54)
- 10:00 a.m. *Vertex operator algebras, modules and intertwining operators.* Preliminary report.  
(28) **Alex J. Feingold\***, State University of New York, Binghamton, and **John F. X. Ries**, Ithaca College (868-17-63)
- 10:30 a.m. *Isomorphic vertex operator algebras induced by global conformal transformations on annuli.*  
(29) **Yi-Zhi Huang**, University of Pennsylvania (868-81-50)

### Special Session on Tilings, I

9:00 a.m.–10:50 a.m. Room 2B, 1616 Walnut Street

- 9:00 a.m. *Some unsolved tiling problems.*  
(30) **Doris Schattschneider**, Moravian College (868-51-106)
- 9:30 a.m. *Periodic tiling and how to compute them.*  
(31) **D. H. Huson**, University of Bielefeld, Germany (868-51-65) (Sponsored by Doris W. Schattschneider)
- 10:00 a.m. *How do matching rules work?*  
(32) **Joshua E. S. Socolar**, IBM T. J. Watson Research Center, Yorktown Heights, New York (868-05-109)
- 10:30 a.m. *Matching rules for quasiperiodic tilings: Topological approach.*  
(33) **André Katz\***, Ecole Polytechnique, France, and **Leonid S. Levitov**, Institute for Theoretical Physics, USSR and Massachusetts Institute of Technology (868-52-145)

### Special Session on Phase Transitions and/or Front Propagation, I

9:00 a.m.–10:50 a.m. Room 1B, 1616 Walnut Street

- 9:00 a.m. *Mathematical existence of crystal growth with Gibbs-Thomson curvature effects.* Preliminary report.  
(34) **Fred Almgren\*** and **Lihe Wang**, Princeton University (868-49-30)
- 9:30 a.m. *Surface energies and phase transitions.* Preliminary report.  
(35) **Irene Fonseca**, Carnegie Mellon University (868-49-80)
- 10:00 a.m. *Motion by crystalline curvature.* Preliminary report.  
(36) **Jean Taylor**, Rutgers University, New Brunswick (868-49-38)
- 10:30 a.m. *Elliptic regularization of motion by mean curvature.* Preliminary report.  
(37) **Tom Ilmanen**, Institute for Advanced Study (868-51-122)

Special Session on Numerical Linear Algebra, I

9:00 a.m.–10:50 a.m. Room 501, 1616 Walnut Street

- 9:00 a.m. *A projection cutting plane algorithm for convex programming problems.* (38)  
**Mordukh E. Primak\*** and **Daniel B. Szyld**, Temple University, Philadelphia (868-65-25) (Sponsored by Daniel B. Szyld)
- 9:30 a.m. *Parallel implementation of the hp-version of the finite element method on a shared-memory architecture.* (39)  
**I. Babuška**, **H. C. Elman\***, University of Maryland, College Park, and **K. Markley**, Rice University (868-65-17)
- 10:00 a.m. *Laplace's equation and the Dirichlet-Neumann map in multiply connected domains.* (40)  
**A. Greenbaum\***, **L. Greengard**, Courant Institute of Mathematical Sciences, New York University, and **G. B. McFadden**, National Institute of Standards and Technology, Maryland (868-65-05)
- 10:30 a.m. *Some recent results on Schwarz type domain decomposition algorithms.* (41)  
**Olof B. Widlund**, Courant Institute of Mathematical Sciences, New York University (868-65-10)

Invited Address

11:00 a.m.–noon Room 501, Temple University Center City, 1619 Walnut Street

- (42) *Phase transitions and front propagation.*  
**Panagiotis E. Souganidis**, Brown University (868-35-153)

Invited Address

1:30 p.m.–2:30 p.m. Room 501, Temple University Center City, 1619 Walnut Street

- (43) *Hyperbolization and metrics of least curvature on 3-manifolds.*  
**Michael T. Anderson**, State University of New York, Stony Brook (868-58-101)

Special Session on Recent Progress in Ricci Curvature and Related Topics, II

2:45 p.m.–4:35 p.m. Room 4B, 1616 Walnut Street

- 2:45 p.m. *Multiplier ideal sheaves and Futaki's invariant.* (44)  
**Alan M. Nadel**, Massachusetts Institute of Technology (868-53-46)
- 3:25 p.m. *On the topological growth of metric balls in a complete manifold with nonnegative Ricci curvature.* Preliminary report. (45)  
**Zhongmin Shen**, University of Michigan, Ann Arbor (868-53-92)
- 4:05 p.m. *Aspects of prescribing Ricci curvature.* Preliminary report. (46)  
**Dennis DeTurck**, University of Pennsylvania (868-53-114)

Special Session on Modular Forms, Arithmetic Algebraic Geometry, II

2:45 p.m.–5:05 p.m. Room 503, 1616 Walnut Street

- 2:45 p.m. *New bounds for exponential sums and a conjecture of MacWilliams and Sloane.* (47)  
**Carlos J. Moreno\***, Bernard M. Baruch College, City University of New York, and **Oscar Moreno**, University of Puerto Rico, Rio Piedras, Puerto Rico (868-11-129)
- 3:15 p.m. *A half-integral weight multiplicity-one theorem.* Preliminary report. (48)  
**Thomas R. Shemanske\***, Dartmouth College, and **Lynne H. Walling**, University of Colorado, Boulder (868-11-104)
- 3:45 p.m. *Number-theoretic constructions of Ramanujan graphs.* (49)  
**Wen-Ching Winnie Li**, Pennsylvania State University, University Park (868-11-124)
- 4:15 p.m. Problem Session

Special Session on Surgery Theory and Singular Spaces, II

2:45 p.m.–5:05 p.m. Room 3B, 1616 Walnut Street

- 2:45 p.m. *Quantum invariants of lens spaces and a Dehn surgery formula.* Preliminary report. (50)  
**Robion Kirby**, University of California, Berkeley, and **Paul Melvin\***, Bryn Mawr College (868-57-156)
- 3:15 p.m. *L-theory and dihedral homology, II.* (51)  
**Guillermo Cortiñas**, Rutgers University, New Brunswick (868-19-133) (Sponsored by James F. Davis)
- 3:45 p.m. *On the UNil group of Cappell.* (52)  
**Frank Connolly\***, University of Notre Dame, and **Tadeusz Kozniowski**, University of Warsaw, Poland (868-57-157)
- 4:15 p.m. *Bounded surgery and non-linear similarity.* Preliminary report. (53)  
**Ian Hambleton\***, McMaster University, and **E. K. Pedersen**, State University of New York, Binghamton (868-57-91) (Sponsored by Ronnie Lee)
- 4:45 p.m. *Cocompact actions on  $S^n \times R^k$ .* Preliminary report. (54)  
**Erik Kjaer Pedersen**, State University of New York, Binghamton (868-57-108)

Special Session on Geometric Analysis, II

2:45 p.m.–5:05 p.m. Room 7B, 1616 Walnut Street

- 2:45 p.m. *On Blaschke's affine surface area formula.* Preliminary report. (55)  
**Erwin Lutwak**, Polytechnic Institute of New York (868-44-110)
- 3:15 p.m. *Discrepancy of halfspaces.* (56)  
**Ralph Alexander**, University of Illinois, Urbana-Champaign (868-52-125)
- 3:45 p.m. *Wavelets and self-affine tilings.* (57)  
**Robert S. Strichartz**, Cornell University (868-41-115)

## Saturday, October 12 (cont'd)

- 4:15 p.m. *A vanishing theorem for distributions and support theorems for Radon transforms.* Preliminary report.  
(58) **Jan Boman**, University of Stockholm, Sweden (868-44-88)
- 4:45 p.m. *Cohomology relative to the germ of an exact analytic form.* Preliminary report.  
(59) **Abdelhamid Meziani**, Florida International University (868-44-150)

### Special Session on Extreme Value Theory, II

**2:45 p.m.–4:35 p.m.** Room 502, 1616 Walnut Street

- 2:45 p.m. *Bounding probabilities connected with multiple event sequences.*  
(60) **Andras Prekopa**, Rutgers University, New Brunswick (868-60-128) (Sponsored by Janos Galambos)
- 3:15 p.m. *Bivariate Bonferroni-type inequalities.*  
(61) **Min-Young Lee**, DanKook University, Korea (868-60-44)
- 3:45 p.m. *Distribution functions related to the largest prime factor function.*  
(62) **Jean Marie DeKoninck**, Université Laval (868-11-107)
- 4:15 p.m. Informal Discussion

### Special Session on Applications of Microlocal Analysis to Partial Differential Equations, II

**2:45 p.m.–5:00 p.m.** Room 6B, 1616 Walnut Street

- 2:45 p.m. *Applications of microlocal analysis to partial differential equations.*  
(63) **J. J. Kohn**, Princeton University (868-35-144)
- 3:20 p.m. *Convex domains of finite type.*  
(64) **Jeffery D. McNeal**, Princeton University (868-35-160) (Sponsored by Alexandrou A. Himonas)
- 3:55 p.m. *Microlocal analytic hypoellipticity for  $\square_{\lambda}$ .*  
(65) **David S. Tartakoff\***, University of Illinois, Chicago, and **Makhlouf Derridj**, University of Paris-Sud, France (868-35-161)
- 4:30 p.m. *Global analytic hypoellipticity of the  $\bar{\partial}$ -Neumann problem on decoupled Hartogs domains in dimension two.* Preliminary report.  
(66) **So-Chin Chen**, State University of New York, Albany (868-32-71)

### Special Session on Variational Problems in Low Dimensional Geometry, II

**2:45 p.m.–5:15 p.m.** Room 8B, 1616 Walnut Street

- 2:45 p.m. *Complete embedded minimal surfaces of finite total curvature with three ends.* Preliminary report.  
(67) **David Hoffman**, University of Massachusetts, Amherst (868-53-173)

- 3:25 p.m. *Harmonic immersions of surfaces into hyperbolic 3-manifolds.*  
(68) **Michael Wolf**, Rice University (868-58-142)
- 4:05 p.m. *Volume minimization of Lagrangian submanifolds under Hamiltonian deformations.*  
(69) **Yong-Geun Oh**, Courant Institute of Mathematical Sciences, New York University (868-53-70)
- 4:45 p.m. *Nonuniqueness and high energy solutions for the Yamabe problem.*  
(70) **Daniel Pollack**, Stanford University (868-35-32)

### Special Session on Rings and Representations, II

**2:45 p.m.–4:35 p.m.** Room 5B, 1616 Walnut Street

- 2:45 p.m. *Lie bialgebra structures for the Witt algebra, the Virasoro algebra, Vect( $S^1$ ), and their dual Lie coalgebras.*  
(71) **Walter J. Michaelis**, University of New Orleans (868-17-165)
- 3:15 p.m. *Witt and Virasoro algebras as Lie bialgebras.*  
(72) **Earl J. Taft**, Rutgers University, New Brunswick and Mathematical Sciences Research Institute, Berkeley (868-17-19)
- 3:45 p.m. *Degree lowering algorithm and applications to the Weyl algebra.*  
(73) **C. A. Dean\***, University of Michigan, Ann Arbor, and **J. W. Kerr**, Michigan State University (868-16-187)
- 4:15 p.m. *On fully invariant ideals of the free group algebra and the free associative algebra.*  
(74) **Samuel M. Vovsi**, Rutgers University, New Brunswick (868-16-140)

### Special Session on Tilings, II

**2:45 p.m.–5:05 p.m.** Room 2B, 1616 Walnut Street

- 2:45 p.m. *Golden isozonohedra, indiscrete regular tessellations, and quasicrystals.* Preliminary report.  
(75) **H. S. M. Coxeter**, University of Toronto (868-51-43)
- 3:15 p.m. *Regular maps constructed from linear groups.*  
(76) **Peter McMullen**, University College of London, England, **Barry Monson**, University of New Brunswick, and **Asia Ivić Weiss\***, York University (868-51-76)
- 3:45 p.m. *Monotypic tilings.* Preliminary report.  
(77) **Egon Schulte**, Northeastern University (868-52-77)
- 4:15 p.m. *Self-similar tiles with one tile.*  
(78) **Karlheinz Grochenig**, University of Connecticut, Storrs (868-52-67)
- 4:45 p.m. *Matching conditions for, and minor modifications of the 2-tile rhomboid set in 3-space.*  
(79) **Robert Ammann**, Billerica, Massachusetts (868-52-181) (Sponsored by Marjorie Senechal)

### Special Session on Phase Transitions and/or Front Propagation, II

**2:45 p.m.–5:05 p.m.** Room 1B, 1616 Walnut Street

- 2:45 p.m. *Dynamical issues for the Cahn-Hilliard equation.*  
(80) **Paul C. Fife**, University of Utah (868-35-55)

- 3:15 p.m. *Dynamics of the Cahn-Hilliard equation.*  
(81) **Peter W. Bates**, Brigham Young University (868-35-34)
- 3:45 p.m. *Slow dynamics of spherical fronts for the Cahn-Hilliard equation.*  
(82) **N. D. Alikakos**, University of Tennessee, Knoxville, and **G. Fusco\***, University of Rome, Italy (868-35-119)
- 4:15 p.m. *Slow evolution for the Cahn-Hilliard equation revisited.*  
(83) **Lia Bronsard\***, Carnegie Mellon University, and **Danielle Hilhorst**, University of Paris, France (868-35-36)
- 4:45 p.m. *On the spectrum of the Cahn-Hilliard operator.*  
(84) **Nicholas D. Alikakos\***, University of Tennessee, Knoxville and University of Crete, Greece, and **Giorgio Fusco**, University of Rome, Italy (868-35-143)

### Special Session on Numerical Linear Algebra, II

**2:45 p.m.–5:05 a.m.** Room 501, 1616 Walnut Street

- 2:45 p.m. *On the convex hull of projection matrices.*  
(85) **Michael L. Overton\***, Courant Institute of Mathematical Sciences, New York University, and **Robert S. Womersley**, University of New South Wales, Australia (868-65-14) (Sponsored by Daniel B. Szyld)
- 3:15 p.m. *Joint stability of two matrices and their joint spectral radius.*  
(86) **Gilbert Strang**, Massachusetts Institute of Technology (868-65-07)
- 3:45 p.m. *Eigenvalues and pseudo-eigenvalues of nonsymmetric random matrices.*  
(87) **Lloyd N. Trefethen**, Cornell University (868-65-20)
- 4:15 p.m. *Updatable, rank-revealing decompositions.*  
(88) **G. W. Stewart**, University of Maryland, College Park (868-65-01)
- 4:45 p.m. *Numerical computation of an analytic, singular value decomposition of a matrix valued function.*  
(89) **Angelika Bunse-Gerstner**, University of Bielefeld, Germany, **Ralph Byers\***, University of Kansas, **Volker Mehrmann**, University of Bielefeld, Germany, and **Nancy K. Nichols**, University of Reading, United Kingdom (868-65-03)

### Session on Analysis

**2:45 p.m.–5:25 p.m.** Room 504, 1616 Walnut Street

- 2:45 p.m. *A relation between the Jacobian and the elementary generalized Wronskians.* Preliminary report.  
(90) **Kenneth Wolsson**, Fairleigh Dickinson University (868-26-53)
- 3:00 p.m. *Zeros of the successive derivatives of power series with Hadamard gaps.*  
(91) **Robert Gethner**, Franklin & Marshall College (868-30-04)
- 3:15 p.m. *Initial value problems and Green's functions for Leveroni wave operators.*  
(92) **Steven D. Bronson\***, **Wing-Tsin Ma** and **Raymond J. Nagem**, Boston University (868-39-182) (Sponsored by Guido V. Sandri)

- 3:30 p.m. *Non-dispersive and isotropic wave operators for a lattice.*  
(93) **Susan Leveroni\*** and **Guido v. H. Sandri**, Boston University (868-39-183)
- 3:45 p.m. *Quantum wavelets: The Dirac variational principle.*  
(94) **D. F. Hsu\***, **D. Coker** and **G. v. H. Sandri**, Boston University (868-41-190)
- 4:00 p.m. *New methods for solving Fredholm integral equations.*  
(95) **Thomas W. Drueding\***, **Guido v. H. Sandri**, Boston University, **Y. M. Fleming Lure** and **H. Y. Michael Yeh**, Caelum Research Corporation, Maryland (868-45-188)
- 4:15 p.m. *Construction of a convolution algebra.*  
(96) **Brahm A. Rhodes\***, Harvard Medical School, and **Thomas W. Drueding**, Boston University (868-13-189)
- 4:30 p.m. *A random number generator based on the logistic equation.*  
(97) **J. J. Collins** and **Guido v. H. Sandri\***, Boston University (868-60-180)
- 4:45 p.m. *Rigorous solutions for elastic wave scattering.*  
(98) **Mark K. Hinders\*** and **Ta-Ming Fang**, Massachusetts Institute of Technology (868-73-184) (Sponsored by Guido V. Sandri)
- 5:00 p.m. *Some numerical integration methods using Taylor polynomials.*  
(99) **Alan Horwitz**, Pennsylvania State University, Media (868-65-127)
- 5:15 p.m. *Exploring Hermite interpolation with mathematica.*  
(100) **Clifford A. Reiter**, Lafayette College (868-65-57)

### Session on Algebra and Geometry

**2:45 p.m.–4:40 p.m.** Room 505, 1616 Walnut Street

- 2:45 p.m. *A note on computing eigenvalues of banded Hermitian Toeplitz matrices.*  
(101) **William F. Trench**, Trinity University (868-15-96)
- 3:00 p.m. *Boolean lattices of function spaces on direct products of groups with zeros.*  
(102) **Hassan Sedaghat**, Virginia Commonwealth University (868-22-83)
- 3:15 p.m. *Construction of a universal point for aperiodic tilings.*  
(103) **Catherine Gorini**, Maharishi International University (868-51-66)
- 3:30 p.m. *The valance and coloring problems.*  
(104) **Jonathan Sondow**, Yeshiva University (868-52-82)
- 3:45 p.m. *Families of nearly neighborly rectangular polytopes.* Preliminary report.  
(105) **Julie D. Simon**, Antioch College (868-52-168)
- 4:00 p.m. *Tiling by stacks.* Preliminary report.  
(106) **Linda Fosnaugh\***, Emporia State University, and **David Klarnar**, University of Nebraska, Lincoln (868-05-131)
- 4:15 p.m. *Inverse problems in design theory.*  
(107) **Vadim Komkov**, Air Force Institute of Technology (868-73-135) (Sponsored by Gregory T. Warhola)
- 4:30 p.m. *The Selberg conjecture for  $SL(3, Z)$ .*  
(108) **Jonathan Huntley\*** and **David E. Tepper**, Bernard M. Baruch College, City University of New York (868-11-58)

## Sunday, October 13

### Special Session on Modular Forms, Arithmetic Algebraic Geometry, III

8:30 a.m.–10:50 a.m. Room 503, 1616 Walnut Street

- 8:30 a.m. *Galois module structure of schemes and modular forms.* (109)  
**Ted Chinburg**, University of Pennsylvania (868-11-95)
- 9:00 a.m. *Torsion points on some Jacobians of modular curves.* (110)  
Preliminary report.  
**Dino J. Lorenzini**, Duke University (868-11-93)
- 9:30 a.m.  *$p$ -Adic complex power and Bernstein-Sato polynomial.* (111)  
**Xiao-Wei Zhu**, University of Oklahoma (868-11-166)
- 10:00 a.m. *Variation of the canonical height in algebraic families.* (112)  
Preliminary report.  
**Joseph Silverman**, Brown University (868-11-29)
- 10:30 a.m. Informal Discussion

### Special Session on Surgery Theory and Singular Spaces, III

8:30 a.m.–10:50 a.m. Room 3B, 1616 Walnut Street

- 8:30 a.m. *Non-characteristic embeddings of Tori.* (113)  
**David Miller**, Swarthmore College (868-57-61)
- 9:00 a.m. *Positive scalar curvature for closed manifolds with finite fundamental group.* (114)  
**Jonathan Rosenberg**, University of Maryland, College Park (868-53-158)
- 9:30 a.m. *Characteristics class and singular spaces.* (115)  
**Sylvain Cappell**, Courant Institute of Mathematical Sciences, New York University (868-57-176)
- 10:00 a.m. *Atiyah invariant of Kahler manifolds and Picard variety.* (116)  
Preliminary report.  
**A. Libgober**, University of Illinois, Chicago (868-57-126)
- 10:30 a.m. *Torsion and the  $K$ -theory of Von Neumann algebras.* (117)  
Preliminary report.  
**Mel Rothenberg**, University of Chicago (868-57-87)

### Special Session on Geometric Analysis, III

8:30 a.m.–10:50 a.m. Room 7B, 1616 Walnut Street

- 8:30 a.m. *The flat horocycle transform on a symmetric space.* (118)  
**Sigurdur Helgason**, Massachusetts Institute of Technology (868-43-23)
- 9:00 a.m. *The infinitesimal rigidity of the complex quadric of dimension four.* (119)  
**Hubert Goldschmidt**, Columbia University (868-53-24)
- 9:30 a.m. *Range characterizations of totally geodesic Radon transforms on compact symmetric spaces.* Preliminary report. (120)  
**Fulton Gonzalez**, Tufts University (868-44-86)

- 10:00 a.m. *Radon transforms and structure of compact symmetric spaces.* Preliminary report. (121)  
**Eric Grinberg**, Temple University, Philadelphia (868-44-149)
- 10:30 a.m. *Real analytic Radon transforms and Pompeiu problems.* (122)  
**Eric Todd Quinto**, Tufts University (868-44-90)

### Special Session on Variational Problems in Low Dimensional Geometry, III

8:30 a.m.–10:55 a.m. Room 8B, 1616 Walnut Street

- 8:30 a.m. *Poincare's geodesics, soap bubbles, and constant-curvature curves.* (123)  
**Frank Morgan**, Williams College (868-53-113)
- 9:10 a.m. *What is (weighted) mean curvature?* Preliminary report. (124)  
**Jean Taylor**, Rutgers University, New Brunswick (868-49-37)
- 9:45 a.m. *Computing optimal geometries.* Preliminary report. (125)  
**Fred Almgren**, Princeton University (868-49-31)
- 10:25 a.m. *Proving area-minimization by slicing.* Preliminary report. (126)  
**Gary R. Lawlor**, Brigham Young University (868-49-42)

### Special Session on Phase Transitions and/or Front Propagation, III

8:30 a.m.–10:50 a.m. Room 1B, 1616 Walnut Street

- 8:30 a.m. *Generalized mean curvature motion.* Preliminary report. (127)  
**L. C. Evans\***, University of California, Berkeley, and **J. Spruck**, University of Massachusetts, Amherst (868-35-74)
- 9:00 a.m. *Front propagation for reaction diffusion equations.* (128)  
**G. Barles\***, University de Tours, France, **H. M. Soner**, Carnegie Mellon University, and **P. E. Souganidis**, Brown University (868-35-33)
- 9:30 a.m. *Curvature-dependent front propagation with boundary conditions.* (129)  
**Peter Sternberg**, Indiana University, Bloomington (868-35-73)
- 10:00 a.m. *Convergence of Allen-Cahn equation.* (130)  
**H. Mete Soner**, Carnegie Mellon University (868-35-81)
- 10:30 a.m. *Models of flame propagation and crystal growth: A differential games approach.* (131)  
**Pierpaolo Soravia**, Brown University (868-35-163)  
(Sponsored by Panagiotis E. Souganidis)

### Special Session on Numerical Linear Algebra, III

8:30 a.m.–10:50 a.m. Room 501, 1616 Walnut Street

- 8:30 a.m. *A direct method for solving unstructured sparse linear systems.* (132)  
**Carl D. Meyer**, North Carolina State University (868-65-22)



9:00 a.m. *A new implementation of the GMRES method.*  
(133) **Lothar Reichel\***, **Z. Bai** and **D. Hu**, University of Kentucky (868-65-08)

9:30 a.m. *Asynchronous parallel iterations for solving nonlinear systems.*  
(134) **L. Elsner**, University of Bielefeld, Germany, **I. Koltracht** and **M. Neumann\***, University of Connecticut, Storrs (868-65-35)

10:00 a.m. *SOR for Markov chain problems.*  
(135) **William J. Stewart**, North Carolina State University (868-65-99) (Sponsored by Daniel B. Szyld)

10:30 a.m. *Convergent iterative methods to find stationary distributions of Markov processes.*  
(136) **Ivo Marek\***, University Karlovy, Czechoslovakia, and **Daniel B. Szyld**, Temple University, Philadelphia (868-65-26)

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Special Session on Recent Progress in Ricci Curvature and Related Topics, III

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9:00 a.m.–10:50 a.m. Room 4B, 1616 Walnut Street

9:00 a.m. *Diffeomorphism finiteness for a certain class of Riemannian manifolds.*  
(137) **Jeff Cheeger**, Courant Institute of Mathematical Sciences, New York University (868-53-72)

9:40 a.m. *Volume comparison under scaling invariant Ricci bound.*  
(138) **Guojun G. Liao\*** and **Jianzhong Su**, University of Texas, Arlington (868-53-51)

10:20 a.m. *Bounds on the fundamental group of a manifold with almost nonnegative Ricci curvature.*  
(139) **Steve Rosenberg**, Boston University, and **Deane Yang\***, Polytechnic Institute of New York (868-53-103)

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Special Session on Extreme Value Theory, III

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9:00 a.m.–10:50 a.m. Room 502, 1616 Walnut Street

9:00 a.m. *Improved asymptotics for tail density estimation.*  
(140) **James Pickands, III**, University of Pennsylvania (868-62-152) (Sponsored by Janos Galambos)

9:30 a.m. *A flaw model with random intensity.* Preliminary report.  
(141) **Howard M. Taylor**, University of Delaware (868-60-118)

10:00 a.m. *Practical application of newer methods of tail estimation to wind engineering: A case study.*  
(142) **James A. Lechner**, **Stefan D. Leigh\*** and **Emil Simiu**, National Institute of Standards and Technology, Maryland (868-62-112) (Sponsored by Bonita V. Saunders)

10:30 a.m. *Extreme values in stochastic epidemic processes.*  
(143) **Grace L. Yang**, University of Maryland, College Park (868-60-130) (Sponsored by Janos Galambos)

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Special Session on Applications of Microlocal Analysis to Partial Differential Equations, III

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9:00 a.m.–10:40 a.m. Room 6B, 1616 Walnut Street

9:00 a.m. *Analytic hypoellipticity of the Kohn Laplacian plus a constant.*  
(144) **Daryl Geller**, State University of New York, Stony Brook (868-35-84)

9:35 a.m. *Boundedness of the FBI transform on Sobolev spaces and propagation of singularities.*  
(145) **S. Berhanu**, Temple University, Philadelphia, and **S. Chanillo\***, Rutgers University, New Brunswick (868-35-117)

10:10 a.m. *Wedge extendability for hypoanalytic structures.* Preliminary report.  
(146) **Mark E. Marson**, Purdue University, West Lafayette (868-35-171)

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Special Session on Rings and Representations, III

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9:00 a.m.–10:50 a.m. Room 5B, 1616 Walnut Street

9:00 a.m. *Quotients of crossed products of Hopf algebras.* Preliminary report.  
(147) **J. Bergen**, DePaul University, and **S. Montgomery\***, University of Southern California (868-16-154)

9:30 a.m. *Delta methods in enveloping rings. II.*  
(148) **Jeffrey Bergen\***, DePaul University, and **D. S. Passman**, University of Wisconsin, Madison (868-16-27)

10:00 a.m. *Cocommutative Hopf algebra actions and the Connes spectrum.* Preliminary report.  
(149) **James Osterburg**, University of Cincinnati, and **Declan Quinn\***, Syracuse University (868-16-155)

10:30 a.m. *Artinian rings with linearly ordered two-sided ideals.*  
(150) **Barbara L. Osofsky\***, Rutgers University, New Brunswick, and **Richard D. Resco**, University of Oklahoma (868-16-94)

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Special Session on Tilings, III

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9:00 a.m.–10:50 a.m. Room 2B, 1616 Walnut Street

9:00 a.m. *Penrose tilings, crystals and dynamical systems.*  
(151) **Charles Radin**, University of Texas, Austin (868-47-39)

9:30 a.m. *Tilings, orbifolds, and symmetry.*  
(152) **John H. Conway**, Princeton University (868-51-105)

10:00 a.m. *An elementary proof of two triangle-tiling theorems of Conway and Lagarias.*  
(153) **Donald C. West**, State University of New York, College at Plattsburgh (868-05-60)

10:30 a.m. *Classification of self-dual tilings.* Preliminary report.  
(154) **Walter Stromquist**, Daniel H. Wagner Associates, Paoli, Pennsylvania (868-51-68)

## Sunday, October 13 (cont'd)

### Special Session on Nonlinear Partial Differential Equations, I

9:30 a.m.–10:50 a.m. Room 504, 1616 Walnut Street

- 9:30 a.m. *Solvability of a fourth order equation in conformal geometry.* Preliminary report.  
(155) **Sun-Yung Alice Chang\***, University of California, Los Angeles, and **Paul C. Yang**, University of Southern California (868-53-12)
- 10:00 a.m. *On uniformly rotating stars.*  
(156) **Yanyan Li**, Rutgers University, New Brunswick (868-35-16) (Sponsored by A. Bahri)
- 10:30 a.m. *Poincaré-Bendixson theory for state dependent differential-delay equations.*  
(157) **John Mallet-Paret**, Brown University, and **Roger D. Nussbaum\***, Rutgers University, New Brunswick (868-35-18)

#### Invited Address

11:00 a.m.–noon Room 501, Temple University Center City, 1619 Walnut Street

- (158) *Tilings, quasicrystals, and Hilbert's 18<sup>th</sup> problem.*  
**Marjorie Senechal**, Smith College (868-52-102)

#### Invited Address

1:30 p.m.–2:30 p.m. Room 501, Temple University Center City, 1619 Walnut Street

- (159) *Critical points at infinity in some variational problems.*  
**Abbas Bahri**, Rutgers University, New Brunswick (868-35-21)

### Special Session on Recent Progress in Ricci Curvature and Related Topics, IV

2:45 p.m.–3:55 p.m. Room 4B, 1616 Walnut Street

- 2:45 p.m. *Manifolds of negatively pinched curvature.*  
(160) **Rugang Ye**, University of California, Santa Barbara (868-53-186)
- 3:25 p.m. *Fredholm operators and Einstein metrics on conformally compact manifolds.* Preliminary report.  
(161) **John M. Lee**, University of Washington (868-53-164)

### Special Session on Modular Forms, Arithmetic Algebraic Geometry, IV

2:45 p.m.–5:05 p.m. Room 503, 1616 Walnut Street

- 2:45 p.m. *Zeta functions of flag varieties and Einstein series for  $GL_n$ .*  
(162) **David J. Wright**, Oklahoma State University, Stillwater (868-11-169)
- 3:15 p.m. *Eisenstein series with explicit expansions.*  
(163) **Paul Feit**, Hamden, Connecticut (868-11-48)
- 3:45 p.m. *Universal local zeta functions.* Preliminary report.  
(164) **Diane Meuser**, Boston University (868-11-64)
- 4:15 p.m. *Bernoulli congruences between periods of modular forms.*  
(165) **G. S. Nelson**, Pennsylvania State University, Erie (868-11-28)
- 4:45 p.m. Informal Discussion

### Special Session on Surgery Theory and Singular Spaces, IV

2:45 p.m.–4:35 p.m. Room 3B, 1616 Walnut Street

- 2:45 p.m. *Links and localised Blanchfield pairings.*  
(166) **Kent Orr**, Indiana University, Bloomington (868-57-167)
- 3:15 p.m. *G-surgery up to topological simple homotopy.*  
(167) **Mark Steinberger\***, State University of New York, Albany, and **Frank Connolly**, University of Notre Dame (868-57-178) (Sponsored by James F. Davis)
- 3:45 p.m. *The equivariant Borel conjecture fails.* Preliminary report.  
(168) **Shmuel Weinberger**, University of Chicago (868-57-170)
- 4:15 p.m. *Periodicity in stable equivariant surgery.* Preliminary report.  
(169) **Min Yan**, University of Michigan, Ann Arbor (868-57-134)

### Special Session on Geometric Analysis, IV

2:45 p.m.–4:35 p.m. Room 7B, 1616 Walnut Street

- 2:45 p.m. *Asymptotic finite propagation speed for heat diffusion on certain Riemannian manifolds.*  
(170) **Jean-Philippe Anker**, Université de Nancy I, France, and **Alberto G. Setti\***, Cornell University (868-58-41)
- 3:15 p.m. *Some direct and inverse problems arising in design of reflecting surfaces.*  
(171) **Vladimir Oliker**, Emory University (868-53-40)
- 3:45 p.m. *Nonlinear Fourier analysis.* Preliminary report.  
(172) **Leon Ehrenpreis**, Temple University, Philadelphia (868-44-148) (Sponsored by Eric L. Grinberg)
- 4:15 p.m. *On stability estimates in the 'hole theorem' for the Radon transform.* Preliminary report.  
(173) **Peter Kuchment\*** and **Ziqi Sun**, Wichita State University (868-44-172) (Sponsored by Eric L. Grinberg)

Special Session on Variational Problems  
in Low Dimensional Geometry, IV

2:45 p.m.—4:35 p.m. Room 8B, 1616 Walnut Street

- 2:45 p.m. *Projective minimal surfaces.* Preliminary report.  
(174) **Lucas Hsu**, Mathematical Sciences Research  
Institute, Berkeley (868-58-177)
- 3:25 p.m. *Variational properties of holomorphic Abelian  
differentials on Riemann surfaces.*  
(175) **Lev Slutskin**, Yeshiva University (868-30-56)
- 4:05 p.m. *Isoperimetric regions in some product manifolds.*  
(176) **Jesus Gonzalo**, Universidad Autonoma de Madrid,  
Spain (868-53-98) (Sponsored by Bruce A. Kleiner)

Special Session on Tilings, IV

2:45 p.m.—4:05 p.m. Room 2B, 1616 Walnut Street

- 2:45 p.m. *Some results on semiregular tessellations of the  
hyperbolic plane.* Preliminary report.  
(177) **Douglas J. Dunham**, University of Minnesota, Duluth  
(868-52-146)
- 3:15 p.m. *Balance of tilings in the hyperbolic plane.*  
(178) **Judith Flagg Moran**, Trinity College (868-05-100)
- 3:45 p.m. *Cube tilings, graphs, and simulation.*  
(179) **Sándor Szabó**, University of the Pacific (868-51-120)  
(Sponsored by Marjorie Senechal)

Special Session on Phase Transitions  
and/or Front Propagation, IV

2:45 p.m.—4:05 a.m. Room 1B, 1616 Walnut Street

- 2:45 p.m. *Singular limits of phase field equations: Stefan-type  
models, and motion by mean curvature.*  
(180) **G. Caginalp**, University of Pittsburgh (868-35-59)
- 3:15 p.m. *Generation and propagation of interfaces for  
reaction-diffusion equations and systems.*  
(181) **Xinfu Chen**, University of Minnesota, Minneapolis  
(868-35-11)

- 3:45 p.m. *Delayed oscillation phenomena.*  
(182) **Jianzhong Su**, University of Texas, Arlington  
(868-35-49)

Special Session on Numerical Linear Algebra, IV

2:45 p.m.—4:05 p.m. Room 501, 1616 Walnut Street

- 2:45 p.m. *Modifying the Shougen-Shuquin algorithm for the  
banded symmetric generalized matrix eigenvalue  
problem.*  
(183) **Linda Kaufman**, AT&T Bell Laboratories, Murray Hill,  
New Jersey (868-65-13)
- 3:15 p.m. *Parallel solution of generalized band symmetric  
eigenvalue problems by sectioning.*  
(184) **Ricardo D. Pantazis**, Duke University (868-65-111)  
(Sponsored by Daniel B. Szyld)
- 3:45 p.m. *Error analysis of update methods for the symmetric  
eigenvalue problem.*  
(185) **Jesse L. Barlow**, Pennsylvania State University,  
University Park (868-65-02) (Sponsored by Daniel B.  
Szyld)

Special Session on Nonlinear  
Partial Differential Equations, II

2:45 p.m.—4:05 p.m. Room 504, 1616 Walnut Street

- 2:45 p.m. *Multivortices in the electroweak theory.*  
(186) **Yisong Yang**, University of New Mexico (868-35-47)
- 3:15 p.m. *Positive solutions of semilinear elliptic equation*  
(187)  $\Delta u + hu \frac{n+2}{n-2} = 0.$   
**Tiancheng Ouyang**, University of Cincinnati  
(868-35-141)
- 3:45 p.m. *Generalized unique continuation theorems.*  
(188) **Libin Mou**, University of Southern California  
(868-35-179)

**W. Wistar Comfort**  
Associate Secretary  
Middletown, Connecticut

# Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.

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# Fargo, North Dakota

## North Dakota State University

### October 25–26

## Program

The eight-hundred-and-sixty-ninth meeting of the American Mathematical Society will be held at North Dakota State University (NDSU), Fargo, North Dakota on Friday, October 25, and Saturday, October 26, 1991. All sessions will be held in the Memorial Union, the Family Life Center, and South Engineering buildings.

### Invited Addresses

By invitation of the Central Section Program Committee, there will be four invited one-hour addresses. The speakers, their affiliations, and the titles of their talks where available are:

**Ian G. Macdonald**, Queen Mary College, *title to be announced*.

**Harald Upmeyer**, University of Kansas, *Operator theory and quantization in several complex variables*.

**Henry C. Wente**, University of Toledo, *Constant mean curvature immersions: A geometrical approach*.

**Sylvia M. Wiegand**, University of Nebraska, Lincoln, *Prime ideals and decompositions of modules*.

### Special Sessions

By invitation of the same committee, there will be eleven special sessions of selected twenty-minute papers. The previously published session on *Operations research has been cancelled*. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

*Commutative algebra*, **Joseph P. Brennan**, North Dakota State University, Fargo, and **Sylvia M. Weigand**.

*Ergodic theory*, **Dogan Comez**, North Dakota State University, Fargo.

*The geometry of equilibrium configurations*, **Robert D. Gulliver**, University of Minnesota, Minneapolis, and **Henry C. Wente**.

*Algebraic geometry*, **David B. Jaffe**, University of Nebraska, Lincoln.

*Nonlinear wave equations*, **Satyanad Kichenassamy**, University of Minnesota, Minneapolis.

*Mathematical foundations of computer graphics*, **James H. Olsen**, and **Mark Pavicic**, North Dakota State University, Fargo.

*Nonselfadjoint operator algebras*, **Justin R. Peters III**, and **Warren R. Wogen**, University of North Carolina, Chapel Hill.

*Multidimensional complex analysis and operator theory*, **Norberto Salinas**, University of Kansas, and **Harald Upmeyer**.

*Graph theory*, **Warren E. Shreve**, North Dakota State University, Fargo.

*Constrained approximation, theory and algorithms*, **Vasant A. Ubhaya**, North Dakota State University, Fargo.

*Lorentz transformations and spacetime geometry*, **Abraham Ungar**, North Dakota State University, Fargo.

Abstracts for consideration for these sessions should have been submitted by the **July 11, 1991** deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of *Notices*.

### Contributed Papers

There will also be sessions for contributed ten-minute papers. Late papers will not be accommodated.

### Registration

The meeting registration desk will be located on the third floor of the Memorial Union building and will be open from 8:00 a.m. to 5:00 p.m. on Friday, October 25, and from 8:00 a.m. to noon on Saturday, October 26. The registration fees are \$30 for members of the AMS, \$45 for nonmembers, and \$10 for students or unemployed mathematicians.

### Petition Table

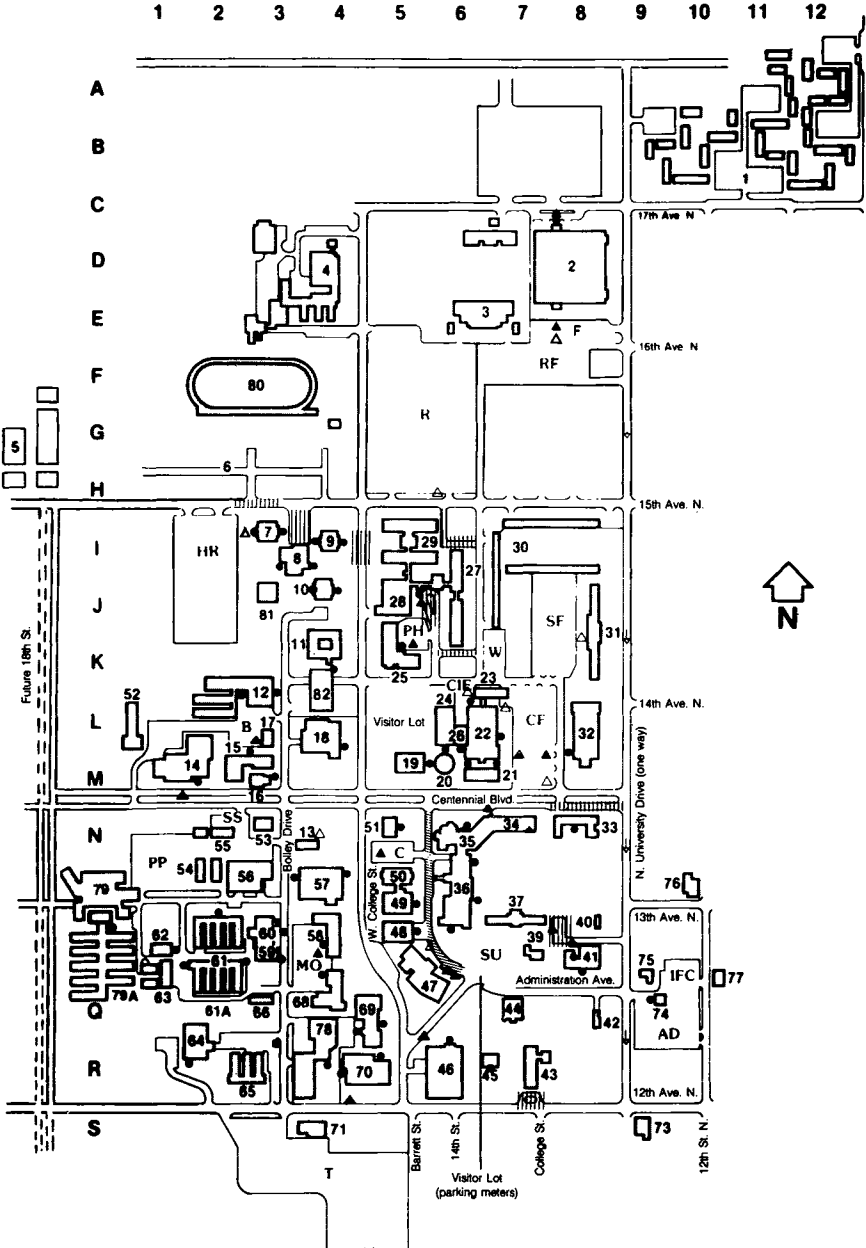
A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Baltimore meeting announcement in this issue of *Notices*.

### Accommodations

Rooms have been blocked for participants at the following hotels or motels in Fargo. Participants should make their

# NDSU

NORTH DAKOTA STATE UNIVERSITY FARGO



- P5 48 Agricultural Engineering
  - P2 61 Agronomy Greenhouse Plant Diagnostic Lab
  - P8 40 Alba Bales House (Family Studies Institute)
  - P9 75 Alumni/Development Center
  - N3 13 Animal Health Facility
  - M6 21 Architecture & Landscape Architecture
  - L6 23 Architecture Quonset
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  - R4 70 Askanae Hall (Little Country Theatre)
  - Q2 64 Auxiliary Enterprises (Food Service & Housing)
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  - Q3 66 Campus Laundry
  - P8 41 Ceres Hall—Admission/Communications/Financial Aid/Counseling/Placement)
  - L6 24 Civil and Industrial Engineering
  - L6 26 Construction Management
  - L3 17 Corn Seed House
  - K4 82 Crop & Weed Sciences Building
  - P2 61 Crop & Weed Sciences Greenhouse
  - E6 3 Decotah Field
  - L6 22 Dolve Hall (Mechanical Engineering)
  - O5 50 Dunbar Laboratories (Biochemistry/Polymers & Coatings)
  - M5 19 Electrical Engineering
  - M6 20 Engineering Administration
  - N6 35 Family Life/4-H Center
  - P2 61 Greenhouses
  - P3 60 Harris Hall (Cereal Science and Food Technology)
  - N3 53 Hastings Hall (State Seed Dept.)
  - P4 68 Heating Plant
  - N7 34 Home Economics
  - N5 51 Horticulture Science
  - P2 61a Horticulture and Plant Pathology Greenhouse
  - O4 57 Hultz Hall (Animal Science/Entomology)
  - O5 49 Ladd Hall (Chemistry)
  - R6 46 Library
  - O10 76 Lutheran Student Center
  - N2 54 Maintenance Bldgs.
  - O6 36 Memorial Union (Varsity Mart)
  - Q4 69 Minard Hall (Humanities and Social Sciences, Education)
  - P4 58 Morrill Hall (Agriculture/Ag Econ)
  - R4 78 Music Education Building (Festival Concert Hall)
  - P7 39 Nelson Health Center
  - P3 59 Northern Crops Institute
  - O1 79 Northern Crops Science Laboratory (sunflowers, sugar beets)
  - Q7 44 Old Main (Administration/Registrar/Business Office)
  - N1 55 Pharmacy Research Caves
  - L8 32 Physical Education Building (ROTC & Women's Athletics)
  - P3 67 Plant Pathology
  - P1 79 Plant Science Greenhouse
  - Q9 74 Post Office
  - P1 63 Potato-Pesticide Storage
  - H1 5 Poultry Research Center
  - P4 68 Power House
  - Q8 42 President's House
  - R7 45 Putnam Hall (Business)
  - R4 78 Reineke Fine Arts Center (Music)
  - J5 28 Residence Dining Center
  - L1 52 Robinson Hall (Veterinary Research)
  - F2 80 Running Track Facility
  - L4 18 Shepperd Arena
  - P5 47 South Engineering (Physics/Computer Network)
  - M3 16 Stevens Auditorium
  - M3 15 Stevens Hall (Natural Sciences)
  - S9 73 St. Paul's Chapel (Newman Center)
  - K5 25 Sudro Hall (Pharmacy/Nursing)
  - P1 62 Sugar Beet Research
  - S4 71 Thordarson Hall (Independent Study/State Film Library)
  - O3 56 Thorson Maintenance Center (Physical Plant)
  - P10 77 United Campus Ministry, YMCA of NDSU
  - M2 14 Van Es (Vet Science/Microbiology)
  - K3 12 Waldron Laboratory (Agriculture, Soil Testing Lab)
  - K4 11 Walster Hall (Agriculture)
  - I3 8 West Dining Center
  - L3 17 Wiidakas Lab (Crop & Weed Sciences)
- Housing Units**
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  - R7 43 Burgum Hall
  - N8 33 Churchill Hall
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  - I5 29 Reed-Johnson Halls
  - I3 7 Seim Hall
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  - Q7 44 Registrar and Business Office (Old Main)
  - Q7 44 Student Affairs (Old Main)
  - O3 56 Traffic (Thorson Maintenance Center)
  - O6 36 Varsity Mart (Memorial Union)

- handicap building access
- ▲ handicap parking
- △ motorcycle parking
- ▨ controlled access area

## Meetings

own arrangements directly with the hotel of their choice and ask for the special AMS meeting rate. The Best Western-Doublewood Inn, Holiday Inn, and the Kelly Inn are located along I-29. The Radisson Inn and the Townhouse Inn are located in downtown Fargo. **The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.**

### **Radisson Inn (1.5 miles from campus)**

201 5th Street North, Fargo, ND 58102  
Telephone: 219-232-3941 or Toll-free: 800-333-3333  
**Deadline for reservations was September 24, 1991.**

Flat rate \$54      Single, Double, Triple  
Restaurant, lounge/casino, weight room, and free van transportation from airport.

### **The Townhouse Inn (1.5 miles from campus)**

301 3rd Avenue North, Fargo, ND 58102  
Telephone: 701-232-8851 or Toll-free: 800-437-4682  
**Deadline for reservations was September 25, 1991.**

Flat rate \$48      Single, Double, Triple  
Restaurant/lounge, indoor pool, sauna, and casino. Free airport transportation.

### **The Kelly Inn (3 miles from campus)**

3800 Main Avenue, Fargo, ND 58103  
Telephone: 701-282-2143 or Toll-free: 800-635-3559  
**Deadline for reservations was October 3, 1991.**

Single \$35      Double \$40

### **The Holiday Inn (4 miles from campus)**

3803 13th Avenue South, Fargo, ND 58103  
Telephone: 701-282-2700 or Toll-free: 800-465-4329  
**Deadline for reservations was October 3, 1991.**

Flat rate \$58      One to four people  
Casino, indoor pool, and free airport transportation.

### **Best Western-Doublewood Inn (4 miles from campus)**

3333 13th Avenue South, Fargo, ND 58103  
Telephone: 701-235-3333 or Toll-free: 800-528-1234  
**Deadline for reservations is October 10, 1991.**

Flat rate \$59      One to four people  
Casino, indoor pool, and free airport transportation.

## Food Service

The Atrium Dining Center, located in the basement of the NDSU Memorial Union, will be open for lunch on Friday

and closed on Saturday. This facility receives very heavy use and it is **highly** recommended that participants look to off-campus facilities for the noon meal on Friday and Saturday. An extensive list of restaurants will be available at the meeting registration desk.

## Parking

Free parking will be available to participants in the Visitors Parking Lot and its overflow lots in the NDSU campus. These lots are located within close proximity to the Memorial Union. Permits will be available at the registration desk.

## Travel and Local Information

Hector International Airport is served by Northwest (via Minneapolis) and United (via Denver/Sioux Falls) Airlines. The airport is immediately adjacent to the NDSU campus. The airport is served by Hertz, Avis, and National car rental agencies. Transportation from the airport to area hotels is best accomplished by hotel courtesy van. Participants should make inquiries of the hotel when making reservations. Taxi service is available from Doyle's Yellow Checker Cab (telephone 701-235-5535). A courtesy phone is available in the vestibule of the airport. The taxis will pick up passengers only if a reservation is made with the dispatcher.

**DRIVING INSTRUCTIONS:** Fargo is located at the intersection of I-29 and I-94 on the border of North Dakota and Minnesota. The university is located approximately two miles east of I-29 at the 12th Avenue North exit (Exit 66).

**BY TRAIN:** Daily train service to Fargo from Minneapolis/Chicago and Seattle/Portland is provided by Amtrak's Empire Builder.

Local transportation is provided by Doyle's Yellow Checker Cab and the Metropolitan Area Transit Bus Service. Bus schedules will be available at the registration desk.

## Weather and Local Attractions

October weather in Fargo is extremely variable. The mean maximum temperature for October 25th is 51°F with a standard deviation of 12 degrees while the mean minimum temperature is 31°F with a standard deviation of nine degrees. The mean precipitation for the month of October is 1.53 inches with a standard deviation of 1.18 inches. There is an average of one inch of snow. The wind for October averages thirteen miles per hour. Thanks are due to John Wheeler for providing this information.

# Program of the Sessions

The time limit for each contributed paper in the sessions is ten minutes. In the special sessions, the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

Abstracts of papers presented in the sessions at this meeting will be found in the October 1991 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

## Friday, October 25

### Special Session on Commutative Algebra, I

8:00 a.m.–10:50 a.m. Century Theater, Memorial Union

- 8:00 a.m. *Picard groups of curves*. Preliminary report.  
(1) **Roger Wiegand**, University of Nebraska, Lincoln (869-13-122)
- 8:30 a.m. *Examples of reflexive modules*.  
(2) **Frank Demeyer**, Colorado State University (869-13-67)
- 9:00 a.m. *Maximal ideals in Laurent polynomial rings*.  
(3) **Budh Nashier**, Florida State University (869-13-37)
- 9:30 a.m. *Modules over Artinian couples*.  
(4) **Christel Rotthaus**, Michigan State University (869-13-24)
- 10:00 a.m. *Descent properties*.  
(5) **Dana Weston**, University of Missouri, Columbia (869-13-151)
- 10:30 a.m. *Lengths of factorization of an element into irreducible elements*. Preliminary report.  
(6) **D. D. Anderson**, University of Iowa (869-13-08)

### Special Session on Algebraic Geometry, I

8:30 a.m.–10:50 p.m. Dakota Ballroom, Memorial Union

- 8:30 a.m. *A determination of the normally generated divisor classes on rational surfaces with integral anticanonical curve*.  
(7) **B. Harbourne**, University of Nebraska, Lincoln (869-14-75)
- 9:00 a.m. *On terminal singularities with triple-point-free resolutions*.  
(8) **Bruce Crauder\***, Oklahoma State University, Stillwater, and **David Morrison**, Duke University (869-14-162)
- 9:30 a.m. *Curves in  $\mathbb{P}^3$  with seminatural cohomology*.  
(9) **Charles Walter**, Rutgers University, New Brunswick (869-14-35)
- 10:00 a.m. *Equisingularity of quasi-ordinary singularities*.  
(10) **Chunsheng Ban**, Ohio State University, Mansfield (869-14-16)

- 10:30 a.m. *Multiplicity of discriminants*. Preliminary report.  
(11) **Paolo Aluffi\***, Florida State University, and **Fernando Cukierman**, University of Kansas (869-14-84)

### Special Session on Multidimensional Complex Analysis and Operator Theory, I

8:30 a.m.–10:50 a.m. Prairie Rose Room, Memorial Union

- 8:30 a.m. *Heat flow and the Berezin-Toeplitz quantization*.  
(12) **L. A. Coburn**, State University of New York, Buffalo (869-47-180)
- 9:00 a.m. *Open problems and conjectures in the function theory of Cartan domains*. Preliminary report.  
(13) **Adam Koranyi**, Herbert H. Lehman College, City University of New York (869-32-46)
- 9:30 a.m. *Invariant differential operators and holomorphic function spaces on bounded symmetric domains*.  
(14) **Zhimin Yan**, University of California, Berkeley (869-32-88)
- 10:00 a.m. *Holomorphic Besov spaces on bounded symmetric domains*.  
(15) **Kehe Zhu**, State University of New York, Albany (869-32-06)
- 10:30 a.m. *Toeplitz and Hankel operators on the Bergman spaces of the unit ball and the polydisk in  $\mathbb{C}^n$* .  
(16) **Karel Stroethoff\***, University of Montana, and **Dechao Zheng**, State University of New York, Stony Brook (869-47-90)

### Special Session on The Geometry of Equilibrium Configurations, I

9:00 a.m.–10:50 a.m. Meadowlark Room, Memorial Union

- 9:00 a.m. *Boundary value problems for variational integrals involving surface curvatures*.  
(17) **Johannes C.C. Nitsche**, University of Minnesota, Minneapolis (869-49-86)
- 9:40 a.m. *Evolution of nonparametric surfaces with speed depending on the mean curvature*.  
(18) **Vladimir I. Oliker\***, Emory University, and **Nina N. Uraltseva**, Leningrad University, USSR (869-35-173)



10:20 a.m. *The regularity and almost holomorphicity of stable minimal surfaces in arbitrary codimension.* Preliminary report.  
 (19) **Richard M. Schoen**, Stanford University (869-53-175)

**Special Session on Nonlinear Wave Equations, I**

**9:00 a.m.–10:20 a.m.** University Chamber, Memorial Union

9:00 a.m. *A steepest descent method for oscillatory Riemann-Hilbert problems.*  
 (20) **Percy Deift\***, Courant Institute of Mathematical Sciences, New York University, and **Xin Zhou**, Yale University (869-35-23)

9:45 a.m. *Existence and non-existence of solitary wave solutions to higher order model evolution equations.* Preliminary report.  
 (21) **Satyanad Kichenassamy** and **Peter J. Olver\***, University of Minnesota, Minneapolis (869-76-22)

**Special Session on Nonselfadjoint Operator Algebras, I**

**9:00 a.m.–10:50 a.m.** Peace Garden, Memorial Union

9:00 a.m. *Hypoprojective Hilbert modules over incidence operator algebras.* Preliminary report.  
 (22) **Paul S. Muhly**, University of Iowa (869-47-15)

9:30 a.m. *Nest embedding limit algebras.* Preliminary report.  
 (23) **Alan Hopenwasser\***, University of Alabama, Tuscaloosa, and **Justin R. Peters**, Iowa State University (869-47-34)

10:00 a.m. *The ideal structure of continuous, semicrossed product algebras.*  
 (24) **Michael P. Lamoureux**, University of Ottawa (869-46-131)

10:30 a.m. *Vector states of some non self-adjoint algebras.*  
 (25) **Sze-Kai Tsui**, Oakland University (869-46-79)

**Special Session on Graph Theory, I**

**9:00 a.m.–10:50 a.m.** Family Life Center, Room 319, Memorial Union

9:00 a.m. *Local indecomposability of certain geometric graphs.*  
 (26) **Jonathan I. Hall**, Michigan State University (869-05-76)

9:30 a.m. *Crossings on edges in graph drawings.*  
 (27) **Heiko Harborth**, University of Braunschweig, Germany (869-05-43)

10:00 a.m. *Connectivity and strong maps of matroids.* Preliminary report.  
 (28) **Talmage James Reid**, University of Mississippi (869-05-19)

10:30 a.m. *Some new results on the limit points of eigenvalues of graphs.*  
 (29) **Michael Doob**, University of Manitoba (869-05-178)

**Special Session on Lorentz Transformations and Spacetime Geometry, I**

**9:00 a.m.–10:50 a.m.** Family Life Center, Room 320, Memorial Union

9:00 a.m. *Discrete spacetime and discrete Lorentz subgroup.*  
 (30) Preliminary report.  
**A. Das**, Simon Fraser University (869-83-179)

9:30 a.m. *A temporal approach to special relativity.*  
 (31) **Robert W. Brehme**, Wake Forest University (869-83-13) (Sponsored by Abraham Ungar)

10:00 a.m. *The abstract Lorentz group.*  
 (32) **Abraham Ungar**, North Dakota State University (869-83-20)

10:30 a.m. *Equivalence and Cartan forms.* Preliminary report.  
 (33) **Peter J. Olver**, University of Minnesota, Minneapolis (869-49-21)

**Invited Address**

**11:15 a.m.–12:05 p.m.** Century Theater, Memorial Union

(34) *Operator theory and quantization in several complex variables.*  
**Harald Upmeyer**, University of Kansas (869-47-54)

**Invited Address**

**1:30 p.m.–2:20 p.m.** Century Theater, Memorial Union

(35) *Title to be announced.*  
**Ian G. Macdonald**, Queen Mary College, England (869-00-174)

**Special Session on Nonselfadjoint Operator Algebras, II**

**2:40 p.m.–5:50 p.m.** Peace Garden, Memorial Union

2:40 p.m. *Absolutely summing maps for operator spaces.*  
 (36) **Edward G. Effros**, University of California, Los Angeles, and **Zhong-Jin Ruan\***, University of Illinois, Urbana-Champaign (869-46-41)

3:30 p.m. *Analytic TAF algebras generated by product type cocycles.*  
 (37) **Bruce H. Wagner\*** and **Yiu-Tung Poon**, Iowa State University (869-46-68)

4:00 p.m. *Ideals in triangular AF algebras.* Preliminary report.  
 (38) **Timothy D. Hudson**, Texas A & M University, College Station (869-46-169)

4:30 p.m. *Z-analytic TAF algebras and dynamical systems.*  
 (39) **Yiu-Tung Poon\*** and **Bruce H. Wagner**, Iowa State University (869-46-149)

5:00 p.m. *Structure of triangular AF algebras.* Preliminary report.  
 (40) **Allan P. Donsig**, Texas A & M University, College Station (869-46-171)

**Friday, October 25 (cont'd)**

5:30 p.m. *Product type analytic triangular UHF algebras.*  
(41) **Belisario Ventura**, California State University, San Bernardino (869-46-143)

**Special Session on Commutative Algebra, II**

**3:00 p.m.–6:50 p.m.** Century Theater, Memorial Union

- 3:00 p.m. *Algebraic varieties and their hyperplane sections.*  
(42) Preliminary report.  
**Craig Huneke**, Purdue University, West Lafayette, and **Bernd Ulrich\***, Michigan State University (869-13-02)
- 3:30 p.m. *Ideals whose Hilbert function and Hilbert polynomial agree at  $n = 1$ .*  
(43) **Judith D. Sally**, Northwestern University (869-13-85)
- 4:00 p.m. *On conditions which imply the invariance of the reduction exponent of an ideal.*  
(44) **Thomas Marley**, University of Nebraska, Lincoln (869-13-128)
- 4:30 p.m. *On relation type and reduction number for high powers of ideals in a commutative Noetherian ring.* Preliminary report.  
(45) **Bernard Johnston\***, Florida Atlantic University, and **D. Katz**, University of Kansas (869-13-127)
- 5:00 p.m. *Mixed multiplicities, joint reductions, and quasi-unmixed local rings.*  
(46) **Irena Swanson**, Purdue University, West Lafayette (869-13-10)
- 5:30 p.m. *The family of residue fields of a zero-dimensional commutative ring.*  
(47) **Robert Gilmer**, Florida State University, and **William Heinzer\***, Purdue University, West Lafayette (869-13-71)
- 6:00 p.m. *The Riemann-Roch problem.*  
(48) **Steven Dale Cutkosky\***, University of Missouri, Columbia, and **V. Srinivas**, T.I.F.R, India (869-13-166)
- 6:30 p.m. *Coefficient ideals in and blowups of a commutative Noetherian domain.*  
(49) **William Heinzer**, Purdue University, West Lafayette, **Bernard Johnston**, Florida Atlantic University, **David Lantz\***, Colgate University, and **Kishor Shah**, Southwest Missouri State University (869-13-102)

**Special Session on The Geometry of Equilibrium Configurations, II**

**3:00 p.m.–6:10 p.m.** Meadowlark Room, Memorial Union

- 3:00 p.m. Informal Discussion
- 3:40 p.m. *How to blow soap bubbles or compactness in conformally invariant variational problems.*  
(50) **Rugang Ye**, University of California, Santa Barbara (869-49-168)

- 4:20 p.m. *Degree 1 singularities of energy minimizing tangent maps to a bumpy sphere.*  
(51) **Heayong Shin**, University of Minnesota, Minneapolis (869-53-147)
- 5:00 p.m. *On one-to-one harmonic mappings and minimal surfaces.*  
(52) **Friedrich Sauvigny**, University of Wisconsin, Milwaukee (869-53-157)
- 5:40 p.m. *The Sharp isoperimetric inequality for radically connected minimal surface space.*  
(53) **Jaigyoung Choe**, Pohang Institute of Science and Technology, Korea, and **Robert Gulliver\***, University of Minnesota, Minneapolis (869-53-158)

**Special Session on Algebraic Geometry, II**

**3:00 p.m.–5:50 p.m.** Dakota Ballroom, Memorial Union

- 3:00 p.m. *The set of line bundles with nontrivial cohomology.*  
(54) **Donu Arapura**, Purdue University, West Lafayette (869-32-11)
- 3:30 p.m. *Branched coverings of surfaces with ample cotangent bundle.*  
(55) **Michael J. Spurr**, East Carolina University (869-14-36)
- 4:00 p.m. *On the characteristic polynomial of a monodromy transformation attached to a family of curves.*  
(56) **Dino J. Lorenzini**, Duke University (869-14-57)
- 4:30 p.m. *Vanishing theorems for ideal sheaves.*  
(57) **Lawrence Ein**, University of Illinois, Chicago (869-14-09)
- 5:00 p.m. *Boundedness of Fano varieties.*  
(58) **Alan M. Nadel**, Massachusetts Institute of Technology (869-14-17)
- 5:30 p.m. *The Lazarsfeld-Rao property on a Gorenstein variety.*  
(59) **Juan C. Migliore\*** and **Giorgio Bolondi**, University of Notre Dame (869-14-33)

**Special Session on Nonlinear Wave Equations, II**

**3:00 p.m.–5:15 p.m.** University Chamber, Memorial Union

- 3:00 p.m. *Two-dimensional periodic waves in shallow water.*  
(60) **Harvey Segur**, University of Colorado, Boulder (869-35-63)
- 3:50 p.m. *Scaling invariance and isomonodromy deformations.*  
(61) Preliminary report.  
**Richard Beals**, Yale University, and **D. H. Sattinger\***, University of Minnesota, Minneapolis (869-35-58)
- 4:40 p.m. *Stability, instability, regularity and global solutions for  $KdV$ -type equations.*  
(62) **Jerry L. Bona**, Pennsylvania State University, University Park (869-35-64)

Special Session on Multidimensional Complex Analysis and Operator Theory, II

3:00 p.m.–5:20 a.m. Prairie Rose Room, Memorial Union

- 3:00 p.m. *Toeplitz operators on  $L^2(\mathbb{R}^d)$* . Preliminary report. (63) **Krzysztof Nowak** and **Richard Rochberg\***, Washington University (869-47-18)
- 3:30 p.m. *Hankel operators on the Bergman space of strongly pseudoconvex domains*. (64) **Huiping Li**, State University of New York, Buffalo (869-32-144)
- 4:00 p.m. *Progress in the theory of random Toeplitz and singular integral operators*. Preliminary report. (65) **Paul S. Muhly**, University of Iowa (869-47-12)
- 4:30 p.m. *Groupoids in operator theory*. (66) **Arlan Ramsay**, University of Colorado, Boulder (869-47-114)
- 5:00 p.m. *Unit spaces of groupoids of Reinhardt measures*. Preliminary report. (67) **Keren Yan**, Indiana University-Purdue University, Indianapolis (869-47-05)

Special Session on Graph Theory, II

3:00 p.m.–5:20 p.m. Family Life Center, Room 319, Memorial Union

- 3:00 p.m. *Efficient domination of the orientations of a graph*. (68) **David W. Bange\***, **Anthony E. Barkauskas**, **Linda H. Host**, University of Wisconsin-La Crosse, and **Lane H. Clark**, Southern Illinois University (869-05-95)
- 3:30 p.m. *Efficient dominating sets in oriented trees*. (69) **David W. Bange**, **Anthony E. Barkauskas\***, **Linda H. Host**, University of Wisconsin, La Crosse, and **Lane H. Clark**, Southern Illinois University, Carbondale (869-05-96)
- 4:00 p.m. *The spanning tree enumeration problem for digraphs*. Preliminary report. (70) **Nathaniel Dean\***, **Peter Winkler**, **A. K. Kelmans**, **Keh Wei Lih** and **William A. Massey**, Bellcore, Morristown, New Jersey (869-05-130)
- 4:30 p.m. *HISTs in planar and toroidal graphs*. Preliminary report. (71) **Joan P. Hutchinson**, Macalester College (869-05-145)
- 5:00 p.m. *The number of multicolored spanning trees in minimum biclique decompositions*. Preliminary report. (72) **Jiuqiang Liu** and **Allen Schwenk\***, Western Michigan University (869-05-141)

Special Session on Lorentz Transformations and Spacetime Geometry, II

3:00 p.m.–5:50 p.m. Family Life Center, Room 320, Memorial Union

- 3:00 p.m. Informal Discussion
- 3:30 p.m. *The Lorentz group in the context of deformation theory*. (73) **Klaus Volpert**, Villanova University (869-17-116)

- 4:00 p.m. *Higher casual structures*. (74) **Geoffrey Martin**, University of Toledo (869-53-133)
- 4:30 p.m. *Spacetime geometry of imagery and visualization for rapidly-moving objects*. Preliminary report. (75) **Harry Gelman**, GTE Government Systems Corporation, Massachusetts (869-83-52) (Sponsored by Abraham Ungar)
- 5:00 p.m. *Lines in spacetime*. (76) **Jost Hinrich Eschenburg**, University of Augsburg, Germany, and **Gregory J. Galloway\***, University of Miami (869-83-101)
- 5:30 p.m. *The structure of static-complete spacetimes*. Preliminary report. (77) **Steven G. Harris**, Saint Louis University (869-83-50)

Special Session on Ergodic Theory, I

3:30 p.m.–5:20 p.m. Family Life Center, Room 122, Memorial Union

- 3:30 p.m. *A multiple parameter subsequence ergodic theorem*. Preliminary report. (78) **Kurt Cogswell**, North Dakota State University, Fargo (869-40-62)
- 4:00 p.m. *Multiparameter and subsequence ergodic theorems for general operators*. Preliminary report. (79) **James Olsen**, North Dakota State University, Fargo (869-47-92)
- 4:30 p.m. *Exact independence out of asymptotic independence*. Preliminary report. (80) **I. Kornfeld**, North Dakota State University, Fargo (869-47-69)
- 5:00 p.m. *Applications of the Carleson-Hunt theorem to ergodic theory*. (81) **Michael Lacey**, Indiana University, Bloomington (869-28-80)

Special Session on Constrained Approximation, Theory and Algorithms, I

3:30 p.m.–6:20 p.m. Family Life Center, Room 124, Memorial Union

- 3:30 p.m. *Constrained best approximation*. Preliminary report. (82) **Frank Deutsch**, Pennsylvania State University, University Park (869-41-106)
- 4:00 p.m. *Recent progress in constrained approximation*. (83) **Joseph Ward**, Texas A & M University, College Station (869-41-110)
- 4:30 p.m. *A family of natural best  $L_1$ -approximants by nondecreasing functions*. (84) **David A. Legg** and **Douglas W. Townsend\***, Indiana University-Purdue University, Ft. Wayne (869-41-109)
- 5:00 p.m. *Strong uniqueness and simultaneous approximation*. Preliminary report. (85) **Alan Egger**, **Robert Huotari\***, Idaho State University, and **Salem M. Sahab**, King Abdulaziz University, Saudi Arabia (869-41-112)
- 5:30 p.m. *Constrained  $L_p$ -approximation by generalized convex functions*. Preliminary report. (86) **Vasant A. Ubhaya** and **Yuesheng Xu\***, North Dakota State University, Fargo (869-41-111)

## Friday, October 25 (cont'd)

- 6:00 p.m. *Best interpolation in a strip.*  
(87) **A. L. Dontchev**, Mathematical Reviews, Ann Arbor, Michigan (869-41-105)

### Session on Algebra and Combinatorics

**3:30 p.m.–4:40 p.m.** Badland Room, Memorial Union

- 3:30 p.m. *Prufer non-D-rings.* Preliminary report.  
(88) **Alan Loper**, Ohio State University, Newark (869-13-93)
- 3:50 p.m. *Lie and Jordan multiplications on a commutative semigroup.* Preliminary report.  
(89) **Jack M. Anderson**, South Dakota State University (869-20-65)
- 4:10 p.m. *Unitary-perfect integers.* Preliminary report.  
(90) **Dale Woods\*** and **D. J. Boyce**, University of Central Oklahoma (869-11-44)
- 4:30 p.m. *Strong embedding and  $K_5$ -minor.*  
(91) **Cun-Quan Zhang**, West Virginia University (869-05-177)

## Saturday, October 26

### Special Session on Commutative Algebra, III

**8:00 a.m.–10:50 a.m.** Century Theater, Memorial Union

- 8:00 a.m. *Powers of ideals and rational surfaces.* Preliminary report.  
(92) **Anthony V. Geramita**, Queen's University (869-14-126)
- 8:30 a.m. *Wreath products and algebraic fundamental groups.*  
(93) **Shreeram S. Abhyankar**, Purdue University, West Lafayette (869-14-03)
- 9:00 a.m. *Additive group actions on affine space.*  
(94) **David R. Finston\***, New Mexico State University, and **James K. Deveney**, Virginia Commonwealth University (869-14-31)
- 9:30 a.m. *The cohomology of algebraic groups.* Preliminary report.  
(95) **Robert M. Fossum**, University of Illinois, Urbana-Champaign (869-20-94)
- 10:00 a.m. *When does a characteristic  $p$  surface singularity have trivial fundamental group?*  
(96) **Steven Dale Cutkosky** and **Hema Srinivasan\***, University of Missouri, Columbia (869-13-167)
- 10:30 a.m. *Some new  $K$ -theoretic invariants for commutative rings.*  
(97) **Steven E. Landsburg**, Colorado State University (869-13-139)

### Special Session on Lorentz Transformations and Spacetime Geometry, III

**8:00 a.m.–10:50 a.m.** Family Life Center, Room 320, Memorial Union

- 8:00 a.m. *Relativity on a 3-manifold and generalized Lorentz matrices.* Preliminary report.  
(98) **D. K. Sen**, University of Toronto (869-83-26)
- 8:30 a.m. *Poisson structures on  $SL(n, C)$ .* Preliminary report.  
(99) **Richard Beals**, Yale University, and **D. H. Sattinger\***, University of Minnesota, Minneapolis (869-22-59)
- 9:00 a.m. *Reflections on Lorentz's transformations of 1892.*  
(100) **Frank R. Tangherlini**, College of the Holy Cross (869-83-14) (Sponsored by Abraham Ungar)
- 9:30 a.m. *Galilei covariant electromagnetic theory, non-relativity of velocity, and the relativistic paradoxes.*  
(101) **Horst E. Wilhelm**, University of Utah (869-78-154) (Sponsored by Abraham Ungar)
- 10:00 a.m. *A new approach to the Compton effect.*  
(102) **Dan Wilkins**, University of Nebraska, Omaha (869-83-99) (Sponsored by Abraham Ungar)
- 10:30 a.m. *The particle-wave dualism in quantum field theories as reflected in the dualism of the Galilei-and Lorentz group.*  
(103) **F. Winterberg**, University of Nevada System, Reno, Nevada (869-83-27) (Sponsored by Abraham Ungar)

### Special Session on The Geometry of Equilibrium Configurations, III

**8:20 a.m.–10:50 a.m.** Meadowlark Room, Memorial Union

- 8:20 a.m. *Driven rotating drops: The stability of the axisymmetric family of equilibria.* Preliminary report.  
(104) **Frederic P. Brulois**, California State University, Dominguez Hills (869-49-66)
- 9:00 a.m. *Green's identities and pendent liquid drops.*  
(105) **Robert Finn**, Stanford University (869-76-163)
- 9:40 a.m. *Harmonic maps on hyperbolic spaces.*  
(106) **Luen-Fai Tam**, University of California, Irvine (869-58-78) (Sponsored by Ronald J. Stern)
- 10:20 a.m. *Upper bounds for eigen values of conformal metrics.*  
(107) **Nicholas Korevaar**, University of Utah (869-53-148)

### Special Session on Nonselfadjoint Operator Algebras, III

**8:30 a.m.–10:50 a.m.** Peace Garden, Memorial Union

- 8:30 a.m. *Stability for commutative subspace lattices.*  
(108) **David R. Larson**, Texas A & M University, College Station, and **David R. Pitts\***, University of Nebraska, Lincoln (869-47-172)
- 9:00 a.m.  *$M$ -ideals and operator algebras.*  
(109) **Timothy G. Feeman**, Villanova University (869-47-124)
- 9:30 a.m. *Automorphism invariant ideals of nest algebras.*  
(110) **John L. Orr**, University of Nebraska, Lincoln (869-47-150)

10:00 a.m. (111) *On bimodules of nest subalgebras of von Neumann algebras.*  
**Xingde Dai**, University of North Carolina, Charlotte (869-47-98)

10:30 a.m. (112) *Invariant ranges in von Neuman algebras.* Preliminary report.  
**Don Hadwin**, University of New Hampshire (869-47-123) (Sponsored by Eric A. Nordgren)

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**Special Session on Multidimensional Complex Analysis and Operator Theory, III**

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**8:30 a.m.–10:50 a.m.** Prairie Rose Room, Memorial Union

8:30 a.m. (113) *Schatten ideal Hankel operators on weighted Bergman spaces on strongly pseudoconvex domains.*  
**Marco M. Peloso**, Politecnico di Torino, Italy (869-47-176)

9:00 a.m. (114) *Toeplitz  $C^*$ -algebras on pseudoconvex domains with transverse symmetries.* Preliminary report.  
**Norberto Salinas**, University of Kansas (869-46-156)

9:30 a.m. (115) *Exhaustion of domains.*  
**Akio Kodama**, University of Toronto, **Steven G. Krantz\***, Washington University, and **Daowei Ma**, University of Chicago (869-32-01)

10:00 a.m. (116) *Blaschke products in several complex variables.* Preliminary report.  
**John P. D'Angelo**, University of Illinois, Urbana-Champaign (869-32-40)

10:30 a.m. (117) *Degeneracy of the pairing between  $A^\infty$  and  $A^{-\infty}$ .*  
**David E. Barrett**, University of Michigan, Ann Arbor (869-32-132)

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**Special Session on Graph Theory, III**

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**8:30 a.m.–10:50 a.m.** Family Life Center, Room 124, Memorial Union

8:30 a.m. (118) *Interval two-step graphs.*  
**J. Richard Lundgren\***, **Craig Rasmussen**, University of Colorado, Denver, and **John S. Maybee**, University of Colorado, Boulder (869-05-72)

9:00 a.m. (119) *New results and open problems in graph labelings.*  
**Joseph A. Gallian**, University of Minnesota, Duluth (869-05-97)

9:30 a.m. (120) *Neighborhood unions and the cycle cover number of a graph.*  
**Guantao Chen**, Memphis State University, **Ronald J. Gould**, Emory University, **Michael S. Jacobson\***, University of Louisville, and **Richard H. Schelp**, Memphis State University (869-05-28)

10:00 a.m. (121) *Balanced networks.* Preliminary report.  
**William Kocay\*** and **Doug Stone**, University of Manitoba (869-05-77) (Sponsored by Warren E. Shreve)

10:30 a.m. (122) *Old and new problems in graph theory.*  
**Paul Erdős**, Hungarian Academy of Science, Hungary (869-05-125)

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**Special Session on Ergodic Theory, II**

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**9:00 a.m.–10:50 a.m.** Family Life Center, Room 122, Memorial Union

9:00 a.m. (123) *Uniform return times theorems for dynamical systems and helical transforms.* Preliminary report.  
**Idris Assani**, University of North Carolina, Chapel Hill (869-28-87)

9:30 a.m. (124) *Convergence and divergence of ergodic averages.* Preliminary report.  
**Roger L. Jones\***, DePaul University, and **Mate Wierdl**, University of North Carolina, Chapel Hill (869-26-91)

10:00 a.m. (125) *Quotients of actions with quasi-invariant measure.*  
**Cesar Silva\*** and **Dave Witte**, Williams College (869-28-142)

10:30 a.m. (126) *On mixing homogeneous spaces.*  
**Arkady Tempelman**, Pennsylvania State University, University Park (869-47-164)

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**Special Session on Algebraic Geometry, III**

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**9:00 a.m.–10:50 a.m.** Dakota Ballroom, Memorial Union

9:00 a.m. (127) *Set theoretic complete intersections in projective three-space.*  
**David B. Jaffe**, University of Nebraska, Lincoln (869-14-82)

9:30 a.m. (128) *Surfaces in  $G(1, P^3)$ .*  
**Mark W. Gross**, University of Michigan, Ann Arbor (869-14-30)

10:00 a.m. (129) *Irreducibility of the Hilbert scheme of complex projective space curves.* Preliminary report.  
**Changho Keem**, Seoul National University, Korea (869-14-39)

10:30 a.m. (130) *On the Artin approximation theorem.*  
**Mark Spivakovsky**, University of Toronto, (869-13-48) (Sponsored by David B. Jaffe)

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**Special Session on Nonlinear Wave Equations, III**

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**9:00 a.m.–10:25 a.m.** University Chamber, Memorial Union

9:00 a.m. (131) *Blowup surfaces for a class of nonlinear wave equations.*  
**Satyanad Kichenassamy** and **Walter Littman\***, University of Minnesota, Minneapolis (869-35-117)

9:50 a.m. (132) *Analyticity properties of multisolitons.*  
**Satyanad Kichenassamy**, University of Minnesota, Minneapolis (869-35-129)

**Saturday, October 26 (cont'd)**

Session on Geometry and Analysis

**9:40 a.m.–10:50 a.m.** Badland Room, Memorial Union

- 9:40 a.m. (133) *Triangular truncation and finding the norm of a Hadamard multiplier.*  
**Carl C. Cowen**, Purdue University, West Lafayette,  
**James R. Angelos** and **Sivaram K. Narayan\***,  
 Central Michigan University (869-15-70)
- 10:00 a.m. (134) *Counterexamples to a conjecture for neutral equations.*  
**Tibor Krisztin**, Bolyai Institute, Hungary, **R. M. Mathsen\***,  
 North Dakota State University, and **Xu Yuantong**,  
 Zhongshan University, China (869-34-04)
- 10:20 a.m. (135) *On the Gauss map of minimal surfaces immersed in  $R^n$ .*  
**Min Ru**, National University of Singapore, Singapore  
 (869-53-73)
- 10:40 a.m. (136) *Jensen's inequality for the Pettis integral: A characterization of the equality case.*  
**Frédéric P. Brulois**, California State University,  
 Dominguez Hills (869-46-47)

Invited Address

**11:15 a.m.–12:05 p.m.** Century Theater, Memorial Union

- (137) *Constant mean curvature immersions: A geometrical approach.*  
**Henry C. Wente**, University of Toledo (869-53-137)

Invited Address

**1:30 p.m.–2:20 p.m.** Century Theater, Memorial Union

- (138) *Prime ideals and decompositions of modules.*  
**Sylvia M. Wiegand**, University of Nebraska, Lincoln  
 (869-13-118)

Special Session on Nonselfadjoint Operator Algebras, IV

**2:40 p.m.–5:50 p.m.** Peace Garden, Memorial Union

- 2:40 p.m. (139) *Hereditary manifolds.*  
**Jim Agler**, University of California at San Diego, La Jolla  
 (869-47-138)
- 3:30 p.m. (140) *Triangular and semitriangular operators.*  
**David R. Larson**, Texas A & M University, College Station  
 (869-46-170)
- 4:00 p.m. (141) *Invariant operator ranges and operator norm inequalities.*  
**Sing-Cheong Ong**, Central Michigan University  
 (869-47-119)

4:30 p.m. (142) *An unusual CSL algebra.* Preliminary report.  
**John Daughtry**, East Carolina University (869-47-07)

5:00 p.m. (143) *Preduals of operator algebras on finite dimensional spaces.*  
**Derek Westwood**, Wright State University, Dayton  
 (869-46-120)

5:30 p.m. (144) *Operator algebras induced by Nagata's principle of idealization.* Preliminary report.  
**Alan Lambert\*** and **Thomas G. Lucas**, University of  
 North Carolina, Charlotte (869-47-42)

Special Session on Commutative Algebra, IV

**3:00 p.m.–5:50 p.m.** Century Theater, Memorial Union

- 3:00 p.m. (145) *Locally complete intersection homomorphisms and Quillen's conjecture on the finiteness of cotangent homology.*  
**Luchezar L. Avramov**, Purdue University, West Lafayette  
 (869-13-55)
- 3:30 p.m. (146) *Weyman's bicomplex and stable monomial ideals.*  
**John A. Eagon\*** and **Joel Roberts**, University of  
 Minnesota, Minneapolis (869-13-121) (Sponsored by  
 Sylvia M. Wiegand)
- 4:00 p.m. (147) *On computing standard bases.*  
**Yonghao Ma**, University of Utah (869-13-56)
- 4:30 p.m. (148) *Sections of vector bundles over affine varieties.*  
**Satya Mandal**, University of Kansas (869-13-38)
- 5:00 p.m. (149) *Serre's conjecture on intersection multiplicity.*  
 Preliminary report.  
**S. P. Dutta**, University of Illinois, Urbana-Champaign  
 (869-13-159)
- 5:30 p.m. (150) *Gorenstein properties of ring homomorphisms.*  
**Luchezar L. Avramov**, Purdue University, West Lafayette,  
 and **Hans-Bjørn Foxby\***, Matematisk Institut,  
 University of Copenhagen, Denmark (869-13-115)

Special Session on Ergodic Theory, III

**3:00 p.m.–4:20 p.m.** Family Life Center, Room 122, Memorial Union

- 3:00 p.m. (151) *Using joinings to prove a generalization of the return time theorem.*  
**Daniel Jay Rudolph**, University of Maryland, College Park  
 (869-28-100)
- 3:30 p.m. (152) *Sequence entropy and mild mixing.*  
**Qing Zhang**, Ohio State University, Columbus  
 (869-28-134)
- 4:00 p.m. (153) *On complete convergence of moving averages.*  
 Preliminary report.  
**M. B. Rao**, North Dakota State University, Fargo  
 (869-28-146) (Sponsored by Frank R. Deutsch)

Special Session on The Geometry of  
Equilibrium Configurations, IV

3:00 p.m.–6:10 p.m. Meadowlark Room, Memorial Union

- 3:00 p.m. *Hypersurfaces with prescribed mean curvature in Riemannian spaces.* Preliminary report. (154) **Ilya J. Bakelman**, Texas A & M University, College Station (869-35-140)
- 3:40 p.m. *Stability of liquid bridges between co-axial tubes.* Preliminary report. (155) **Umadhar M. Patnaik**, University of Toledo (869-58-136) (Sponsored by Henry C. Wentz)
- 4:20 p.m. *The geometry and analysis of extremal maps.* (156) **S. Walter Wei**, University of Oklahoma (869-53-153)
- 5:00 p.m. *Stability theorems for curves and application to the asymptotics of certain curvature flows.* Preliminary report. (157) **Andrejs E. Treibergs**, University of Utah (869-53-53)
- 5:40 p.m. Problem Session

Special Session on Algebraic Geometry, IV

3:00 p.m.–5:50 p.m. Dakota Ballroom, Memorial Union

- 3:00 p.m. *Colorings of planar maps and graph curves.* (158) **Rick Miranda**, Colorado State University (869-14-49)
- 3:30 p.m. *A  $q$ -expansion principle for families of Calabi-Yau manifolds.* (159) **David R. Morrison**, Duke University (869-32-155)
- 4:00 p.m. *Ideals as sections of projective modules.* (160) **M. P. Murthy\***, University of Chicago, and **Satya Mandal**, University of Kansas (869-13-161) (Sponsored by David B. Jaffe)
- 4:30 p.m. *Varieties with universal zeta functions.* (161) **Diane Meuser**, Boston University (869-11-152)
- 5:00 p.m. *Micro-local characterization of quasihomogeneous singularities.* (162) **Stephen S.-T. Yau**, University of Illinois at Chicago (869-14-74)
- 5:30 p.m. *Twisted exponential sums and slopes of Frobenius for generalized hypergeometric functions.* (163) **Alan Adolphson**, Oklahoma State University, Stillwater, and **Steven Sperber\***, University of Minnesota, Minneapolis (869-14-135)

Special Session on Multidimensional Complex  
Analysis and Operator Theory, IV

3:00 p.m.–5:50 p.m. Prairie Rose Room, Memorial Union

- 3:00 p.m. *Spectral properties of essentially normal Bergman pairs.* Preliminary report. (164) **Raul E. Curto**, University of Iowa (869-47-113)
- 3:30 p.m. *Spectra of some composition operators.* (165) **Barbara D. MacCluer\***, University of Richmond, and **Carl C. Cowen**, Purdue University, West Lafayette (869-47-25)

- 4:00 p.m. *Index theorems for  $G$ -invariant transversally elliptic operators.* (166) **Jeffrey Fox**, State University of New York, Albany and University of Colorado, Boulder, and **Peter Haskell\***, Virginia Polytechnic Institute and State University (869-46-29)
- 4:30 p.m. *Ext-theory for smooth algebras.* (167) **Xiaolu Wang**, University of Maryland, College Park (869-47-83)
- 5:00 p.m. *Toeplitz algebras and Riemannian flows.* (168) **Efton Park**, Indiana University-Purdue University, Indianapolis (869-47-89)
- 5:30 p.m. *Secondary characteristic classes and leafwise Toeplitz operators.* (169) **Jerome Kaminker**, Indiana University-Purdue University, Indianapolis (869-47-181)

Special Session on Graph Theory, IV

3:00 p.m.–5:20 p.m. Family Life Center, Room 124, Memorial Union

- 3:00 p.m. *My favorite problems in Ramsey theory.* (170) **R. L. Graham**, AT&T Bell Laboratories, Murray Hill, New Jersey (869-05-60)
- 3:30 p.m. *Graphs with Linearly bounded Ramsey numbers.* (171) **Guantao Chen** and **R. H. Schelp\***, Memphis State University (869-05-61)
- 4:00 p.m. *Methods for evolving useful graphs.* (172) **Geoffrey Exoo**, Indiana State University (869-05-165) (Sponsored by Warren E. Shreve)
- 4:30 p.m. *Subgraphs of a hypercube containing no small even cycles.* (173) **Fan R. K. Chung**, Bellcore, Morristown, New Jersey (869-05-160)
- 5:00 p.m. *Path variable graphs.* (174) **Ralph Faudree**, Memphis State University (869-05-51)

Special Session on Constrained Approximation,  
Theory and Algorithms, II

3:00 p.m.–5:50 p.m. Family Life Center, Room 319, Memorial Union

- 3:00 p.m. *Constrained approximation at IMSL.* (175) **Philip Smith**, International Mathematical Statistics Library Incorporated, Houston, Texas (869-41-107)
- 3:30 p.m. *The Newton method for convex regression, data smoothening, and quadratic programming with bounded constraints.* (176) **Wu Li** and **John Sweitts\***, Old Dominion University (869-41-108)
- 4:00 p.m. *Estimation and approximation using infinite dimensional convex programs with entropy type objectives.* (177) **Jonathan M. Borwein**, University of Waterloo (869-90-32)
- 4:30 p.m. *A convex programming approach to constrained approximation.* Preliminary report. (178) **Jon Borwein** and **Adrian Lewis\***, University of Waterloo (869-49-45)

## Saturday, October 26 (cont'd)

- 5:00 p.m. *Active set algorithms for isotonic regression.*  
(179) **Michael J. Best**, University of Waterloo (869-49-104)  
(Sponsored by Vasant A. Ubhaya)
- 5:30 p.m. *Generalized convex functions and best  $L_p$  approximation.*  
(180) **Ronald M. Mathsen** and **Vasant A. Ubhaya\***, North Dakota State University, Fargo (869-41-103)

## Special Session on Lorentz Transformations and Spacetime Geometry, IV

- 3:00 p.m.—3:50 p.m.** Family Life Center, Room 320, Memorial Union
- 3:00 p.m. Informal Discussion
- 3:30 p.m. *Left-invariant Lorentzian metrics on 3-dimensional lie groups.*  
(181) **Phillip E. Parker**, Wichita State University (869-53-81)

**Andy R. Magid**  
Associate Secretary  
Norman, Oklahoma

## Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.  
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# Santa Barbara, California University of California at Santa Barbara November 9–10

## Program

The eight-hundred-and-seventieth meeting of the American Mathematical Society (AMS) will be held at the University of California at Santa Barbara (UCSB) on Saturday, November 9, and Sunday, November 10, 1991. All special sessions will be held in Girvetz Hall and all invited addresses will be in the auditoriums of Girvetz and North Halls. This meeting will be held in conjunction with a meeting of the Southern California section of the Mathematical Association of America (MAA).

### Invited Addresses

By invitation of the Western Section Program Committee, there will be three invited one-hour addresses. The speakers, their affiliations, and the titles of their talks where available are:

**Daryl Cooper**, University of California at Santa Barbara, *title to be announced*.

**Richard S. Elman**, University of California, Los Angeles, *Invariants and the algebraic theory of quadratic forms*.

**Stanley J. Osher**, University of California, Los Angeles, *Numerically capturing shocks and fronts with applications to physics, engineering, geometry and image processing*.

### Special Sessions

By invitation of the same committee, there will be five special sessions of selected twenty-minute papers. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

*Low dimensional topology and negatively curved groups*, **Daryl Cooper** and **Darren Long**, University of California at Santa Barbara.

*Applied probability*, **Anant P. Godbole**, Michigan Technological University, and **Svetlozar T. Rachev**, University of California at Santa Barbara.

*Noncommutative homological algebra*, **Kenneth Goodearl**, **Birge Zimmermann Huisgen**, and **Julius M. Zelmanowitz**, University of California at Santa Barbara.

*Quadratic forms*, **William B. Jacob**, University of California at Santa Barbara.

*Knotting phenomena in the natural sciences*, **Kenneth C. Millett**, University of California at Santa Barbara, and **Louis Kauffman**, University of Illinois at Chicago.

Abstracts for consideration for these sessions should have been submitted by the **July 11, 1991** deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of *Notices*.

### Contributed Papers

There will also be sessions for contributed ten-minute papers. Late papers will not be accommodated.

### Activities of Other Organizations

The Southern California Section of the MAA will meet on Saturday, November 9. An invited address will be presented by **Michael Freedman**, University of California, San Diego. An MAA invited address will be presented by **Paul Halmos**, Santa Clara University, and a luncheon address will be presented by **Michael Townsend**, Harvey Mudd College. In addition, there will be a panel discussion on issues related to the mathematical preparation of school teachers and a contributed paper session on *Mathematical gems*. A workshop, titled *Computer technology in the classroom: College algebra to linear algebra*, will be presented by **David Lovelock**, University of Arizona. There is a \$10 registration fee for this seminar. Registration is limited so reservations are encouraged and may be purchased in advance from Barbara Beechler, Department of Mathematics, Pitzer College, Claremont, CA 91711.

Of special interest to students, there will also be a panel discussion of recent graduates titled *Is there life after the Bachelor's Degree?* and a demonstration of the feats and techniques of *mental mathematics* by **Arthur Benjamin**, Harvey Mudd College.

### Registration

The meeting registration desk will be located in room 1106 of Girvetz Hall. The registration desk will be open from 8:30 a.m. to 2:00 p.m. on both Saturday and Sunday, November 9 and 10. The registration fees are \$30 for both days for members of the AMS, \$45 for nonmembers, and \$10 for students or unemployed mathematicians. There is a special one-day fee of \$15 for MAA members for Saturday only.

**Social Event**

On Saturday, November 9, a noontime luncheon will be held for MAA and AMS participants at the University Center adjacent to the meeting site. The luncheon program will include a talk by **Michael Townsend**, Harvey Mudd College, entitled *Look what they've done to my song, Ma!: The use of computers in mathematical proofs*. Seating will be limited and participants are strongly urged to purchase tickets in advance from Barbara Beechler, Department of Mathematics, Pitzer College, Claremont, CA 91711. The cost of the luncheon is \$8.00 per person.

On Saturday evening, November 9, the Department of Mathematics (UCSB) will host a reception for all participants.

**Petition Table**

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Baltimore meeting announcement in this issue of *Notices*.

**Accommodations**

There are many motels in the Santa Barbara area and those nearest UCSB are in Goleta on Calle Real. Calle Real is immediately adjacent (parallel) to Freeway 101. The room tax is included in all prices below. **The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.**

The following motels are located on State Street in Santa Barbara and are further from UCSB and the airport than those hotels located in the town of Goleta: Pepper Tree (805-687-5511); Sandman (805-687-2468); Sandpiper (805-687-5326); and El Prado Motor Inn located in downtown Santa Barbara (805-966-0807).

**Goleta Valley Inn**

Fairview Avenue at Hollister, Goleta, CA  
Telephone: 805-967-5591  
Single \$45                  Double \$55

**Hampton Inn**

5620 Calle Real, Goleta, CA  
Telephone: 805-967-3200  
Single \$80                  Double \$86

The Airbus (surface transportation) to and from Los Angeles Airport (LAX) makes a stop at this hotel.

**Holiday Inn**

5650 Calle Real, Goleta, CA  
Telephone: 805-964-6241  
Single \$102                  Double \$112

**Motel 6**

5897 Calle Real, Goleta, CA  
Telephone: 805-964-3596  
Single \$40                  Double \$45

**Pilot House Motel**

Fairway Avenue, Goleta, CA  
Telephone: 805-967-2336  
Single \$32                  Double \$36

**Cathedral Oaks Lodge**

4770 Calle Real, Goleta, CA  
Telephone: 805-964-3511  
Closest to UCSB (moderately long walking distance to campus).  
Single \$78                  Double \$88

**Food Service**

The Deli, located in the University Center, sells freshly made sandwiches and light meal items and is open Saturday from 11:00 a.m. to 4:00 p.m. (closed on Sundays). The Country Store, also located in University Center, is a mini-market and coffee shop and is open Saturday and Sunday from 7:30 a.m. to 9:00 p.m. The Arbor, located northwest of the library, serves prepared sandwiches, soup, pizza, and assorted fast food items. The Arbor is open Saturday from 8:30 a.m. to 6:00 p.m. and Sunday from 9:30 a.m. to 11:00 p.m.

Santa Barbara has many excellent restaurants, but most are not within walking distance from the campus. Participants may want to walk to Isla Vista, the student ghetto west of the campus. The food served there is inexpensive and often interesting. It is suggested that participants walk over and see what's cooking..

**Parking**

The most convenient parking lots are lots 21 and 29, northwest and west respectively, of the Old Gym. In general, there is no charge to park on campus during weekends, but cars left on campus overnight may be towed. Several lots have signs indicating "**Enforced 24 hours**". These should be avoided unless a UC parking sticker is displayed on the windshield of the vehicle. The meeting dates coincide with Homecoming Weekend which may make on-campus parking more difficult than normal.

**Travel and Local Information**

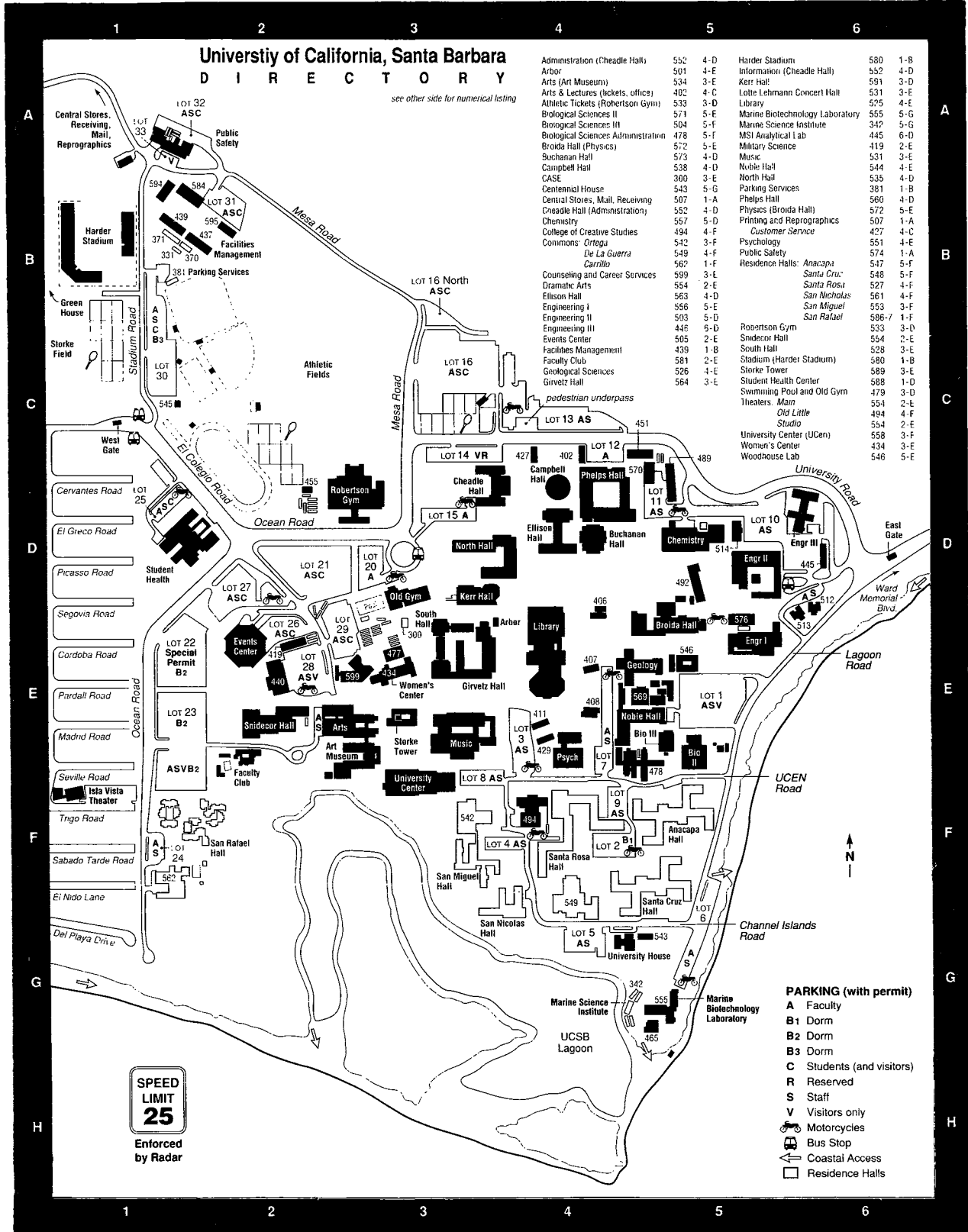
The University of California at Santa Barbara is located eight miles northwest of Santa Barbara, near the town of Goleta, adjacent to Isla Vista, and near the Santa Barbara Airport. The airport is served by United, American, and several commuter airlines. The airport terminal is within easy taxi distance of the UCSB campus and the Goleta motels listed previously. Santa Barbara Airbus (805-964-7759) offers transportation between Los Angeles International Airport and Santa Barbara, Goleta, and Isla Vista (closest to campus for \$52 roundtrip).

When arriving by car from the north on 101, exit at Storke Road and make a right turn off the exit ramp. Follow

## Meetings

Storke Road approximately one mile to the end after a sharp left turn, it becomes El Colegio. Follow El Colegio another one-and-one half miles to the campus. Participants may obtain a campus map from the kiosk at the west entrance and may inquire about parking. When arriving by car from

the south on 101, continue past Santa Barbara until the Highway 217 sign to UCSB is reached. The correct exit from 101 is immediately after the exit for Patterson Avenue. Follow Ward Memorial Boulevard (this is also Highway 217) to the kiosk located at the east entrance to the campus.



# Program of the Sessions

The time limit for each contributed paper in the sessions is ten minutes. In the special sessions, the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

Abstracts of papers presented in the sessions at this meeting will be found in the October 1991 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

## Saturday, November 9

### Special Session on Knotting Phenomena in the Natural Sciences, I

8:30 a.m.–10:50 a.m. Room 2115, Girvetz Hall

- 8:30 a.m. *Knot generation, identification and enumeration.*  
(1) **Kenneth C. Millett**, University of California, Santa Barbara (870-57-70)
- 9:00 a.m. *Spiral waves in oscillating reactions.* Preliminary report.  
(2) **De Witt L. Sumners**, Florida State University (870-92-45)
- 9:30 a.m. *Thickness of knots.*  
(3) **Jonathan K. Simon**, University of Iowa (870-57-67)
- 10:00 a.m. *On the energy of knots.*  
(4) **Michael H. Freedman**, University of California at San Diego, La Jolla (870-57-66)
- 10:30 a.m. *The ground-state energy function of a knot.*  
(5) **H. K. Moffatt**, University of Cambridge, England (870-57-68) (Sponsored by Kenneth C. Millett)

### Special Session on Applied Probability, 1

9:00 a.m.–10:50 a.m. Room 1115, Girvetz Hall

- 9:00 a.m. *Catalytic surface-reaction models.*  
(6) **Maury Bramson**, University of Wisconsin, Madison, and **Claudia Neuhauser\***, University of Southern California (870-60-36)
- 9:30 a.m. *Internal and external monotonicity properties of marked point processes.*  
(7) **Moshe Shaked**, University of Arizona, and **J. George Shanthikumar\***, University of California, Berkeley (870-60-77) (Sponsored by Anant P. Godbole)
- 10:00 a.m. *On the rate of convergence in Stein's method.*  
(8) **Yosef Rinott**, University of California at San Diego, La Jolla (870-60-29) (Sponsored by Anant P. Godbole)
- 10:30 a.m. *The Monge-Kantorovich mass-transportation problem.* Preliminary report.  
(9) **Svetlozar T. Rachev**, University of California, Santa Barbara (870-60-02)

### Special Session on Noncommutative Homological Algebra, I

9:00 a.m.–10:50 a.m. Room 1116, Girvetz Hall

- 9:00 a.m. *Projective resolutions.*  
(10) **Edward L. Green**, Virginia Polytechnic Institute and State University (870-16-74) (Sponsored by Kenneth R. Goodearl)
- 9:30 a.m. *Finitistic dimensions of fixed rings. I.* Preliminary report.  
(11) **Ellen Kirkman\*** and **James Kuzmanovich**, Wake Forest University (870-16-47)
- 10:00 a.m. *Finitistic dimensions of fixed rings. II.* Preliminary report.  
(12) **Ellen E. Kirkman** and **James Kuzmanovich\***, Wake Forest University (870-16-48)
- 10:30 a.m. *Global dimension of rings of differential operators on projective varieties.* Preliminary report.  
(13) **Brad Shelton**, University of Oregon (870-16-75) (Sponsored by Kenneth R. Goodearl)

### Special Session on Quadratic Forms, I

9:00 a.m.–10:50 a.m. Room 1119, Girvetz Hall

- 9:00 a.m. *Distribution of genera of integral quadratic forms among rational classes.*  
(14) **Andrew G. Earnest**, Southern Illinois University, Carbondale (870-11-42)
- 9:30 a.m. *Recent results and problems in quadratic forms.*  
(15) **Shmuel Friedland**, University of Illinois, Chicago (870-11-44)
- 10:00 a.m. *Positive definite  $\mathbb{Z}$ -lattices defined by finite groups.*  
(16) **Alexander J. Hahn**, University of Notre Dame (870-11-38)
- 10:30 a.m. *Some problems in integral quadratic forms.*  
(17) **J. S. Hsia**, Ohio State University, Columbus (870-11-10)

### Session on Analysis

9:00 a.m.–10:50 a.m. Room 2116, Girvetz Hall

- 9:00 a.m. *Markov finite approximations of Markov operators.*  
(18) **Jiu Ding**, University of Southern Mississippi (870-41-09) (Sponsored by Gary L. Walls)

- 9:20 a.m. *Obtuse convex cones in a Hilbert space.*  
(19) **Frédéric P. Brulois**, California State University, Dominguez Hills (870-46-13)
- 9:40 a.m. *Differential equations in the spectral parameter, Darboux transformations and a heirarchy of master symmetries for  $KdV$ .*  
(20) **Jorge P. Zubelli\***, University of California, Santa Barbara, and **Franco Magri**, University of Milano, Italy (870-35-25)
- 10:00 a.m. *Integral points of  $P^n - \{2n + 1$  hyperplanes in general position.*  
(21) **Min Ru\***, National University of Singapore, Singapore and University of Notre Dame, and **Pit-Mann Wong**, University of Notre Dame (870-14-32)
- 10:20 a.m. *The mountain impasse theorem.*  
(22) **Kyryl Tintarev**, University of California, Irvine (870-35-89) (Sponsored by Bernard Russo)
- 10:40 a.m. *Non-characteristic embeddings of the  $n$ -dimensional torus in the  $(n + 2)$ -dimensional torus.*  
(23) **David Miller**, Swarthmore College (870-57-21)

Invited Address

**2:15 p.m.–3:05 p.m.** Room 1004, Girvetz Hall

- (24) *Knot theory,  $SL_2C$  and Newton polygons.*  
**Daryl Cooper**, University of California, Santa Barbara (870-57-57)

Special Session on Low Dimensional Topology and Negatively Curved Groups, I

**3:15 p.m.–6:05 p.m.** Room 1112, Girvetz Hall

- 3:15 p.m. *Dehn filling hyperbolic 3-manifolds.*  
(25) **Colin Adams**, Williams College (870-57-28)
- 3:45 p.m. *Non-negatively curved Dehn fillings.* Preliminary report.  
(26) **Steven Bleiler\***, Portland State University, and **Craig Hodgson**, University of Melbourne, Australia (870-57-90)
- 4:15 p.m. *Volumes of hyperbolic Haken manifolds.*  
(27) **Marc Culler**, University of Illinois, Chicago (870-51-65) (Sponsored by Daryl Cooper)
- 4:45 p.m. *Restricted Gromov groups and amalgams.*  
(28) **Benjamin Fine\***, Fairfield University, and **Gerhard Rosenberger**, University of Dortmund, Germany (870-20-20)
- 5:15 p.m. *A covering invariant of graph manifolds.* Preliminary report.  
(29) **Shicheng Wang**, Beijing University, Peoples Republic of China, and **Ying-Qing Wu\***, University of California, Santa Barbara (870-57-73) (Sponsored by Daryl Cooper)
- 5:45 p.m. *Higher order arf invariants for surfaces embedded in  $\mathbb{R}^3$ .*  
(30) **Fred Hickling**, Santa Clara University (870-57-14)

Special Session on Applied Probability, II

**3:15 p.m.–5:05 p.m.** Room 1115, Girvetz Hall

- 3:15 p.m. *Brownian models of multiclass queueing networks.*  
(31) **Ruth J. Williams**, University of California at San Diego, La Jolla (870-60-18)
- 3:45 p.m. *Schur-concave survival functions and survival analysis.* Preliminary report.  
(32) **Richard E. Barlow\***, University of California, Berkeley, and **Fabio Spizzichino**, University of Rome, Italy (870-60-56) (Sponsored by Anant P. Godbole)
- 4:15 p.m. *Tagged particles and singularities in self-organizing systems.*  
(33) **J. M. Carlson**, University of California, Santa Barbara, **E. R. Grannan**, AT&T Bell Laboratories, Murray Hill, New Jersey, and **G. H. Swindle\***, University of California, Santa Barbara (870-60-63)
- 4:45 p.m. *Phase transitions for the score in matching random sequences.*  
(34) **Michael S. Waterman\*** and **Richard Arratia**, University of Southern California (870-60-08)

Special Session on Noncommutative Homological Algebra, II

**3:15 p.m.–5:35 p.m.** Room 1116, Girvetz Hall

- 3:15 p.m. *Schur's double centralizer theorem: A Hopf algebra approach, and related questions.*  
(35) **Daivida Fischman**, University of Southern California (870-16-49)
- 3:45 p.m. *Nilpotent elements in a Grothendieck ring.*  
(36) **Robert M. Guralnick**, University of Southern California, Los Angeles (870-16-15)
- 4:15 p.m. *Simple Noetherian domains as fixed rings.*  
(37) **R. Guralnick** and **S. Montgomery\***, University of Southern California (870-16-16)
- 4:45 p.m. *The exchange property for quasi-continuous modules.*  
(38) **Saad H. Mohamed**, Kuwait University, Kuwait, and **Bruno J. Mueller\***, McMaster University (870-16-06)
- 5:15 p.m. *Cocommutative Hopf algebra actions and the Connes spectrum.* Preliminary report.  
(39) **James Osterburg**, University of Cincinnati, and **Declan Quinn\***, Syracuse University (870-16-55)

Special Session on Quadratic Forms, II

**3:15 p.m.–6:05 p.m.** Room 1119, Girvetz Hall

- 3:15 p.m. *On primitive spinor exceptional representations by ternary quadratic forms.*  
(40) **David C. Hung**, State University of New York, Binghamton (870-11-43)
- 3:45 p.m. *Representations by indefinite unimodular lattices.*  
(41) **Donald G. James**, Pennsylvania State University, University Park (870-11-05)
- 4:15 p.m. *A structure theorem for a pair of quadratic forms.*  
(42) **Youyu Shao**, Ohio State University, Columbus (870-11-35)

## Saturday, November 9 (cont'd)

- 4:45 p.m. *Minimal norm Jordan splitting in dyadic local fields.*  
(43) Preliminary report.  
**Fei Xu**, Ohio State University, Columbus (870-11-11)  
(Sponsored by William B. Jacob)
- 5:15 p.m. *Integral quadratic forms and Enriques surfaces.*  
(44) **V. V. Nikulin**, Steklov Mathematical Institute, USSR  
and University of Notre Dame (870-11-62) (Sponsored  
by William B. Jacob)
- 5:45 p.m. *Some arithmetic relations on the representation*  
(45) *numbers of quadratic forms.*  
**Lynne H. Walling**, University of Colorado, Boulder  
(870-11-22)

### Special Session on Knotting Phenomena in the Natural Sciences, II

3:15 p.m.–6:05 p.m. Room 2115, Girvetz Hall

- 3:15 p.m. *Dilation factors for braided links.*  
(46) **Jerôme E. Los**, University de Nice, France and  
University of California, Santa Barbara (870-54-07)  
(Sponsored by Kenneth C. Millett)
- 3:45 p.m. *Knots and braids in dynamical systems.*  
(47) **Robert F. Williams**, University of Texas, Austin  
(870-34-27)
- 4:15 p.m. *Replication and recombination knots in DNA.*  
(48) **Sylvia Spengler**, Lawrence Berkeley Laboratory,  
California (870-57-91) (Sponsored by Kenneth C.  
Millett)
- 4:45 p.m. *Polynomial invariants of links and the structure of*  
(49) *recombination.* Preliminary report.  
**Louis H. Kauffman**, University of Illinois, Chicago  
(870-55-19)
- 5:15 p.m. *Surgery on cusp neighborhoods.*  
(50) **Ronald J. Stern**, University of California, Irvine  
(870-57-69)
- 5:45 p.m. *Which automorphisms of complete graphs are*  
(51) *realizable in 3-space?*  
**Erica Flapan**, Pomona College (870-57-31)

### General Session

3:15 p.m.–5:25 p.m. Room 2116, Girvetz Hall

- 3:15 p.m. *The relation of Pascal's triangle to statistical*  
(52) *mechanics.* Preliminary report.  
**Harold Elcaness**, Las Vegas, Nevada (870-70-88)  
(Sponsored by Looy Simonoff)
- 3:35 p.m. *Maximal-boundary theory converse to minimal-surface*  
(53) *theory in variational-calculus pure-mathematics.*  
**Edward Siegel**, Synergetics Paradigm Dichotomy,  
California (870-99-83) (Sponsored by Alfred S. Tang)
- 3:55 p.m. *Synergetics paradigm and dichotomy "common*  
(54) *functioning principle".*  
**A. Smith\*** and **Edward Siegel**, Synergetics Paradigm  
Dichotomy, California (870-99-84) (Sponsored by  
Alfred S. Tang)

- 4:15 p.m. *Why our discipline (mathematics) is incorrectly*  
(55) *identified as a science.* Preliminary report.  
**G. Arthur Mihram\***, University of California, Los  
Angeles, and **Danielle Mihram**, University of Southern  
California (870-01-87)
- 4:35 p.m. *A new view of the Markov and Lagrange spectra.*  
(56) Preliminary report.  
**C. Musès**, Mathematics and Morphology Research  
Center, Canada (870-11-12) (Sponsored by K. Demys)
- 4:55 p.m. *Prime decomposition of knots in Lorenz-like templates.*  
(57) **Michael Sullivan**, University of Texas, Austin  
(870-57-52)
- 5:10 p.m. *Fundamental solutions for some differential operators*  
(58) *with  $C^\infty$ -coefficients.*  
**Todor Todorov**, California Polytechnic State University  
(870-35-95)

## Sunday, November 10

### Special Session on Applied Probability, III

8:30 a.m.–10:50 a.m. Room 1115, Girvetz Hall

- 8:30 a.m. *Finite clusters in continuous percolation.* Preliminary  
(59) report.  
**Kenneth S. Alexander**, University of Southern  
California (870-60-54)
- 9:00 a.m. *Long-range percolation.*  
(60) **Mathew D. Penrose**, University of California, Santa  
Barbara (870-60-23) (Sponsored by Anant P. Godbole)
- 9:30 a.m. *Functional discrete limit theorems for random*  
(61) *mappings.*  
**R. Arratia** and **S. Tavaré\***, University of Southern  
California (870-60-64) (Sponsored by Anant P.  
Godbole)
- 10:00 a.m. *The inverse problem for phase-type distributions.*  
(62) **Robert S. Maier**, University of Arizona (870-60-72)
- 10:30 a.m. *Logistic and semi-logistic processes.*  
(63) **Barry C. Arnold**, University of California, Riverside  
(870-60-80) (Sponsored by Anant P. Godbole)

### Special Session on Knotting Phenomena in the Natural Sciences, III

8:30 a.m.–10:50 a.m. Room 2115, Girvetz Hall

- 8:30 a.m. *3-manifolds and 2-complexes: Some recent results.*  
(64) **Dale Rolfsen**, University of British Columbia  
(870-57-71)
- 9:00 a.m. *Simple balanced categories and invariants of tangles*  
(65) *and 3-manifolds.*  
**Nicolai Reshetikhin**, University of California, Berkeley  
(870-57-85)
- 9:30 a.m. *The quantum  $G_2$  link invariant.*  
(66) **Greg Kuperberg**, University of California, Berkeley  
(870-57-61)
- 10:00 a.m. *Applications of the spectral parameter tangle of V.*  
(67) *Jones.*  
**Józef H. Przytycki**, University of California, Riverside  
and Warsaw University, Poland (870-57-76)

10:30 a.m. *Alexander invariants.*  
(68) **Hubert Saleur**, Yale University (870-57-86)  
(Sponsored by Louis H. Kauffman)

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Special Session on Low Dimensional Topology  
and Negatively Curved Groups, II

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**9:00 a.m.–10:50 a.m.** Room 1112, Girvetz Hall

9:00 a.m. *Counting incompressible surfaces in hyperbolic*  
(69) *3-manifolds.*  
**Joel Hass**, University of California, Davis (870-57-58)

9:30 a.m. *Local rigidity and Dehn surgery space.* Preliminary  
(70) report.  
**Steve Kerckhoff**, Stanford University (870-53-46)

10:00 a.m. *Weak concentration points for Kleinian groups.*  
(71) **Darryl McCullough**, University of Oklahoma  
(870-20-26)

10:30 a.m. *Measured laminations for non-negatively curved*  
(72) *groups.* Preliminary report.  
**Lee D. Mosher\*** and **Ulrich Oertel**, Rutgers  
University, Newark (870-57-93)

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Special Session on Noncommutative  
Homological Algebra, III

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**9:00 a.m.–10:20 a.m.** Room 1116, Girvetz Hall

9:00 a.m. *Noncommutative characteristic polynomials.*  
(73) Preliminary report.  
**Hyman Bass**, Columbia University (870-16-82)

9:30 a.m. *Dixmier's conjecture for the first Weyl algebra.*  
(74) **C. A. Dean\***, University of Michigan, Ann Arbor, and **J.**  
**W. Kerr**, Michigan State University (870-16-92)

10:00 a.m. *Induced bimodules, annihilator primes, and 'lying*  
(75) *over'.* Preliminary report.  
**Edward S. Letzter**, University of Utah (870-16-50)

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Special Session on Quadratic Forms, III

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**9:00 a.m.–10:50 a.m.** Room 1119, Girvetz Hall

9:00 a.m. *Spherical geometry and sphere packings-Kelper's*  
(76) *conjecture and beyond.*  
**Wu-Yi Hsiang**, University of California, Berkeley  
(870-51-81)

9:30 a.m. *Eigenvalues of symmetric integer matrices.*  
(77) **Dennis R. Estes**, University of Southern California  
(870-11-40)

10:00 a.m. *Weak  $*$ -orderings on  $*$ -fields.*  
(78) **K. H. Leung**, National University of Singapore,  
Republic of Singapore (870-12-01)

10:30 a.m. *Formal groups and Dirichlet L-functions.*  
(79) **Nancy Childress\***, Arizona State University, and **Jeff**  
**Stoppie**, University of California, Santa Barbara  
(870-12-41)

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Invited Address

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**11:00 a.m.–11:50 a.m.** Room 1004, Girvetz Hall

(80) *Numerically capturing shocks and fronts with*  
*applications to physics, engineering, geometry and*  
*image processing.*  
**Stanley J. Osher**, University of California, Los  
Angeles (870-00-94)

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Invited Address

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**2:00 p.m.–2:50 p.m.** Room 1004, Girvetz Hall

(81) *Invariants and the algebraic theory of quadratic forms.*  
**Richard S. Elman**, University of California, Los  
Angeles (870-11-30)

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Special Session on Low Dimensional Topology  
and Negatively Curved Groups, III

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**3:00 p.m.–5:20 p.m.** Room 1112, Girvetz Hall

3:00 p.m. *Heegaard splittings of compact orientable product*  
(82) *manifolds.* Preliminary report.  
**Jennifer Schultens**, University of California, Santa  
Barbara (870-57-34)

3:30 p.m. *The Taft flying conjecture.*  
(83) **William Menasco**, State University of New York,  
Buffalo, and **Morwen Thistlethwaite\***, University of  
Tennessee, Knoxville (870-57-59)

4:00 p.m. *Deforming hyperbolic 3-manifolds.* Preliminary report.  
(84) **Walter D. Neumann**, Ohio State University, Columbus,  
and **Alan W. Reid\***, University of Aberdeen, Scotland  
and Ohio State University (870-57-51)

4:30 p.m. *Length functions and outer space.*  
(85) **John Smillie** and **Karen Vogtmann\***, Cornell  
University (870-20-60)

5:00 p.m. *Quasiisometries. and bicomings.*  
(86) **Hsueh-Ling Huynh** and **Wing Yew Poon\***, University  
of California, Berkeley (870-20-17)

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Special Session on Applied Probability, IV

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**3:00 p.m.–4:50 p.m.** Room 1115, Girvetz Hall

3:00 p.m. *Convergence of some partially parallel Gibbs samplers*  
(87) *with annealing.*  
**Roberto H. Schonmann**, University of California, Los  
Angeles (870-60-04) (Sponsored by Anant P. Godbole)

3:30 p.m. *Stationary Poisson sequences.*  
(88) **Aaron M. Gross\*** and **James B. Robertson**,  
University of California, Santa Barbara (870-60-24)

4:00 p.m. *Some results on Poisson approximation.*  
(89) **Anant P. Godbole**, Michigan Technological University  
(870-60-79)

4:30 p.m. *Taylor series solution of the M/M/1 queueing system.*  
(90) **Alan Krinik**, California State Polytechnic University  
(870-60-03)

**Sunday, November 10 (cont'd)**

**Special Session on Quadratic Forms, IV**

**3:00 p.m.–4:20 p.m.** Room 1119, Girvetz Hall

3:00 p.m. *Noncommutative Prüfer rings.*  
(91) **Patrick J. Morandi**, New Mexico State University, Las Cruces (870-16-39)

3:30 p.m. *Constructions of valued division algebras.*  
(92) **Al Sethuraman**, California State University, Northridge (870-16-33)

4:00 p.m.  *$Q(i)$ -division rings and admissibility.*  
(93) **Steven G. Liedahl**, University of California, Los Angeles (870-12-37)

**Lance W. Small**  
Associate Secretary  
La Jolla, California

**Presenters of Papers**

Numbers following the names indicate the speakers' positions on the program.

● AMS Invited Lecturer

\* AMS Special Session Speaker

- |                        |                        |                        |                          |
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| * Alexander, K. S., 59 | * Hahn, A. J., 16      | * Montgomery, S., 37   | * Shao, Y., 42           |
| * Arnold, B. C., 63    | * Hass, J., 69         | * Morandi, P. J., 91   | * Shelton, B., 13        |
| * Barlow, R. E., 32    | * Hickling, F., 30     | * Mosher, L. D., 72    | Siegel, E., 53           |
| * Bass, H., 73         | * Hsia, J. S., 17      | * Mueller, B. J., 38   | * Simon, J. K., 3        |
| * Bleiler, S., 26      | * Hsiang, W.-Y., 76    | Musès, C., 56          | Smith, A., 54            |
| Brulois, F. P., 19     | * Hung, D. C., 40      | * Neuhauser, C., 6     | * Spengler, S., 48       |
| * Childress, N., 79    | * James, D. G., 41     | * Nikulin, V. V., 44   | * Stern, R. J., 50       |
| ● Cooper, D., 24       | * Kauffman, L. H., 49  | ● Osher, S. J., 80     | Sullivan, M., 57         |
| * Culler, M., 27       | * Kerckhoff, S., 70    | * Penrose, M. D., 60   | * Sumners, D. W., 2      |
| * Dean, C. A., 74      | * Kirkman, E., 11      | * Poon, W. Y., 86      | * Swindle, G. H., 33     |
| Ding, J., 18           | * Krinik, A., 90       | * Przytycki, J. H., 67 | * Tavaré, S., 61         |
| * Earnest, A. G., 14   | * Kuperberg, G., 66    | * Quinn, D., 39        | * Thistlethwaite, M., 83 |
| Elcaness, H., 52       | * Kuzmanovich, J., 12  | * Rachev, S. T., 9     | Tintarev, K., 22         |
| ● Elman, R. S., 81     | * Letzter, E. S., 75   | * Reid, A. W., 84      | Todorov, T., 58          |
| * Estes, D. R., 77     | * Leung, K. H., 78     | * Reshetikhin, N., 65  | * Vogtmann, K., 85       |
| * Fine, B., 28         | * Liedahl, S. G., 93   | * Rinott, Y., 8        | * Walling, L. H., 45     |
| * Fischman, D., 35     | * Los, J. E., 46       | * Rolfsen, D., 64      | * Waterman, M. S., 34    |
| * Flapan, E., 51       | * Maier, R. S., 62     | Ru, M., 21             | * Williams, R. F., 47    |
| * Freedman, M. H., 4   | * McCullough, D., 71   | * Saleur, H., 68       | * Williams, R. J., 31    |
| * Friedland, S., 15    | Mihram, G. A., 55      | * Schonmann, R. H., 87 | * Wu, Y.-Q., 29          |
| * Godbole, A. P., 89   | Miller, D., 23         | * Schultens, J., 82    | * Xu, F., 43             |
| * Green, E. L., 10     | * Millett, K. C., 1    | * Sethuraman, A., 92   | Zubelli, J. P., 20       |
| * Gross, A. M., 88     |                        |                        |                          |



# Baltimore Meetings

## January 8–11, 1992

### *First Announcement*



The Inner Harbor, Baltimore.

#### IMPORTANT DEADLINES

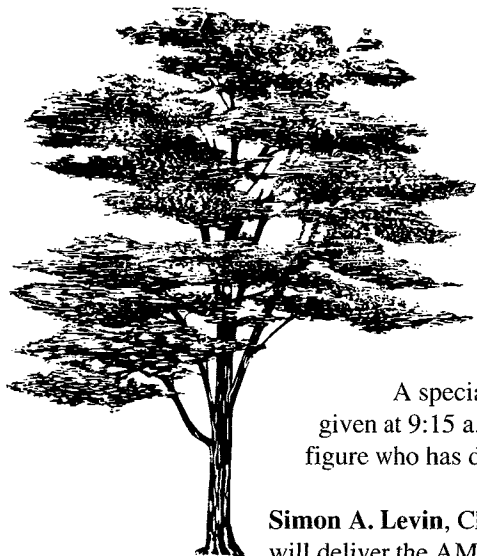
AMS Abstracts For Consideration for Special Sessions Of Contributed Papers	Expired October 2
MAA Abstracts Of Contributed Papers	Expired
EARLY Preregistration and Housing	October 29
ORDINARY Preregistration/Housing/Tickets	November 18
Employment Register (Applicants & Employers)	November 18
MAA Minicourse Preregistration	November 18
Motions for AMS Business Meeting	December 8
Hotel Changes and Cancellations with Service Bureau	December 10
FINAL Preregistration (no housing or tickets)	December 10
Cancellations for all Banquets (50% refund)	December 30
Preregistration Cancellations (50% refund)	January 3
Employment Register Cancellations (50% refund)	January 3

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## *Mathematics and the Environment*



The AMS-MAA Joint Meetings Committee, in recognition of rising environmental concerns throughout the world wishes to draw attention to the following events in the program:

A special **Welcome Address** in keeping with this environmental "thread" will be given at 9:15 a.m. on Wednesday. Although the speaker is not yet firm, it will be a public figure who has demonstrated concern for environmental issues.

**Simon A. Levin**, Charles A. Alexander Professor of Biological Sciences at Cornell University, will deliver the AMS-MAA Environmental Address at 11:00 a.m. on Thursday. Levin will speak on *Problems of scale in ecology*.

The AMS program contains a Special Session on *Environmental modeling*, organized by **B. A. Fusaro**, Salisbury State University, and **Roland H. Lamberson**, Humboldt State University. This Special Session will meet at 4:15 p.m. on Wednesday and at 1:00 p.m. on Friday.

The MAA program contains a number of related events:

A contributed paper session on *Environmental mathematics* organized by **B. A. Fusaro**, Salisbury State University, and **Margaret Barry Cozzens**, Northeastern University, will meet on Thursday morning and on Saturday. Papers are invited that treat topics that are suitable for a liberal arts mathematics course or for a modeling course, preferably at the sophomore-junior level.

A **panel discussion**, sponsored by the MAA ad hoc Committee on Mathematics and the Environment (B. A. Fusaro, Chair), will take place at 9:30 a.m. on Friday, and is titled *Getting started*.

A **Student Workshop** titled *Environmental mathematics* is jointly sponsored by the same committee and the MAA Committee on Student Chapters (Howard Anton, Chair) and is scheduled from 2:00 p.m. to 4:00 p.m. on Friday. The workshop will be repeated on Saturday at 9:00 a.m.

**Minicourse #4** on *Environmental modeling* is being organized by **Robert McKelvey**, Environmental Research Lab EPA, Corvallis. Part A is scheduled from 2:15 p.m. to 4:15 p.m. on Wednesday, and Part B from 2:15 p.m. to 4:15 p.m. on Thursday. Enrollment is limited to 80.

In addition, a number of nonprofit environmental groups, including the **Chesapeake Bay Foundation**, can be found in the exhibit hall. Interested participants can pick up literature and information from these organizations during the hours that the exhibits are open.

The AMS-MAA Joint Meetings Committee has been striving to make these meetings environmentally responsible. For example, the programs have been printed on recycled paper for some time now, and the use of styrofoam cups has been eliminated whenever refreshments are served at any of the meeting events. Beginning with this meeting, all participants are asked to deposit their plastic badge holders in the marked containers provided for this purpose before leaving the meetings, so that they can be reused again at future meetings. We encourage everyone to cooperate in this effort to cut waste and keep costs down.

## The Scientific Program

The January 1992 Joint Mathematics Meetings, including the 98th Annual Meeting of the AMS, the 75th Annual Meeting of the Mathematical Association of America, and the 1992 annual meetings of the Association for Women in Mathematics and the National Association for Mathematicians, will be held January 8–11 (Wednesday–Saturday), 1992, in Baltimore, Maryland. Sessions will be held in the Baltimore Convention Center and the Hyatt Regency Baltimore.

### Welcome Address

There will be a Welcome Address for all participants at 9:15 a.m. on Wednesday.

### AMS-MAA Invited Addresses

By invitation of the AMS-MAA Joint Program Committee three speakers will address the AMS and MAA on the history or development of mathematics. The names of the speakers, their affiliations, the titles, dates, and times of their talks follow:

**Joan S. Birman**, Columbia University, *A new look at knot polynomials*, 11:10 a.m. Wednesday;

**I. M. Singer**, Massachusetts Institute of Technology, *The current interface of geometry and elementary particle physics*, 11:10 a.m. Saturday;

**J. Ernest Wilkins, Jr.**, Clark Atlanta University, *Optimization for extended services for heat transfer*, 11:10 a.m. Friday.

### Other AMS-MAA Sessions and Events

Also please see page 952 for Environmental Mathematics sessions and events.

There will be a special presentation featuring **Richard J. Shaker**, National Security Administration, titled *The agency that came in from the cold*, at 7:15 p.m. on Wednesday.

### Values and Rewards in the Mathematics Profession:

The AMS Committee on Science Policy (Michael C. Reed, Chair) and the MAA Science Policy Committee (John A. Thorpe, Chair) are cosponsoring this panel discussion from 9:30 a.m. to 10:55 a.m. on Wednesday. This session will focus on issues raised in many recent reports dealing with infrastructure problems in science and mathematics. The MS 2000 report recommends broadening attitudes and value systems. The David II report recommends broadening the reward structure. The Joint Policy Board for Mathematics has appointed a committee on Professional Values, Recognition and Rewards. Other science organizations, including the Conference Board on the Mathematical Sciences and Sigma Xi, have also raised these issues. The principal speaker will be **Daniel E. Koshland, Jr.**, editor of *Science*, the journal of the American Association for the Advancement of Science. Respondents include **Calvin C. Moore**, University of California, Berkeley; and **David A. Sanchez**, National Science Foundation. The organizer and moderator is **John A. Thorpe**, SUNY at Buffalo.

**Special Session:** There will be a Special Session jointly sponsored by the AMS and MAA on *Mathematics and education reform* organized by **Naomi Fisher**, University of Chicago; **Harvey B. Keynes**, University of Illinois; and **Philip D. Wagreich**, University of Minnesota, on Wednesday at 2:15 p.m., Thursday at 8:00 a.m., and Friday at 8:00 a.m. The Wednesday and Thursday sessions will cover a variety of educational activities by mathematicians, while the Friday session will focus on NSF vertically integrated projects.

**Panel Discussion:** The AMS and MAA are cosponsoring a panel discussion on *The undergraduate linear algebra curriculum* from 7:00 p.m. to 10:00 p.m. on Thursday. The panel is being organized by the Linear Algebra Curriculum Study Group (A. Duane Porter, Chair). There will be a series of short talks followed by a discussion. Topics may include past work of the Linear Algebra Curriculum Study group, suggested course outlines and reports from faculty who have used them, pedagogy/teaching strategies, technology, and a microcomputer demonstration.

### Other AMS-MAA Events

**Social for First-time Attendees:** The AMS and the MAA Committee on Membership (Susan Forward, Chair) are cosponsoring a social on Wednesday from 6:00 p.m. to 7:00 p.m. for participants who are attending their first national mathematics meeting and for others who would like to learn some of the secrets to surviving in the environment of a large meeting.

**Concert:** An encore musical performance by Past Presidents **William Browder** (AMS) and **Leonard Gillman** (MAA) may be heard at 5:15 p.m. on Saturday.

## 98th Annual Meeting of the AMS

January 8–11, 1992

**Sixty-Fifth Josiah Willard Gibbs Lecture:** The 1992 Gibbs Lecture will be presented at 8:30 p.m. on Wednesday, by **Michael E. Fisher**, University of Maryland, College Park.

**Prizes:** The 1992 Frank Nelson Cole Prize in Number Theory, the 1992 Prize for Distinguished Public Service, and Citations for Public Service will be awarded at 4:25 p.m. on Thursday.

**Colloquium Lectures:** A series of three Colloquium Lectures will be given by **Robert P. Langlands**, Institute for Advanced Study. The lectures will be given at 1:00 p.m. daily, Wednesday through Friday.

**Retiring Presidential Address:** William Browder will deliver his Retiring Presidential Address, at 10:05 a.m. Wednesday. Browder was President of the Society 1989–1990.

**Invited Addresses:** By invitation of the AMS Program Committee for National Meetings, there will be at least four fifty-minute invited addresses. The names and affiliations of the speakers, their titles, and the days and times they will talk are as follows:

**Yakov M. Eliashberg**, Stanford University, *On the border of symplectic geometry and complex analysis*, Wednesday, 4:25 p.m.;

**Marina Ratner**, University of California, Berkeley, *Lie groups in ergodic theory*, 9:00 a.m. Friday;

**Walter Rudin**, University of Wisconsin, Madison, *Holomorphic mappings from  $C^m$  to  $C^n$* , 2:15 p.m. Thursday;

**Michael Shearer**, North Carolina State University, *Waves in elastic-plastic materials*, 3:20 p.m. Thursday;

**Special Sessions:** Also by invitation of the AMS Program Committee for National Meetings, there will be Special Sessions of selected twenty-minute papers. The topics of these Special Sessions, the names and affiliations of the mathematicians arranging them, and the tentative days and times they will meet are: (Also, please see the page of events devoted to Environmental Mathematics on page 952.)

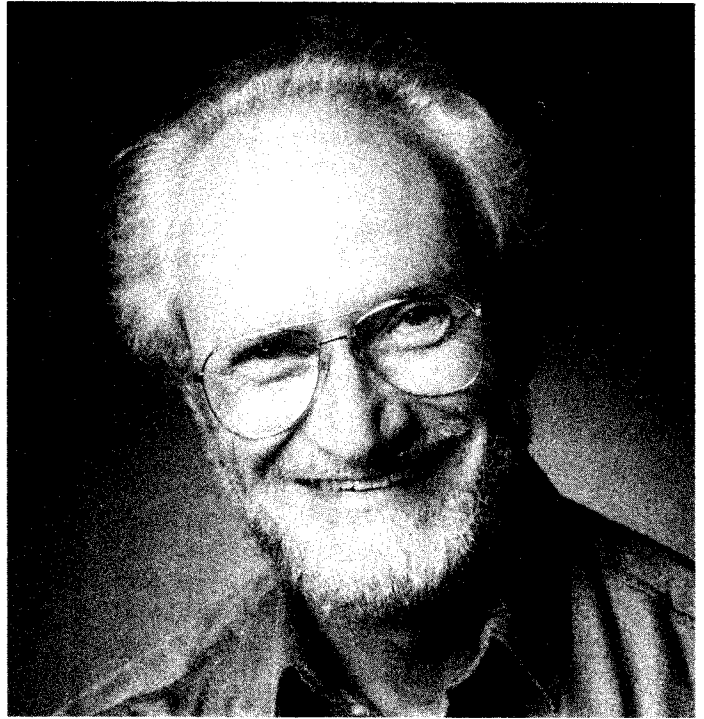
*Preparing the college mathematics teachers of the future*, **Bettye Anne Case**, Florida State University, 1:00 p.m. Friday, and 8:00 a.m. and 1:00 p.m. Saturday.

*Design and codes*, **John Dillon**, National Security Agency, 8:00 a.m. and 2:15 p.m. Wednesday, and 8:00 a.m. and 2:15 p.m. Thursday.

*Bergman spaces*, **Peter L. Duren**, University of Michigan, Ann Arbor; and **Boris Korenblum**, State University of New York, Albany, 8:00 a.m. Thursday, and 8:00 a.m. and 1:00 p.m. Friday.

*Symplectic topology*, **Yakov M. Eliashberg**, Stanford University, 8:00 a.m. and 2:15 p.m. Thursday, 1:00 p.m. Friday, and 8:00 a.m. Saturday.

*History of mathematics*, **Florence Fasanelli**, MAA; **Victor J. Katz**, University of the District of Columbia; and



William Browder

**David E. Rowe**, Pace University, 8:00 a.m. Friday and 8:00 a.m. and 1:00 p.m. Saturday.

*Invariant theory*, **Frank Grosshans**, West Chester University of Pennsylvania, 8:00 a.m. and 1:00 p.m. Friday, and 8:00 a.m. Saturday.

*Classical real analysis*, **Paul D. Humke**, St. Olaf College; and **Brian S. Thomson**, Simon Fraser University, 8:00 a.m. and 2:15 p.m. Wednesday and 2:15 p.m. Thursday.

*Iteration and factorization of entire and meromorphic functions*, **Zhong Li**, Peking University, and **C.-C. Yang**, Hong Kong University of Science and Technology, 2:15 p.m. Wednesday, and 8:00 a.m. and 2:15 p.m. Thursday.

*Function theoretic methods in partial differential equations*, **Peter A. McCoy**, United States Naval Academy, 8:00 a.m. Thursday, 1:00 p.m. Friday, and 8:00 a.m. Saturday.

*Interaction of harmonic analysis, signal processing and computational mathematics*, **M. Zuhair Nashed**, University of Delaware, 2:15 p.m. Wednesday and 8:00 a.m. and 2:15 p.m. Thursday.

*Index theory*, **Jonathan M. Rosenberg**, University of Maryland, College Park, 8:00 a.m. and 2:15 p.m. Wednesday and 8:00 a.m. and 2:15 p.m. Thursday.

*Stability and control*, **Seenith Sivasundaram**, Embry-Riddle Aeronautical University, 8:00 a.m. and 1:00 p.m. Friday and 8:00 a.m. Saturday.

*Algebraic topology*, **W. Stephen Wilson**, Johns Hopkins University, 8:00 a.m. and 1:00 p.m. Friday and 8:00 a.m. Saturday.

Abstracts for consideration for presentation in one of these sessions **should have been submitted by September 11**,



Michael E. Fisher, Gibbs Lecturer.

**1991, three weeks earlier than the deadline for contributed papers.**

**Contributed Papers:** There will be sessions for contributed papers on Wednesday, Thursday, Friday, and Saturday.

Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics, and should be sent to Abstracts, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, Rhode Island 02940, **so as to arrive by the abstract deadline of October 2, 1991.** A charge of \$16 is imposed for retyping abstracts that are not in camera-ready form.

**Late papers cannot be accepted.**

**Electronic Submission of Abstracts:** This service is available to those who use the  $\text{T}_{\text{E}}\text{X}$  typesetting system and can be used for abstracts of papers to be presented at this meeting. Requests to obtain the package of files may be sent by electronic mail on the Internet to **abs-request@math.ams.com**. Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Secretary to Director of Publication, American Mathematical Society, Publications Division, P.O. Box 6248, Providence, RI 02940. When requesting the Abstracts package, users should be sure to specify whether they want the plain  $\text{T}_{\text{E}}\text{X}$ ,  $\mathcal{A}\mathcal{M}\mathcal{S}\text{-T}_{\text{E}}\text{X}$ , or the  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$  package. Again, late papers cannot be accepted.

#### Other AMS Sessions

**Session for Reviewers for Mathematical Reviews:** There will be an informal session for reviewers for Mathematical Reviews (MR), and those interested in becoming reviewers, on Friday at 6:00 p.m. Members of the MR Editorial Committee and the MR staff will make a short presentation and there will be an opportunity for reviewers to ask questions and make comments and suggestions. Refreshments will be provided.

**Committee on Science Policy:** The Committee on Science Policy (Michael C. Reed, Chair) will sponsor an address by a prominent public figure on Friday at 10:05 a.m.

The same committee will also sponsor a panel discussion on *PhD Employment: Is there a crisis?* at 8:30 p.m. on Friday. The panel will feature an update from the AMS Task Force on PhD Employment.

**Committee on Education:** The Committee on Education, **Ramesh A. Gangolli** (Chair), University of Washington, will sponsor this panel discussion on *Directions for AMS Action in Education* on Saturday at 8:30 a.m. The panel will be moderated by the committee Chair and focus on the AMS role in mathematics education.

#### Other AMS Events

**Council Meeting:** The Council of the Society will meet at 2:00 p.m. on Tuesday.

**Business Meeting:** The Business Meeting of the Society will take place at 4:25 p.m. on Thursday. The secretary notes the following resolution of the Council: Each person who attends a Business Meeting of the Society shall be willing and able to identify himself as a member of the Society. In further explanation, it is noted that *each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society.*

The Society has a Committee on the Agenda for Business Meetings. The purpose is to make Business Meetings orderly and effective. The committee does not have legal or administrative power. It is intended that the committee consider what may be called "quasi-political" motions. The committee has several possible courses of action on a proposed motion, including but not restricted to

- (a) doing nothing;
- (b) conferring with supporters and opponents to arrive at a mutually accepted amended version to be circulated in advance of the meeting;
- (c) recommending and planning a format for debate to suggest to a Business Meeting;
- (d) recommending referral to a committee;
- (e) recommending debate followed by referral to a committee.

There is no mechanism that requires automatic submission of a motion to the committee. However, if a motion has not been submitted through the committee, it may be thought reasonable by a Business Meeting to refer it rather than to act on it without benefit of the advice of the committee.

The committee consists of M. Salah Baouendi, Robert M. Fossum (Chair), and Carol L. Walker.

In order that a motion for the Business Meeting of January 8, 1992 receive the service offered by the committee in the most effective manner, it should be in the hands of the secretary by December 8, 1991.

#### 75th Annual Meeting of the MAA

January 8 – 11, 1992

**Retiring Presidential Address:** Past President **Lida K. Barrett**, Mississippi State University, will give her Retiring Presidential Address titled *Mathematics goes public* at 3:20 p.m. on Friday.

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

**David H. Carlson**, San Diego State University, Saturday, 9:00 a.m.

**Ingrid Daubechies**, Rutgers University and AT&T Bell Labs, *Wavelets making waves in mathematics and engineering*, Thursday, 10:05 a.m.

**James W. Demmel**, University of California, Berkeley, Wednesday, 3:20 p.m.

**Jeffrey Shallit**, University of Waterloo, *Real numbers with bounded partial quotients*, Friday, 2:15 p.m.

**Harold Stevenson**, Department of Psychology, University of Michigan, Ann Arbor, *Problems in mathematics: East*



Lida K. Barrett

*Asian and the United States*, Saturday, 10:05 a.m.

**Minicourses:** Seventeen 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: (Also, be sure to see the section on Environmental Mathematics on page 952.)

**Minicourse #1:** *Alternatives to the lecture method in collegiate mathematics*, **Julian Weissglass**, University of California, Santa Barbara. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Wednesday, and Part B from 8:00 a.m. to 10:00 a.m. on Thursday. Enrollment is limited to 40.

This course will provide participants with information about using alternatives to the lecture method—particularly small group discussion methods. The goal is to enable teachers to get their students actively involved in doing, discussing and writing about mathematics. Participants will engage in small group learning activity, see video clips, discuss the issues involved and learn about the research literature. Attention will be paid to educational and organizational issues, assessment, and student's reactions.

**Minicourse #2:** *The Harvard calculus reform project: Hands-on experience with the project materials*, **Deborah Hughes Hallett**, Harvard University; **Sheldon P. Gordon**, Suffolk Community College; **William McCallum**, University of Arizona; and **Thomas W. Tucker**, Colgate University. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Wednesday, and Part B from 2:15 p.m. to 4:15 p.m. on Thursday. Enrollment is limited to 40.

This minicourse will familiarize the participants with the philosophy and the materials being developed under the

Harvard Calculus Reform Project. It will describe the philosophy behind the project and its implementation at a variety of institutions. The project is based on the *Rule of Three* in which most topics are presented geometrically, numerically and symbolically to enhance student understanding of the concepts of calculus. Participants will be provided sample materials to examine, try out and bring home to incorporate into their own classes.

**Minicourse #3:** *Using history in teaching calculus*, **V. Frederick Rickey**, Bowling Green State University. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Wednesday, and Part B from 2:15 p.m. to 4:15 p.m. on Thursday. Enrollment is limited to 80.

Students of calculus instinctively ask many penetrating questions: What is calculus? What good is it? Why are the concepts presented the way they are? When the calculus reform movement eliminates computational drudgery to concentrate on the fundamental ideas of the calculus, it will be even more imperative to respond to these questions. The answers are inherently historical, and so by interjecting an historical vein into our teaching we can respond to these questions in meaningful and inspiring ways. A wide variety of ideas for using the history of the calculus that have been successfully used to motivate students will be presented. A bibliography and historical notes will be provided.

**Minicourse #5:** *Using group projects in calculus*, **Stephen Hilbert**, **John Maceli**, **Eric Robinson**, **Diane Schwartz** and **Stanley Seltzer**, Ithaca College. Part A is scheduled from 4:30 p.m. to 6:30 p.m. on Wednesday, and Part B from 7:00 p.m. to 9:00 p.m. on Thursday. Enrollment is limited to 80.

Many have recommended using projects and/or cooperative learning in calculus courses. The organizers have been teaching calculus using group projects since Spring 1989. Open-ended projects challenge students to develop problem-solving skills beyond looking for a similar problem solved in the text or class notes. This minicourse will address issues relating to the use of group projects in calculus, including an overview, examples of projects, hands-on experience working in a group on a project, and the impact on the curriculum.

**Minicourse #6:** *Introduction to research in the teaching and learning of undergraduate mathematics: Examples in calculus*, **Joan Ferrini-Mundy**, University of New Hampshire; and **Kathleen Heid**, Pennsylvania State University. This Minicourse is sponsored by the MAA Committee on Research in Undergraduate Mathematics Education (Ed Dubinsky, Chair). Part A is scheduled from 4:30 p.m. to 6:30 p.m. on Wednesday, and Part B from 1:00 p.m. to 3:00 p.m. on Saturday. Enrollment is limited to 30.

Can better understandings of how students learn, and of how teaching affects learning, lead to more effective undergraduate mathematics experiences? The formation of working groups interested in pursuing this question will be encouraged. By viewing data from research studies of learning and teaching calculus and other areas, and by

conducting clinical interviews with undergraduate students, participants will gain first-hand introductory experience with qualitative research methods. An overview of literature and resources helpful to those interested in "getting started" in research of this nature will be provided. "Homework" between sessions is planned.

**Minicourse #7:** *Using NETPAD software to teach and learn about graphs*, **Nathaniel Dean**, Bellcore; and **Joseph G. Rosenstein**, Rutgers University. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Thursday, and Part B from 8:00 a.m. to 10:00 a.m. on Saturday. Enrollment is limited to 30.

The NETPAD software provides an easy way to draw and analyze graphs using computers. It can be a valuable tool for both research and hands-on teaching of graph-theoretic concepts. It can be used like an electronic pencil and notepad to draw, modify, save, and recall graphs or networks and such attributes as colors of vertices or weights of edges. It can also be used to access a library of NETPAD algorithms for manipulating and analyzing graphs. NETPAD was developed at Bell Communications Research, and it will be used in this course to introduce basic concepts involving graphs and graph algorithms and to demonstrate how it can be used for theoretical research, for industrial research, and to enhance teaching.

NETPAD is a portable system that runs on workstations under the X Windows System. The participants will gain hands-on experience, and the NETPAD software and documentation will be made available to all participants at no additional charge. There are no prerequisites for this minicourse.

**Minicourse #8:** *CAS laboratory projects for first year calculus using DERIVE*, **Carl L. Leinbach**, Gettysburg College; and **Marvin L. Brubaker**, Messiah College. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Thursday, and Part B from 8:00 a.m. to 10:00 a.m. on Saturday. Enrollment is limited to 30.

This course is designed to acquaint participants with a method of presenting calculus as a laboratory course. In addition to discussing the philosophy and the logistics of a laboratory calculus course, participants will have hands-on experience working in simulated laboratory sessions. Laboratories will be conducted using the DERIVE Computer Algebra System.

**Minicourse #9:** *Learning abstract algebra by programming in ISETL* **Ed Dubinsky**, Purdue University; and **Uri Leron**, Technion-IIT. Part A is scheduled from 2:15 p.m. to 4:15 p.m. on Thursday, Part B from 2:00 p.m. to 4:00 p.m. on Friday, and Part C from 3:30 p.m. to 5:30 p.m. on Saturday. Enrollment is limited to 30.

The organizers believe that undergraduates' difficulty in learning abstract algebra has less to do with the complexity of the theorems than with the abstract nature of the mathematical objects involved. Programming in a mathematical language can help by getting students to construct those objects on the computer, allowing mathematical operations to be, for them, activities about meaningful objects. The

minicourse is a hands-on experience in doing this with ISETL. No previous programming background is necessary.

**Minicourse #10:** *How to make effective use of inexpensive pocket computers to develop the concepts and techniques of calculus*, **Franklin Demana** and **Bert K. Waits**, Ohio State University. Part A is scheduled from 7:00 p.m. to 9:00 p.m. on Thursday, and Part B from 1:00 p.m. to 3:00 p.m. on Saturday. Enrollment is limited to 40.

Inexpensive (\$100 or less) pocket computers are dramatically changing the way calculus is taught (and the way students learn). Participants will use the latest "state of the art" Texas Instruments pocket computers—powerful tools that permit the user to make and test generalizations by looking at a large number of examples quickly, make solving graphically and numerically a realistic and powerful problem solving technique, and make noncontrived examples routine for all students. Topics include limits, continuity, differentiation, integration, optimization, sequences, series, vectors, matrices, and motion simulation.

**Minicourse #11:** *Instituting a mathematics placement program: Creating order out of chaos in freshman mathematics*, **Philip C. Curtis, Jr.**, University of California, Los Angeles. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Friday, and Part B from 2:00 p.m. to 4:00 p.m. on Friday. Enrollment is limited to 40.

Members of the MAA Committee on Testing will use lectures, worksheets, and question and answer sessions to present an overview of the task of establishing a mathematics placement program. Topics covered will include: reasonable expectations of a placement program, tests available through the MAA Placement Test Program (PTP), selection or creation of a placement test or series of tests, statistical analysis of test items and tests, methods of establishing a cutoff score, and administration of a placement program.

**Minicourse #12:** *Mathematical modeling with a spreadsheet*, **Stephen D. Comer** and **Hughes B. Hoyle III**, The Citadel. Part A is scheduled from 8:00 a.m. to 10:00 a.m. on Friday, and Part B from 1:00 p.m. to 3:00 p.m. on Saturday. Enrollment is limited to 30.

This minicourse will give participants hands-on experience building spreadsheet models which enhance the teaching of introductory mathematics. Applications and sample assignments will be drawn from the maximum and minimum problems, linear programming, and the mathematics of finance. Participants will use Lotus 1-2-3 on the new Hewlett-Packard palmtop PC. No prior experience using a spreadsheet or the palmtop PC will be assumed.

**Minicourse #13:** *Integrating calculus and physics for freshmen*, **Joan R. Hundhausen** and **F. Richard Yeatts**, Colorado School of Mines. Part A is scheduled from 8:00 a.m. to 10:00 a.m., Friday, and Part B from 1:00 p.m. to 3:00 p.m., Saturday. Enrollment is limited to 35.

This minicourse is based upon the organizers' experiences in developing and teaching an integrated course in calculus and physics, but also will be addressed to those who are particularly interested in emphasizing applications in a tra-

ditional calculus course. Sessions will feature discussion of physical applications in motivating and illustrating calculus concepts, modeling, use of parameters, and problem-solving. Participants will be offered guidance on the design and implementation of Laboratory/Workshop exercises. Some practical considerations such as student preparation and motivation, textbooks, sequencing and reinforcement of topics, and testing will be discussed.

**Minicourse #14:** *The Fibonacci and Catalan numbers*, **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology. Part A is scheduled from 8:00 a.m. to 10:00 a.m., Friday, and Part B from 3:30 p.m. to 5:30 p.m., Saturday. Enrollment is limited to 80.

In introductory courses in discrete or combinatorial mathematics one encounters the Fibonacci numbers—and sometimes the Catalan numbers. This minicourse will review and then extend this first encounter as it examines some of the properties these numbers exhibit as well as applications where these sequences rise. A survey of applications dealing with chemistry, physics, computer science, linear algebra, set theory, graph theory, and number theory will show why these sequences are of interest and importance.

**Minicourse #15:** *Why, when and how to use CAS calculators in calculus and linear algebra instruction*, **John Kenelly** and **Donald R. LaTorre**, Clemson University. Part A is scheduled from 7:00 p.m. to 9:00 p.m., Friday, and Part B from 3:30 p.m. to 5:30 p.m. on Saturday. Enrollment is limited to 30.

This minicourse will be a hands-on consideration of why the power of CAS calculators is needed in undergraduate mathematics and how their portability gives special advantages in both day-to-day classes and testing. The participants will work through specific examples showing when and how to use the unit effectively to enhance instruction in calculus and linear algebra. Part A will concentrate on calculus with an emphasis on differentiation and integration concepts, arc length, power series and selected multidimensional topics. Part B will focus on linear algebra with an emphasis on elimination methods, factorization techniques, orthogonality concepts, and eigenvalues and eigenvectors.

**Minicourse #16:** *Challenging students with research projects in calculus*, **Douglas Kurtz** and **David Pengelley**, New Mexico State University. Part A is scheduled for 7:00 p.m. to 9:00 p.m. on Friday, and Part B from 3:30 p.m. to 5:30 p.m. on Saturday. Enrollment is limited to 80.

Intellectually demanding and interesting two-week projects improve student attitudes and engender independent learning. Students gain pride in their work by “making a problem their own”. Instructors find teaching calculus rewarding and are impressed by their students’ accomplishments. An introduction to an established departmental projects program will be provided. Participants will grapple with interacting with students about particular projects, creating projects, and with using group projects and a help laboratory. Materials will be provided.

**Minicourse #17:** *Advanced workshop on DERIVE*, **David R. Stoutemyer**, University of Hawaii and Soft Warehouse, Inc., 2:15 p.m. to 4:15 p.m. on Wednesday. This minicourse is intended for persons who have had at least six months of experience in using DERIVE, preferably in classroom or workshop situations. Enrollment is limited to 30.

The lenient menu-driven interface of the DERIVE computer algebra program enables it to be used in support of mathematical education with very little investment in learning its elementary features. However, guidance is helpful for using the programming feature of DERIVE to extend the built-in features for educational or research applications. This two-hour hands-on workshop course is designed to provide that guidance for experienced DERIVE users.

**Participants interested in attending any of the MAA Minicourses should complete the MAA Minicourse Pre-registration Form found at the back of this issue and send it directly to the MAA office at the address given on the form so as to arrive prior to the November 18 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 registration fee for MAA Minicourses # 7, 8, 9 is \$60 each and the registration fee for MAA Minicourse # 17 is \$30. All other MAA Minicourses are \$36 each.

The MAA Minicourses are open only to persons who register for the Joint 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 NOVEMBER 18.**

**Contributed Papers:** Contributed papers are being accepted on nine topics. The topics, organizers, their affiliations, and the probable days they will meet are (also see the section on Environmental Mathematics at the Baltimore meetings):

- *Research in undergraduate education*, **Ed Dubinsky**, Purdue University, Thursday and Friday mornings. Presentations are invited that describe research on the learning and teaching of any aspect of undergraduate



mathematics. Descriptions of courses taught must be in the context of investigations into such questions as to how mathematics is learned, methods of teaching, effectiveness of the approach, and similar issues.

- *Mathematics placement testing programs: Their organization, administration and problems*, **Rose Hamm**, College of Charleston; and **John G. Harvey**, University of Wisconsin, Madison, Wednesday. Papers on various aspects of placement testing programs are welcome. Of special interest are the test(s) used and the other data used (e.g., aptitude scores, high school GPA's), as well as the problems that arise and the ways of solving them.
- *The "seven-into-four" problem*, **David H. Carlson**, San Diego State University; and **Ann Watkins**, California State University, Northridge, Wednesday and Friday afternoons. This session was organized by the Committee on Calculus Reform and the First Two Years (CRAFTY). Papers are invited which present innovative ways of solving the seven-into-four problem. Seven courses (Calculus I, II, and III, Differential Equations, Discrete Mathematics, Linear Algebra, and Probability/Statistics) have been recommended for the first four semesters of college mathematics. Is it possible to squeeze them all in? What are some good partial solutions to the problem?
- *Innovations in mathematics courses for business*, **Wade Ellis, Jr.**, West Valley College; and **Barbara A. Jur**, Macomb Community College, Wednesday morning and Thursday afternoon. This session is organized by the CUPM Subcommittee on Service Courses, which focuses on service courses for business students. Contributed papers may address issues of specialized business subject matter, innovative instructional techniques, the relationship of business-oriented courses to the mathematics curriculum, or other related topics.
- *Actuarial mathematics education and research*, **James W. Daniel**, University of Texas, Austin, Saturday. Sponsored by the Actuarial Faculty Forum. Contributions should address educational (or research) issues in actuarial mathematics, including such topics as curricula, teaching methods, program organization, textbooks, software, professional exams, and research.
- *A toolbox for liberal arts mathematics courses*, **John Emert** and **Kay Meeks**, Ball State University, Thursday afternoon and Friday morning. Liberal arts mathematics courses generally include as goals the changing of students' perception of mathematics and the illumination of relationships between mathematics and other disciplines. The purpose of this session is to share innovative, yet practical and transferable, ideas and techniques which can aid in the development and realization of these common goals. Topics for discussion may include: creative classroom techniques and assignments; fresh, unusual topics for inclusion in courses; and specific ways to encourage students' discovery of the usefulness of mathematics in their own fields of study.

- *Mathematics for the health sciences*, **Henry C. Foehl**, Philadelphia College of Pharmacy and Science, Friday. Papers contributed for this session should describe the content of courses or sequences of courses that constitute part or all of the mathematics requirements for degree programs in the health or health-related sciences. Of particular interest are criteria for selecting the appropriate content for such courses and methods for integrating the content into the curricula of various degree programs, especially where the courses also serve as the mathematics component of a core curriculum.
- *Using spreadsheets to teach mathematics*, **Robert S. Smith**, Miami University, Wednesday morning and Thursday afternoon. The spreadsheet is a powerful and versatile—yet easy to use—software tool that has become increasingly popular in the teaching of the mathematical sciences. It is ideal for implementing algorithms which rely upon iterative procedures or recurrence relations, and is a natural tool for solving many types of applied problems. This session invites papers which illustrate the spreadsheet as a problem solving, data analysis, or graphing tool. Papers are also invited which demonstrate how the spreadsheet can be used to prove theorems, discover patterns and results, or illustrate mathematical concepts. Papers which describe courseware that is developed around the spreadsheet are strongly encouraged.

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes. The deadline for submitting papers was **September 11**.

Rooms where sessions of contributed papers will be held are equipped with an overhead projector and screen. Blackboards are **not** available. Persons having other equipment needs should contact the MAA Associate Secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403-1222; electronic mail: ross@math.uoregon.edu) as soon as possible, but in any case **prior to November 1**. Upon request, the following will be made available: one additional overhead projector/screen, 35mm carousel slide projector, or  $1/2''$  or  $3/4''$  VHS video cassette recorder with one color monitor.

Organizers are cautioned that requests for equipment made at the meeting may not be able to be satisfied because of budgetary restrictions.

#### Other MAA Sessions

**John von Neumann Presentation:** On the first day of the meeting there will be a special presentation by John von Neumann's brother, Nicholas A. Vonneumann, by now practically the only surviving witness of von Neumann's early years. The presentation, titled *The philosophical legacy of John von Neumann*, will report on the evolution of his formative years and will include John's attitude concerning manifestations of nature, pragmatism, positivism, pure versus applied science, responsibility of scientists, geopolitics, etc.

Although the material to be presented is primarily from Nicholas' perspective, it is part of an overall scenario that should be of interest to future historians.

An exhibit of memorabilia and photographs from the Von Neumann family will be on display in the exhibit area.

**Sculpture Exhibit:** Sculpture by Helaman Ferguson will be on display in the exhibit area.

**Mathematical Life Outside Academia: Input from the Real World:** This panel discussion is sponsored by the Committee on Mathematicians Outside Academia (Patrick D. McCray, Chair) and is scheduled on Wednesday, from 8:00 a.m. to 9:20 a.m. The moderator is **S. Brent Morris**, National Security Agency.

**ICME-7 (August 17-23, 1992):** This panel discussion, scheduled from 8:00 a.m. to 9:20 a.m. on Wednesday, is sponsored by the United States Commission on Mathematical Instruction and is chaired by **Eileen L. Poiani**, Saint Peter's College. The panelists are **Florence D. Fasanelli**, consultant to MAA/SUMMA; **Bernard R. Hodgson**, Université Laval and Chair of the National Committee for ICME-7; **Martin Johnson**, University of Maryland; **Eric R. Miller**, Brock University and member of the International Program Committee for ICME-7; and **Paul Zorn**, St. Olaf College.

**Reception for Elementary Teachers:** By invitation of the MAA, a reception for elementary school teachers will be held on Wednesday from 4:30 p.m. to 6:00 p.m.

**How to Start and Maintain a Departmental Colloquium:** This panel discussion is sponsored by the Visiting Lectures Committee (**James G. Ware**, University of Tennessee at Chattanooga, Chair) and is scheduled from 8:30 a.m. to 9:50 a.m. on Thursday. Panel members are the committee Chair; **Jean B. Chan**, Sonoma State University; **Sandy Grabiner**, Pomona College; and **Deane Arganbright**, Whitworth College.

**Curriculum Initiatives: Statistics, Geometry, Environment, Assessment, and Quantitative Literacy:** This panel discussion organized by **James R. C. Leitzel**, MAA and Ohio State University; and **Lynn A. Steen**, St. Olaf College, is scheduled from 8:30 a.m. to 9:50 a.m. on Thursday.

**Preparing Teachers of Mathematics:** The panel discussion is jointly sponsored by COMET, the Committee on the Mathematical Education of Teachers (James R. C. Leitzel, Chair) and CTUM, the Committee on the Teaching of Undergraduate Mathematics (Don R. Lick, Chair). It will take place 2:15 p.m. to 4:10 p.m. on Thursday. The panel will address issues in preparing and providing continuing professional development for teachers of mathematics at all levels. The panelists are **Bettye Anne Case**, Florida State University; **Ed Dubinsky**, Purdue University; **Patricia L. Jones**, University of Southwestern Louisiana; and **Glenda Lappan**, (Michigan State University). The moderators are **James R. C. Leitzel** and **Don R. Lick**.

**Guidelines for Undergraduate Mathematics Programs:** The ad hoc Committee on Guidelines (John D. Fulton,

Chair), which is sponsoring this panel discussion scheduled from 2:15 p.m. to 4:10 p.m. on Thursday, is preparing a set of Guidelines for Undergraduate Mathematics Programs for consideration by the MAA Board of Governors. The committee is nearing completion of its task and seeks advice from mathematicians. The Guidelines are intended to be used by departments of mathematics for self-assessment or assessment by other reviewers. The current draft version incorporates current policy statements of our professional organizations as well as data from the recent CBMS survey of departments. The panelists are **John D. Fulton**, The University of West Florida; **David J. Lutzer**, College of William & Mary; and **John A. Thorpe**, SUNY at Buffalo. They will address the draft document, its rationale and seek input from the audience.

**The Source Book for College Mathematics Teaching:** This panel discussion is scheduled from 8:00 a.m. to 9:20 a.m. on Friday. This panel discussion is sponsored by CTUM, the Committee on the Teaching of Undergraduate Mathematics. The moderator is the Chair of the committee, **Don R. Lick**, Eastern Michigan University, and the panel members are **Carole Ann Bauer**, Triton College; **Ed Dubinsky**, Purdue University; **Peter Ross**, Santa Clara University; and **Alan H. Schoenfeld**, University of California, Berkeley.

**Statistics for the Twenty-First Century:** This panel discussion is scheduled from 8:00 a.m. to 9:20 a.m. on Friday. The organizers are **Florence S. Gordon**, New York Institute of Technology, and **Sheldon P. Gordon**, Suffolk Community College. Participants are **Robert V. Hogg**, University of Iowa; **J. Laurie Snell**, Dartmouth College; and **Ann Watkins**, California State University, Northridge.

**SUMMA Workshop:** SUMMA, Strengthening Underrepresented Minority Mathematics Achievement, is sponsoring a workshop led by **Winson Coleman**, University of the District of Columbia; and **Carol Malloy**, Mathematics and Science Education Network, University of North Carolina, scheduled from 9:00 a.m. to 10:55 a.m. on Friday.

**Site Testing of New Calculus Projects:** This panel discussion is sponsored by CRAFTY, CUPM Subcommittee on Calculus Reform and the First Two Years (Thomas W. Tucker, Chair) and is scheduled from 9:30 a.m. to 10:55 a.m. on Friday. The participants are **Tom Dick**, Oregon State University; **Ed Dubinsky**, Purdue University; **Deborah Hughes Hallett**, Harvard University; **David A. Smith**, Duke University; and **Wayne Roberts** (moderator), CRAFTY. As calculus reform moves into the beta test stage, one of the better ways for an institution to become involved in the effort to strengthen calculus instruction is to be a test site for an established calculus project. This panel will discuss the experiences of four such projects engaged in ambitious programs to implement their ideas and methods at a variety of institutions.

**Poetry Readings:** A general poetry reading is scheduled from 7:00 p.m. to 10:00 p.m. on Friday. This reading has been organized by **JoAnne Growney**, **Dan Kalman**, and **Elena Marchisotto**. From 1:00 p.m. to 2:00 p.m.

on Saturday there will be a special reading entitled *The calculus virgin*. **Louis Leithold**, mathematician, and artist-poet **d'Arcy Hayman** will read poetry and show drawings which are d'Arcy Hayman's passionate and thrilling response to Louis Leithold's seminar on calculus for teachers of Advanced Placement calculus. These readings are sponsored by the Humanistic Mathematics Network (Alvin White).

**CAS Workshop Renion:** This has been organized by **Donald B. Small**, West Point, and is scheduled at 7:30 p.m. on Friday.

**New 1991 Skits:** New skits and discussions of micro-inequities are dramatizations of incidents that actually happened in 1991 to women in mathematics, including students. Micro-inequities are events that may seem funny later but chip away at women like drops of water on a rock. After laughing, those who like may join discussions about how we can diminish the number of micro-inequities experienced by women in mathematics. These skits are sponsored by the Committee on the Participation of Women (Patricia C. Kenschaft, Chair) and are scheduled from 7:30 p.m. to 9:30 p.m. on Friday.

**Symbolic Computer Systems:** **David Tall**, Warwick, will make a special presentation titled *Processes and symbols in the mind* from 8:00 a.m. to 8:50 a.m. on Saturday. This presentation is cosponsored by CUPM Subcommittee on Symbolic Computer Systems (Zaven A. Karian, Chair) and CCIME, the Committee on Computers in Mathematics Education (Eugene A. Herman, Chair).

This committee is sponsoring a panel discussion titled *Future directions in symbolic computing software* from 1:00 p.m. to 3:00 p.m. on Saturday. The moderator is **Zaven A. Karian**, Denison University, and the panelists are **Ben Friedman**, Wolfram Research; **Brenton Leong**, University of Waterloo; and **David Stoutemyer**, Soft Warehouse, Inc.

**The Advanced Placement Calculus Program: a Pump or a Filter?:** This panel discussion is scheduled from 1:00 p.m. to 3:00 p.m. on Saturday and is sponsored by the CEEB-MAA College Board Committee on Mutual Concerns (Philip C. Curtis, Jr. and Carole E. Greenes, Co-Chairs). Among the participants are **Judith Broadwin**, Jericho High School; **John W. Kenelly**, Clemson University; **Daniel Kennedy**, The Baylor School; and **David J. Lutzer**, College of William and Mary. The panel will focus on mathematics education reform issues for AP calculus. The moderator is **Philip C. Curtis, Jr.**, University of California, Los Angeles.

**Two-Year College Reception:** The Committee on Two-Year Colleges is sponsoring an informal reception for two-year college faculty from 6:15 p.m. to 7:30 p.m. on Thursday.

**Prize Session and Business Meeting:** The MAA Prize Session and Business Meeting is scheduled from 4:25 p.m. to 5:30 p.m. on Friday. The Chauvenet Prize, the Yueh-Gin Gung & Dr. Charles Y. Hu Award for Distinguished Service to Mathematics and several Certificates of Meritorious Service will be presented. This meeting is open to all

members of the Association.

**Board of Governors:** The MAA Board of Governors will meet from 8:00 a.m. to 4:00 p.m. on Tuesday, January 7. This meeting is open to all members of the Association.

**Section Officers:** There will be a Section Officers' meeting from 7:00 p.m. to 9:00 p.m. on Tuesday, January 7.

### *Student Activities*

Also, be sure to see page 952 for Environmental Mathematics sessions.

There will be a special presentation titled *The art of mental calculation*, **Arthur T. Benjamin**, Harvey Mudd College, from 2:15 p.m. to 3:15 p.m. on Thursday. Benjamin has demonstrated his rapid mental calculation skills all over the world.

The Committee on Student Chapters and Pi Mu Epsilon are co-sponsoring a **Student Hospitality Center** which will be open from the opening of registration until noon on Saturday.

There will be a **Career Fair** on Thursday from 4:00 p.m. to 7:00 p.m. sponsored by the Committee on Student Chapters. This special event is intended to provide an opportunity for prospective employers of mathematically trained people to make the academic mathematics community more aware of the needs of such employers, and of the variety of career opportunities available to people with a strong mathematics background. The Career Fair is open to all who register for the Joint Meetings. However, if you are an undergraduate student or high school teacher interested in attending **only** the Career Fair, please contact the MAA office in Washington for the appropriate registration form.

A **Breakfast for Student Chapter Advisors and Coordinators** is scheduled from 7:00 a.m. to 8:00 a.m. on Friday in the Hospitality Center.

*Contemporary Problems in Graph Theory* is the title of a **Special Student Lecture** by **Carolyn Mahoney**, California State University at San Marcos, that is especially targeted for students. This lecture will begin at 7:30 p.m. on Friday and is cosponsored by the Committee on Student Chapters (Howard Anton, Chair) and the Committee on Minority Participation in Mathematics (Manuel P. Berriozábal and Sylvia T. Bozeman, Co-Chairs).

### *Activities of Other Organizations*

The **Association of Research Libraries** is sponsoring a session on *Electronic delivery of scientific and technical information to scientists* on Friday from 2:00 p.m. to 4:00 p.m. This session is being organized by **Ann Okerson**, ARL Office of Scientific & Academic Publishing, and will feature **Keith Dennis**, Cornell University, where the Commission on Preservation and Access is scanning mathematical monographs; **Lorrin Garson**, American Chemical Society, where a group is doing retrospective scanning of their journal literature for online delivery and is becoming a leader in indexing and abstracting services; and **David Rodgers**, AMS

e-MATH, who will discuss the advances of the e-MATH system.

The **Association for Women in Mathematics (AWM)** will conduct a Workshop on Tuesday, January 7, from 9:00 a.m. to 6:30 p.m., in order to provide opportunities for women to discuss their research and to participate in a number of other events during the day. There will be talks by ten postdocs; a graduate student poster session; a panel to discuss research funding, the graduate school environment, and pipeline issues; a luncheon; and a special program and dinner where participants will have the opportunity to meet established women mathematicians. All mathematicians (female and male) are invited to attend the entire program.

AWM has obtained grant funds for this Workshop. Female mathematicians are urged to contact AWM, Box 178, Wellesley College, Wellesley, MA 02181, for application procedures, keeping in mind that completed applications must be received at the AWM office by October 15, 1991.

Registration for this Workshop will be held from 7:00 p.m. to 9:00 p.m. on Monday, and 8:00 a.m. to 9:00 a.m. on Tuesday in the Hyatt Regency Baltimore.

Information on the AWM Workshop Dinner can be found in the **Social Events** section of this announcement.

The AWM is sponsoring a panel discussion on graduate education at 3:20 p.m. Wednesday.

The thirteenth annual AWM Emmy Noether Lecture will be given by **Nancy J. Kopell**, Boston University, at 9:00 a.m. on Thursday.

The AWM Business Meeting and Prize Session is scheduled from 4:20 p.m. to 4:50 p.m. on Wednesday. The Louise Hay Award for Contributions to Mathematics Education will be given.

An open reception is planned for 9:30 p.m. on Wednesday.

The **Board on Mathematical Sciences (BMS)** is sponsoring a panel discussion titled *Educating mathematicians* at 8:00 a.m. Wednesday. Near the end of 1991 the National Research Council will publish a report on doctoral and postdoctoral education in the mathematical sciences. This report will describe the findings of an eighteen-month study, conducted by a committee of BMS, to identify characteristics of doctoral and postdoctoral programs that are particularly effective in educating mathematicians. The panel presentation will be an opportunity to discuss the results of this study and to sample the reactions of the mathematical community. The organizer is **Ronald G. Douglas**, SUNY at Stony Brook.

The **Joint Policy Board for Mathematics** and the **Office of Governmental and Public Affairs (JPBM/OGPA)** will sponsor a session on public policy on Thursday evening.

The **National Association of Mathematicians (NAM)** invites all participants to a luncheon on Friday from noon to 1 p.m. (please see more detailed information in the **Social Events** section of this announcement) where **Gloria Gilmer**, Math-Tech, Inc., will give the Cox-Talbot Address.

NAM will have a session on *Presentations by recent doctoral recipients*, organized by **Gerald R. Chacere**, Howard

University, and scheduled at 9:00 a.m. on Friday.

NAM will also sponsor a panel discussion on *The fate of minority mathematics students*, moderated by **William A. Hawkins**, SUMMA, on Saturday from 9:00 a.m. to 10:00 a.m.

The NAM Business Meeting will take place from 10:00 a.m. to 10:55 a.m. on Saturday, January 11. **Rogers J. Newman**, Southern University, will preside.

The **National Science Foundation (NSF)** will sponsor a session on *The Changing Environment for NSF Funding of Research and Education* from 5:45 p.m. to 6:45 p.m. on Wednesday. Members of the NSF Advisory Committees for Mathematical Sciences and Education and Human Resources will join NSF staff in a discussion of how programs at NSF have been changing in recent years and the implications of this for members of the community seeking funding. There will be an opportunity for discussion with the audience.

NSF invites participants at the Joint Mathematics Meetings to meet informally with staff members over the lunch hour (noon to 1:00 p.m.) daily, Wednesday to Saturday, January 8-11.

The NSF will also be represented at a booth in the exhibit area. NSF staff members will be available to provide counsel and information on NSF programs of interest to mathematicians. The booth will be open the same days and hours as the exhibits. Times that staff will be available will be posted at the booth.

The **Rocky Mountain Mathematics Consortium (RMMC)** Board of Directors will meet on Friday from 2:15 p.m. to 4:10 p.m.

### Other Events of Interest

**AMS Information Booth:** All meeting participants are invited to visit the AMS Information Booth during the meetings. Complimentary coffee and tea will be served. A special gift will be available for participants, compliments of the AMS. The Membership Manager of the Society will be at the booth to answer questions about membership in the Society.

**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 meetings 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.

**Exhibits:** The book, educational media and software exhibits will be open 1:00 p.m. to 5:00 p.m. on Wednesday, 9:00 a.m. to 5:00 p.m. on Thursday and Friday, and 9:00 a.m. to noon on Saturday. All participants are encouraged to visit the exhibits during the meeting. **Participants visiting the exhibits will be asked to display their meeting badge or acknowledgement of preregistration from the Mathemat-**

ics Meetings Service Bureau in order to enter the exhibit area.

**Joint Books, Journals and Promotional Materials Exhibit:** This exhibit will be open the same hours as the other exhibits, and affords participants the opportunity to order publications from various commercial publishers not represented at the meeting.

**Mathematical Sciences Employment Register:** Those wishing to participate in the Baltimore Employment Register should read carefully the important article about the Register which follows this meeting announcement.

*Social Events*

**It is strongly recommended that tickets for these events be purchased through preregistration, since only a very limited number of tickets will be available for sale on-site.** Tickets purchased through preregistration will be mailed with the badge and program unless the participant instructs otherwise on the Preregistration/Housing Form. In that case, participants can pick up their ticket(s) at the meeting at the same time as their badge and program. To get a 50 percent refund, **returned tickets must be received by the Mathematics Meetings Service Bureau by December 30.** After that date no refunds can be made. Special meals are available at all banquets, upon request, including vegetarian, but this must be indicated on the Preregistration/Housing Form in advance.

**AMS 25-Year Member Banquet:** All meeting participants are invited to attend the annual banquet to honor individuals who have been members of the Society for twenty-five years or more. This banquet provides an excellent opportunity to socialize with fellow participants in a relaxed atmosphere. The banquet will be held on Saturday, January 11, with a cash bar reception at 6:30 p.m. and dinner at 7:30 p.m. The attendee who has been a member of the Society for the greatest number of years will receive a special tribute. Each attendee will receive a memento of the occasion and there will be a drawing for door prizes.

The menu includes baby bibb salad, mixed grill of chicken and sirloin, seasonal vegetables, apple streudel with vanilla sauce, and nonalcoholic beverages. Vegetarian meals are available on request. Tickets are \$25 each; the price includes tax and gratuity.

**AWM Workshop Dinner:** Association for Women in Mathematics will host a dinner after the conclusion of their Workshop on Tuesday at 6:30 p.m. The menu includes rainbow salad, chicken marsala, fresh vegetables, chocolate eclair, and coffee/tea. All participants are invited to attend the banquet, whether or not they attended the Workshop. Vegetarian meals are available upon request. Tickets are \$26 each, including tax and gratuity.

**MER Banquet:** The Mathematicians and Education Reform (MER) Network welcomes all mathematicians who are interested in issues in precollege mathematics education to attend the MER Banquet on Wednesday at 6:00 p.m. This is an opportunity to make or renew ties with other

mathematicians who are involved in educational projects. There will be a brief presentation of the current activities and future plans of the MER Network, but the evening's main feature promises to be lively conversation among the participants.

There will be a cash bar beginning at 6:30 p.m. Dinner will be served at 7:30 p.m. and includes crab bisque, chicken picatta, seasonal vegetables, chocolate torte, and nonalcoholic beverages. Vegetarian meals are available on request. Tickets are \$26 each, including tax and gratuity.

**NAM Luncheon:** The National Association of Mathematicians will host a luncheon at noon on Friday. Tickets are \$22 each, including tax and gratuity. The menu will be announced at a later date.

**How to Preregister and Get a Room**

*How to Preregister*

The importance of preregistration cannot be overemphasized. Those who preregister pay fees considerably lower than the fees that will be charged for registration at the meeting and will receive typeset badges instead of typewritten ones. Participants who preregister by the **ORDINARY** deadline of November 18 may utilize the housing services offered by the Mathematics Meetings Service Bureau.

**Joint Mathematics Meetings**

Member of AMS, Canadian Mathematical Society, MAA	\$105
Emeritus Member of AMS, MAA	\$ 25
Nonmember	\$163
Student/Unemployed	\$ 25

**Employment Register**

Employer	\$125
Additional interviewer (each)	\$ 60
Applicant	\$ 30
Employer posting fee	\$ 30

**AMS Short Course**

Student/Unemployed	\$ 25
All Other Participants	\$ 60
Emeritus Member of AMS, MAA	\$ 25

**MAA Minicourses**

(if openings available)

Minicourses # 1, 2, 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 16	\$ 36
Minicourses # 7, 8, 9	\$ 60
Minicourse # 17	\$ 30

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 badge, if so requested. Badges are required to obtain discounts at the AMS and MAA Book

Sales and to cash a check with the Joint Meetings cashier. If a preregistrant should arrive too late in the day to pick up his/her badge, he/she may show the acknowledgment of preregistration received from the Mathematics Meetings Service Bureau as proof of registration.

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 Service Bureau to refund amounts less than \$2. Preregistration forms received well before the deadline of December 10 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. 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 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 because of age or 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.

**Preregistration deadlines:** There are three separate preregistration deadlines, each with its own advantages and benefits.

<b>EARLY</b> Preregistration	October 29
<b>ORDINARY</b> Preregistration (and Housing)	November 18
<b>FINAL</b> Preregistration (no Housing, tickets Employment Register)	December 17

**EARLY Preregistration:** Those who preregister by the **EARLY** deadline of October 29 will be eligible for a drawing to select the winners of complimentary hotel rooms in Baltimore. Multiple occupancy of these rooms is permissible. The location of rooms to be used in this lottery will be based on the number of complimentary rooms available in the various hotels. Therefore, the free room may not necessarily be in the winner's first choice hotel. Winners will be randomly selected from the names of all participants who preregister by October 29. The winners will be notified by mail prior to December 31. **So preregister early!** (A list of the winners in San Francisco appears in the section titled **How to Get a Room.**)

**ORDINARY Preregistration:** Those who preregister by the **ORDINARY** deadline of November 18 may still utilize the housing services offered by the Mathematics Meetings Service Bureau, but are not eligible for the room lottery.

**FINAL Preregistration:** Those who preregister by the **FINAL** deadline of December 10 must pick up their badge and program at the meetings. Unfortunately, it is not possible to provide **FINAL** preregistrants with housing, tickets to special events, or Employment Register preregistration. However, participants may register onsite for the Employment Register and tickets may still be available for purchase at the meetings. **Please note that the December 10 deadline is firm and any forms received after that date will be returned and full refunds issued.**

**ELECTRONIC Preregistration:** Preregistration through electronic mail is also available. Anyone wishing to preregister through this method should send a message to MEET@MATH.AMS.COM requesting this service. A message will be sent back within 24 hours with instructions on how to complete the format required. **Credit card is the ONLY method of payment which can be accepted for electronic preregistration.** Forms received through this method will be treated in the same manner as forms received through U.S. mail, and the same deadlines apply. Receipt of the Preregistration/Housing Form and payment will be acknowledged by the Mathematics Meetings Service Bureau. Participants are advised to bring a copy of this acknowledgement with them to Baltimore. The same deadlines apply as for preregistration by mail.

All **EARLY** and **ORDINARY** preregistrants will receive formal acknowledgements prior to the meetings. **FINAL** preregistrants will receive instead a letter from the Mathematics Meetings Service Bureau (including receipt of payment) prior to the meetings.

Both **EARLY** and **ORDINARY** preregistrants will receive their badge, program, and prepurchased tickets by

mail two to three weeks before the meetings, unless they check the appropriate box to the contrary on the Preregistration/Housing Form. So, it is extremely important that the mailing address given on the Preregistration/Housing Form be one at which the participant can receive this mailing. Due to the delays that occur in the U.S. mail to Canada, it is strongly suggested that preregistrants from Canada choose to pick up their preregistration material at the meeting as opposed to having it mailed. There will be a special Registration Assistance desk at the Joint Meetings to assist individuals who either do not receive this mailing or who have a problem with their registration. Please note that a \$2 replacement fee will be charged for programs and badges that are mailed but not taken to Baltimore. Unfortunately, it will not be possible to make changes in Baltimore to badges received through the mail before the meetings.

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.

There will be a list of preregistrants sorted by area of interest posted at the meetings. 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. (A list of these numbers appears on the back of the AMS and MAA abstract forms.) The master copy of this list will be available for review by participants at the Directory of Registrants located near the registration area.

### ***How to Get a Room***

Participants must preregister by the **ORDINARY** deadline of November 18 in order to obtain hotel accommodations through the Mathematics Meetings Service Bureau. Be sure to complete the Housing section of the Preregistration/Housing Form completely, after reading the information in this section thoroughly. Participants are asked to rank all hotels on the form after reviewing the following two pages.

**Handicapped:** People with special requirements for housing should make these clear when submitting the Preregistration/Housing Form.

The following participants received complimentary hotel rooms during the San Francisco meetings. They qualified for these rooms by submitting their Preregistration/Housing Form by the **EARLY** preregistration deadline. Since these rooms can be occupied by as many as four persons, this represented a considerable savings.

### **Handlery**

Peter A. Kuchment  
Margaret L. Reese

Sohindar Sachdev

### **King George**

Temple H. Fay

### **Mark Twain**

Lucy I. Dechene

Robert P. Webber

### **Villa Florence**

Loki Natarajan

All participants wishing to preregister for the Baltimore meetings are urged to consider the **EARLY deadline of October 29** in order to qualify for the Baltimore room Lottery. (See the section titled **How To Preregister**).

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 a 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.

### **Miscellaneous Information**

**Audio-Visual Equipment:** Standard equipment in all session rooms is one overhead projector and screen. (Invited 50-minute speakers are automatically provided with two overhead projectors.) **Blackboards are not available.**

MAA speakers requiring additional equipment may make written request for one additional overhead projector/screen, 35mm carousel slide projector, or VHS video cassette recorder with one color monitor. Such requests should be addressed to the MAA Associate Secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403). These requests should be received by **November 1**.

All other speakers requiring additional equipment should contact the Audio-Visual Coordinator for the meetings at the

Meetings

How to Obtain Hotel Accommodations

The rates listed below are subject to a 12 percent sales/occupancy tax. Checkin time for all hotels is 3:00 p.m. except for the Marriott which is 4:00 p.m.. Checkout time for all hotels is noon. Participants desiring confirmed reservations for the following hotels must make the reservations through the Mathematics Meetings Service Bureau prior to the November 18, 1991 deadline. Reservations, cancellations, and/or changes at these hotels CANNOT be made by calling the hotel directly until after December 20, 1991. Please make all changes to or cancellations of hotel reservations with the Service Bureau in Providence through December 10, 1991. The telephone number in Providence is 401-455-4148. The Service Bureau cannot accept changes after December 10, 1991; however, changes and cancellations can be called in directly to the hotels after December 20, 1991. Please allow the Service Bureau from December 11 to December 20 to get all final housing lists and changes sent to the hotels. In addition, the hotels need this time to input all final housing lists and changes into their systems. It is imperative that all hotels listed on the back of the preregistration form be numbered in order of preference to insure accurate hotel assignments.

The hotels listed below are full service hotels. They offer a LIMITED number of nonsmoking rooms and are equipped for the handicapped. Special attention will be given to participants with special needs if they are noted on the prereg form. Rooms in the Omni and Stouffers have windows that open. Please note that the distance from the hotels to the Convention Center can be found in the "Location" column.

**GUARANTEE REQUIREMENTS:** \$50 by check OR a credit card guarantee with VISA, MasterCard, or American Express (for housing only). No other credit cards will be accepted. American Express cards may be used for housing guarantees only and not for preregistration. For room payments, the hotels accept all major credit cards. Personal checks are accepted at all hotels except the Days Inn with personal identification with photo and a credit card backup. The Days Inn accepts personal checks only in advance of arrival.

Location	Description	Single	Double	Double 2 beds	Triple 2 beds	Triple 2 beds w/cot	Quad 2 beds	Quad 2 beds w/cot	Suites* (starting rates)
Hyatt Regency (Headquarters) 300 Light Street Baltimore, MD 21202 301-528-1234 Distance: .10 miles	Restaurants, Lounge, Outdoor Pool, Health Club, Tennis Courts. Parking \$7 per day (In/Out)**. Children 18 yrs. and younger free.	\$ 85	\$ 95	\$ 95	\$ 115	\$ N/A***	\$ 135	\$ N/A***	\$ 225+
REGULAR									
STUDENT*****		76	76	76	96	N/A***	116	N/A***	225+
Stouffer Harborplace 202 East Pratt Street Baltimore, MD 21202 301-547-1200 Distance: .15 miles	Restaurant, Lounge, Indoor Pool, Sauna. Parking \$8 per day (In/Out)**. Children 18 yrs. and younger free.	85	95	95	105	N/A	115	N/A	185+
STANDARD-REGULAR									
STANDARD-STUDENT*****		75	75	75	75	N/A	75	N/A	185+
HARBORVIEW		105	115	115	125	N/A	135	N/A	275+
CLUB		110	120	120	130	N/A	140	N/A	275+

\* All reservations for suites must be made directly with the Service Bureau. The hotel can supply general information only.

\*\* All parking rates listed pertain to overnight guests only. Parking tickets must be validated at the front desk.

\*\*\* The Hyatt offers a flat fee of \$20 per hotel stay for the use of a rollaway.

\*\*\*\* Participant must be a certified student or unemployed to qualify for these rates (see section on "How to Preregister" in Notices or Focus for definitions).

In addition, the Service Bureau lists as an alternative to hotel housing Amanda's Bed and Breakfast Service. Amanda's offers several homes in the Inner Harbor area. Rates range from \$60 to over \$100 and include either a continental or full breakfast. For reservations and more information, please call 301-225-0001.

(CONTINUED ON NEXT PAGE)



How to Obtain Hotel Accommodations (continued)

	Location	Description	Single	Double	Double 2 beds	Triple 2 beds	Triple 2 beds w/cot	Quad 2 beds	Quad 2 beds w/cot	Suites* (starting rates)
Sheraton Inner Harbor	300 South Charles Street Baltimore, MD 21202 301-962-8300 Distance: .10 miles	Restaurant, Lounge, Health Club, Indoor Pool, Sauna. Parking \$9 per day (In/Out)**. Children 17 yrs. and younger free.	\$83	\$93	\$93	\$108	\$108	\$123	\$123	\$325+
			REGULAR	73	73	88	88	103	103	325+
Marriott Inner Harbor	110 South Eutaw Street Baltimore, MD 21201 301-962-0202 Distance: .25 miles	Restaurant, Lounge, Indoor Pool, Sauna, Exercise Room. Parking \$7 per day (In/Out)**. Children 17 yrs. and younger free.	78	88	88	103	118	118	133	205+
			REGULAR	78	78	93	108	108	123	205+
Omni Inner Harbor	101 West Fayette Street Baltimore, MD 301-752-1100 Distance: .35 miles	Restaurants, Lounge, Outdoor Pool, Exercise Facility. Parking \$9 per day (In/Out)**. Children 18 yrs. and younger free.	75	75	75	95	110	115	130	200+
			STUDENT***	69	79	79	89	99	109	200+
Holiday Inn Inner Harbor	301 West Lombard Street Baltimore, MD 21201 301-685-3500 1-800-HOLIDAY Distance: .20 miles	Restaurant, Lounge, Indoor Pool, Sauna. Parking \$4 per day (In/Out)**. Children 18 yrs. and younger free.	55	65	65	75	N/A	85	N/A	125
			REGULAR	55	65	75	N/A	85	N/A	125
Days Inn Inner Harbor	100 Hopkins Place Baltimore, MD 21201 301-576-1000 Distance: .15 miles	Restaurant, Lounge, Outdoor Pool. Parking \$4.50 per day (In/Out)**. Children 12 yrs. and younger free.	55	65	65	75	N/A	85	N/A	125
			STUDENT***	55	65	75	N/A	85	N/A	125

\* All reservations for suites must be made directly with the Service Bureau. The hotel can supply general information only.

\*\* All parking rates listed pertain to overnight guests only. Parking tickets must be validated at the front desk.

In addition, the Service Bureau lists as an alternative to hotel housing Amanda's Bed and Breakfast Service. Amanda's offers several homes in the Inner Harbor area. Rates range from \$60 to over \$100 and include either a continental or full breakfast. For reservations and more information, please call 301-225-0001.

AMS office in Providence at 401-455-4140, or electronic mail WSD@MATH.AMS.COM by **November 1**.

Speakers are cautioned that requests for equipment made at the meeting may not be able to be satisfied because of budgetary restrictions.

**Child Care:** Information on child care will be available in future updates to this announcement. Participants are reminded they should contact these agencies directly.

In addition, a Parent-Child Lounge will be located in the Baltimore Convention Center. This room will be furnished with casual furniture, a crib, a changing area, and a VCR and monitor for viewing videotapes. The tapes, appropriate for children, can be checked out at the Telephone Message section of the registration desk. 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.

**Information Distribution:** A table is set up in the registration area for dissemination of general information of possible interest to the members.

A second table is set up in the book sale area for the dissemination of information of a **mathematical** nature **not** promoting a product or program for sale.

**If a person or group wishes to display information of a mathematical nature promoting a product or program for sale, they may do so in the book sale area at the Joint Books, Journals and Promotional Materials exhibit for a fee of \$30 per item.**

If a person or group would like to display material in the book sale area separate from the Joint Books table, the proponent must reimburse the AMS and MAA for any extra furnishings requested (tables, chairs, easels, etc.) in addition to payment of the \$30 per item fee. (This latter display is also subject to space availability.)

The administration of these tables is in the hands of the AMS-MAA Joint Meetings Committee, as are all arrangements for Joint Mathematics Meetings. The following rules and procedures apply.

1. Announcements submitted by participants should ordinarily be limited to a single sheet no more than 8½" × 14".
2. A copy of any announcement proposed for either table is to be sent to the Director of Meetings, American Mathematical Society, Post Office Box 6887, Providence, Rhode Island 02940 to arrive at least one week before the first day of the scientific sessions.
3. The judgment on the suitability of an announcement for display rests with the Joint Meetings Committee. It will make its judgments on a case-by-case basis to establish precedents.
4. Announcements of events competing in time or place with the scheduled scientific program will not be accepted.

5. Copies of an accepted announcement for either table are to be provided by the proponent. Announcements are not to be distributed in any other way at the meetings (for example, not by posting or personal distribution of handbills).
6. It may be necessary to limit the number of events or the quantity of announcements distributed at a meetings.
7. At the close of registration, both tables will be swept clean. Therefore, a proponent who wishes the return of extra copies should remove them before the close of registration.

**Mail:** All mail and telegrams for persons attending the Joint Meetings should be addressed as follows: Name of Participant, Joint Mathematics Meetings, Baltimore Convention Center, One West Pratt Street, Baltimore, MD 21201. Mail and telegrams so addressed may be picked up at the mailbox outside the meetings registration area. U.S. mail not picked up will be forwarded after the meetings to the mailing address given on the participant's registration record.

**Petition Table:** At the request of the AMS Committee on Human Rights of Mathematicians, a table will be made available in the meetings registration area at which petitions on behalf of named individual mathematicians suffering from human rights violations may be displayed and signed by meetings participants acting in their individual capacities.

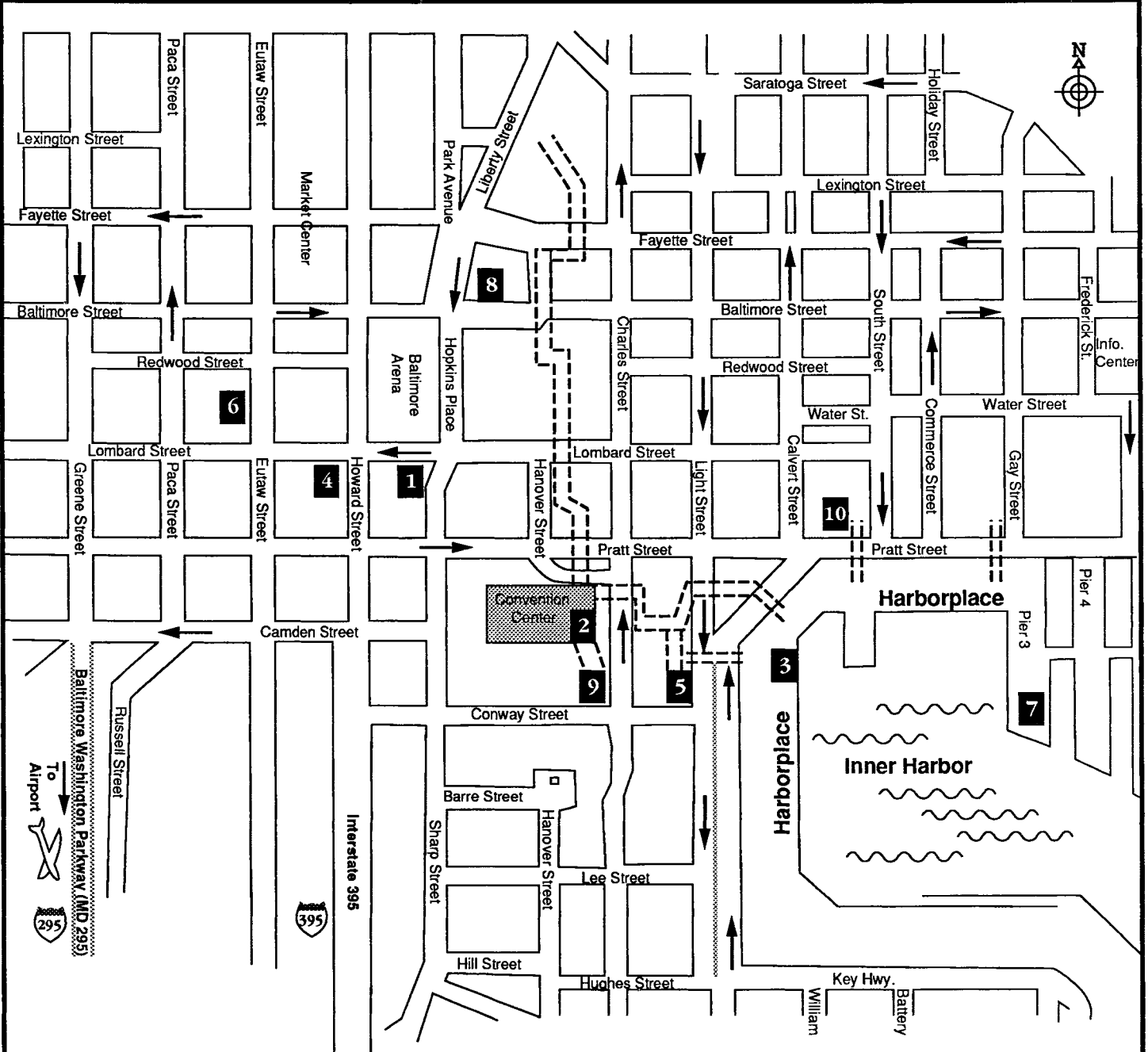
Signs of moderate size may be displayed at the table, but must not represent that the case of the individual in question is backed by the Committee on Human Rights unless it has, in fact, so voted. Volunteers may be present at the table to provide information on individual cases, but notice must be sent at least seven (7) days in advance of the meetings to the Director of Meetings in Providence (telephone 401-455-4137). Since space is limited, it may also be necessary to limit the number of volunteers present at the table at any one time. The Committee on Human Rights may delegate a person to be present at the table at any or all times, taking precedence over other volunteers.

Any material which is not a petition (e.g., advertisements, résumés) will be removed by the staff. **When registration closes, any material on the table will be discarded, so individuals placing petitions on the table should be sure to remove them prior to the close of registration.**



**Telephone Messages:** A telephone message center is located in the registration area to receive incoming calls for participants. **The center is open from January 7 through 11 during the hours that the 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 410-234-1501.

**Travel:** Baltimore-Washington International Airport, located 14 miles south of Baltimore, is served by all major airlines. Shuttle vans depart the airport every 30 minutes from 5:30 a.m. to 11:00 p.m., and stop at major downtown

# Downtown Baltimore



- |                       |                       |
|-----------------------|-----------------------|
| 1 - Days Inn Hotel    | 6 - Marriott          |
| 2 - Convention Center | 7 - National Aquarium |
| 3 - Harborplace       | 8 - Omni              |
| 4 - Holiday Inn       | 9 - Sheraton          |
| 5 - Hyatt             | 10 - Stouffers        |

 Indicate directions on one-way streets  
 Indicates skywalk

**JOINT MATHEMATICS MEETINGS  
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TRAVCON, INC., the official travel management firm for the January 8-11, 1992 Joint Mathematics Meetings to be held in Baltimore, Maryland, has arranged for special discounts aboard US Air.\*

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\*US Air has been designated as the official airline carrier for the Baltimore Meeting because it provides the most convenient service for the majority of participants from across the country. However, if US Air does not provide convenient service from your area, TRAVCON will be happy to inform you of the most convenient flights and lowest available airfare on other airlines.

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hotels. The fare is \$6.50 one way and \$12 round trip. For information or reservations, telephone 301-859-0800. Taxi fare from the airport to downtown hotels is metered, and costs approximately \$17 for up to four people.

Some Amtrak trains and some MARC commuter trains traveling north stop at the BWI station, then at Penn Station in Baltimore. The approximate frequency is two trains per hour. For information, call Amtrak at 1-800-872-7245 or MARC at 1-800-325-7245.

Driving directions: From the northeast, travel south on I-95, continue through the Ft. McHenry tunnel. Exit shortly past the tunnel at I-395 (Exit 53, marked "Downtown"), and take it until it ends. Then follow signs to the Inner Harbor. From the north, travel south on I-83, remain on I-83 until it ends. Proceed south to Lombard Street, then west to St. Paul, then south to the Inner Harbor. From the west, travel east on I-70 and exit at the Baltimore beltway (I-695). Proceed south (counterclockwise) to I-95. Take I-95 north to downtown, as from the south. From the south, travel north on I-95, exit at I-395 (Exit 53, marked "Downtown"), and take it until it ends. Then follow signs to the Inner Harbor.

For some years now, the AMS-MAA Joint Meetings Committee has engaged a travel agent for the January and August meetings in an effort to ensure that everyone attending these meetings is able to obtain the best possible airfare. This service is being performed by TRAVCON; their advertisement can be found elsewhere in this meeting announcement.

**Weather:** January weather in Baltimore is generally cool and cloudy. Normal daily maximum and minimum temperatures are 41.0° F (5.0° C) and 24.3° F (-4.2° C), with extremes of 75° F (24° C) and -7° F (-22° C). On the average, 23 days of the month are cloudy or partly cloudy, and precipitation — totaling 3 inches and usually rain — occurs on 10 days.

#### *Joint Program Committee*

Members of the AMS-MAA Joint Program Committee are Nancy K. Stanton (Chair), Roger A. Horn, Raymond L. Johnson, and Gerald J. Porter.

#### *AMS Program Committee for National Meetings*

Members are James G. Arthur, Spencer Bloch, Robert M. Fossum (ex-officio), Dusa McDuff, Peter Sarnak, Nancy K. Stanton, and Jean E. Taylor (Chair).

#### *MAA Program Committee*

Members are David W. Ballew, Susan J. Devlin, B. A. Fusaro, Leon Henkin, Roger Horn (Chair), Raymond L. Johnson, L. Carl Leinbach, Louise A. Raphael, and Lawrence C. Washington.

#### *Local Arrangements Committee*

The members of the Local Arrangements Committee are Thomas E. Armstrong, John Chollet, Marie A. Dowling, James F. Gilroy, William H. Jaco (ex-officio), Alan F. Karr (Chair), Nathaniel Knox, Robert LeWand, George Mackiw, Kenneth A. Ross (ex-officio), Lance W. Small (ex-officio), and Marcia P. Sward (ex-officio).



## Selfadjoint and Nonselfadjoint Operator Algebras and Operator Theory

(Contemporary Mathematics, Volume 120)

**Robert S. Doran, Editor**

This book contains papers presented at the NSF/CBMS Regional Conference on Coordinates in Operator Algebras, held at Texas Christian University in Fort Worth in May 1990. During the conference, in addition to a series of ten lectures by Paul S. Muhly (which will be published in a CBMS Regional Conference Series volume), there were twenty-eight lectures delivered by conference participants on a broad range of topics of current interest in operator algebras and operator theory. This volume contains slightly expanded versions of most of those lectures. Participants were encouraged to bring open problems to the conference, and, as a result, there are over one hundred problems and questions scattered throughout this volume. Readers will appreciate this book for the overview it provides of current topics and methods of operator algebras and operator theory.

1991 *Mathematics Subject Classification*: 22, 46, 47; 05, 06, 18, 20, 57

ISBN 0-8218-5127-6, LC 91-19767, ISSN 0271-4132; 215 pages (softcover), July 1991

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# Timetable

(Eastern Standard Time)

All sessions will be held in the Baltimore Convention Center and the Hyatt Regency Baltimore.

**Monday,  
January 6**

**AMS SHORT COURSE SERIES**  
*New Scientific Applications of Geometry and Topology*

MORNING		AFTERNOON
9:00 a.m.–2:30 p.m.	SHORT COURSE REGISTRATION	1:30 p.m.–2:45 p.m.
10:30 a.m.–10:45 a.m.	<i>Introduction, De Witt L. Sumners</i>	SHORT COURSE LECTURE #2 <i>Geometry and topology of DNA and DNA-protein interactions</i> <b>James H. White</b>
10:45 a.m.–noon	SHORT COURSE LECTURE #1 <i>Mathematical approaches to DNA structure and function</i> <b>Nicholas R. Cozzarelli</b>	3:00 p.m.–4:15 p.m.
		SHORT COURSE LECTURE #3 <i>Knot theory and DNA</i> <b>De Witt L. Sumners</b> Discussion period
		4:15 p.m.–4:45 p.m.

**Tuesday,  
January 7**

	American Mathematical Society	Mathematical Association of America	Other Organizations
<b>MORNING</b>		BOARD OF GOVERNORS' MEETING	
8:00 a.m.–4:00 p.m.			
8:30 a.m.–11:30 a.m.	SHORT COURSE REGISTRATION		
9:00 a.m.–10:15 a.m.	SHORT COURSE LECTURE #4 <i>The topology of polymers</i> <b>Stuart G. Whittington</b>		
10:45 a.m.–noon	SHORT COURSE LECTURE #5 <i>Knots and chemistry</i> <b>Jonathan K. Simon</b>		
<b>AFTERNOON</b>			
2:00 p.m.–3:15 p.m.	SHORT COURSE LECTURE #6 <i>Knots and physics</i> <b>Louis H. Kauffman</b>		
2:00 p.m.–7:00 p.m.	COUNCIL MEETING		
3:00 p.m.–7:00 p.m.	<div style="border: 1px solid black; padding: 5px;">           REGISTRATION FOR JOINT MEETINGS            Sharp Street Lobby, Baltimore Convention Center         </div>		

**TIMETABLE**

<b>Tuesday, January 7 (cont'd)</b>	American Mathematical Society	Mathematical Association of America	Other Organizations
<b>AFTERNOON</b> (cont'd)  3:15 p.m. – 3:45 p.m.	SHORT COURSE Discussion period		
<b>EVENING</b>  7:00 p.m. – 9:00 p.m.		SECTION OFFICERS' MEETING	
<b>Wednesday, January 8</b>	American Mathematical Society	Mathematical Association of America	Other Organizations
<b>MORNING</b>			
7:30 a.m. – 4:00 p.m.	EMPLOYMENT REGISTER		
9:00 a.m. – 9:30 a.m.	EMPLOYMENT REGISTER ORIENTATION SESSION		
7:30 a.m. – 4:00 p.m.	REGISTRATION Sharp Street Lobby, Baltimore Convention Center		
8:00 a.m. – 10:55 a.m.	SPECIAL SESSIONS Design and codes, I  Index Theory, I  Classical real analysis, I  SESSIONS FOR CONTRIBUTED PAPERS	CONTRIBUTED PAPER SESSIONS <i>Mathematics placement testing programs: Their organization, administration, and problems, Part A</i> <b>Rose Hamm</b> <b>John G. Harvey</b>  <i>Innovations in mathematics courses for business, Part A</i> <b>Wade Ellis, Jr.</b> <b>Barbara A. Jur</b>  <i>Using spreadsheets to teach mathematics, Part A</i> <b>Robert S. Smith</b>	
8:00 a.m. – 10:00 a.m.		MINICOURSE #1 (Part A) <i>Alternatives to the lecture method in collegiate mathematics</i> <b>Julian Weissglass</b>  MINICOURSE #2 (Part A) <i>The Harvard calculus reform project: Hands-on experience with the project materials</i> <b>Deborah Hughes Hallett</b> <b>Sheldon P. Gordon</b> <b>William McCallum</b> <b>Thomas W. Tucker</b>	

**TIMETABLE**

**Wednesday,  
January 8 (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**MORNING (cont'd)**

8:00 a.m.–10:00 a.m.

MINICOURSE #3 (Part A)  
*Using history in teaching calculus*  
**V. Frederick Rickey**

8:00 a.m.–9:20 pm

COMMITTEE ON  
MATHEMATICIANS OUTSIDE  
ACADEMIA PANEL DISCUSSION  
*Mathematical life outside academia:  
Input from the real world*  
**S. Brent Morris, moderator**

BOARD ON MATHEMATICAL  
SCIENCES PANEL  
DISCUSSION  
*Educating mathematicians*  
**Ronald G. Douglas, organizer**

ICME-7 PANEL DISCUSSION  
**Florence D. Fasanelli**  
**Bernard R. Hodgson**  
**Martin Johnson**  
**Paul Zorn**  
**Eileen Poiani, chair**

9:15 a.m.–9:30 a.m.

WELCOME ADDRESS

9:30 a.m.–10:55 a.m.

AMS-MAA SCIENCE POLICY COMMITTEES  
PANEL DISCUSSION  
*Values and rewards in the mathematics  
profession*  
**John A. Thorpe, organizer**

10:05 a.m.–10:55 a.m.

RETIRING PRESIDENTIAL  
ADDRESS  
*Title to be announced*  
**William Browder**

11:10 a.m.–noon

AMS-MAA INVITED ADDRESS  
*A new look at knot polynomials*  
**Joan S. Birman**

**AFTERNOON**

noon–1:00 p.m.

NATIONAL SCIENCE FOUNDATION  
Informal Discussion Group

1:00 p.m.–2:00 p.m.

COLLOQUIUM LECTURE I  
*Title to be announced*  
**Robert P. Langlands**



**TIMETABLE**

**Wednesday,  
January 8 (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**AFTERNOON  
(CONT'D)**

1:00 p.m.– 5:00 p.m.

BOOK SALE

BOOK SALE

EXHIBITS

2:15 p.m.– 3:05 p.m.

JOHN VON NEUMANN  
PRESENTATION  
*The philosophical legacy of John von  
Neumann*  
**Nicholas A. Vonneumann**

2:15 p.m.– 5:30 p.m.

AMS-MAA SPECIAL SESSION  
*Mathematics and education reform, I*  
**Naomi D. Fisher**  
**Harvey B. Keynes**  
**Philip D. Wagreich**

2:15 p.m.– 6:00 p.m.

SPECIAL SESSIONS  
*Design and codes, II*

*Iteration and factorization of entire  
and meromorphic functions, I*

*Classical and real analysis, II*

*Interaction of harmonic analysis,  
signal processing, and computational  
mathematics, I*

*Index theory, II*

CONTRIBUTED PAPER SESSIONS

*The "seven-into-four" problem,  
Part A*  
**David H. Carlson**  
**Ann Watkins**

*Mathematics placement testing  
programs: their organization,  
administration, and problems, Part B*  
**Rose Hamm**  
**John G. Harvey**

SESSIONS FOR CONTRIBUTED  
PAPERS

2:15 p.m.– 4:15 p.m.

MINICOURSE #4 (Part A)  
*Environmental modeling*  
**Robert McKelvey**

MINICOURSE #17  
*Advanced workshop on Derive*  
**David R. Stoutemyer**

3:20 p.m.– 4:20 p.m.

INVITED ADDRESS  
*Title to be announced*  
**James W. Demmel**

ASSOCIATION FOR WOMEN  
IN MATHEMATICS (AWM)  
PANEL DISCUSSION

4:15 p.m.– 6:00 p.m.

SPECIAL SESSION  
*Environmental modeling, I*  
**B. A. Fusaro**

4:20 p.m.– 4:50 p.m.

AWM BUSINESS MEETING

**TIMETABLE**

**Wednesday,  
January 8 (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**AFTERNOON  
(CONT'D)**

4:25 p.m.– 5:15 p.m.

INVITED ADDRESS  
*On the border of symplectic  
geometry and complex analysis*  
**Yakov Eliashberg**

4:30 p.m.– 6:00 p.m.

ELEMENTARY SCHOOL  
TEACHERS' RECEPTION

4:30 p.m.– 6:30 p.m.

MINICOURSE #5 (Part A)  
*Using group projects in calculus*  
**Stephen Hilbert**  
**John Maceli**  
**Eric Robinson**  
**Diane Schwartz**  
**Stanly Seltzer**

5:45 p.m. - 6:45 p.m.

MINICOURSE #6 (Part A)  
*Introduction to research in the  
teaching and learning of  
undergraduate mathematics:  
Examples in calculus*  
**Joan Ferrini-Mundy**  
**Kathleen Heid**

NSF SESSION  
*The changing environment for  
NSF funding of research and  
education*

6:00 p.m.– 7:00 p.m.

NEW ATTENDEES SOCIAL

6:00 p.m.– 8:15 p.m.

MATHEMATICIANS AND  
EDUCATION REFORM  
BANQUET

7:15 p.m.– 8:15 p.m.

AMS-MAA SPECIAL PRESENTATION  
*The agency that came in from the cold*  
**Richard J. Shaker**

8:30 p.m.– 9:30 p.m.

JOSIAH WILLARD GIBBS  
LECTURE  
Title to be announced  
**Michael E. Fisher**

9:30 p.m.–11:00 p.m.

AWM OPEN RECEPTION

**Thursday,  
January 9**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**MORNING**

7:30 a.m.– 4:00 p.m.

REGISTRATION  
Sharp Street Lobby, Baltimore Convention Center

**TIMETABLE**

**Thursday,  
January 9, (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**MORNING** (cont'd)

8:00 a.m.–10:55 a.m.

**AMS-MAA SPECIAL SESSION**  
*Mathematics and education reform, II*

**SPECIAL SESSIONS**

*Bergman spaces, I*

*Symplectic topology, I*

*Iteration and factorization of entire  
and meromorphic functions, II*

*Design and codes, III*

*Interaction of harmonic analysis,  
signal processing, and computational  
mathematics, II*

*Function theoretic methods in partial  
differential equations, I*

*Index theory, III*

**CONTRIBUTED PAPER SESSIONS**

*Environmental mathematics (Part A)*  
**B. A. Fusaro**  
**Margaret Barry Cozzens**

*Research in undergraduate  
mathematics education, (Part A)*  
**Ed Dubinsky**

8:00 a.m.–10:00 a.m.

**SESSIONS FOR CONTRIBUTED  
PAPERS**

**MINICOURSE #7 (Part A)**  
*Using NETPAD software to teach  
and learn about graphs*  
**Nathaniel Dean**  
**Joseph G. Rosenstein**

**MINICOURSE #8 (Part A)**  
*CAS laboratory projects for first year  
calculus using DERIVE*  
**Carl L. Leinbach**  
**Marvin L. Brubaker**

8:30 a.m.– 9:50 a.m.

**VISITING LECTURES COMMITTEE  
PANEL DISCUSSION**  
*How to start and maintain a  
departmental colloquium*  
**Deane Arganbright**  
**Jean B. Chan**  
**Sandy Grabiner**  
**James G. Ware, chair**

**PANEL DISCUSSION**  
*Curriculum initiatives*  
**James R. C. Leitzel, co-organizer**  
**Lynn A. Steen, co-organizer**

9:00 a.m.– 9:50 a.m.

**AWM EMMY NOETHER  
LECTURE**  
Title to be announced  
Nancy Kopell

**TIMETABLE**

**Thursday,  
January 9, (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**MORNING** (cont'd)

9:00 a.m.– 5:00 p.m.

BOOK SALE

BOOK SALE

9:00 a.m.– 5:00 p.m.

EXHIBITS

8:00 a.m.

EMPLOYMENT REGISTER DISTRIBUTION OF SCHEDULES

9:00 a.m.– 5:00 p.m.

EMPLOYMENT REGISTER INTERVIEWS

10:05 a.m.–10:55 a.m.

INVITED ADDRESS  
*Wavelets making waves in  
mathematics and engineering*  
**Ingrid Daubechies**

11:10 a.m.– noon

AMS-MAA ENVIRONMENTAL ADDRESS  
The problems of scale in ecology  
**Simon A. Levin**

**AFTERNOON**

noon– 1:00 p.m.

NATIONAL SCIENCE FOUNDATION  
Informal Discussion Group

1:00 p.m.– 2:00 p.m.

COLLOQUIUM LECTURE, II  
Title to be announced  
**Robert P. Langlands**

2:15 p.m.– 3:05 p.m.

INVITED ADDRESS  
*Holomorphic mappings from  $C^n$  to  $C^n$*   
**Walter Rudin**

2:15 p.m.– 3:15 p.m.

STUDENT PRESENTATION  
*The art of mental calculation*  
**Arthur T. Benjamin**

2:15 p.m.– 4:10 p.m.

SPECIAL SESSIONS  
*Design and codes, IV*  
  
*Interaction of harmonic analysis,  
signal processing, and computational  
mathematics, III*

CONTRIBUTED PAPER SESSION  
*Inovations in mathematics courses  
for business, Part B*  
**Wade Ellis, Jr.**  
**Barbara A. Jur**

**TIMETABLE**

**Thursday,  
January 9, (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**AFTERNOON**  
(cont'd)

2:15 p.m.– 4:10 p.m.

**SPECIAL SESSIONS**  
*Symplectic topology, II*

*Classical and real analysis, III*

*Iteration and factorization of entire  
and meromorphic functions, III*

*Index theory, IV*

**CONTRIBUTED PAPER SESSIONS**  
*A toolbox for liberal arts mathematics  
courses, Part A*  
**John Emert**  
**Kay Meeks**

*Using spreadsheets to teach  
mathematics, Part B*  
**Robert S. Smith**

2:15 p.m.– 4:10 p.m.

**SESSIONS FOR CONTRIBUTED  
PAPERS**

**COMMITTEE ON THE  
MATHEMATICAL EDUCATION OF  
TEACHERS AND THE COMMITTEE  
ON THE TEACHING OF  
UNDERGRADUATE  
MATHEMATICS PANEL  
DISCUSSION**  
*Preparing teachers of mathematics*  
**Betty Anne Case**  
**Ed Dubinsky**  
**Patricia L. Jones**  
**Glenda Lappan**  
**James R. C. Leitzel, co-moderator**  
**Don R. Lick, co-moderator**

**MINICOURSE #2 (Part B)**  
*The Harvard calculus reform project:  
Hands-on experience with the  
project materials*  
**Deborah Hughes Hallett**  
**Sheldon P. Gordon**  
**William McCallum**  
**Thomas W. Tucker**

**MINICOURSE #3 (Part B)**  
*Using history in teaching calculus*  
**V. Frederick Rickey**

**MINICOURSE #4 (Part B)**  
*Environmental modeling*  
**Robert McKelvey**

**MINICOURSE #9 (Part A)**  
*Learning abstract algebra by  
programming in ISETL*  
**Ed Dubinsky**  
**Uri Leron**

3:20 p.m.– 4:10 p.m.

**INVITED ADDRESS**  
Title to be announced  
**Michael Shearer**

**TIMETABLE**

<b>Thursday, January 9, (cont'd)</b>	American Mathematical Society	Mathematical Association of America	Other Organizations
<b>AFTERNOON</b> (cont'd)  4:00 p.m.– 7:00 p.m.  4:25 p.m.– 6:00 p.m.	   <b>AMS PRIZE SESSION AND BUSINESS MEETING</b>	   <b>CAREER FAIR</b>	
<b>EVENING</b>  6:15 p.m.– 7:30 p.m.  6:15 p.m.– 8:00 p.m.  7:00 p.m.– 9:00 p.m.  7:00 p.m.–10:00 p.m.	          <div data-bbox="570 827 1430 911" style="border: 1px solid black; padding: 5px; text-align: center;"> <b>JOINT POLICY BOARD FOR MATHEMATICS AND OFFICE OF GOVERNMENTAL AND PUBLIC AFFAIRS SESSION</b> </div>          <div data-bbox="566 1432 1057 1545" style="border: 1px solid black; padding: 5px; text-align: center;"> <b>AMS-MAA PANEL DISCUSSION</b>  <i>Linear algebra in the undergraduate curriculum</i>  <b>A. Duane Porter, moderator</b> </div>	   <b>TWO-YEAR COLLEGE RECEPTION</b>          <b>MINICOURSE #5 (Part B)</b> <i>Using group projects in calculus</i> <b>Stephen Hilbert</b> <b>John Maceli</b> <b>Eric Robinson</b> <b>Diane Schwartz</b> <b>Stanley Seltzer</b>  <b>MINICOURSE #10 (Part A)</b> <i>How to make effective use of inexpensive pocket computers to develop the concepts and techniques of calculus</i> <b>Franklin Demana</b> <b>Bert K. Waits</b>	          <b>COMAP COUNCIL MEETING</b>
<b>Friday, January 10</b>	American Mathematical Society	Mathematical Association of America	Other Organizations
<b>MORNING</b>  7:30 a.m.– 4:00 p.m.		<div data-bbox="570 1835 1430 1902" style="border: 1px solid black; padding: 5px; text-align: center;"> <b>REGISTRATION</b>            Spring Street Lobby, Baltimore Convention Center         </div>	

**TIMETABLE**

**Friday,  
January 10, (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**MORNING** (cont'd)

8:00 a.m.–9:20 a.m.

CTUM PANEL DISCUSSION  
*The source book for college  
mathematics teaching*  
**Carol Ann Bauer**  
**Ed Dubinsky**  
**Don R. Lick, moderator**  
**Peter Ross**  
**Alan H. Schoenfeld**

PANEL DISCUSSION  
*Statistics for the twenty-first century*  
**Florence S. Gordon**  
**Sheldon P. Gordon**

MINICOURSE #11 (Part A)  
*Instituting a mathematics placement  
program: Creating order out of  
chaos in freshman mathematics*  
**Philip C. Curtis Jr.**

MINICOURSE #12 (Part A)  
*Mathematical modeling with a  
spreadsheet*  
**Stephen D. Comer**  
**Hughes B. Hoyle III**

MINICOURSE #13 (Part A)  
*Integrating calculus and physics for  
freshman*  
**Joan R. Hundhausen**  
**F. Richard Yeatts**

MINICOURSE #14 (Part A)  
*The Fibonacci and Catalan numbers*  
**Ralph P. Grimaldi**

8:00 a.m.–10:00 a.m.

CONTRIBUTED PAPER SESSIONS  
*Research in undergraduate  
education, Part B*  
**Ed Dubinsky**

*A toolbox for liberal arts mathematics  
courses, Part B*  
**John Emert**  
**Kay Meeks**

*Mathematics for the health sciences,  
Part A*  
**Henry C. Foehl**

8:00 a.m.–10:55 a.m.

SPECIAL SESSIONS  
Bergman spaces, II

History of mathematics, I

Invariant theory, I

Stability and control, I

Algebraic topology, I

SESSIONS FOR CONTRIBUTED  
PAPERS

**TIMETABLE**

**Friday,  
January 10, (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**MORNING** (cont'd)

8:00 a.m.–10:55 a.m.

AMS-MAA SPECIAL SESSION  
*Mathematics and education reform*  
**Naomi D. Fisher**  
**Harvey B. Keynes**  
**Philip D. Wagreich**

8:00 a.m.

EMPLOYMENT REGISTER DISTRIBUTION OF SCHEDULES

9:00 a.m.– 5:00 p.m.

EMPLOYMENT REGISTER INTERVIEWS

9:00 a.m.– 9:50 a.m.

INVITED ADDRESS  
*Lie groups in ergodic theory*  
**Marina Ratner**

9:00 a.m.–10:55 a.m.

SUMMA WORKSHOP  
**Winson Coleman**  
**Carol Malloy**

NATIONAL ASSOCIATION  
OF MATHEMATICIANS  
(NAM) SESSION  
*Presentations by recent  
doctoral recipients*  
**Gerald Chachere, moderator**

9:00 a.m.– 5:00 p.m.

BOOK SALE

BOOK SALE

9:00 a.m.– 5:00 p.m.

EXHIBITS

9:30 a.m.–10:55 a.m.

AD HOC COMMITTEE ON  
MATHEMATICS AND THE  
ENVIRONMENT PANEL  
DISCUSSION  
*Getting started*  
**B. A. Fusaro, chair**

CUPM SUBCOMMITTEE ON  
CALCULUS REFORMS AND THE  
FIRST TWO YEARS (CRAFTY)  
PANEL DISCUSSION  
*Site testing of new calculus projects*  
**Tom Dick**  
**Ed Dubinsky**  
**Deborah Hughes Hallett**  
**David A. Smith**  
**Wayne Roberts**



**TIMETABLE**

<b>Friday, January 10, (cont'd)</b>	American Mathematical Society	Mathematical Association of America	Other Organizations
<b>MORNING</b> (cont'd)  10:05 a.m.–10:55 a.m.   11:10 a.m.– noon	COMMITTEE ON SCIENCE POLICY GOVERNMENT SPEAKER Speaker and title to be announced	<div data-bbox="516 552 1042 667" style="border: 1px solid black; padding: 5px; text-align: center;">             AMS-MAA INVITED ADDRESS  <i>Optimization for extended services for heat transfer</i>  <b>J. Ernest Wilkins, Jr.</b> </div>	
<b>AFTERNOON</b>  noon– 1:00 p.m.   noon– 1:00 p.m.  1:00 p.m.– 2:00 p.m.  1:00 p.m.– 4:10 p.m.   2:00 p.m.– 4:00 p.m.	<div data-bbox="516 768 1390 869" style="border: 1px solid black; padding: 5px; text-align: center;">             NATIONAL SCIENCE FOUNDATION              Informal Discussion Group           </div> COLLOQUIUM LECTURE III Title to be announced <b>Robert P. Langlands</b>  SPECIAL SESSIONS <i>Preparing the college mathematics            teachers of the future, I</i>  <i>Bergman spaces, III</i>  <i>Symplectic topology, III</i>  <i>Environmental modeling, II</i>  <i>Invariant theory, II</i>  <i>Function theoretic methods in partial            differential equations, II</i>  <i>Stability and control, II</i>  <i>Algebraic topology, II</i>  SESSIONS FOR CONTRIBUTED PAPERS	CONTRIBUTED PAPER SESSIONS <i>The "seven-into-four" problem,            Part B</i> <b>David H. Carlson</b> <b>Ann Watkins</b>  <i>Mathematics for the health sciences,            Part A</i> <b>Henry C. Foehl</b>   MINICOURSE #9 (Part B) <i>Learning abstract algebra by            programming in ISETL</i> <b>Ed Dubinsky</b>	NAM COX-TALBOT ADDRESS AND LUNCHEON Title to be announced <b>Gloria Gilmer</b>          ASSOCIATION OF RESEARCH LIBRARIES SESSION <i>Electronic delivery of scientific            and technical information to            scientists</i> <b>Ann Okerson, organizer</b>

**TIMETABLE**

**Friday,  
January 10, (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**AFTERNOON** (cont'd)

2:00 p.m.– 4:00 p.m.

**MINICOURSE #11 (Part B)**  
*Instituting a mathematics placement  
program: Creating order out of  
chaos in freshman mathematics*  
**Philip C. Curtis, Jr.**

**AD HOC COMMITTEE ON  
MATHEMATICS AND THE  
ENVIRONMENT STUDENT  
WORKSHOP A**  
**B. A. Fusaro, chair**

2:15 p.m.– 3:05 p.m.

**INVITED ADDRESS**  
*Real numbers with bounded partial  
quotients*  
**Jeffrey Shallit**

2:15 p.m.– 4:10 p.m.

**ROCKY MOUNTAIN  
MATHEMATICS  
CONSORTIUM BOARD OF  
DIRECTORS' MEETING**

3:20 p.m.– 4:10 p.m.

**RETIRING PRESIDENTIAL  
ADDRESS**  
*Mathematics goes public*  
**Lida K. Barrett**

4:25 p.m.– 5:30 p.m.

**PRIZE SESSION AND BUSINESS  
MEETING**

**EVENING**

6:00 p.m.– 7:00 p.m.

**SESSIONS FOR REVIEWERS FOR  
MATHEMATICAL REVIEWS**

7:00 p.m.– 9:00 p.m.

**MINICOURSE #15 (Part A)**  
*Why, when, and how to use CAS  
calculators in calculus and linear  
algebra instruction*  
**John Kenelly**  
**Donald R. LaTorre**

**MINICOURSE #16 (Part A)**  
*Challenging students with research  
projects in calculus*  
**Douglas Kurtz**  
**David Pengeley**

**TIMETABLE**

<b>Friday, January 10, (cont'd)</b>	American Mathematical Society	Mathematical Association of America	Other Organizations
<b>EVENING</b> (cont'd)			
7:00 p.m.–10:00 p.m.		<b>POETRY READINGS</b> <b>JoAnne Growney</b> <b>Dan Kalman</b> <b>Elena Marchisotto</b>	
7:30 p.m.– 8:20 p.m.		<b>COMMITTEE ON STUDENT CHAPTERS SPECIAL LECTURE</b> <i>Contemporary problems in graph theory</i> <b>Carolyn Mahoney</b>	
7:30 p.m.– 9:00 p.m.		<b>CAS WORKSHOP REUNION</b> <b>Donald B. Small, organizer</b>	
7:30 p.m.– 9:30 p.m.		<b>COMMITTEE ON THE PARTICIPATION OF WOMEN</b> <i>New 1991 skits</i> <b>Patricia C. Kenschaft</b>	
8:30p.m.–10:00 p.m.	<b>COMMITTEE ON SCIENCE POLICY PANEL DISCUSSION</b> Title and speakers to be announced		
<b>Saturday, January 11</b>	American Mathematical Society	Mathematical Association of America	Other Organizations
<b>MORNING</b>			
7:30 a.m.– 3:00 p.m.	<b>REGISTRATION</b> Sharp Street Lobby, Baltimore Convention Center		
8:00 a.m.– 8:50 a.m.		<b>CUPM SUBCOMMITTEE ON SYMBOLIC COMPUTER SYSTEMS SPECIAL PRESENTATION</b> <i>Processes and symbols in the mind</i> <b>Zaven A. Karian</b>	
8:00 a.m.–10:55 a.m.	<b>SPECIAL SESSIONS</b> <i>Preparing the college mathematics teacher for the future, II</i>  <i>Symplectic topology, IV</i>  <i>History of mathematics, II</i>  <i>Invariant theory, III</i>  <i>Function theoretic methods in partial differential equations, III</i>	<b>MINICOURSE #7 (Part B)</b> <i>Using NETPAD software to teach and learn about graphs</i> <b>Nathaniel Dean</b> <b>Joseph G. Rosenstein</b>  <b>MINICOURSE #8 (Part B)</b> <i>CAS laboratory projects for first year calculus using DERIVE</i> <b>Carl L. Leinbach</b> <b>Marvin L. Brubaker</b>	

**TIMETABLE**

**Saturday,  
January 11**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**MORNING**

8:00 a.m.–10:55 a.m.

*Stability and control, III*  
*Algebraic topology, III*  
SESSIONS FOR CONTRIBUTED  
PAPERS

CONTRIBUTED PAPER SESSIONS  
*Environmental mathematics, Part B*  
**B. A. Fusaro**  
**Margaret Barry Cozzens**  
  
*Actuarial mathematics education and  
research, Part A*  
**James W. Daniel**

8:30 a.m.–10:00 a.m.

COMMITTEE ON EDUCATION  
PANEL DISCUSSION  
Title and speakers to be announced  
**Ramesh A. Gangolli, chair**

9:00 a.m.– 9:50 a.m.

INVITED ADDRESS  
Title to be announced  
**David H. Carlson**

9:00 a.m.–10:00 a.m.

NAM PANEL DISCUSSION  
*The fate of minority  
mathematics students*  
**William A. Hawkins,**  
**moderator**

9:00 a.m.–11:00 a.m.

AD HOC COMMITTEE ON  
MATHEMATICS AND THE  
ENVIRONMENT STUDENT  
WORKSHOP B  
**B. A. Fusaro, chair**

9:00 a.m.– noon

BOOK SALE

BOOK SALE

9:00 a.m.– noon

EXHIBITS

10:00 a.m.–10:55 a.m.

NAM BUSINESS MEETING

10:05 a.m.–10:55 a.m.

INVITED ADDRESS  
*Problems in mathematics: East  
Asian and the United States*  
**Harold Stevenson**

11:10 a.m.– noon

AMS-MAA INVITED ADDRESS  
*The current interface of geometry and elementary  
particle physics*  
**I. M. Singer**

**TIMETABLE**

**Saturday,  
January 11, (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**AFTERNOON**

noon– 1:00 p.m.

NATIONAL SCIENCE FOUNDATION  
Informal Discussion Group

1:00 p.m.– 2:00 p.m.

POETRY READING  
*The calculus virgin*  
**Louis Leithold**  
**d'Arcy Hayman**

1:00 p.m.– 3:00 p.m.

CEEB-MAA COLLEGE BOARD  
COMMITTEE ON MUTUAL  
CONCERNS PANEL DISCUSSION  
*The AP calculus program*  
**Philip C. Curtis, Jr.**  
**Carole E. Greenes**

CUPM SUBCOMMITTEE ON  
SYMBOLIC COMPUTER SYSTEMS  
PANEL DISCUSSION  
**Zaren A. Karian, chair**

1:00 p.m.– 5:30 p.m.

SPECIAL SESSIONS  
*Preparing the college mathematics  
teacher for the future, III*

*History of mathematics, III*

SESSIONS FOR CONTRIBUTED  
PAPERS

CONTRIBUTED PAPER SESSIONS  
*Environmental mathematics, Part C*  
**B. A. Fusaro**  
**Margaret Barry Cozzens**

*Actuarial mathematics education and  
research, Part B*  
**James W. Daniel**

1:00 p.m.– 3:00 p.m.

MINICOURSE #6 (Part B)  
*Introduction to research in the  
teaching and learning of  
undergraduate mathematics:  
Examples in calculus*  
**Joan Ferrini-Mundy**  
**Kathleen Heid**

MINICOURSE #10 (Part B)  
*How to make effective use of  
inexpensive pocket computers to  
develop the concepts and  
techniques of calculus*  
**Franklin Demana**  
**Bert K. Waits**

MINICOURSE #12 (Part B)  
*Mathematical modeling with a  
spreadsheet*  
**Stephen D. Comer**  
**Hughes B. Hoyle III**

**TIMETABLE**

**Saturday,  
January 11, (cont'd)**

American  
Mathematical Society

Mathematical  
Association of America

Other  
Organizations

**AFTERNOON** (cont'd)

1:00 p.m.– 3:00 p.m.

MINICOURSE #13 (Part B)  
*Integrating calculus and physics for  
freshman*  
**Joan R. Hundhausen**  
**F. Richard Yeatts**

3:30 p.m.– 5:30 p.m.

MINICOURSE #9 (Part C)  
*Learning abstract algebra by  
programming in ISETL*  
**Ed Dubinsky**  
**Uri Leron**

MINICOURSE #14 (Part B)  
*The Fibonacci and Catalan numbers*  
**Ralph P. Grimaldi**

MINICOURSE #15 (Part B)  
*Why, when, and how to use CAS  
calculators in calculus and linear  
algebra instruction*  
**John Kenelly**  
**Donald R. LaTorre**

MINICOURSE #16 (Part B)  
*Challenging students with research  
projects in calculus*  
**Douglas Kurtz**  
**David Pengelley**

**EVENING**

5:15 p.m.– 6:45 p.m.

AMS-MAA CONCERT  
**William Browder**  
**Leonard Gillman**

7:30 p.m.–10:00 p.m.

25-YEAR-MEMBER BANQUET

American Mathematical Society Short Course Series

**Introductory Survey Lectures on**  
***New Scientific Applications of Geometry and Topology***  
Baltimore, Maryland, January 6-7, 1992

The Society gratefully acknowledges the support of Genentech, Inc. for the Short Course in Baltimore. Please see the related article in the News and Announcements section in this issue of *Notices*.

The American Mathematical Society, in conjunction with its ninety-eighth Annual Meeting, will present a two day Short Course entitled "New Scientific Applications of Geometry and Topology" on Monday and Tuesday, January 6-7, 1992, at Baltimore Convention Center, Baltimore, Maryland. The program is under the direction of De Witt Sumners of The Florida State University.

During the last decade, experimental scientists have become increasingly aware that geometry and topology can be used in the interpretation and design of experiments. Molecular biologists use differential geometry and knot theory in the analysis of experiments on circular DNA molecules which elucidate spatial conformation (helical twist and supercoiling) and the mechanism of life-sustaining enzymes (topoisomerases and recombinases). Chemists synthesize molecular knots and links and study the chemical and physical ramifications of random topological entanglement in polymers. Knot theory is the common ground for topology and physics where a new spectrum of invariants for knots and 3-manifolds has been born. This Short Course will introduce both the mathematics and science necessary for the understanding of these and other applications.

**Monday, January 6, 1992**

**Nicholas R. Cozzarelli**, Department of Molecular and Cell Biology, University of California, Berkeley, *Mathematical approaches to DNA structure and function*

**James H. White**, University of California, Los Angeles, *Geometry and topology of DNA and DNA-protein interactions*

**De Witt L. Sumners**, Florida State University, *Knot theory and DNA*

**Tuesday, January 7, 1992**

**Stuart G. Whittington**, Department of Chemistry, University of Toronto, *The topology of polymers*

**Jonathan K. Simon**, University of Iowa, *Knots and chemistry*

**Louis H. Kauffman**, University of Illinois at Chicago, *Knots and physics*

Synopses and accompanying reading lists follow. Lecture notes will be mailed to those who preregister and will be available at the Short Course registration desk for those registering on site.

Advance registration fee: \$60 (\$25 student/unemployed/emeritus). Onsite registration fee: \$75 (\$30 student/unemployed/emeritus). Registration and housing information can be found in this issue of *Notices*, see the section **How to preregister and get a room in the meetings section.**

**Synopses and Reading Lists:**

**Mathematical Approaches to DNA Structure and Function** (Nicholas R. Cozzarelli). The genetic information for all organisms is encoded in a linear fashion in the extremely long biopolymer called deoxyribonucleic acid (DNA). DNA can be considered to be two strings helically wound around each other. Each string may be joined to itself at the ends and at regular intervals along its length. This isolates topologically closed domains which are characterized by a linking number, LK, between the strings. LK is less than that of an unconstrained DNA molecule and this stress in the DNA causes it to coil up in a regular and compact form called supercoiling. The DNA in all organisms is supercoiled to about the same degree. The LK is controlled by enzymes called topoisomerases that have the remarkable ability to pass DNA molecules through each other. Mutations and drugs, including many cancer chemotherapeutic agents, that inhibit topoisomerases immediately kill cells. This proves that the complex topology of DNA is essential for survival.

There are two additional important topological properties of DNA. Circular DNA molecules wind about each other to form links, or catenanes, and DNA molecules get tied up into knots. Knotting and catenation are often essential intermediates in DNA duplication and genetic recombination but like supercoiling must be completely removed to separate the two strings in the distribution to progeny cells. Topoisomerases perform this role of untying knots and unlinking catenanes. The number of possible knots and catenanes that DNA can form is astronomically large and has necessitated the use of topological invariants to describe their structure.

The topology of these forms provides a record of the structure of their precursors and the mechanism of the enzymes that formed them. Thus, topological methods are now used routinely in many areas of biology.

I will discuss how and why DNA supercoils, catenanes, and knots are formed in cells. The methods used to determine DNA topology will be explained and illustrated. Finally, I will give in detail a few specific examples of how topology has been used to understand DNA structure and function.

[1] Steven A. Wasserman and Nicholas R. Cozzarelli, Biochemical topology: Applications to DNA recombination and replication *Science* **232** (1986) 951-960

[2] N. R. Cozzarelli and J. C. Wang (Eds.), *DNA topology and its biological effects*, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1990

[3] James C. Wang, DNA topoisomerases: Nature's solution to the topological ramifications of the double-helix structure of DNA, *The Harvey Lectures Series* 81 (1987), 93-110

[4] W. R. Bauer, F. H. C. Crick, J. H. White, Supercoiled DNA, *Scientific American* **243** (1980), 118-133

[5] Roger D. Kornberg, Aaron Klug, The nucleosome, *Scientific American* **244** (1981), 48-64

[6] Maxim D. Frank-Kamenetskii, Alexandr V. Volgodskii, Topological aspects of the physics of polymers: The theory and its biophysical applications, *Sov. Phys. Usp.* **24**(8) (1981), 679-696

**Geometry and Topology of DNA and DNA-Protein Interactions** ( James H. White). DNA, the primary genetic material of most organisms, is usually visualized as a double helix in which two complementary sugar phosphate backbone chains wind around a straight common axis. It is now clear, however, that often the axis of the double helix is not linear but curved. Indeed, the double helix axis can wind in space to form a new helix of higher order, in which case the DNA is said to be supercoiled. Furthermore, the axes of many DNA are closed curves. In this case the two chains are linked curves, that is, they may not be separated without physical breaking of one or both of the chains. Supercoiling of closed DNA is an extremely important physical property of such DNA. For example the free energy of supercoiling assists processes that require untwisting or denaturation of DNA, such as DNA replication or transcription. That is, it allows strand-binding proteins to force apart the two strands of the DNA double helix, allowing freer access to the genetic information stored in the base sequence. Supercoiling assists the compaction of DNA into the cellular packaging. For example eukaryotic DNA is wound around nucleosomes in a similar manner to thread being wound about a spool. Supercoiling of DNA plays a direct role in bringing together and aligning distant DNA sequences, vital for recombination. Supercoiling also causes changes in the helical repeat of a DNA (the number of base pairs between successive turns of the helical backbone). Such changes can alter the binding of proteins and affect phasing between pairs of sequences.

In recent years, the application of geometric and topological methods to molecular biology has provided a new understanding of the relation between the twisted paired strands of the genetic molecule DNA and its overall supercoiled structure. In addition, the geometric and topological

changes in the DNA caused by the interaction of protein complexes such as nucleosomes with the DNA can now be quantized. These topics will be the subject of this lecture. In particular, it will be shown by geometric techniques that the linking number of a closed circular DNA associated with a protein complex is the sum of two experimentally accessible quantities: the winding number determined by the protein complex, a number directly related to the helical repeat, and the surface linking number, a geometric constant that accounts for the topological effects of the protein complex on the super-coiling of the DNA. These results will be applied to various experiments involving x-ray diffraction, nuclease digestion and chemical probes of DNA wrapped on nucleosomes.

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**Knot Theory and DNA** (De Witt Sumners). In order to initiate and control various life processes of the cell, enzymes manipulate DNA in topologically interesting ways. *Topoisomerase* passes DNA through itself by means of an enzyme-bridge transient break, and *recombinase* breaks DNA apart and recombines to different ends. In the experimental study of DNA structure and enzyme mechanism, biologists perform experiments in which enzymes act on circular DNA substrate molecules. The circular form of the DNA traps some of the enzyme-caused changes in DNA geometry and topology. By observing the changes in DNA geometry (supercoiling) and topology (knotting and linking), the enzyme mechanism can be described and quantized. This talk will review some of these experimental results, and will focus on the tangle model for site-specific recombination. This model uses experimental information (gel electrophoresis and electron microscopy) to write down tangle equations which quantize changes in DNA topology. The solution of these tangle equations involves some recently-developed knot theory. Using this model, the enzyme mechanism and the spatial structure of the active enzyme-DNA complex can be computed.

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**Topology of Polymers** (Stuart G. Whittington). Self-avoiding walks on a regular three dimensional lattice (such as  $Z^3$ ) have proved to be a useful model of the spatial configuration of linear polymer molecules in dilute solution. Similarly, ring polymers can be modelled by (self-avoiding) polygons on a lattice. If the polygon has  $n$ -edges then it is known that the number of distinct polygons (up to translation) increases exponentially with  $n$ . Interesting questions arise about the probability that a randomly chosen polygon (with  $n$  edges) is unknotted. It can be shown that this probability decreases to zero (exponentially rapidly) as  $n$  goes to infinity. This talk will focus on the methods used in such proofs, and on related questions about the kinds of knots which occur. E.g. is the knot likely to be prime or composite? How complex is the knot likely to be? Similar questions arise about the entanglement complexity of embeddings of graphs in  $Z^3$ .

Many problems in this area are still open, and the talk will also review some useful numerical methods (especially Monte Carlo approaches). E.g. Monte Carlo methods have been used to estimate the knot probability for polygons with several hundred edges, and to investigate how the dimensions (such as the radius of gyration) of polygons depend on their knot type.

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**Knots and Chemistry** (Jonathan K. Simon). Chemists can make knots! Topologically novel molecules such as linked rings, Mobius ladder graphs, and trefoil knots have been synthesized "from scratch". The structures are orders of magnitude smaller than the DNA knots, so the emphasis here is on how to control the synthesis (geometric rigidity of some parts of the molecules, flexibility of others) and how to prove the structures are what one hopes, problematic since measurements of structure are indirect. While the topology content has been primarily motivation—chemists embrace the challenge of synthesizing elegant and novel structures—there must be some technical connections: One cannot prove (chemically) that some flexible molecule is a knot or link without invoking some topological properties of the alleged structure. For linked rings, the "property" has been just the act of linking itself, while for Mobius ladders and the trefoil knot there also is chirality, the fact that some structures

are different from their mirror images. For the trefoil knot, chirality is classical, while for Mobius ladders it was not proven until after the chemistry was done and the question raised. Motivated jointly by chemical ideas and questions, and as a natural extension of classical knot theory, people are studying the "knot theory of graphs". Just as we ask about classification, computable invariants, and symmetries of knots, there are similar questions for graphs such as theta curves,  $K(5)$ ,  $K(3,3)$ , etc. Also important insight has been gained into the relation between rigid and flexible symmetry. If a given structure can be deformed to its mirror image, can it be deformed to a shape that has rigid symmetry? In answering this question, knot theory has contributed not so much to a particular synthesis or proof, but rather to chemical methodology.

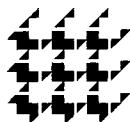
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**Knots and Physics** (Louis H. Kauffman). A knot is an embedding of a circle into Euclidean three dimensional space. The topological theory of knots studies the problem of classification of such embeddings up to the equivalence relation of ambient isotopy. Two knots are ambient isotopic if there is one parameter (The parameter is on the unit interval.) continuous family of embeddings starting at the first knot and ending at the second knot. Since this classification problem can be modelled by the macroscopic properties of rope in ordinary space (or by molecules in microspace), there is a direct connection between knots and physics. However, since the advent of the Jones polynomial and its generalizations it has become apparent that the theory of knots is deeply connected with the techniques and ideas in modern statistical mechanics and quantum field theory. In this introductory lecture we shall begin by recalling the history of knot theory and the history of quantum mechanics. Knot theory had its start with the construction of the first tables of knots. These tables were constructed at the behest of Lord Kelvin, who theorized that atoms were knotted

vortices in the ether. We then review the mathematics and history of the Alexander polynomial, its reformulations by Ralph Fox and by John Conway. Conway's polynomial leads directly to the Jones polynomial by a remarkable variation of parameters. We then discuss the context of the Jones polynomial, its relationship with the Temperley Lieb algebra, its direct modelling via discrete statistical mechanics, and the generalizations of these ideas via the Yang-Baxter Equation and Quantum Groups. We show how the quantum groups of Drinfeld and Jimbo are intimately related to the construction of knot invariants and invariants of 3-manifolds, and how the quantum groups interrelate knot theory, Lie algebras and statistical mechanics. The lecture concludes with a brief introduction to Witten's approach to invariants of knots and three manifolds via functional integrals and conformal field theory.

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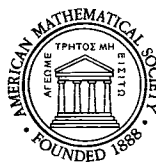


## RELIABILITY OF COMPUTER AND COMMUNICATION NETWORKS

Fred Roberts, Frank Hwang, and Clyde Monma, Editors

Reliability problems arise with increasing frequency as our modern systems of telecommunications, information transmission, transportation, and distribution become more and more complex. In December 1989 at DIMACS at Rutgers University, a workshop on Reliability of Computer and Communication Networks was held to examine the discrete mathematical methods relevant to these problems. There were nearly ninety participants, including theoretical mathematicians, computer scientists, and electrical engineers from academia and industry, as well as network practitioners, engineers, and reliability planners from leading companies involved in the use of computer and communications networks. This volume, published jointly with the Association for Computing Machinery, contains the proceedings from this Workshop.

The aim of the Workshop was to identify the latest trends and important open problems, as well as to survey potential practical applications. The Workshop explored questions of computation of reliability of existing systems and of creating new designs to insure high reliability, in addition to the closely related notion of survivability. Redundancy, single stage and multistage networks, interconnected networks, and fault tolerance were also covered. The Workshop emphasized practical applications, with many invited speakers from a variety of companies which are dealing with practical network reliability problems. The success of the Workshop in fostering many new interactions among researchers and practitioners is reflected in the proceedings, which provide an exciting look at some of the major advances at the forefront of this important field of research.



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# Mathematical Sciences Employment Register January 8, 9, & 10 Baltimore Convention Center

The Mathematical Sciences Employment Register, held annually at the Joint Mathematics Meetings in January, provides opportunities for mathematical scientists seeking professional employment to meet employers who have positions to be filled. Job listings (or descriptions) and résumés prepared by employers and applicants are assigned code numbers and displayed at the meeting so that members of each group may determine which members of the other group they would like to have an opportunity to interview. Requests for interviews are submitted at the meeting on the interview request form indicating the code number of the applicant or employer you wish to have an opportunity to interview. The algorithm under which the computer program works does **not** assign or match participants according to their qualifications. Therefore, employers and applicants should be aware that interviews with unqualified parties may occur. This algorithm maximizes the number of interviews which can be scheduled subject to constraints determined by the number of time periods available, the numbers of applicants and employers, and the pattern of requests.

The Mathematical Sciences Employment Register is apparently unique among employment services offered by professional organizations in the sciences, engineering and the humanities. The computer programs used are constructed around a matching program, devised by Donald R. Morrison, and based on an algorithm described in his paper "Matching Algorithms" in *Journal of Combinatorial Theory*, volume 6 (1969), pages 20 to 32; see also "Matching Algorithms" (abstract) *Notices*, August 1967, page 630. The number of interviews arranged by the program is significantly greater than the number possible at the employment registers of other organizations, in many cases greater by an order of magnitude.

The Mathematical Sciences Employment Register is sponsored by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics; it is operated by members of the AMS staff under the general supervision of the joint AMS-MAA-SIAM Committee on Employment Opportunities.

Questions about the Employment Register should be addressed to the Employment Register Coordinator at the American Mathematical Society at 401-455-4142, or by e-mail: [CAK@MATH.AMS.COM](mailto:CAK@MATH.AMS.COM). The telephone number to be used after the Register begins in Baltimore is 410-234-1500. Participants should note that this number is for those who will be participating in the Employment Register and is not for contacting participants or taking messages. Those who wish to leave messages should call the message center telephone number found in the Baltimore meeting announcement.

## 1992 Employment Register Schedule

### Wednesday, January 8

**7:30 a.m.** Distribution of Employment Register material for nonpreregistered and preregistered participants who did not receive material by mail.

**9:00 a.m.** Short (optional) orientation session.

**9:30 a.m. – 4:00 p.m.** Submission all interview request forms in order to receive a schedule of appointments for Thursday interviews. This applies to both preregistered and nonpreregistered participants.

**N.B. No interviews are held on Wednesday.**

### Thursday, January 9

**8:00 a.m.** Distribution of interview schedules.

**9:00 a.m. – 4:00 p.m.** Submission of all interview request forms in order to receive a schedule of appointments for Friday interviews.

**9:00 a.m. – 5:00 p.m.** Interviews.

### Friday, January 10

**8:00 a.m.** Distribution of interview schedules.

**9:00 a.m. – 5:00 p.m.** Interviews.

**Requests for Thursday interviews MUST BE SUBMITTED ON WEDNESDAY BETWEEN 9:30 a.m. and 4:00 p.m. Requests for Friday interviews MUST BE SUBMITTED ON THURSDAY BETWEEN 9:00 a.m. and 4:00 p.m.** Those who fail to do so cannot be included in the pool of available participants when the matching program which schedules the interviews is run on the computer that night. This applies to all employers and applicants, whether preregistered or on-site registrants. Forms submitted with preregistration achieve registration for the Employment Register only. These forms do not automatically include the participant in the interviewing process.

Fifteen-minute intervals are allowed for interviews, including two or three minutes between successive interviews. The interviews are scheduled in half-day sessions: Thursday morning and afternoon, and Friday morning and afternoon, amounting to four half-day sessions for interviews. There are ten time periods (9:00–11:15 a.m.) in which interviews can be scheduled in the morning and fourteen time periods (12:45–4:30 p.m.) in the afternoon.

Requests for interviews will be accommodated depending on the availability of participants. The scheduling program

does NOT have a provision allowing participants to specify particular times for interviews beyond the choice of session (day, and morning or afternoon).

The Friday afternoon session is the "employers' choice" session. For this session interviews will be scheduled on the basis of requests made by employers. Applicants do not submit specific interview requests for this session, but in order to participate they must indicate their availability for the session by returning the Interview Request Form appropriately marked for Friday afternoon.

Applicants should be aware of the fact that interviews arranged by the Employment Register represent only an initial contact with employers and that hiring decisions are not ordinarily made during or immediately following such interviews. **Applicants are advised to bring a number of copies of their vitae or résumés so that they may leave them with prospective employers.**

#### **ALERT TO APPLICANTS:**

Applicants should be aware that the current job market for mathematicians seeking academic employment is tight. We anticipate that the Baltimore Employment Register will experience a similar imbalance between applicants and employers as occurred at the 1991 San Francisco Employment Register – almost five applicants per employer. In San Francisco the average number of interviews per applicant was seven, and applicants in Baltimore should expect a similar number of interviews. As in the past, applicants whose highest degree is a master's or bachelor's should be aware that most jobs listed will require a doctorate. Most jobs listed will be academic.

### **Preregistration Procedures**

Preregistration for the Mathematical Sciences Employment Register **must be completed by November 18, 1991**. Applicants and employers (including all interviewers) who wish to preregister for the Employment Register must also register for the Joint Mathematics Meetings. **Forms for preregistration, housing, the applicant résumé form, and the employer form are located in the back of this issue.**

Employer and applicant forms received after the **November 18 deadline cannot** be included in the printed lists.

Those who preregister by the deadline of **November 18** will receive their badge, program and Employment Register material in the mail two to three weeks prior to the meeting, unless they indicate otherwise.

Those who preregister for the Joint Meetings by the **FINAL** deadline of December 10, must register for the Employment Register on-site. The Mathematics Meetings Service Bureau regrets it is unable to accommodate Employment Register registration for the **FINAL** deadline. Therefore, it is important that one submit these forms by **November 18**, if one wishes to appear in the lists. However, all employers' job listings and applicants' résumés will be posted at the meeting, so that applicants and employers may review them.

#### **Preregistered Applicants**

In addition to the Joint Meetings preregistration fee, there is an applicant fee of \$40 payable **prior to the November 18 deadline**. These fees must accompany the Preregistration/Housing Form.

The December issue of *Employment Information in the Mathematical Sciences (EIMS)* will contain of the résumés of applicants who have preregistered **by November 18**. Forms not received in time cannot be included in this issue. See the instructions on preparation of applicant forms elsewhere in the back of this issue.

#### **Applicants Not Planning to Attend**

Applicants seeking professional positions in the mathematical sciences who do not plan to attend the meeting in Baltimore may submit résumés for publication in the December issue of *EIMS* if they use the Mathematical Sciences Employment Register Form for Applicants at the back of this issue and observe the deadline of November 18. There is no charge for this service. Nonregistered applicants' résumés will not be posted at the Employment Register if the participant is not attending the meeting.)

#### **Preregistered Employers**

In addition to the Joint Meetings preregistration fee, there is a separate charge for each employer who will be interviewing applicants at the register.

Please refer to the Preregistration/Housing Form for a list of the Joint Mathematics Meetings and Employment Register fees. These fees must accompany the Preregistration/Housing Form. The registration fee for employers covers the cost of a copy of the December Issue of *EIMS*. This publication contains printed copies of the résumés of applicants who preregistered prior to the deadline.

**It is requested that employers submit both employer and Preregistration/Housing Forms with appropriate fees in the same envelope. It would also be helpful if the names of co-interviewers are listed on the employer form. If possible, these individuals should also preregister at the same time.**

It is the policy of some institutions to pay for employer fees. These payments do not always accompany the preregistration forms but are sent in after the deadline has passed, or when the meeting is over. It is important that the institution's fiscal department indicate the name of the participating employer with their remittance advice or payment order so that proper credit can be made in Providence.

Employers are encouraged to provide more than one interviewer, when they are able to do so, in order to increase the number of interviews which may be scheduled.

**Please take care to indicate on the form the number and names of interviewers for whom simultaneous interviews may be scheduled.** Every interviewer who wishes to interview applicants for a position(s) and receive a separate schedule and table must pay the applicable employer registration fee in addition to the Joint Meetings registration fee. In the case of multiple job listings submitted on one

or more employer forms, only one code number will be assigned. At the meeting each interviewer must submit an interview request form using the same code number in order to receive a schedule and be seated at a separate table. Interviewers for the same positions will be seated next to each other. However, if specific interviewers want to interview applicants separately for a position within the same department then each job description must be submitted on a separate form and the applicable fees remitted for each position. Each position will be assigned a separate code number.

A coded strip at the bottom of the form summarizes the information on each form. All employers are required to complete the summary strip. This is used to prepare the Winter List of Employers for distribution to the applicants at the meeting.

#### *Winter Lists of Employers*

The Winter List of Employers consists of summaries of the position listings submitted by the employers who preregistered for the meeting. It will be distributed to the applicants participating in the Register. Others may purchase the Winter List of Employers at the AMS Exhibit and Book Sale at the meeting or from the Providence office after the meeting. The price at the meeting is \$8 each. Any copies remaining after the meeting will be available from the Providence office of the Society for \$10 each. The list will not be updated with employers who register at the meeting.

#### *Employers Not Planning to Interview*

Employers who do not plan to participate in the Employment Register, but wish to display job descriptions, may obtain special forms from Carole Kohanski, Mathematical Sciences Employment Register, P. O. Box 6887, Providence, RI 02940. These job descriptions must be received in the Providence office by **November 18** along with the fee of \$30 for this service.

Employers who attend the Joint Mathematics Meetings, but do not want to interview, can post job descriptions at the Employment Register. **Postings will not be allowed in the Joint Meetings registration area.** A fee of \$30 will be charged and must be paid at the Joint Mathematics Meetings registration desk prior to posting the form. Participants should be sure to inform the cashier that they would like to post a job description but are not planning to interview and should obtain the proper receipt in order to receive the form

necessary for posting at the Employment Register desk. The form may then be obtained at the Employment Register area.

### **December Issue of Employment Information in the Mathematical Sciences**

The periodical *EIMS* publishes six issues per year listing open positions in academic, governmental and industrial organizations, primarily in North America. *EIMS* is a joint project of the American Mathematical Society (publisher), the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

The December issue of *EIMS* contains résumés of persons seeking professional positions in the mathematical sciences. Résumés of applicants taking part in the Employment Register and those not attending will be included in the December 1991 issue provided they are received before the November 18 deadline. Other mathematical scientists who wish to be included may have their résumés printed if the same deadline is observed.

Additional copies of the December Issue of *EIMS* will be available for sale at the AMS Exhibit and Book Sale at the meeting. Prices at the meeting are \$9 each for the December issue. Any copies remaining after the meeting will be available from the Providence office of the Society for \$16 each.

#### *List of Retired Mathematicians Available for Employment*

The *List of Retired Mathematicians* will be included in the December and January issues of the publication *EIMS*. Retired mathematicians who are interested in being included in the list may send the following information to the Mathematical Sciences Employment Register, P. O. Box 6887, Providence, Rhode Island 02940.

1. Full name
2. Mailing address
3. Highest degree, year, university
4. Most recent employment, institution
5. Type of position desired
6. Academic or industrial employment preferred
7. Date available for employment (month/year)
8. Geographic location preferred

The deadline for receipt of this information is **November 18**. Offprints of the list will be available from the Mathematical Sciences Employment Register at the above address.

# Joint Summer Research Conferences in the Mathematical Sciences

*Mount Holyoke College, South Hadley, Massachusetts, June 13 to July 24, 1992*

The 1992 Joint Summer Research Conferences in the Mathematical Sciences will be held at Mount Holyoke College, South Hadley, Massachusetts, from June 13 to July 24. It is anticipated that the series of conferences will be supported by grants from the National Science Foundation and other agencies.

There will be nine conferences in nine different areas of mathematics. The topics and organizers for the conferences were selected by the AMS, Institute of Mathematical Statistics (IMS), and the Society for Industrial and Applied Mathematics (SIAM) Committee on Joint Summer Research Conferences in the Mathematical Sciences. The selections were based on suggestions made by the members of the committee and individuals submitting proposals. The committee considered it important that the conferences represent diverse areas of mathematical activity, with emphasis on areas currently especially active, and paid careful attention to subjects in which there is important interdisciplinary activity at present.

The conferences emulate the scientific structure of those held throughout the year at Oberwolfach. These conferences are intended to complement the Society's program of annual Summer Institutes and Summer Seminars, which have a larger attendance and are substantially broader in scope. The conferences are research conferences and are not intended to provide an entree to a field in which a participant has not already worked.

It is expected that funding will be available for a limited number of participants in each conference. Others, in addition to those funded, will be welcome, within the limitations of the facilities of the campus. In the spring a brochure of information will be mailed to all who are requesting to attend the conferences. The brochure will include information on room and board rates, the residence and dining hall facilities, travel, local information, and a Residence Housing Form to use to request on-campus accommodations. Information on off-campus housing will also be included in the brochure. Participants will be responsible for making their own housing and travel arrangements. Each participant will be required to pay nominal registration and social fees.

Those interested in attending one of the conferences should send the following information to the Summer Research Conference Coordinator, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940 or by E-Mail: [CAK@MATH.AMS.COM](mailto:CAK@MATH.AMS.COM) on the Internet.

## **Please type or print the following:**

1. Title and dates of conference desired
2. Full name
3. Mailing address
4. Telephone number and area code for office, home and electronic-mail addresses, FAX number
5. A short paragraph describing your scientific background relevant to the topic of the conference
6. Financial assistance requested; please estimate cost of travel
7. Indicate if support is not required and if interested in attending even if support is not offered.

**The deadline for receipt of requests for information is March 2, 1992.** Requests to attend will be forwarded to the Organizing Committee for each conference for consideration after the deadline of March 2. All applicants will receive a formal invitation, Brochure of Information, notification of financial assistance, and a tentative scientific program (if the Chairman has prepared one in advance; otherwise programs will be distributed at registration) from the AMS by April 15. Funds available for these conferences are limited and individuals who can obtain support from other sources should do so. The allocation of grant funds is administered by the AMS office, and the logistical planning for the conferences is also done by the AMS. However, it is the responsibility of the Chairman of the Organizing Committee of each conference to determine the amount of support participants will be awarded. This decision is **not** made by the AMS. Women and members of minority groups are encouraged to apply and participate in these conferences.

Any questions concerning the scientific portion of the conference should be directed to the chair or any member of the Organizing Committee.

The Joint Summer Research Conferences in the Mathematical Sciences are under the direction of the AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences. The following committee members chose the topics for the 1992 conferences: John A. Burns, Fan R. K. Chung, Leonard Evens, Martin Golubitsky, Anthony W. Knapp, Peter W. K. Li, Emanuel Parzen, Stewart B. Priddy, Michael Shub and Gregg J. Zuckerman.

**N.B. Lectures begin on Sunday morning and run through Thursday. Check-in for housing begins on Saturday. No lectures are held on Saturday.**

**Saturday, June 13 to Friday, June 19**

*Conformal field theory, topological field theory, and quantum groups*

MOSHE FLATO (University de Dijon), Co-Chair

JAMES LEPOWSKY (Rutgers University), Co-Chair

PAUL SALLY (University of Chicago), Co-Chair

Conformal field theory (in two dimensions), and topological field theory (in two, three, and four dimensions) have played extraordinary roles in the recent and ongoing interaction of mathematics and physics. Both types of quantum field theories have deep connections with the rapidly growing theory of quantum groups, another discipline attracting both mathematicians and physicists. The conference will emphasize these theories and the interrelationships among them.

Specific topics to be covered will include:

1. (CFT): Algebraic and geometrical formulations of CFT; vertex operator algebras; infinite dimensional (graded) Lie algebras and Lie groups; semi-infinite and BRST cohomology; modular functors; moduli spaces of Riemann surfaces—possibly equipped with holomorphic vector bundles—and (projectively) flat connections over moduli spaces.

2. (TFT): Geometrical and topological formulations of TFT; vector spaces of physical states; mapping class groups and their representations; topological modular functors; moduli spaces of flat vector bundles over smooth surfaces; geometric quantization of moduli spaces; relations between CFT and 2D and 3D TFT; new invariants of 3 manifolds—possibly containing links and tangles; possible relations between Donaldson-Floer theory of 4 manifolds and 4D TFT.

3. (Quantum groups): Algebraic and algebro-geometric formulations of quantum groups; mathematical vs. physical perspectives on quantum groups; finite dimensional representations, R-matrices, crystal bases for representation spaces; new invariants of 3 manifolds—possibly containing links and tangles; comparison with invariants obtained from CFT and TFT.

**Saturday, June 20 to Friday, June 26**

*Cohomology, representations and actions of finite groups*

JON F. CARLSON (University of Georgia), Chair

The primary aim of the conference will be to explore some of the many problems in the cohomology of finite groups and its applications to representation theory and to topology. The development of algebraic topology has always been closely linked to that of homological algebra, and from the very beginning the cohomology of groups was a significant source of examples and motivation. Cohomology is also a natural tool for studying the theory of modules over a finite group as well as the actions of groups on other structures. In the last decade the cohomology of finite groups has been an area of rapidly increasing activity and the major researchers in the subject have come from very diverse

backgrounds. Yet the overlap in both the interest in the results and the methods of investigation has been significant. The conference will bring together some of the people working in the area to share both their knowledge and their problems. The topics to be discussed include applications to homotopy theory and the actions of the Steenrod algebra, the structure of cohomology rings, advances in the computation of cohomology, and the action of finite groups on complexes and applications to modular and integral representation theory.

Members of the Organizing Committee: Alejandro Adem, (University of Wisconsin), Jonathan L. Alperin, (University of Chicago), and R. James Milgram, (Stanford University).

**Saturday, June 20 to Friday, June 26**

*Nielsen Theory and Dynamical Systems*

CHRISTOPHER MCCORD (University of Cincinnati), Chair

This conference will explore applications of the algebraic-topological methods of Nielsen theory to dynamical systems. The topological aspects of the conference will center on Nielsen fixed point theory, and will include related topics such as the Nielsen-Thurston classification of surface diffeomorphisms.

The fixed-point theory centers around the Nielsen number  $N(f)$  of a self-map. The Nielsen number is a homotopy invariant and provides a lower bound for the number of fixed points of  $f$ . This is usually a sharp lower bound, in the sense that there is a map  $g$  homotopic to  $f$  with exactly  $N(f)$  fixed points. There has been a surge in the development of the field in the last two decades. In particular, a number of “Nielsen-type” theories have been developed to explore fixed-point problems in different settings, such as smooth maps on manifolds; area-preserving maps; and equivariant maps; and compact maps on noncompact spaces. An area of particular emphasis has been the study of periodic points. There has also been substantial progress in improving the computability of the theory. Some of the computational methods developed include the Jiang condition; relations with Lefschetz numbers; product formulas; connections with braid groups; a relative theory and a local theory.

Several of the developments in Nielsen theory have moved it closer to dynamical systems. One very promising subject is the significance of the collection  $\{N(f^n)\}$  of Nielsen numbers of all iterates of a self-map. This has been used to define a Nielsen zeta function, to compute a lower bound on topological entropy, and to find conditions which guarantee that a map is homotopically periodically finite: that there is a homotopic map with a finite collection of periodic points. Another development has arisen from the study of one-parameter families of maps. This can be applied to detect periodic orbits of continuous dynamical systems, which “standard” Nielsen theory cannot detect.

Dynamical systems, of course, is a very broad discipline, including many topics and using a wide variety

of methods. This conference will focus on those aspects of dynamics which are most likely to interact profitably with Nielsen theory, such as: Anosov and pseudo-Anosov systems; area-preserving maps; detection and counting of periodic structures of maps and flows; Morse-Smale diffeomorphisms; surface diffeomorphisms; twist maps; and zeta functions.

The conference will bring together researchers in Nielsen theory and dynamical systems. It will allow dynamicists and topologists to explore the growing connections between the two fields. By promoting interaction between researchers in the two disciplines, we hope to encourage further interdisciplinary research.

Members of the Organizing Committee: Joan Birman (Columbia University), Robert Brown (University of California, Los Angeles), John Franks (Northwestern University) and Boju Jiang, (Peking University).

### Saturday, June 27 to Friday, July 3

#### *The Penrose Transform and Analytic Cohomology in Representation Theory*

ROBERT J. BASTON (Oxford University, England)  
Co-Chair

MICHAEL G. EASTWOOD (Adelaide University, Australia)  
Co-Chair

The use of cohomology in the representation theory of a semisimple Lie group has a long and distinguished history, beginning with Bott's version of the Borel-Weil theorem and continuing with Schmid's formulation and proof of the Kostant-Langlands conjecture. These realize important classes of representations as Dolbeault cohomology of sheaves on homogeneous spaces. To avoid substantial analytic difficulties, Zuckerman and Vogan introduced an algebraic analogue of cohomology, known now as cohomological parabolic induction, which has proved invaluable in classifying admissible and unitary representations.

Despite much effort, the relationship between analytic and algebraic cohomology and the structure of the analytic representations themselves is still poorly understood.

The "Penrose transform" is the name given to a certain construction in complex integral geometry. It may be regarded as a complex version of the Radon transform and provides intertwining operators between various geometric representations of semisimple Lie groups. This leads one to the construction of some unitary representations directly on Dolbeault cohomology avoiding the usual analytic difficulties.

As shown by Barchini, Knapp, and Zierau, it may also be used in special circumstances directly to compare the analytic and algebraic cohomology. A direct geometric interpretation of Zuckerman's construction has also been given by Schmid and Wolf. The main aim of the conference will be to consider these various advances and suggest future avenues for research.

A second aim of the conference will be to investigate recent interactions between representation theory and differential geometry. An example of this is Guillemin's use of principal series in studying Zoll manifolds. Another example is the use of Verma modules and parabolic invariant theory in the study of invariant differential operators.

Members of the Organizing Committee: Victor Guillemin (Massachusetts Institute of Technology), Joseph Wolf (University of California, Berkeley), and Roger Zierau (Oklahoma State University).

### Saturday, June 27 to Friday, July 3

#### *Wavelets and applications*

CHARLES K. CHUI (Texas A & M University), Co-Chair  
STEPHAN MALLAT (Courant Institute of Mathematical Sciences, New York University), Co-Chair

The subject of "wavelets" has recently drawn much attention of many mathematical scientists from various disciplines. It is creating a common link between mathematicians, physicists and electrical engineers. The objective of this subject is to construct powerful bases functions for a broad spectrum of applications. Many problems that require local analysis in the phase space (time-frequency) can be treated effectively with a wavelet transform. These problems have multidisciplinary components ranging from pure mathematics such as operator theory and harmonic analysis to more concrete applications in signal processing.

This conference will focus on recent developments of the wavelet transform and its applications to: mathematical analysis, numerical analysis, algorithms, stochastic processes, turbulence, transient signal characterization, signal compression... It is intended to bring together researchers from various disciplines to exchange information and ideas and to promote joint research efforts.

### Saturday, July 4 to Friday, July 10

#### *Commutative Algebra: Syzygies, Multiplicities and Birational Algebra*

WILLIAM HEINZER (Purdue University), Co-Chair  
CRAIG HUNEKE (Purdue University), Co-Chair  
JUDITH D. SALLY (Northwestern University), Co-Chair

Striking new techniques have been introduced into the field of Commutative Algebra. These include the use of intersection theory and local Chern characters, cohomology of various sorts: local, étale and phantom, linkage theory and a remarkable new closure operator, tight closure, which has led to powerful constraints on systems of parameters in Noetherian rings. The purpose of the conference is to bring together leading researchers and young researchers in the field to stimulate further progress in the open problems which are approachable by the new techniques.

Topics to be emphasized include:

(i) Local homological conjectures, tight closure, Cohen-Macaulay modules.



(ii) Problems related to syzygies, including the Buchsbaum-Eisenbud-Horrocks conjecture about Betti numbers of modules of finite length over a regular local ring.

(iii) Multiplicity theory and Hilbert functions, including long standing open problems about the vanishing and non-vanishing of the intersection multiplicity of two finitely generated modules.

(iv) Birational study of rings which is, in a broad sense, the study of resolution of singularities in the most algebraic terms possible.

### Saturday, July 11 to Friday, July 17

#### *Change-point problems*

EDWARD CARLSTEIN (University of North Carolina),  
Co-Chair

HANS-GEORG MÜLLER (University of California, Davis),  
Co-Chair

DAVID SIEGMUND (Stanford University), Co-Chair

Change-point models occur in various areas of statistics and are of increasing importance for many applications. The conference focuses on modern developments, adopting a broad view of what constitutes a change-point problem and integrating classical techniques with modern approaches. Special emphasis will be given to new approaches which tackle challenging problems arising from applied fields.

Recent applications of change-point methods in the widest sense include: Statistical image processing and edge detection in noisy images, which can be viewed as a multidimensional change-point respectively boundary detection problems; change-points in economic regression models (split or two-phase regression); detection of discontinuities in geophysical applications, e.g., temperature gradients in deep sea waters or changes in mineral content as a function of distance along an experimental bore; changes in hazard rates as were shown to occur some time after bone-marrow transplantation for leukemia patients; the comparison and matching of DNA sequences; the handling of critical boundary effects for the nonparametric estimation of pharmacokinetic concentration curves after drug administration.

Problems to be discussed include accordingly:

1. The problem of detecting and locating a change in the distribution in a sequence of random variables. This problem has been treated under parametric assumptions and more recently with nonparametric methods.

2. Sequential versions of the above and of other change-point problems, with important applications in industrial quality control.

3. Detection and location of a change-point or discontinuity in a regression function or a derivative. Parametric two-phase regression models have many applications and are well established, whereas more recent nonparametric approaches require smoothness assumptions for the regression function.

4. The problem of estimating smooth curves when there are known discontinuities or boundary points; adaptation of

splines, kernel estimators, etc.

5. Detection and location of a change-point in a hazard function under random censoring.

6. Change-points in the intensity function of a Poisson process or other point process or field.

7. Multidimensional extensions, with important applications in image analysis. Here change-points in a generalized sense are boundaries or ridges, where the boundary may be assumed to be a smooth or parametrically determined curve.

8. Bootstrap methods for nonparametrically assessing the variability of change-point estimators. This includes the study of innovative computational algorithms.

### Saturday, July 11 to Friday, July 17

#### *Control and Identification of Partial Differential Equations*

H. T. BANKS (University of Southern California),  
Co-Chair

K. ITO (University of Southern California), Co-Chair

Recently there are an increasing number of applications where modeling by partial differential equations is crucial to the understanding of the system dynamics and the mathematical theory and the computational methodology in control of distributed parameter systems have experienced significant progress. Most theoretical work on the control of partial differential equations has concentrated on linear systems. But there is a great deal of applications driven interest in developing theories for more complicated nonlinear systems. Motivated by these facts, the objectives of this conference are (i) to discuss the recent developments of the linear theory, (ii) to discuss sources of nonlinear control problems in partial differential equations and (iii) to discuss possible mathematical tools for nonlinear control problems. The subjects of discussion include (i) Mathematical modeling and System identification, (ii) Linear optimal feedback control, (iii) Numerical methods, (iv) Stochastic control and (v) Nonlinear control for systems governed by partial differential equations.

The conference will bring together leading researchers in the fields above. It is intended to accelerate the progress in both modeling and control problems involving partial differential equations.

Members of the Organizing Committee: Chris Byrnes, (Washington University), Richard H. Fabiano, (Texas A&M University).

### Saturday, July 18 to Friday, July 24

#### *Adaptive Designs*

STEVE DURHAM (University of South Carolina), Co-chair  
NANCY FLOURNOY (The American University), Co-chair

Adaptive designs assume that sequential observations are made, and that in addition, treatment allocation probabilities are modified depending upon information as it accrues. Adaptive designs have been proposed for applications from a wide variety of fields including inventory, management con-

trol, searches, Markovian decisions, clinical trials, weapons testing, and testing the strength of materials.

This conference focuses on recent developments in the theory and application of adaptive designs and aims to stimulate further development by

\* providing a forum for statisticians whose work is motivated by different applications to discuss problems of mutual interest and to facilitate effective collaboration on research projects.

\* providing a forum for probabilists and other theorists

to exchange pertinent developments with statisticians who are focusing on applications.

\* identifying problems and issues in adaptive design that span applications and documenting the richness of the field.

\* identifying complications that must be accommodated in the mathematical models and numerical implementations to make them useful to the target applications.

Members of the Organizing Committee: Michael Woodroffe (University of Michigan) and Marvin Zelen (Harvard University).

## THE THEORY OF SUBNORMAL OPERATORS



JOHN B. CONWAY

Mathematical Surveys and Monographs, Volume 36

“In a certain sense, subnormal operators were introduced too soon because the theory of function algebras and rational approximation was also in its infancy and could not be properly used to examine this class of operators. The progress in the theory of subnormal operators that has come about during the last several years grew out of applying the results of rational approximation.”—from the Preface

This book is the successor to the author's 1981 book on the same subject. In addition to reflecting the great strides in the development of subnormal operator theory since the first book, the present work is oriented toward rational functions rather than polynomials. Although the book is a research monograph, it has many of the traits of a textbook, including exercises.

The book requires background in function theory and functional analysis, but is otherwise fairly self-contained. The first few chapters cover the basics about subnormal operator theory and present a study of analytic functions on the unit disk. Other topics included are: some results on hyponormal operators, an exposition of rational approximation interspersed with applications to operator theory, a study of weak-star rational approximation, a set of results that can be termed structure theorems for subnormal operators, and a proof that analytic bounded point evaluations exist.

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**Individual member \$77**, List price \$128,  
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# Invited Addresses and Special Sessions

## Invited Addresses at AMS Meetings

The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings, the list of speakers is incomplete.

### *Baltimore, MD, January 1992*

Please refer to the first announcement elsewhere in this issue.

### *Springfield, MO, March 1992*

Alexander Eremenko	Peter J. Olver
Julia Knight	Ernst A. Ruh

### *Tuscaloosa, AL, March 1992*

Jane M. Hawkins	Serge Ochanine
Charles A. Micchelli	Peter M. Winkler

### *Bethlehem, PA, April 1992*

Jean-Luc Brylinski	Edward Y. Miller
Ingrid Daubechies	Douglas C. Ravenel

### *Cambridge, England, June 1992*

(Joint meeting with the London Mathematical Society)

John M. Ball	Nigel J. Hitchin
Lawrence Craig Evans	Edward Witten
Benedict H. Gross	

### *Dayton, OH, October 1992*

Martin Golubitsky	Louis H. Kauffman
Jonathan I. Hall	J. T. Stafford

Invited addresses at Sectional Meetings are selected by the Section Program Committee, usually twelve to eighteen months in advance of a meeting. Members wishing to nominate candidates for invited addresses should send the relevant information to the Associate Secretary for the Section who will forward it to the Section Program Committee.

## Organizers and Topics of Special Sessions

The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of *Notices* went to the printer. The section below entitled **Information for Organizers** describes the timetable for announcing the existence of Special Sessions.

### *January 1992 Meeting in Baltimore, Maryland*

Associate Secretary: Lance W. Small

*Deadline for organizers: Expired*

*Deadline for consideration: Expired*

Please refer to the first announcement elsewhere in this issue.

### *March 1992 Meeting in Tuscaloosa, Alabama*

Southeastern Section

Associate Secretary: Joseph A. Cima

*Deadline for organizers: Expired*

*Deadline for consideration: December 12, 1991*

Richard C. Brown, *Spectral theory of ordinary and partial differential operators*

Jon M. Corson, Martyn Russell Dixon, Martin J. Evans and Frank Roehl, *Infinite groups and group rings*

Dwight A. Duffus and Peter M. Winkler, *Combinatorial problems on partially ordered sets*

Jane M. Hawkins, Karma Kajani, Karl Petersen and Mate Wierdl, *Theory and dynamical systems*

Alan Hopenwasser and Cecelia Laurie, *Operator algebras*

Vo Thanh Liem and Bruce S. Trace, *Geometric topology*

Kai-Ching Lin, *Harmonic analysis and related topics*

Charles A. Micchelli and R. A. Zalik, *Title approximation theory: modern methods*

### *March 1992 Meeting in Springfield, Missouri*

Central Section

Associate Secretary: Andy R. Magid

*Deadline for organizers: Expired*

*Deadline for consideration: December 12, 1991*

Nakhle Habib Asmar and Stephen John Montgomery-Smith, *Harmonic analysis*

Margaret M. Bayer, *Combinatorics and discrete geometry*

Wenxiang Chen and Shou Chuan Hu, *Partial differential equations*

William J. Heinzer, Craig Hunecke and Kishor M. Shah,  
*Commutative algebra*

Luis Hernandez and Ernst A. Ruh, *The geometry of connections*

Jerry A. Johnson and Benny D. Evans, *Microcomputers in the upper division and graduate curriculum*

Niky Kamran and Peter J. Olver, *Lie algebras, cohomology, and new applications to quantum mechanics*

Ellen Maycock Parker,  *$C^*$ -algebras and algebraic topology*

Boris M. Schein, *Semigroups*

Vera B. Stanojevic, *Fourier analysis*

Xingping Sun and Xiang Min Yu, *Approximation theory*

David Wright, *Automorphisms of affine spaces*

**April 1992 Meeting in Bethlehem, Pennsylvania**

Eastern Section

Associate Secretary: W. Wistar Comfort

Deadline for organizers: Expired

Deadline for consideration: January 2, 1992

Edward F. Assmus, Jr. and Jennifer D. Key, *Finite geometry*

Grahame Bennett, Jeffrey S. Connor and Andrew K. Snyder,  
*Sequence spaces*

Jean-Luc Brylinski and Dennis A. McLaughlin, *Characteristic classes, algebraic K-theory and field theory*

Donald M. Davis and Douglas C. Ravenel, *Homotopy theory*

David L. Johnson and Penny D. Smith, *To be announced*

Xiao-Song Lin, *New invariants of links and 3-manifolds*

Lee J. Stanley, *Combinatorial set theory*

Joseph E. Yukich, *Stochastic processes*

**June 1992 Meeting in Cambridge, England**

(Joint Meeting with the London Mathematical Society)

Associate Secretary: Robert M. Fossum

Deadline for organizers: Expired

Deadline for consideration: February 7, 1992

Béla Bollobás and Ronald L. Graham, *Probabilistic combinatorics*

John Coates, *Number theory*

Richard D. James, *The microstructure of crystals*

W. B. Raymond Lickorish, *Geometric topology in low dimensions*

Jan Saxl, *To be announced*

**October 1992 Meeting in Dayton, Ohio**

Central Section

Associate Secretary: Andy R. Magid

Deadline for organizers: January 30, 1992

Deadline for consideration: July 13, 1992

Joanne M. Dombrowski and Richard Mercer, *Operator theory and operator algebras*

Anthony B. Evans and Terry A. McKee, *Combinatorics and graph theory*

Louis H. Kauffman, *Knots and topological quantum field theory*

**January 1993 Meeting in San Antonio, Texas**

Associate Secretary: W. Wistar Comfort

Deadline for organizers: April 13, 1992

Deadline for consideration: September 17, 1992

**March 1993 Meeting in Knoxville, Tennessee**

Southeastern Section

Associate Secretary: Joseph A. Cima

Deadline for organizers: June 26, 1992

Deadline for consideration: To be announced

**April 1993 Meeting in Salt Lake City, Utah**

Western Section

Associate Secretary: Lance W. Small

Deadline for organizers: July 9, 1992

Deadline for consideration: To be announced

**May 1993 Meeting in DeKalb, Illinois**

Central Section

Associate Secretary: Andy R. Magid

Deadline for organizers: August 21, 1992

Deadline for consideration: To be announced

**August 1993 Meeting in Vancouver, British Columbia, Canada**

Associate Secretary: Lance W. Small

Deadline for organizers: November 11, 1992

Deadline for consideration: To be announced

**October 1993 Meeting in College Station, Texas**

Central Section

Associate Secretary: Andy R. Magid

Deadline for organizers: January 22, 1993

Deadline for consideration: To be announced

**January 1994 Meeting in Cincinnati, Ohio**

Associate Secretary: Joseph A. Cima

Deadline for organizers: April 5, 1993

Deadline for consideration: To be announced

**March 1994 Meeting in Lexington, Kentucky**

Southeastern Section

Associate Secretary: Joseph A. Cima

Deadline for organizers: June 18, 1992

Deadline for consideration: To be announced

**March 1994 Meeting in Manhattan, Kansas**

Central Section

Associate Secretary: Andy R. Magid

Deadline for organizers: June 25, 1993

Deadline for consideration: To be announced

**January 1995 Meeting in Denver, Colorado**

Associate Secretary: Andy R. Magid

Deadline for organizers: April 20, 1994

Deadline for consideration: To be announced

**March 1995 Meeting in Chicago, Illinois**

Central Section

Associate Secretary: Andy R. Magid

Deadline for organizers: June 24, 1994

Deadline for consideration: To be announced

**January 1996 Meeting in Orlando, Florida**

Associate Secretary: Lance W. Small

Deadline for organizers: April 12, 1995

Deadline for consideration: To be announced

**Information for Organizers**

Special Sessions at Annual and Summer Meetings are held under the supervision of the Program Committee for National

Meetings (PCNM). They are administered by the Associate Secretary in charge of that meeting with staff assistance from the Meetings and Editorial Departments in the Society office in Providence.

According to the "Rules for Special Sessions" of the Society, Special Sessions are selected by the PCNM from a list of proposed Special Sessions in essentially the same manner as individuals are selected to give Invited Addresses. The number of Special Sessions at a Summer or Annual Meeting is limited. The algorithm that determines the number of Special Sessions allowed at a given meeting, while simple, is not repeated here, but can be found in "Rules for Special Sessions" on page 614 in the April 1988 issue of *Notices*.

Each person selected to give an Invited Address is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the PCNM or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an *ex-officio* member of the committee and whose address may be found below). These proposals must be in the hands of the PCNM at least nine months prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Proposals that are sent to the Providence office of the Society, to *Notices*, or directed to anyone other than the Associate Secretary will have to be forwarded and may not be received in time to be considered for acceptance.

It should be noted that Special Sessions must be announced in *Notices* in such a timely fashion that any member of the Society who so wishes may submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration. This deadline is usually three weeks before the deadline for abstracts for the meeting in question.

Special Sessions are very effective at Sectional Meetings and can usually be accommodated. The processing of proposals for Special Sessions for Sectional Meetings is handled in essentially the same manner as for Annual and Summer Meetings by the Section Program Committee. Again, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline after which members can no longer send abstracts for consideration for presentation in that Special Session.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. These proceedings appear in the book series *Contemporary Mathematics*.

More precise details concerning proposals for and organizing of Special Sessions may be found in the "Rules for Special Sessions" or may be obtained from any Associate Secretary.

### *Proposals for Special Sessions to the Associate Secretaries*

The programs of Sectional Meetings are arranged by the Associate Secretary for the section in question:

#### Western Section

Lance W. Small, Associate Secretary  
Department of Mathematics  
University of California, San Diego  
La Jolla, CA 92093  
Electronic mail: g\_small@math.ams.com  
(Telephone 619-534-3590)

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Chapel Hill, NC 27599-3902  
Electronic mail: g\_cima@math.ams.com  
(Telephone 919-962-1050)

As a general rule, members who anticipate organizing Special Sessions at AMS meetings are advised to seek approval at least nine months prior to the scheduled date of the meeting. No Special Sessions can be approved too late to provide adequate advance notice to members who wish to participate.

Proposals for Special Sessions at the June 29-July 1, 1992, meeting in Cambridge, England, only, should be sent to Professor Fossum at the Department of Mathematics, University of Illinois, Urbana, IL 61801, Telephone: 217-244-1741, Electronic mail: rnf@math.ams.com

### **Information for Speakers**

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled. Contributors should know that there is a limitation in size of a single Special Session, so that it is sometimes true that all places are filled by invitation. Papers not accepted for a Special Session are considered as ten-minute contributed papers.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Editorial Department, American Mathematical Society, P. O. Box 6248, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the

program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Electronic submission of abstracts is available to those who use the  $\text{\TeX}$  typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to [abs-request@math.ams.com](mailto:abs-request@math.ams.com). Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Electronic Abstracts, American Mathematical Society, Publications Division, P.O. Box 6248, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain  $\text{\TeX}$ ,  $\text{\AMS-TeX}$ , or the  $\text{\L\TeX}$  package.

### Number of Papers Presented

#### Joint Authorship

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks

more than once. An author can speak by invitation in more than one Special Session at the same meeting.

An individual may contribute only one abstract by title in any one issue of *Abstracts*, but joint authors are treated as a separate category. Thus, in addition to abstracts from two individual authors, one joint abstract by them may also be accepted for an issue.

### Site Selection for Sectional Meetings

Sectional Meeting sites are recommended by the Associate Secretary for the Section and approved by the Committee of Associate Secretaries and Secretary. Recommendations are usually made eighteen to twenty-four months in advance. Host departments supply local information, ten to twelve rooms with overhead projectors for contributed paper sessions and Special Sessions, an auditorium with twin overhead projectors for invited addresses, and registration clerks. The Society partially reimburses for the rental of facilities and equipment, and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the Associate Secretary for the Section.

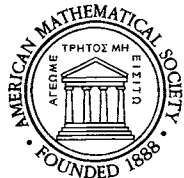
## Littlewood-Paley Theory and the Study of Function Spaces

Michael Frazier, Björn Jawerth, and Guido Weiss

CBMS Regional Conference Series, Number 79 • Supported by the National Science Foundation

Littlewood-Paley theory was developed to study function spaces in harmonic analysis and partial differential equations. Recently, it has contributed to the development of the  $\phi$ -transform and wavelet decompositions. Based on lectures presented at the NSF-CBMS Regional Research Conference on Harmonic Analysis and Function Spaces, held at Auburn University in July 1989, this book is aimed at mathematicians, as well as mathematically literate scientists and engineers interested in harmonic analysis or wavelets. The authors provide not only a general understanding of the area of harmonic analysis relating to Littlewood-Paley theory and atomic and wavelet decompositions, but also motivation and background helpful in understanding the recent theory of wavelets.

The book begins with some simple examples which provide an overview of the classical Littlewood-Paley theory. The  $\phi$ -transform, wavelet, and smooth atomic expansions are presented as natural extensions of the classical theory. Finally, applications to harmonic analysis (Calderón-Zygmund operators), signal processing (compression), and mathematical physics (potential theory) are discussed.



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# Mathematical Sciences Meetings and Conferences

1991–1992. **Mittag-Leffler Institute Academic Program for 1991–1992: Combinatorics**, Djursholm, Sweden. (Apr. 1991, p. 359)

1991–1992. **1991–1992 Special Year on Automorphic Forms in Number Theory**, Centre de Recherches Mathématiques, Université de Montréal. (Sep. 1991, p. 832)

\* 1991–1992. **DIMACS Special Year: Graph Theory and Algorithms**, Center for Discrete Mathematics, Rutgers, The State University of New Jersey.

**PROGRAM:** The special theme for the academic year 1991/1992 is Graph Theory and Algorithms. The special year will emphasize such topics as extremal graphs, graph structures, random graphs and randomized algorithms, network algorithms and data structures, graph embeddings and parallel architectures, and applications of graph theory and algorithms.

**ORGANIZING COMMITTEE:** F. Chung (co-chair), Bellcore; T. Trotter (co-chair), Arizona State; R. Graham, AT&T Bell Labs; D. Johnson, AT&T Bell Labs; R. Karp, U.C. Berkeley; T. Leighton, MIT; C. Monma, Bellcore; F. Roberts, Rutgers; B. Tarjan, Princeton; C. Thomassen, Technical Univ. of Denmark.

**INFORMATION:** Co-chairs: F. Chung, Bellcore, frkc@bellcore.com and T. Trotter, Arizona State, iawtt@asuacad.bitnet; Rutgers, The State Univ. of New Jersey, P.O. Box 1179, Piscataway, NJ 08855-1179; 908-932-5928; center@dimacs.rutgers.edu; Fax: 908-932-5932.

## September 1991

\* 29–October 2. **Sup'Eur '91 Fall Meeting—Supercomputing in Europe (User's Group)**, Rome, Italy.

**INFORMATION:** M. Schaerf or A. Cavallo, Univ. of Rome, "La Sapienza", Scientific Computer Center, Piazzale Aldo Moro, 5-, 100185 Rome-Italy; email: schaarf@itcasur.bitnet.

## October 1991

1–4. **SCAN-91 IMACS-GAMM International Symposium on Computer Arithmetic and Scientific Computation**, Universität Oldenburg, Germany. (Feb. 1991, p. 145)

5. **Thirty-Third Algebra Day—Trends in Linear Algebra**, Centre for Research in Algebra and Number Theory, Carleton University—University of Ottawa, Canada. (Jul./Aug. 1991, p. 641)

6–12. **Arbeitsgemeinschaft mit Aktuellem Thema (wird in den Mitteilungen der DMV Heft 3/1991 bekanntgegeben)**, Oberwolfach,

THIS SECTION contains announcements of meetings and conferences of interest to some segment of the mathematical public, including *ad hoc*, local, or regional meetings, and meetings or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. (Information on meetings of the Society, and on meetings sponsored by the Society, will be found inside the front cover.)

AN ANNOUNCEMENT will be published in *Notices* if it contains a call for papers, and specifies the place, date, subject (when applicable), and the speakers; a second full announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in each issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (\*) mark those announcements containing new or revised information.

IN GENERAL, announcements of meetings and conferences held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of *Notices*, care of the American Mathematical Society in Providence.

DEADLINES for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

EFFECTIVE with the 1990 volume of *Notices*, the complete list of Mathematical Sciences Meetings and Conferences will be published only in the September issue. In all other issues, only meetings and conferences for the twelve-month period following the month of that issue will appear. As new information is received for meetings and conferences that will occur later than the twelve-month period, it will be announced at the end of the listing in the next possible issue. That information will not be repeated until the date of the meeting or conference falls within the twelve-month period.

Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

7–9. **Second Symposium on High Performance Computing**, Montpellier, France. (Feb. 1991, p. 145)

7–10. **The Ninth International Symposium on Applied Algebra, Algebraic Algorithms, and Error Correcting Codes**, New Orleans, LA. (Dec. 1990, p. 1458)

7–10. **IMA-INRIA Workshop on Transfer of Mathematics to Industry in the U.S. and France**, University of Minnesota, Minneapolis, MN. (Sep. 1991, p. 834)

7–10. **Workshop on Groups and Computation**, Rutgers University, New Brunswick, NJ. (Sep. 1991, p. 834)

7–11. **Workshop on Stochastic and Deterministic Models**, Trieste, Italy. (Sep. 1990, p. 938)

7–11. **Computer Science Logic '91**, Berne, Switzerland. (Jul./Aug. 1991, p. 641)

12–13. **Eastern Section**, Temple University, Philadelphia, PA.

**INFORMATION:** W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

13–19. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

14–16. **Mathématique et Informatique**, Centre International de Rencontres Mathématiques. (May/Jun. 1991, p. 473)

14–18. **IMA Workshop on Sparse Matrix Computations: Graph Theory Issues and Algorithms**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1140)

14–18. **DIMACS Workshop on Experimental Analysis of Network Flows and Matching**, Rutgers University, Piscataway, NJ. (Sep. 1991, p. 834)

16–18. **SIAM Workshop on Micromechanics**, Leesburg, VA. (Nov. 1990, p. 1288)

16–18. **IFAC/IMACS/IFIP Workshop on Cultural Aspects of Automation**, Krems, Austria. (May/Jun. 1991, p.473)

18–19. **Differential and Delay Equations**, Iowa State University, Ames, Iowa. (Jan. 1991, p. 50)

18–19. **Thirteenth Midwest Probability Colloquium**, Northwestern University, Evanston, IL. (Jul./Aug. 1991, p. 641)

18–19. **1991 Mathematical Sciences Department Chairs Colloquium**, Arlington, VA. (Jul./Aug. 1991, p. 641)

20–26.  **$C^*$ -Algebren**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 50)

20–26. **Third International Workshop—Conference on Evolution Equations, Control Theory, and Biomathematics**, Han-sur-Lesse, Belgium. (Jul./Aug. 1991, p. 641)

21–25. **Analyse Algébrique des Perturbations Singulières**, Centre International de Rencontres Mathématiques. (May/Jun. 1991, p. 473)

22–25. **Visualization '91 - Visual Strategies for Knowledge**, San Diego, CA. (Sep. 1991, p. 834)

25–26. **Central Section**, North Dakota State University, Fargo, ND.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940. Please note corrected date of meeting from previous *Notices* listings.

25–26. **Eleventh Annual Southeastern-Atlantic Regional Conference on Differential Equations**, Mississippi State University, Mississippi State, MS. (Apr. 1991, p. 365)

26–27. **West Coast Operator Algebra Seminar**, University of California, Los Angeles. (Jul./Aug. 1991, p. 642)

27–November 2. **Statistische Entscheidungstheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 50)

27–November 2. **Convergence Structures in Topology and Analysis**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 50)

29–31. **Second Congress of the Italian Association for Artificial Intelligence (AI\*IA)**, Palermo, Italy. (Mar. 1991, p. 243)

## November 1991

1–2. **Sixth Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference**, St. Norbert College, DePere, WI. (Sep. 1991, p. 834)

1–3. **Partial Differential Equations and Mechanics**, Southern Illinois University, Carbondale, IL. (May/Jun. 1991, p. 474)

3–6. **ORSA/TIMS Joint National Meeting**, Anaheim, CA. (May/Jun. 1991, p. 474)

3–9. **Mengenlehre**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

4–8. **Second SIAM Conference on Geometric Design**, Tempe, AZ. (Nov. 1990, p. 1289)

4–8. **Les Processus Stochastiques en Théorie des Épidémies**, Centre International de Rencontres Mathématiques. (May/Jun. 1991, p. 474)

9. **Differential Geometry Day**, Eastern Illinois University, Charleston, IL. (May/Jun. 1991, p. 474)

9–10. **Western Section**, University of California, Santa Barbara.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

11–15. **IMA Workshop on Combinatorial and Graph-Theoretic Problems in Linear Algebra**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1140)

15–17. **Fourth Annual International Conference on Technology in Collegiate Mathematics**, Portland, OR. (Jul./Aug. 1991, p. 642)

17–23. **Singularitäten der Kontinuumsmechanik: Numerische und Konstruktive Methoden zu Ihrer Behandlung**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

\*18–21. **DIMACS Workshop on Planar Graphs: Structures and Algorithms**, Center for Discrete Mathematics, Rutgers, The State University of New Jersey.

PROGRAM: The special theme for the academic year 1991/1992 is Graph Theory and Algorithms. The special year will emphasize such topics as extremal graphs, graph structures, random graphs and randomized algorithms, network algorithms and data structures, graph embeddings and parallel architectures, and applications of graph theory and algorithms.

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INFORMATION: Organizer: T. Trotter, iacwtt@asuacad.bitnet; Rutgers, The State Univ. of New Jersey, P.O. Box 1179, Piscataway, NJ 08855-1179; 908-932-5928; email: center@dimacs.rutgers.edu; Fax: 908-932-5932.

18–22. **Workshop on Discrete Groups, Number Theory and Ergodic Theory**, Mathematical Sciences Research Institute (MSRI), Berkeley, CA. (May/Jun. 1991, p. 474)

18–22. **Supercomputing '91**, Albuquerque, NM. (Mar. 1991, p. 243)

20–26.  **$C^*$ -Algebren**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

21–22. **MSI/Stony Brook Conference on Nonlinear Analysis and Computation**, Stony Brook, NY. (Sep. 1991, p. 835)

24–30. **Numerische Methoden der Approximationstheorie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

25–29. **Séminaire Sud-rhodanien de Géométrie**, Centre International de Rencontres Mathématiques. (May/Jun. 1991, p. 474)

26–29. **Conference on Representation Theories of Lie Groups and Lie Algebras**, Misasa, Tottori, Japan. (May/Jun. 1991, p. 474)

## December 1991

**Fourth International Conference on Numerical Combustion**, St. Petersburg, FL. (Feb. 1991, p. 146)

1–7. **Statistik Stochastischer Prozesse**, Oberwolfach, F.R.G. (Jul./Aug. 1990, p. 746)

2–4. **Fourth International Conference on Numerical Combustion**, St. Petersburg, FL. (May/Jun. 1991, p. 474)

2–4. **Titre à Préciser**, Centre International de Rencontres Mathématiques. (May/Jun. 1991, p. 474)

2–6. **Workshop on Statistical Methods in Imaging**, Mathematical Sciences Research Institute, Berkeley, CA. (Oct. 1990, p. 1140)

2–9. **SIAM Conference on Combustion**, St. Petersburg, FL. (Nov. 1990, p. 1289)

6–7. **The Midwest Conference on Differential Equations**, University of Iowa, Iowa City, IA. (Jul./Aug. 1991, p. 642)

7–10. **Canadian Mathematical Society Winter Meeting**, Victoria, B.C., Canada. (Oct. 1990, p. 1141)

8–14. **Stochastic Geometry, Geometric Statistics, Stereology**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

9–13. **Femmes et Mathématiques—Congrès Européen**, Centre International de Rencontres Mathématiques. (May/Jun. 1991, p. 475)

10–12. **Ninth Biennial Conference on Modelling and Simulation**, Queensland, Australia. (May/Jun. 1991, p. 475)

12–16. **NATO Advanced Research Work-**



shop: **Algebraic Topology and Algebraic K-Theory**, Lake Louise, Alberta, Canada. (Jul./Aug. 1991, p. 642)

15–21. **Quantenstochastik**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

23–26. **International Conference on Generalized Functions and Their Applications**, Banaras Hindu University, Varanasi, India. (Dec. 1990, p. 1458)

27–31. **Holiday Symposium on the Impact of Software Systems in Mathematical Research**, New Mexico State Univ., Las Cruces, NM. (Jul./Aug. 1990, p. 746)

1992

1992. **IMACS Symposium on Symbolic Computation in Engineering Design**, IDN, Lille, France. (Jul./Aug. 1990, p. 746)

**IMACS International Conference on Computational Physics**, University of Colorado, Boulder, CO. (Oct. 1990, p. 1141)

Spring 1992. **International Conference on Finite Elements and Boundary Elements in Geophysics**, Monterey, CA. (Oct. 1990, p. 1141)

Spring 1992. **IMACS Symposium on Mathematical Modelling**, Wiener Neustadt, Germany. (May/Jun. 1991, p. 475)

Spring 1992. **Third IMACS International Conference on Expert Systems in Numerical Computing**, Purdue University, West Lafayette, IN. (May/Jun. 1991, p. 475)

\* Spring 1992. **DIMACS Workshop on Expander Graphs: Theory and Applications**, Center for Discrete Mathematics, Rutgers, The State University of New Jersey.

PROGRAM: The special theme for the academic year 1991/1992 is Graph Theory and Algorithms. The special year will emphasize such topics as extremal graphs, graph structures, random graphs and randomized algorithms, network algorithms and data structures, graph embeddings and parallel architectures, and applications of graph theory and algorithms.

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INFORMATION: Organizer: P. Diaconis and J. Friedman, jf@princeton.edu; Rutgers, The State Univ. of New Jersey, P.O. Box 1179, Piscataway, NJ 08855-1179; 908-932-5928; center@dimacs.rutgers.edu; Fax: 908-932-5932.

January 1992

1–11. **Mathematische Optimierung**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

3–6. **International Conference on Random Mappings, Partitions, and Permutations**, University of Southern California, Los Angeles, CA. (Sep. 1991, p. 835)

3–7. **Seventh Texas International Symposium on Approximation Theory**, Austin, TX. (Sep. 1991, p. 835)

5–8. **Second Caribbean Conference on the Fluid Dynamics**, University of the West Indies, St. Augustine, Trinidad. (Jan. 1991, p. 51)

\* 5–8. **Second International Symposium on Artificial Intelligence and Mathematics**, Fort Lauderdale, FL.

PROGRAM: This is the second of a biennial series featuring applications of mathematics in artificial intelligence as well as artificial intelligence techniques and results in mathematics. It also represents a step towards improving contacts and promoting cross-fertilization between the two areas.

SPONSORS: Florida Atlantic University. Additional sponsorship is pending. Partial travel subsidies may be available to young researchers.

PROGRAM COMMITTEE: The program committee is made up of 29 members from worldwide institutions. General Chair: M. Golumbic, IBM Science & Technology Haifa; Conference Chair: F. Hoffman, Florida Atlantic Univ.; Program Chair: J.-L. Lassez, IBM Yorktown Heights.

INVITED SPEAKERS: K. Ebcioglu, IBM Yorktown Heights; J.-C. Latombe, Stanford Univ.; Z. Manna, Stanford Univ.; H.-O. Peitgen, Univ. of Bremen and Florida Atlantic.

ACCOMMODATIONS: The symposium will be held at the Fort Lauderdale Marina Marriott located at 1881 Southeast Seventeenth St., Fort Lauderdale, FL 33316; 305-463-4000 or 1-800-228-9290 (U.S. and Canada only); FAX: 305-527-6705. You must contact the Marriott Reservations Desk by December 13 and mention the symposium to get the preferred rate of \$85 per night single or double.

REGISTRATION: The registration fee for the Symposium is \$135 regular; \$65 student, for registration by December 27, 1991. Late and door registration is \$165 (\$100 for students).

INFORMATION: F. Hoffman, Florida Atlantic Univ., Dept. of Math., P.O. Box 3091, Boca Raton, FL 33431; email: hoffman@acc.fau.edu or hoffman@fauvax.bitnet.

6–7. **AMS Short Course on "New Scientific Applications of Geometry and Topology"**, Baltimore, MD. (Jul./Aug. 1991, p. 643)

\* 6–17. **Topology Workshop**, Pontifical Catholic University, Rio de Janeiro, Brazil. (Please note changes from Apr. 1991, p. 366)

MINICOURSES: R. Stern, Recent developments in smooth 4-manifolds (first week); E. Ghys, Horocyclic flow and ergodic theory (second week); A. Adem, Cohomology and actions of finite groups; N. Saldanha, Geometric structures of 2- and 3-manifolds (for grad students).

INVITED SPEAKERS: (Revised list): S. Blank, M. Boileau, J.-P. Brasselet, C. Camacho, L. Conlon, M. Craizer, D. Gabai, J. Harrison, J. Heitsch, S. Hurder, F. Kammer, R. Langevin, D. Lehmann, S. Lins, S. Matsumoto, W. Meeks, Y. Mitsumatsu, J.M. Montesinos, J. Palis, D. Randall, H. Rosenberg, N.N. dos Santos, J.-C. Sikorav, D. Sullivan, T. Tsuboi, P. Walczak.

6–17. **International Research Workshop on Banach Space Theory**, Merida, Venezuela. (Jul./Aug. 1991, p. 643)

8–11. **Joint Mathematics Meetings**, Baltimore, MD. (including the annual meetings of the AMS, AWM, MAA and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

12–18. **Applied Dynamics and Bifurcation**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

\* 13–15. **DIMACS Workshop: Graph Embeddings and Parallel Architectures**, Center for Discrete Mathematics, Rutgers, The State University of New Jersey.

PROGRAM: The special theme for the academic year 1991/1992 is Graph Theory and Algorithms. The special year will emphasize such topics as extremal graphs, graph structures, random graphs and randomized algorithms, network algorithms and data structures, graph embeddings and parallel architectures, and applications of graph theory and algorithms.

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INFORMATION: Organizers: T. Leighton, ftl@math.mit.edu; B. Maggs, bruce@research.nj.nec.com; A. Rosenberg, rsnbrg@elys.cs.umass.edu; Rutgers, The State Univ. of New Jersey, P.O. Box 1179, Piscataway, NJ 08855-1179; 908-932-5928; center@dimacs.rutgers.edu; Fax: 908-932-5932.

13–17. **IMA Workshop on Linear Algebra, Markov Chains, and Queuing Models**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)

15–17. **Workshop on Stochastics and Analysis**, Universität Zürich, Zürich, Switzerland. (May/Jun. 1991, p. 475)

\* 17. **Joint Meeting with the Edinburgh Mathematical Society**, International Centre for Mathematical Sciences, Edinburgh, Scotland.

ORGANIZING COMMITTEE: J.M. Ball (Heriot-Watt), J.W. Christian (Oxford), R.D. James (Minnesota), O. Penrose (Heriot-Watt).

INVITED SPEAKERS: R.D. James and A.R. Mitchell.

INFORMATION: International Centre for Mathematical Sciences, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS; Tel: (031) 451 3227; FAX: (031) 451 3249; email: icms@cara.ma.hw.ac.uk.

19–25. **Modelltheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

26–February 1. **Applied and Computational Convexity**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

27–29. **Third ACM-SIAM Symposium on Discrete Algorithms**, Orlando, FL. (Feb. 1991, p. 146)

30–February 1. **International Meeting on Nonlinear Boundary Value Problems in Science and Engineering: Analytic Methods**, University of Wollongong, New South Wales, Australia. (Jul./Aug. 1991, p. 643)

### February 1992

2–8. **Thermodynamische Materialtheorien**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

\* 3. **Joint Meeting of the ICMS and the Royal Society of Edinburgh**, International Centre for Mathematical Sciences, Edinburgh, Scotland.

ORGANIZING COMMITTEE: J.M. Ball (Heriot-Watt), J.W. Christian (Oxford), R.D. James (Minnesota), O. Penrose (Heriot-Watt).

INVITED SPEAKERS: H.E. Huppert and A.P. Sutton.

INFORMATION: International Centre for Mathematical Sciences, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS; Tel: (031) 451 3227; FAX: (031) 451 3249; email: icms@cara.ma.hw.ac.uk.

3–7. **Eighth International Conference on Data Engineering**, Phoenix, AZ. (Jul./Aug. 1991, p. 643)

9–15. **Numerical Methods for Parallel Computing**, Oberwolfach, Federal Republic of

Germany. (Jan. 1991, p. 51)

10–11. **Workshop on Amenable Ergodic Theory**, Mathematical Sciences Research Institute (MSRI), Berkeley, CA. (May/Jun. 1991, p. 475)

16–22. **Funktiontheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

17–22. **Informatics '92**, Havana, Cuba. (Sep. 1991, p. 836)

23–29. **p-Adische Analysis und Anwendungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

24–28. **IEEE Computer Society COMP-CON Spring '92**, San Francisco, CA. (Jan. 1990, p. 62)

24–28. **Elliptic Curves and Related Topics**, Sainte-Adèle, France. (Sep. 1991, p. 836)

24–March 1. **IMA Workshop on Iterative Methods for Sparse and Structured Problems**, University of Minnesota, Minneapolis, MN. (Jul./Aug. 1991, p. 643)

### March 1992

March 1992. **1992 ASL Annual Meeting**, Duke University, Durham, NC. (Apr. 1991, p. 366)

1–7. **Klassifizierende Räume und Anwendungen der Steenrod-Algebra**, Oberwolfach, Germany. (Jan. 1991, p. 52)

3–5. **ACM 1992 Computer Science Conference**, Kansas City, MO. (Jul./Aug. 1991, p. 644)

5–6. **Twenty-third SIGCSE ('92) Technical Symposium**, Kansas City, MO. (Jul./Aug. 1991, p. 644)

8–14. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

13–14. **Southeastern Section**, University of Alabama, Tuscaloosa, AL.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

15–21. **Regelungstheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

20–21. **Central Section**, Southwest Missouri State University, Springfield, MO.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

21–27. **Workshop on Fluid Dynamics and Statistical Physics**, Institute for Advanced Study, Princeton, NJ. (Jul./Aug. 1991, p. 644)

22–28. **Teichmüller-Theorie und Modulräume Riemannscher Flächen**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

22–28. **Georgia Tech.-UAB International**

**Conference on Differential Equations and Mathematical Physics**, Atlanta, GA. (Jul./Aug. 1991, p. 644)

24–28. **GAMM Annual Meeting**, Leipzig, Germany. (Sep. 1991, p. 836)

\* 24–28. **Algebraic Groups and Their Representations**, University of California, Los Angeles.

PROGRAM: The program will be dedicated in part to Robert Steinberg. There will be ten featured speakers. Entries for shorter talks in special sections are welcome.

INFORMATION: M. Schacher or V. Varadajan, Dept. of Math., UCLA, Los Angeles, CA 90024-1555; 213-825-1087 (M. Schacher) or 213-825-4798 (V. Varadajan); mms@math.ucla.edu or vsv@math.ucla.edu.

27–28. **Eighth South-Eastern Analysis Meeting (SEAM VIII)**, University of Tennessee, Knoxville, TN. (Sep. 1991, p. 836)

29–April 4. **Topologische Methoden in der Gruppentheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

29–April 5. **Sixth International Conference on Geometry**, University of Haifa, Israel (postponed from March 1991 because of the Gulf War). (Jul./Aug. 1991, p. 644)

30–April 2. **Thirty-fourth British Theoretical Mechanics Colloquium**, University of Keele, England. (Sep. 1991, p. 836)

30–April 3. **Workshop on Statistical Methods in Molecular Biology**, Mathematical Sciences Research Institute, Berkeley, CA. (Sep. 1991, p. 836)

### April 1992

April 1992. **Eighth International Conference on Mathematical and Computer Modelling**, United States. (Sep. 1990, p. 939)

5–11. **Algebraische K-Theorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

5–11. **Informationstheorie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1991, p. 644)

6–10. **IMA Workshop on Linear Algebra for Signal Processing**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)

7–10. **Twenty-third Annual Iranian Mathematics Conference**, Razi University, Bakhtaran, Iran. (Sep. 1991, p. 836)

9–11. **Symplectic Topology**, University of Arkansas, Fayetteville, Arkansas. (Sep. 1991, p. 837)

11–12. **Eastern Section**, Lehigh University, Bethlehem, PA.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887,

Providence, RI 02940.

12–18. **Mathematische Logik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

13–17. **Workshop on Lie Groups, Ergodic Theory, and Geometry**, Mathematical Sciences Research Institute (MSRI), Berkeley, CA. (May/Jun. 1991, p. 476)

19–25. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

26–May 2. **Gruppentheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

30–May 1. **Twenty-third Annual Pittsburgh Conference on Modeling and Simulation**, University of Pittsburgh, PA. (Jul./Aug. 1991, p. 644)

### May 1992

May 1992. **Conference on Classification of Algebraic Varieties**, L'Aquila, Italy. (Apr. 1991, p. 366)

3–9. **Wavelett (Signalverarbeitung)**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

\* 4–6. **1992 ACM Symposium on the Theory of Computing**, Victoria, British Columbia, Canada.

PROGRAM: Papers presenting original research on theoretical aspects of computer science. Typical but not exclusive topics of interest include: Algorithms and data structures, automata and formal languages, computability and complexity, computational geometry, cryptography, databases, logics of programs, machine learning, parallel and distributed computation, robotics, semantics of programming languages, VLSI layout and design.

CALL FOR PAPERS: Deadline for receipt of abstracts is November 5, 1991. Sixteen copies of an abstract not to exceed ten pages in length should be sent to the address below.

INFORMATION: A. Wigderson, (STOC 92 Chair), Computer Science Dept., Princeton Univ., Princeton, NJ 08544; email: avi@princeton.edu.

10–16. **Geschichte der Mathematik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

11–13. **Fourth SIAM Conference on Optimization**, Chicago, IL. (Feb. 1991, p. 146)

11–15. **IUTAM Symposium on Inverse Problems in Engineering Mechanics**, Tokyo, Japan. (Sep. 1991, p. 837)

17–23. **Quadratische Formen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

18–23. **Second European Conference on Computer Vision**, Santa Margherita Ligure, Italy. (Jul./Aug. 1991, p. 645)

\* 18–23. **Low-Dimensional Topology**, Knoxville, TN.

PROGRAM: The conference is funded in part by the Science Alliance, a State of Tennessee Center of Excellence. It is oriented towards a broad spectrum of low-dimensional topology. Besides 30- and 50-minute talks there will be special survey talks in the following fields: Negatively curved groups, R-trees, minimal surfaces, hyperbolic 3-manifolds, combinatorial 3-manifolds, gauge theoretic aspects of 3-manifolds.

ORGANIZING COMMITTEE: F. Bonahon (USC), K. Johannson (Knoxville), P. Scott (Ann Arbor).

INVITED SPEAKERS: M. Bestvina (UCLA), J. Cannon (Brigham Young), A. Casson (Berkeley), R. Fintushel (East Lansing), P. Scott (Ann Arbor), P. Shalen (Chicago).

INFORMATION: K. Johannson, Dept. of Math., Univ. of Tennessee, Knoxville, TN 37966; email: johannso@utkvt1 (bitnet); johann@mathsun13.math.utk.edu.

24–30. **Kommutative Algebra und Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

25–28. **NATO Advanced Research Workshop: Asymptotic-Induced Numerical Methods for PDE's, Critical Parameters, and Domain Decomposition**, Beaune, France. (Sep. 1991, p. 837)

\* 28–30. **ICCI '92—Fourth International Conference on Computing and Information**, Toronto, Canada.

INFORMATION: A.A. Topsis, Preferably by email to anestis@clid.yorku.ca or anestis@yeti.cs.yorku.ca; Computer Science, Atkinson College, York Univ., Toronto, Ontario, Canada M3J 1P3; Fax: 416-436-5773.

29–31. **Twenty-first International Symposium on Multi-Valued Logic**, Sendai 980, Japan. (Jan. 1990, p. 62)

31–June 6. **Singularitäten**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

31–June 6. **Free Resolutions in Algebraic Geometry and Representation Theory**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

### June 1992

June 1992. **IMACS Symposium on Numerical Computing and Mathematical Modelling**, Bangalore, India. (Oct. 1990, p. 1141)

\* June 1992. **Continuum Models for the Mi-**

**crostructure of Crystals**, International Centre for Mathematical Sciences, Edinburgh, Scotland.

PROGRAM: A one-month period of concentration focused on an international conference during the week June 8–13.

ORGANIZING COMMITTEE: J.M. Ball (Heriot-Watt), J.W. Christian (Oxford), R.D. James (Minnesota), O. Penrose (Heriot-Watt).

INVITED SPEAKERS: G. Arlt (Aachen), K. Bhattacharaya (Courant), K. Binder (Mainz), J.W. Cahn (NIST), M. Chipot (Metz), J.W. Christian (Oxford), C.M. Elliott (Sussex), P.C. Fife (Utah), N. Firoozye (Heriot-Watt/Minnesota), I. Fonseca (Carnegie-Mellon), J. Hyde (Oxford), R.D. James (Minnesota), W.C. Johnson (Carnegie-Mellon), A. Khachaturyan (Rutgers), D. Kinderlehrer (Carnegie-Mellon), R.V. Kohn (Courant), J.L. Lebowitz (Rutgers), M. Luskin (Minnesota), T. Miyazaki (Nagoya), S. Müller (Bonn), G. Parry (Bath), R.L. Pego (Maryland), G.R. Purdy (McMaster), A.L. Roitburd (Maryland), N. Schryvers (Antwerp), J. Sethna (Cornell), V. Sverak (Heriot-Watt/Prague), P.J. Swart (Cornell).

INFORMATION: International Centre for Mathematical Sciences, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS; Tel: (031) 451 3227; FAX: (031) 451 3249; email: icms@cara.ma.hw.ac.uk.

1–5. **Seventh International Conference on Graph Theory, Combinatorics, Algorithms, and Applications**, Western Michigan University, Kalamazoo, MI. (May/Jun. 1991, p. 476)

1–5. **IMA Workshop on Linear Algebra for Control Theory**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)

7–13. **Computational Group Theory**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

8–11. **Sixth SIAM Conference on Discrete Mathematics**, University of British Columbia, Vancouver, Canada. (May/Jun. 1991, p. 476)

8–13. **Zero-dimensional Schemes**, Ravello, Italy. (Sep. 1991, p. 837)

12–14. **Canadian Mathematical Society Summer Meeting**, York University, North York, Ontario, Canada. (Nov. 1990, p. 1289)

14–20. **Fifth International Symposium on Statistical Decision Theory and Related Topics**, Purdue University, West Lafayette, IN. (Sep. 1990, p. 938)

14–20. **Freiformkurven und Freiformflächen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

15–19. **Twenty-first International Conference on Stochastic Processes and their Applications**, Toronto, Canada. (May/Jun. 1990, p. 613)

15–19. **Fourth Conference on Formal Power Series and Algebraic Combinatorics**, Université du Québec a Montréal. (Sep. 1991, p. 837)

17–20. **Fourth International Conference on Computers and Learning, ICCAL '92**, Acadia University, Nova Scotia, Canada. (Feb. 1991, p. 147)

21–27. **Porous Media**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

22–25. **Seventh Annual IEEE Symposium on Logic in Computer Science**, Santa Cruz, CA. (Sep. 1991, p. 838)

23–26. **Homotopy Theory**, Sorrento, Italy. (Jul./Aug. 1991, p. 645)

28–July 4. **Hyperbolic Systems of Conservation Laws**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

29–30. **International Conference on the Development of Mathematics from 1900 to 1950**, Luxembourg. (Sep. 1991, p. 838)

29–July 1. **Joint Meeting with the London Mathematical Society**, Cambridge, England.

INFORMATION: H. Daly, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.

29–July 5. **Nineteenth International Colloquium on "Group Theoretical Methods in Physics"**, Salamance, Spain. (May/Jun. 1991, p. 476)

### July 1992

1–10. **Stochastic Analysis Workshop of Guadeloupe-Silivri**, Pointe-à-Pitre, France. (Jul./Aug. 1991, p. 645)

5–11. **Mathematische Modellierung und Simulation Elektrischer Schaltungen**, Oberwolfach, Germany. (Jul./Aug. 1991, p. 645)

\* 5–August 1. **NSF Regional Geometry Institute: Computational Algebraic Geometry**, Amherst College, Amherst, MA.

PROGRAM: Amherst, Hampshire, Holy Cross, Mount Holyoke, Smith and Williams Colleges, and the Univ. of Massachusetts at Amherst will host an NSF-funded Regional Geometry Institute for approximately 100 algebraic geometers, graduate students, undergraduates, and high school teachers on the campus of Amherst College in Amherst, MA. The research component of the Institute will concentrate on Computational Algebraic Geometry. Rather than a conference for experts, the Institute will focus on teaching the new computational methods in algebraic geometry. The first two weeks will feature introductory lectures by D. Eisenbud (Brandeis) and M. Stillman (Cornell), and there will also be several series of lectures on Varieties of Low Dimension and Codi-

mension. During the second two weeks, there will be lecture series on Combinatorial Methods in Algebraic Geometry and on Applications and Computational issues. There will also be demonstrations of programs like *Maple*, *REDUCE*, *Macaulay*, and *CoCoA*, and the Institute will have 30 workstations for participants to use. In addition, there will be lectures and discussions involving the high school faculty and undergraduate students attending the conference.

INVITED SPEAKERS: J. Canny (Berkeley), W. Decker (Saarbrücken), D. Eisenbud (Brandeis), M. Giusti (Ecole Polytechnique), J. Harris (Harvard), S. Katz (Oklahoma State), R. Stanley (MIT), B. Sturmfels (Cornell), and A. Zelevinski (Northeastern).

PARTICIPANTS: The Institute seeks approximately 40 mathematicians who have active research programs in or closely related to algebraic geometry and who are willing to engage in activities with the other groups at the Institute. There is also funding for about 20 graduate students.

INFORMATION: For application forms and more information about the Institute, contact D. Cox, Research Director, Regional Geometry Institute, Dept. of Math. and Comp. Sci., Amherst College, Amherst, MA 01002; 413-542-2082; email: rgi@cs.amherst.edu. Deadline for application is **March 15, 1992**.

6–10. **European Congress of Mathematics**, Paris, France. (May/Jun. 1991, p. 476)

6–10. **Mathematical Conferences in Perth**, University of Western Australia. (Sep. 1991, p. 838)

6–31. **IMA Summer Program on Environmental Studies: Mathematical, Computational, and Statistical Analysis**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 838)

6–August 14. **Summer Program in Mathematical Physiology**, Mathematical Sciences Research Institute, Berkeley, CA. (Sep. 1991, p. 838)

11–18. **St. Andrews Colloquium**, University of St. Andrews, Scotland. (Jul./Aug. 1991, p. 645)

12–17. **International Colloquium on Automata, Languages and Programming**, Vienna, Austria. (Jul./Aug. 1991, p. 645)

12–18. **Arithmetic Algebraic Geometry**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

19–24. **SIAM Annual Meeting (SIAM's 40th Anniversary)**, Los Angeles, CA. (Feb. 1991, p. 147)

19–25. **Lower-Dimensional Theories and Domain Decomposition Methods in Mechanics**, Oberwolfach, Federal Republic of

Germany. (Feb. 1991, p. 147)

19–25. **Applications of Nonstandard-Analysis to Analysis, Functional Analysis, and Probability Theory**, Heinrich Fabri-Institut der Universität Tübingen, Blaubeuren (Ulm), Federal Republic of Germany. (Jul./Aug. 1991, p. 645)

20–24. **The Fifth International Conference on Fibonacci Numbers and their Applications**, University of St. Andrews, St. Andrews, Scotland. (May/Jun. 1991, p. 476)

20–24. **Algorithms for Approximation**, Cranfield Institute of Technology, Oxford. (Sep. 1991, p. 839)

20–26. **International Conference on Algebraic Geometry**, Université Paris-Sud. (Please note date change from Apr. 1991, p. 363)

26–31. **Eighteenth International Symposium on Rarefied Gas Dynamics (RGD18)**, University of British Columbia, Vancouver, Canada. (May/Jun. 1991, p. 477)

26–August 1. **Variationsrechnung**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

### August 1992

August 1992. **The International Conference Lobachevsky and Modern Geometry devoted to the 200th Anniversary of Lobachevsky's birthday**, Kazan, USSR. (Feb. 1991, p. 147)

\* August 1992. **Kinetics of Phase Transitions**, International Centre for Mathematical Sciences, Edinburgh, Scotland.

PROGRAM: A one-month period of concentration focused on an international conference during the week August 10-14.

ORGANIZING COMMITTEE: J.M. Ball (Heriot-Watt), J.W. Christian (Oxford), R.D. James (Minnesota), O. Penrose (Heriot-Watt).

INVITED SPEAKERS: G. Arlt (Aachen), K. Bhattacharaya (Courant), K. Binder (Mainz), J.W. Cahn (NIST), M. Chipot (Metz), J.W. Christian (Oxford), C.M. Elliott (Sussex), P.C. Fife (Utah), N. Firoozye (Heriot-Watt/Minnesota), I. Fonseca (Carnegie-Mellon), J. Hyde (Oxford), R.D. James (Minnesota), W.C. Johnson (Carnegie-Mellon), A. Khachaturyan (Rutgers), D. Kinderlehrer (Carnegie-Mellon), R.V. Kohn (Courant), J.L. Lebowitz (Rutgers), M. Luskin (Minnesota), T. Miyazaki (Nagoya), S. Müller (Bonn), G. Parry (Bath), R.L. Pego (Maryland), G.R. Purdy (McMaster), A.L. Roitburd (Maryland), N. Schryvers (Antwerp), J. Sethna (Cornell), V. Sverak (Heriot-Watt/Prague), P.J. Swart (Cornell).

INFORMATION: International Centre for Mathematical Sciences, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS;

Tel: (031) 451 3227; FAX: (031) 451 3249; email: icms@cara.ma.hw.ac.uk.

- 2-8. **Algebraische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)
- 3-7. **Sixth Workshop on Lie-Admissible Formulations**, Clearwater, FL. (Mar. 1991, p. 244)
- 3-7. **Fifth International Meeting of Statisticians in the Basque Country**, San Sebastian, Spain. (Jul./Aug. 1991, p. 646)
- 3-7. **Second Meeting of the International Linear Algebra Society (ILAS)**, University of Lisbon, Portugal. (Sep. 1991, p. 839)
- 9-15. **Jordan-Algebren**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)
- \* 13-17. **First Colloquium on Numerical Analysis**, Plovdiv, Bulgaria.

CONFERENCE TOPICS: Numerical methods of algebra, of approximation theory, for ordinary and partial differential equations.

CALL FOR PAPERS: Abstracts for contributed papers should be received by January 1, 1992.

INFORMATION: Secretary S. Zlatev, Math. Faculty of the Plovdiv Univ., Tsar Assen Str. 24, Plovdiv 4000, Bulgaria; or Drumi Bainov, P.O. Box 45, 1504 Sofia, Bulgaria.

- 16-22. **Reelle Analysis**, Oberwolfach, Germany. (Jul./Aug. 1991, p. 646)
- 16-23. **Seventh International Congress on Mathematical Education (ICME-7)**, Québec, Canada.
- 17-23. **Seventh International Conference on Mathematical Education (ICME-7)**, Université Laval, Québec, Canada. (Sep. 1991, p. 839)
- \* 18-22. **Third Colloquium on Differential Equations**, Plovdiv, Bulgaria.

CONFERENCE TOPICS: Ordinary differential equations: General, functional, impulsive, stochastic, integro-differential equations, dynamical systems and symplectic geometry, bifurcation theory, invariant manifolds, oscillation theory, difference equations, control theory, numerical analysis; Partial differential equations: Linear and nonlinear-general, scattering theory and inverse problems, nonlinear hyperbolic equations-lifespan and blow-up of the solutions, global existence and stability, oscillation theory, numerical analysis.

CALL FOR PAPERS: Abstracts for contributed papers should be received by January 1, 1992.

INFORMATION: Secretary S. Zlatev, Math. Faculty of the Plovdiv Univ., Tsar Assen Str. 24, Plovdiv 4000, Bulgaria; or Drumi Bainov, P.O. Box 45, 1504 Sofia, Bulgaria.

- 19-26. **World Congress of Nonlinear Analysts**, Melbourne, FL. (Nov. 1990, p. 1289)
- 22-28. **Eighteenth International Congress of Theoretical and Applied Mechanics**, Technion-Israel Institute of Technology, Haifa, Israel. (Jan. 1991, p. 52)
- 23-29. **Mathematical Finance**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)
- 26-28. **IMACS RM2S '92 Kobe**, Kobe University, Kobi, Japan. (May/June. 1991, p. 477)
- 30-September 5. **Komplexe Analysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

### September 1992

- September 1992. **IMACS 2nd International Conference on System Simulation and Scientific Computing-BICSC '92**, Beijing, China. (May/June. 1991, p. 477)
- 6-12. **Topologie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)
- 8-11. **IMA Tutorial: Introduction to Linear Multivariable Control, Optimal Design, and Parameter Estimation**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 839)
- 13-19. **4-Dimensional Manifolds**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)
- 16-18. **Second SIAM Conference on Control in the 90s**, Minneapolis, MN. (Feb. 1991, p. 148)
- 17-19. **International Conference on Group Theory**, University of Timisoara, Romania. (Jul./Aug. 1991, p. 646)
- 20-26. **Funktionalgleichungen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)
- 21-25. **IMA Workshop on Robust Control Theory**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 839)
- 27-October 3. **Darstellungstheorie Endlicher Gruppen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

### October 1992

- 4-10. **Funktionalanalysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

11-17. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

- 12-16. **IMA Workshop on Control Systems Design for Advanced Engineering Systems: Complexity, Uncertainty, Information, and Organization**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)
- 16-19. **Second SIAM Conference on Dynamical Systems**, Salt Lake City, UT. (Jul./Aug. 1991, p. 646)
- 18-24. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)
- 22-30. **Forty-sixth Conference and Congress of the International Federation for Information and Documentation**, Madrid, Spain. (May/June. 1991, p. 477)
- 25-31. **Stochastische Analysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)
- 30-November 1. **Central Section**, Right State University, Dayton, OH.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

### November 1992

- 1-7. **Kombinatorik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)
- 8-14. **Numerische Integration**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)
- 13-19. **IMA Workshop on Control and Optimal Design of Distributed Parameter Systems**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)
- 14-16. **The Third Biennial Conference of the Allahabad Mathematical Society**, Allahabad, India. (May/June. 1991, p. 477)
- 15-21. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)
- 16-20. **International Congress on Numerical Methods in Engineering and Applied Sciences**, University of Concepción, Concepción, Chile. (Jul./Aug. 1991, p. 646)
- 16-20. **IMA Period of Concentration: Flow Control**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)
- 3-11. **The International Congress of Mathematicians 1994**, Zürich, Switzerland. (Mar. 1991, p. 244)

## New AMS Publications

### MEDITATIONES ALGEBRAICAE, AN ENGLISH TRANSLATION OF THE WORK OF EDWARD WARING

Dennis Weeks, Editor and Translator

"Some time ago, I attended a lecture by a prominent computer scientist, a man of Chinese origin, who began with the words, 'Since there are very few Chinese people in the audience, I will give my talk in the universal language of Science: Broken English.'...

"In the 18th Century, the universal language of Science was Latin, and it does no injustice to those (essentially all) scientific writers whose native language was not Latin to note that they probably wrote 'broken Latin' in many cases. For reasons of historical interest and personal curiosity, I have chosen to translate from Latin to English a work by Edward Waring. Can I then represent accurately what would have been found in Waring's English language draft (if one ever existed) by matching my broken Latin to his, with virtually no English language fragments to aid me?"

—from the Translator's foreword

"Waring's Formulas" and "Waring's Problem" are well known to mathematicians. Those familiar with symmetric functions in algebra will likely know of the English mathematician Edward Waring, who treated this subject in his 1782 book, *Meditationes algebraicae*. Waring, born in 1734, was appointed Lucasian Professor at Cambridge University at the unusually young age of twenty-five and was known in his time as a profound and accomplished researcher. However, his writings have been nearly inaccessible because of their numerous typographical and printing errors, corrigenda, and addenda, not to mention his own awkward, obscure, and poorly organized writing style.

In the present volume, a translation from the Latin of the third and last edition of *Meditationes algebraicae*, the translator has produced what amounts to a fourth edition, not only making the work available in English but also incorporating many of the corrections and additions that had appeared separately. The translator has made judicious choices about when to use modern terminology if archaic usage would confuse the reader, and when to retain the original words to preserve the historic flavor of the book. Also included as an appendix is the only critical review of *Meditationes* ever published, written in 1923 by Franz X. Mayer, a Cistercian monk who taught secondary school mathematics in Switzerland. Historians and mathematicians will likely find this volume of great interest.

1991 *Mathematics Subject Classifications*: 01A75, 01A50; 05E05, 11-03, 11P05

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1991 *Mathematics Subject Classifications*: 47G10, 81T13, 81U10,

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## RATIONAL APPROXIMATIONS AND ORTHOGONALITY

E. M. Nikishin and V. N. Sorokin

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### Contents

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## ELEMENTS OF THE GEOMETRY AND TOPOLOGY OF MINIMAL SURFACES IN THREE-DIMENSIONAL SPACE

A. T. Fomenko and A. A. Tuzhilin

(Translations of Mathematical Monographs, Volume 93)

This book grew out of lectures presented to students of mathematics, physics, and mechanics by A. T. Fomenko at Moscow University, under the auspices of the Moscow Mathematical Society. The book describes modern and visual aspects of the theory of minimal, two-dimensional surfaces in three-dimensional space. The main topics covered are: topological properties of minimal surfaces, stable and unstable minimal films, classical examples, the Morse-Smale index of minimal two-surfaces in Euclidean space, and minimal films in Lobachevskian space. Requiring only a standard first-year calculus and elementary notions of geometry, this book brings the reader rapidly into this fascinating branch of modern geometry.

### Contents

**Physical prerequisites:** *Interfaces between two media; The principle of economy in nature; Classical minimal surfaces in  $\mathbb{R}^3$ : Catenoids; The helicoid; The minimal surface equation, Bernstein's problem, The Scherk surface; Periodic minimal surfaces; Complete minimal surfaces; General properties of minimal surfaces in  $\mathbb{R}^3$ : Isothermal coordinates; Harmonicity and conformality, The Gaussian mapping and the Weierstrass representation; The global Weierstrass representation; Total curvature and complete minimal surfaces; The geometry of complete minimal surfaces of finite total curvature; Indices of two-dimensional minimal surfaces in  $\mathbb{R}^3$ .*

1991 *Mathematics Subject Classification*: 53A10  
ISBN 0-8218-4552-7, LC 91-21604, ISSN 0065-9282  
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## ASSISTANTSHIPS AND GRADUATE FELLOWSHIPS IN THE MATHEMATICAL SCIENCES, 1991-1992

This publication is an indispensable source of information for students seeking support for graduate study in the mathematical sciences. Because it provides data from a broad range of academic institutions, it is also a valuable resource for mathematical sciences departments and faculty.

*Assistantships and Graduate Fellowships* brings together a wealth of information about resources available for graduate study in mathematical sciences departments in the U.S. and Canada. For each department listed, it provides the number of faculty, graduate students, and degrees awarded (BAs, MAs, and PhDs). Stipend amounts and the number of awards available are given, as well as information about foreign language requirements and the acceptability of critical, expository, or historical theses for the mathematics PhD. Numerous display advertisements from mathematical sciences departments throughout the country provide additional information.

Also listed are sources of support for graduate study and travel, summer internships, and graduate study in the U.S. for foreign nationals. Finally, a list of reference publications for fellowship information makes *Assistantships and Graduate Fellowships* a centralized and comprehensive resource.

1991 *Mathematics Subject Classification*: 00  
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### SOCIÉTÉ MATHÉMATIQUE DE FRANCE, ASTÉRISQUE

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## SINGULAR INTEGRALS AND RECTIFIABLE SETS IN $\mathbb{R}^n$ ; AU DELÀ DES GRAPHES LIPSCHITZIENS

G. David and S. Semmes

(Astérisque, Number 193)

This monograph is concerned with quantitative versions of the notion of rectifiability. A  $d$ -dimensional subset of  $\mathbb{R}^n$  is called rectifiable if it is contained in the union of a countable family of  $d$ -dimensional  $C^1$  submanifolds, except possibly for a set of Hausdorff measure zero. This is clearly a qualitative condition, since no bounds are involved. The main result of this book provides the equivalence between several conditions which

can be viewed as providing a natural definition for quantitative rectifiability. An amusing feature of the authors' methods is that singular integral operators provide a bridge for passing between various geometrical conditions. The authors also obtain a higher-dimensional version of Peter Jones' traveling salesman theorem.

### Contents

*Dyadic cubes and the corona decomposition; From (C1) to (C2); (C2) implies a local symmetry condition; The local symmetry condition (LS) implies the weak geometric lemma; Approximation of  $E$  in measure; Building the stopping-time regions, and some of their properties; The construction of the approximating Lipschitz graph; Pushing the square*

*function estimates from  $E$  to the graph of  $A$ ; Controlling a square function of  $A$  in terms of  $J(S, \psi)$ ; The end of the proof that (C2) implies (C4); The proof that (C3) implies (C4); Preliminary discussion; Pushing estimates on  $\beta_1(x, t)$  from  $E$  down to the approximating Lipschitz graph; The end of the proof that (C3) implies (C4); (C4) implies (C3); The main step in the proof that (C4) implies (C5); An extension theorem; The proof that (C4) implies (C7); A variant of (C2) and (C3).*

1991 *Mathematics Subject Classifications*: 42, 49Q15, 90  
ISSN 0303-1179  
145 (softcover), 1991  
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# MEMOIRS of the American Mathematical Society Volume 90

## Maximal Subgroups of Exceptional Algebraic Groups

Gary M. Seitz  
Number 441

The goal of this book is the determination of the maximal closed connected subgroups of the simple algebraic groups of exceptional type. The main result recovers the results of Dynkin and extends them to cover the case of algebraic groups over algebraically closed fields of positive characteristic. The author first reduces to the case of semisimple subgroups, and then studies them via their action on the Lie algebra of the overlying exceptional group. The analysis is facilitated by a particular 1-dimensional torus of the subgroup which determines a labelling of the Dynkin diagram of the exceptional group. The results of this paper, when combined with previous results concerning maximal subgroups of classical algebraic groups, yield a reasonably complete analysis of the maximal closed connected subgroups of simple algebraic groups.

1980 *Mathematics Subject Classifications*: 20  
ISBN 0-8218-2504-6, LC 90-26491,  
ISSN 0065-9266  
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## Boundedness Results for Operators with Singular Kernels on Distribution Spaces

Rodolfo H. Torres  
Number 442

Discrete decomposition techniques for spaces for functions or distributions are very useful tools for studying many problems in analysis. In this work, the author uses this type of decomposition, associated with the so-called  $\phi$ -transform and wavelet-transform theories, to analyze a large class of operators, including pseudodifferential operators, Calderón-Zygmund operators, and other operators with singular kernels. The methods used combine Littlewood-Paley type characterizations of spaces of distributions with certain atomic and molecular decompositions. In this way, the study of operators on most of the classical function spaces—such as Hardy spaces, Besov-Lipschitz spaces, and Sobolev spaces—can be accomplished in a unified manner. The book is written in an expository style that makes it suitable for advanced graduate students in analysis

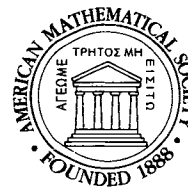
1980 *Mathematics Subject Classifications*: 43;  
46, 47  
ISBN 0-8218-2505-4, LC 90-26446,  
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## Mapping Class Groups of Low Genus and Their Cohomology

D.J. Benson and F.R. Cohen  
Number 443

This book is concerned with the calculation of the cohomology of the mapping class group of a closed oriented surface of genus two. The methods used involve braid groups, modular representations of symmetric groups, and configuration spaces.

1980 *Mathematics Subject Classifications*:  
57, 20; 55  
ISBN 0-8218-2506-2, LC 90-26421,  
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104 pages (softcover), March 1991  
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# AMS Reports and Communications

## Recent Appointments

Committee members' terms of office on standing committees expire on January 31 following the year given in parentheses following their names, unless otherwise specified.

### The January Meeting in San Francisco

The January 1991 Joint Mathematics Meetings, including the 97th annual meeting of the American Mathematical Society, the 74th Annual Meeting of the Mathematical Association of America, the 1991 annual meeting of the National Association of Mathematicians, and the 20th Anniversary celebration of the Association for Women in Mathematics, were held January 16–19 (Wednesday–Saturday), 1991, in San Francisco, California. Scientific sessions took place in the San Francisco Hilton on Hilton Square. There were 3,667 registrants, including 2,660 members of the Society.

**AMS-AWM-MAA Invited Address.** In honor of the 20th anniversary of the founding of the Association for Women in Mathematics, there was a special joint AMS-AWM-MAA Invited Address by CHRISTEL ROTTHAUS of Michigan State University on *Some nonstandard construction methods for local noetherian rings*. Professor Rotthaus was introduced by Jill P. Mesirov.

**AMS-MAA Invited Addresses.** By invitation of the AMS-MAA Joint Program Committee, three speakers addressed the AMS and MAA on history or development of mathematics. The speakers, and their affiliations and titles were SHING S. CHERN, University of California Berkeley, *Characteristic forms*; REBECCA A. HERB, University of Maryland, College Park,

HARISH-CHANDRA and his work; and FRANK MORGAN, Williams College, *Compound soap bubbles, shortest networks, and minimal surfaces*. The speakers were introduced by William P. Thurston, M. Susan Montgomery, and Frederick J. Almgren, respectively.

**Sixty-Fourth Josiah Willard Gibbs Lecture.** The 1991 lecture was presented by SIR MICHAEL ATIYAH, Master of Trinity College. His title was *The mysteries of space*. William Browder, President of the Society, introduced Sir Michael.

**Retiring Presidential Address.** G. D. MOSTOW, Yale University, delivered his retiring Presidential Address on *From Coxeter diagrams to Kummer identities*. William Browder, President of the Society, introduced Ex-president Mostow.

**Colloquium Lectures.** A series of three Colloquium Lectures were delivered by ROBERT D. MACPHERSON, Massachusetts Institute of Technology, on *Intersection homology and perverse sheaves*. Presiding at the lectures were William Browder, Michael Artin, and Sheldon Katz.

**Invited Addresses.** By invitation of the AMS Program Committee for National Meetings, there were five fifty-minute invited addresses. The speakers, their affiliations and titles, and their introducers were as follows: NOAM D. ELKIES, Harvard University, *Elliptic curves and number theory*, (Gary Cornell); MARIA KLAWE, University of British Columbia, *Matrix searching and its applications*, (Kevin McCurley); GRIGORII A. MARGULIS, Harvard University, *Subgroup actions on homogeneous spaces and number theory*, (G. D. Mostow); KENNETH A. RIBET, University of California Berkeley, *Two-dimensional modular representations of the Galois group of  $Q$ ,*

(Henri Gillet); and HECTOR SUSSMAN, Rutgers University, *Recent results and open problems in deterministic nonlinear control theory*, (Kevin Grasse).

**Special Sessions.** By invitation of the same committee, there were sixteen special sessions of selected twenty-minute papers. The topics of the sessions and the names and affiliations of the organizers were as follows:

*Matrix searching, Monge arrays and Ackermann's inverse: Algorithms and lower bounds*, ALOK AGGARWAL, IBM Yorktown Heights, and MARIA M. KLAWE, University of British Columbia;

*Computing optimal geometries*, FREDERICK J. ALMGREN, Rutgers University, ALBERT MARDEN, University of Minnesota, and JEAN E. TAYLOR, Rutgers University;

*Geometric Fourier analysis*, WILLIAM BECKNER, University of Chicago, and J. MICHAEL PEARSON, Florida International University;

*Turbulence, mathematical aspects*, MELVYN S. BURGER, University of Massachusetts;

*$C^*$ -algebras and noncommutative topology*, BRUCE E. BLACKADAR, University of Nevada, Reno;

*Oscillation and dynamics in delay equations*, JOHN R. GRAEF, Mississippi State University, and JACK K. HALE, Georgia Institute of Technology;

*Deterministic nonlinear control theory and related topics*, KEVIN GRASSE, University of Oklahoma, and HECTOR J. SUSSMAN, Rutgers University;

*Analytical methods in convexity*, HELMUT GROEMER, University of Arizona, Tucson, and JANE SANGWINE-YAGER, St. Mary's College;

*Real algebraic geometry*, WILLIAM B. JACOB, University of California, Santa Barbara;

*History of mathematics*, FLORENCE FASANELLI, George Washington University, VICTOR J. KATZ, University of the District of Columbia, and DAVID ROWE, Pace University;

*Combinatorial design theory*, ESTHER R. LAMKEN, Institute for Defense Analyses;

*Boundary behavior in partial differential equations*, KIRK E. LANCASTER, Wichita State University;

*Hopf algebras*, M. SUSAN MONTGOMERY, University of Southern California, and EARL J. TAFT, Rutgers University;

*Automatic theorem proving*, DAVID MUMFORD, Harvard University;

*Arithmetical algebraic geometry*, KENNETH A. RIBET, University of California, Berkeley;

*Entire theory*, ANTOINETTE TREMBINSKA, John Jay College of Criminal Justice, CUNY.

**AMS-MAA Special Sessions.** By invitation of the same committee, and in

conjunction with the MAA, there were three jointly sponsored special sessions of selected twenty-minute papers. The topics of the sessions, and the names and affiliations of the organizers were as follows:

*Research in undergraduate mathematics education*, ED DUBINSKY, Purdue University, and JAMES J. KAPUT, Southeastern Massachusetts University;

*Mathematics and education reform*, NAOMI D. FISHER, University of Illinois at Chicago, HARVEY B. KEYNES, University of Minnesota, and PHILLIP D. WAGREICH, University of Illinois at Chicago;

*Research papers by undergraduates*, LESTER J. SENECHAL, Mount Holyoke College.

**Contributed Papers.** There were forty-seven AMS sessions for contributed ten minute papers. The following mathematicians presided at these sessions: Samih A. Obaid, Patrick Reardon, Rudolph M. Najjar, George Bal-

glou, Michael M. Neumann, Leonard C. Sulski, Robert E. Kennedy, Steven C. Leth, Peter Jau-Shyong Shiue, Monty J. Strauss, Julie D. Simon, Della C. Duncan, Robin B. Brooks, Saul Stahl, Vlastimil H. Dlab, Thomas E. Bengtson, Yousef Alavi, Roger Wiegand, Seenith Sivasundram, Robert P. Webber, Howard Osborn, P. Sundar, Ioannis K. Argyros, Raghu R. Gompala, Kent Pearce, Stephen D. Comer, Mary Rosen, Joseph Straight, Robert Berman, Dale T. Smith, Francis J. Flanagan, M. Vinayagamoorthy, Pierre A. Grillet, Sarah E. Holte, Roger Kraft, David L. Skoug, M. Nouri-Moghadam, Thomas M. Zachariah, Maria R. Zack, Robert Acar, Russell G. Bilyeu, Aaron R. Todd, John Gregory, Sherwood Washburn, Seth F. Oppenheimer, and Daniel H. Luecking.

**Andy R. Magid**  
Associate Secretary  
Norman, Oklahoma

## Miscellaneous

### Personals

**Steven Irl Marcus**, L.B. (Preach) Meaders Professor in Engineering at the University of Texas at Austin, has been appointed director of the Systems Research Center (SRC) at the University of Maryland at College Park.

**Julia Mueller**, of Fordham University, has received an NSF Visiting Professorship for Women. She will spend the academic year 1991-1992 at Columbia University.

### Deaths

**John W. Bunce**, of the University of Kansas, died on July 18, 1991, at the

age of 48. He was a member of the Society for 24 years.

**Enzo R. Gentile**, of the University of Buenos Aires, died on April 6, 1991, at the age of 62. He was a member of the Society for 33 years.

### Visiting Mathematicians

#### Supplementary List

Mathematicians visiting other institutions during the 1990-1991 and 1991-1992 academic years have been listed in recent issues of *Notices*: December 1990, p. 1466; November 1990, p. 1295; October 1990, p. 1148; Septem-

ber 1990, p. 959; July/August 1990, p. 758.

**Aurel Bejancu** (Romania), University of Windsor, Differential Geometry, 9/91-12/91.

**Nicolae Dinculeanu** (U.S.A.), Université de Paris, Vector Measures and Integration Theory, Functional Analysis, 8/91-12/91.

**Sören Illman** (Finland), Princeton University, Topology, 9/91-6/92.

**Xian-He Sun**, (China), Clemson University, Mathematics/Computer Science, 8/91-5/92.

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*Maharishi International University*  
Valery Alexandrovich Kholodnyi  
*Mississippi State University*  
Agnes R Miciano  
*Rockefeller University*  
Carole E Landisman  
Darren B Orbach  
*SUNY, College at Brockport*  
Robin C Pronti  
*Shippensburg University of Pa*  
Charles G Jones  
*St Louis University*  
Robert Andrew Korte  
*United States Naval Academy*  
David Michael Brett-Major  
Donald Scott Cunningham  
Carl Harvey Ebersole  
Paul Wilson Miller  
Frederic Edward Nauck  
Vincent Callahan Vertin  
*University de Montreal*  
Mustapha AitAbdelmalek  
*University of California, Davis*  
Alex John Aretakis  
Noah Samuel Brannen  
Kevin Todd Brewer  
Jerome Martin Coleman  
Xiaopeng Dong  
Judith Karen Epstein  
Lisheng Gao  
Yunyun Gu  
Daniel J Heath  
Richard Alan Kavinsky  
Lothar G Mans  
Michael Robert Penkava  
Raymond Sim  
Luke J Simcik  
Slawomir Jozef Solecki  
Lance Lyle Thompson  
Binh X Truong  
Eiko Nakayama Tyler  
Tong Yang  
Dante Giuliano di Tommaso  
*University of Colorado, Boulder*  
Scott David Ahlgren  
Fabio Ancona  
Jane A Arledge  
Lea Verdin Carty  
Joanne Marie Lapierre  
Arnold Reed Miller  
Dean L Moore  
Douglas Craig Peterson  
Simon T Wong  
*University of Connecticut, Storrs*  
Shiho Pan  
*University of Massachusetts, Boston*  
Mary Glaser  
*University of Minnesota-Minneapolis*  
Karl Michael Kattchee  
*University of Missouri, Columbia*  
Ratnam Ratnaseelan  
*University of Missouri, St Louis*  
Patrick T Robinson  
*University of North Texas*  
Sandra A Smith  
*University of Rochester*  
Nora Franzova  
Tianpei Huang  
Jung-Soon Hyun  
*Western Illinois University*  
Jianlin Cheng  
*Western Michigan University*  
Ian C Walters Jr

# Postdoctoral Positions

## Research or Research/Teaching 1990–1991

Postdoctoral positions, either research or a combination of research and teaching, available through academic departments for 1990–1991 are listed below. An asterisk is used to indicate that the information was not yet available.

### Alabama

Univ of Alabama at Birmingham  
Mathematics 1

### California

Univ of California, Berkeley  
Mathematics 6  
Univ of California, Los Angeles  
Biostatistics 2  
Mathematics 7  
Univ of California, San Diego  
Mathematics 2  
Univ of California, Santa Cruz  
Mathematics 2  
Univ of Southern California  
Mathematics 5

### Colorado

Univ of Colorado, Boulder  
Applied Mathematics 1-2

### Connecticut

Univ of Connecticut  
Mathematics 1

### District of Columbia

George Washington Univ  
Mathematics 7

### Florida

Florida Inst of Tech  
Applied Mathematics 2  
Univ of Central Florida  
Mathematics 2

### Georgia

Univ of Georgia  
Mathematics 3

### Illinois

Northwestern Univ  
Engineering Sciences and Applied  
Mathematics 2  
Mathematics 5

### Indiana

Purdue Univ  
Mathematics 1  
Univ of Notre Dame  
Mathematics 2

### Maryland

Johns Hopkins Univ  
Mathematical Sciences 2  
Univ of Maryland, College Park  
Computer Science 3

### Massachusetts

Harvard Univ  
Biostatistics 9  
Massachusetts Inst of Tech  
Mathematics 15

### Michigan

Michigan State Univ  
Mathematics 2  
Univ of Michigan  
Mathematics 7

### Minnesota

Univ of Minnesota  
Mathematics 2

### Missouri

Washington Univ  
Mathematics 8

### Montana

Montana State Univ  
Mathematical Sciences 1

### Nebraska

Univ of Nebraska, Lincoln  
Computer Science  
and Engineering 2  
Mathematics and Statistics 1

### New Hampshire

Dartmouth Coll  
Mathematics and Computer  
Science 2

### New Mexico

New Mexico Inst of Mining & Tech  
Mathematics 2

### New York

Columbia Univ  
Statistics 1  
Cornell Univ  
Applied Mathematics 5  
Operations Research 1  
New York Univ, Courant  
Mathematics 20  
Rensselaer Polytechnic Inst  
Mathematical Sciences 1  
State Univ of New York at Stony  
Brook  
Applied Mathematics  
and Statistics 3  
Mathematics 5  
Univ of Rochester  
Statistics 1

### North Carolina

North Carolina State Univ  
Mathematics 2  
Statistics 1

Postdoctoral Positions

Univ of North Carolina, Chapel Hill  
Biostatistics 3  
Univ of North Carolina, Charlotte  
Mathematics 2

**Ohio**

Ohio State Univ  
Mathematics 15  
Ohio Univ  
Mathematics 1  
Univ of Toledo  
Mathematics 1

**Oklahoma**

Oklahoma State Univ  
Mathematics 5  
Univ of Oklahoma  
Mathematics 1

**Oregon**

Oregon State Univ  
Statistics 2

**Pennsylvania**

Carnegie Mellon Univ  
Mathematics 6  
Statistics 4  
Pennsylvania State Univ  
Mathematics 2  
Univ of Pennsylvania  
Computer and Information  
Science 4  
Univ of Pittsburgh  
Mathematics and Statistics 1

**Rhode Island**

Brown Univ  
Applied Mathematics 6  
Univ of Rhode Island  
Computer Science and Statistics 1

**South Carolina**

Univ of South Carolina  
Mathematics 4

**Texas**

Rice Univ  
Mathematical Sciences 6  
Mathematics 5  
Univ of Houston  
Mathematics 5

**Utah**

Brigham Young Univ  
Mathematics 3  
Univ of Utah  
Mathematics 3

**Vermont**

Univ of Vermont  
Mathematics and Statistics 17

**Virginia**

Virginia Polytech Inst and State Univ  
Computer Science 2

**Washington**

Washington State Univ  
Mathematics 1

**Wisconsin**

Univ of Wisconsin, Madison  
Mathematics 4

**Canada**

Dalhousie Univ  
Mathematics, Statistics, and  
Computing Science 5  
McGill Univ  
Mathematics and Statistics Varies  
McMaster Univ  
Mathematics and Statistics 8  
Ottawa-Carleton Inst for Graduate  
Studies and Research in Mathematics  
and Statistics 6  
Queen's Univ  
Mathematics and Statistics 1-5  
Simon Fraser Univ  
Mathematics and Statistics 4-5  
Univ of Alberta  
Statistics and Applied Probability 2  
Univ of Calgary  
Mathematics and Statistics 1  
Univ of Toronto  
Computer Science 6-8  
Mathematics 15  
Univ of Victoria  
Mathematics and Statistics 2  
York Univ  
Mathematics and Statistics 4

The  
**Joy of  
TEX**  
A Second Edition  
Gourmet Guide  
to Typesetting  
with the *AMS-TEX*  
macro package

M. D. SPIVAK, Ph.D.

This is the second edition of *The Joy of TEX*, the user-friendly guide to *AMS-TEX*, which is a software package based on the revolutionary computer typesetting language *TEX*. *AMS-TEX* was designed to simplify the typesetting of mathematical quantities, equations, and displays, and to format the output according to any of various preset style specifications. This second edition of *Joy* has been updated to reflect the changes introduced in Version 2.0 of the *AMS-TEX* macro package.

The first two parts of the manual, "Starters" and "Main Courses," teach the reader how to typeset the kind of text and mathematics one ordinarily encounters. "Sauces and Pickles," the third section, treats more exotic problems and includes a 60-page dictionary on special techniques. The manual also includes descriptions of conventions of mathematical typography to help the novice technical typist. Appendices list handy summaries of frequently used and more esoteric symbols.

This manual will prove useful for technical typists as well as scientists who prepare their own manuscripts. For the novice, exercises sprinkled generously throughout each chapter encourage the reader to sit down at a terminal and learn through experimentation.

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## Stipends for Study and Travel

- Information from the December 1990 issue not yet confirmed. The dates have been updated for the coming year.

### Graduate Support

**American Association for the Advancement of Science. Summer Fellowship.** Provides support for up to twenty outstanding graduate students in the natural and social sciences and engineering as intern reporters, researchers, and production assistants in the mass media for 10 weeks during the summer. (Exceptional undergraduate or postdoctoral students will also be considered.) Fellows will work for radio and television stations, newspapers and magazines and will have their travel expenses and stipends paid by the AAAS. Fellows will have the opportunity to: observe and participate in the process by which events and ideas become news; improve their communication skills by teaming to describe complex technical subjects in a manner understandable by the public; and increase their understanding of editorial decision-making and the manner in which information is effectively disseminated. Each fellow will: attend an orientation and evaluation session in Washington, DC; begin the internship in mid-June; and submit an interim and final report to AAAS to help evaluate the program. Interested students should write for more information and application procedures to: Manager, Mass Media Science and Engineering Fellows Program, American Association for the Advancement of Science, 1333 H Street, N.W., Washington, DC 20005. Application deadline will be about January 15, 1992.

**American Association of University Women (AAUW) Educational Foundation. American Fellowships.** Postdoctoral and dissertation fellowships for women who are citizens or permanent residents of the U.S. Applicants for the postdoctoral fellowships must hold a doctoral degree by the application deadline, November 15. The Founders Fellowship provides \$25,000 for a senior scholar in any field; the other fellowships provide \$20,000, and some have disciplinary restrictions. The dissertation fellowships provide stipends of \$12,500, for the final year of writing the dissertation. An applicant must have completed all coursework,

passed all examinations, and have had the dissertation proposal or plan approved by the application deadline. For more information, contact: AAUW Educational Foundation, American Fellowships, 1111 16th Street, NW, Washington, DC 20036; telephone: 202-728-7603.

**American Association of University Women (AAUW) Educational Foundation. Career Development Grants** (formerly project RENEW). These grants are intended to support women who are continuing their self-development through higher education. Funding is provided to women who are preparing themselves to re-enter the work force, change careers, or advance a current career. Special consideration is given to AAUW members who submit qualified applications. Preference is given to applicants pursuing non-traditional coursework. These grants are one-time only awards. Minority women are encouraged to apply. Candidate eligibility: These grants are open to women who: are U.S. citizens or permanent residents; hold a baccalaureate degree; have received last degree five or more years ago; plan to pursue coursework at a fully accredited two or four year college or university, or at a technical school that is licensed, accredited, or approved by the Federal Veterans Administration; and, enroll in courses that are pre-requisites for professional employment plans. Funds are provided for tuition, fees, books, transportation (to/from/at school), and dependence care. Funds are not available for the final year of terminal degree professional programs (i.e., MBA, JD, MD, etc.). Ph.D. candidates may apply only for funding for coursework; not for dissertation research or writing. Candidates who fulfill eligibility requirements of other fellowship programs offered by the AAUW Educational Foundation *will not be considered* for funding from this grant and therefore, must apply to the appropriate program. Deadline: January 1. Award Range: \$1,000 - \$5,000. AAUW Educational Foundation, Career Development Grants, 1111 16th Street, NW, Washington, DC 20036; telephone: 202-728-7603.

**American Association of University Women (AAUW) Educational Foundation. Eleanor Roosevelt Fund Teacher Enrichment Sabbatical Fellowship.** Created as the first programmatic component of the Eleanor Roosevelt Fund for Women and Girls, the purpose is two-fold. First, it recognizes

and rewards good teachers and second, it enables teachers to improve their ability to teach girls. Candidate eligibility: This program is open to full-time female classroom teachers who: are U.S. citizens or permanent residents; teach at U.S. public schools in grades K-12; have at least 5 consecutive years full-time teaching experience; plan to continue teaching for the next five years; and, can demonstrate commitment to educational opportunities for women and girls through work in the classroom, the school district and the community. Award range: \$1,000 - \$10,000. The amount of the award depends on the period of study undertaken. Teachers are not required to have sabbaticals from the school district. Coursework and/or research can be conducted during the summer or part-time. AAUW Educational Foundation, ERF Teacher Fellowships, 1111 16th Street, NW, Washington, DC 20036; telephone: 202-728-7603.

**American Association of University Women (AAUW) Educational Foundation.** *Selected Professions Fellowships.* These are awarded to women who are citizens or permanent residents of the U.S. in designated fields. The fields of law, medicine and the MBA program are open to minority women only. Fellowships for master's degree candidates, including those enrolled in one-year programs, are available for the final year of study in computer/information science, mathematics/statistics, architecture, and engineering (includes, for engineering only, the final year of Ph.D.). The fellowships, which range from \$5,000 to \$9,500, are for full-time study. The deadline is December 15, for all fields of study except MBA (February 1) and Engineering Dissertation (November 15). For more information, contact: AAUW Educational Foundation, Selected Profession Fellowships, 1111 16th Street, NW, Washington, DC 20036; telephone: 202-728-7603.

**American Society for Engineering Education.** *ONR Graduate Fellowship Program.* About 50 36-month fellowships will be granted by the Office of Naval Research to support study and research leading to a doctoral degree in one of the following fields: electrical engineering, computer science, naval architecture and ocean engineering, materials science, applied physics, aerospace/mechanical engineering, oceanography, mathematics, biological/biomedical sciences, cognitive/neural sciences, and chemistry. Applicants must be citizens of the U.S. (of any age) who have not attended graduate school since receiving their baccalaureate degree. The fellowships, tenable at U.S. institutions offering doctoral degrees in the designated science and engineering disciplines, offer a stipend of \$15,000 per 12-month year. In addition, ONR will provide the affiliated institution, on behalf of each Fellow, full tuition and fees, and will provide \$2,000 per year to the Fellow's department. The application deadline is January 15, 1992. Application materials are available from the American Society for Engineering Education (ASEE), Eleven Dupont Circle, Suite 200, Washington, DC 20036; 202-745-3616 or 202-293-7080.

**American Statistical Association (ASA).** See listing in the Postdoctoral Support section for information.

- **Argonne National Laboratory.** See listing in the Postdoctoral Support section for information.

**Associated Western Universities (AWU).** AWU is a contractor for the U.S. Department of Energy, providing fellowships for teaching faculty members and to student participants who desire to become involved in an energy or energy-related research project at one of the cooperative laboratories or centers in the western U.S. For information telephone or write to Associated Western Universities, Inc., 4190 South Highland Drive, Suite 211, Salt Lake City, Utah 84124; 801-278-0799.

**Bunting-Cobb Graduate Residential Fellowships for Women.** Women graduate students enrolled in math, science, or engineering programs at Rutgers University's Graduate School on its New Brunswick campus have a special opportunity. Douglass College, the largest women's college in the nation, offers the Bunting-Cobb Graduate Residential Fellowship program. The Fellowship includes a stipend of \$2,000 for new graduate students as well as room and board in the Bunting-Cobb Math, Science, and Engineering Hall. The Fellowship is renewable; second-year students receive a stipend of \$4,000 plus room and board. Bunting-Cobb Fellows serve as mentors to the undergraduates in the residence hall. The hall is equipped with a microcomputer room and a resource library. For information about the Bunting-Cobb Fellowship, please contact Dr. Ellen F. Mappen, Director, Douglass Project for Rutgers Women in Math, Science, and Engineering at 908-932-9197. For information about graduate study at Rutgers, please contact Beverly Tarter at 908-932-7711.

**California State Graduate Fellowships.** The state offers fellowships of up to \$6,490 to cover tuition and fees only, for residents of California who attend accredited graduate or professional schools located in California. Write to California Student Aid Commission, Graduate Fellowship Program, P.O. Box 510621, Sacramento, California 94245-0621. The application deadline for 1992-1993 awards is March 2, 1992.

**Center for Naval Analyses (CNA).** *Summer Employment.* CNA is engaged in a broad spectrum of operations research and systems analysis studies for the U.S. Navy, Marine Corps, and other government agencies. Opportunities are available for graduate students in operations research, economics, engineering, mathematics, physics, and statistics. Assignments include analysis related to force level planning, manpower, logistics, and operational effectiveness. U.S. citizenship required. Submit resume to Mr. Paul M. Moke, Employment Manager, Center for Naval Analyses, 4401 Ford Avenue, Alexandria, Virginia 22302-0268.



**Committee on Institutional Cooperation.** *CIC Minorities Fellowships in the Sciences, Mathematics and Engineering.* Fellowships are offered to American Indians, Black Americans, Mexican Americans and Puerto Ricans for graduate study leading to the Ph.D. The fellowships provide full tuition plus an annual stipend of at least \$9,000 for each of five years. They may be used at any of these thirteen CIC universities: University of Chicago, University of Illinois, University of Illinois-Chicago, Indiana University, University of Iowa, University of Michigan, Michigan State University, University of Minnesota, Northwestern University, Ohio State University, Purdue University, University of Wisconsin-Madison, University of Wisconsin-Milwaukee, or Pennsylvania State University. The deadline for applications for the 1992-1993 academic year is January 2, 1992. Detailed information about the program can be obtained by writing to the CIC Minorities Fellowships Program, Kirkwood Hall-111, Indiana University, Bloomington, Indiana 47405 or by calling toll-free 1-800-457-4420.

**Fellowships in Mathematics and Molecular Biology.** The Program in Mathematics and Biology has graduate and postdoctoral fellowship support available. Current topics in the Program include geometry, topology, and sequence analysis of DNA, molecular dynamics, and mapping functions and algorithms for DNA and protein structure prediction. Other areas will be considered. Fellowships can be held at any University or College in the United States. Application deadline is February 1, 1992. Women and minorities are encouraged to apply. Funding can begin June 1, 1992. Apply to Dr. Sylvia J. Spengler/Dr. Nicholas R. Cozzarelli, Program in Mathematics and Molecular Biology, 214A Stanley Hall, University of California, Berkeley, CA 94720; email [sylviaj@violet.berkeley.edu](mailto:sylviaj@violet.berkeley.edu) or [sylviaj@ucbviole.bitnet](mailto:sylviaj@ucbviole.bitnet).

**Fellowships in Residence at the Smithsonian Institution.** See listing in the Postdoctoral Support section for more information.

**Florida Endowment Fund.** *The McKnight Doctoral Fellowship Program.* McKnight Doctoral Fellowship provides up to \$5,000 in tuition and fees plus an annual stipend of \$11,000 to 25 African-American citizens to pursue Ph.D. degrees at participating Florida universities. Applicants must hold or be receiving a bachelor's degree from a regionally accredited college or university. Contingent upon successful academic progress, the maximum length of the award is five years. The Florida Endowment Fund provides the first three years and the student's university continues funding at the same level of support for an additional two years. Detailed information and application packets can be obtained by writing or calling: The Florida Endowment Fund for Higher Education, 201 E. Kennedy Boulevard, Suite #1525, Tampa, FL 33602; 813-272-2772. The deadline for applications for Fall 1991 is: January 15, 1992.

**Ford Foundation Predoctoral and Dissertation Fellowships for Minorities.** Predoctoral and dissertation fellowships consisting of annual stipends of \$11,500 and \$18,000 respectively are available to minorities enrolled in research-based doctoral programs in mathematics, engineering, and other fields. These will be offered on a competitive basis to individuals who are citizens or nationals of the U.S., and who are members of the following groups: Alaskan Natives (Eskimo or Aleut), Native American Indians, Black/African Americans, Mexican Americans/Chicanos, Native Pacific Islanders (Polynesian or Micronesian), and Puerto Ricans. The predoctoral awards also include an allowance to the awardee's university in lieu of tuition and fees. Students interested in the 1992 doctoral fellowships may obtain application materials from the Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418. The deadline for applications is November 8, 1991. Students interested in the 1992 predoctoral and dissertation fellowship should contact The Fellowship Office at the above address in September 1991 or call 202-334-2872.

**Georgia Institute of Technology.** *President's Fellowships.* These stipends of \$4,000 for twelve months are awarded to a selected number of highly qualified U.S. nationals who intend to pursue doctoral degrees. The awards are highly competitive; selection is based on academic criteria and evidence of scholarship. Participants are expected to maintain high academic standing. The Fellowships are intended to supplement other forms of support and can be extended for three additional years based on academic performance and research potential. *Graduate Research/Teaching Assistantships.* Usually awarded at a one-third time basis at a salary of \$9,628 per twelve months, plus waiver of all tuition and fees. Appointments are based primarily on scholarship and ability to contribute to ongoing programs of the school. Prospective students who consider themselves highly qualified for an award should include with their application for admission a letter describing in as much detail as possible their qualifications and needs. Write to the Dean, College of Computing, Georgia Institute of Technology, Atlanta, Georgia 30332-0280.

**Daniel and Florence Guggenheim Foundation.** Fellowships for U.S. and Canadian residents interested in jet propulsion, energy conversion, fluid mechanics and flight structures. For information on flight structures, write to the Department of Civil Engineering and Engineering Mechanics, Columbia University. For information on applied physics and materials science; dynamics and control systems; energy conversion, propulsion, and combustion; energy and environmental policy; flight science and technology; and fluid mechanics, and computational and experimental fluid mechanics, write to the Director of Graduate Studies, Department of Mechanical and Aerospace Engineering, Princeton University, Princeton, New Jersey 08544.

**Fannie and John Hertz Foundation Fellowships.** The stipend is \$15,000, plus \$8,000-\$10,000 cost-of-education allowance per nine month year. Offered on the basis of academic (A- undergraduate GPA) and research performance, recommendations, and personal technical interview, for the support of personal and institutional expenses during graduate education directed toward the Ph.D. degree in applied physical sciences. Tenable at the Department of Applied Science of the Davis Campus, and at all campuses of the University of California; California Institute of Technology; Carnegie-Mellon University; The University of Chicago; Cornell University; Courant Institute of Mathematical Sciences, New York University; Georgia Institute of Technology; Harvard University; Johns Hopkins University; University of Illinois at Urbana-Champaign; Massachusetts Institute of Technology; Polytechnic Institute of New York; Princeton University; Rensselaer Polytechnic Institute; Rice University; University of Rochester; Stanford University; University of Texas at Austin; Texas A& M University; Vanderbilt University; University of Washington, Seattle; University of Wisconsin, Madison and Yale University, New Haven, Connecticut. Application deadline is November 1. Applicants should write to the Office of the Graduate Dean at these institutions, or write directly to the Hertz Foundation, Box 5032, Livermore, California 94551-5032.

**Hughes Aircraft Company Fellowships.** Masters and Doctoral Fellowships are awarded on a competitive basis to qualified individuals in Engineering and Science for study at selected universities in the fields of electrical, mechanical, aerospace or systems engineering, computer science, mathematics, or physics. Most are awarded on a work-study basis. U.S. citizenship is required. G.P.A. must be at least 3.0/4.0. Write to the Hughes Aircraft Company, Corporate Fellowship Office, Technical Education Center, P.O. Box 45066, Bldg. C1/B168, Los Angeles, California 90045-0066.

**Hubert H. Humphrey Doctoral Fellowships.** Awards are made by the U.S. Arms Control and Disarmament Agency (ACDA) to stimulate interest in the study of arms control in universities around the country by supporting unclassified doctoral dissertation research in the field. Applicants must be U.S. citizens or nationals and must have completed all requirements for the doctorate, except the dissertation, at a U.S. college or university. (Law students are also eligible.) The stipend will be \$5,000 for a 12-month period, plus applicable tuition and fees of up to \$3,400 for one year. Application deadline is March 15, for the 12-month award period beginning in either September or the following January. For application materials write: Hubert H. Humphrey Fellowship Program, U.S. Arms Control and Disarmament Agency, Washington, DC 20451.

**Kosciuszko Foundation.** Scholarships and grants for Americans of Polish background. Application deadline is October 15. For information write to Scholarship and Exchange

Programs, the Kosciuszko Foundation, 15 East 65th Street, New York, New York 10021.

**Laboratory Graduate Participation.** Supports full-time thesis and dissertation research at participating DOE research facilities for M.A. and Ph.D. candidates majoring in the life, physical, and social sciences; mathematics; and engineering. Applicants must be U.S. citizens who have completed all requirements for the degree except thesis or dissertation research. The annual stipend is \$12,000-\$14,400 plus certain tuition and fees and additional allowances for dependents. Additional information and application materials may be obtained from Science/Engineering Education Division, Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, Tennessee 37831-0117.

**National Science Foundation. Graduate Fellowships.** Three-year awards available to citizens or nationals of the U.S. for full-time study leading to master's or doctoral degrees in science (including mathematics). Awards made only to students who have completed less than one year of graduate study in science or engineering. Stipends of \$13,500 proposed for 1992-1993 for a 12-month tenure. No dependency allowances. Education allowance paid to fellowship institution. Application deadline November 8. Further information and application materials may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, DC 20418; 202-334-2872.

**National Science Foundation. Minority Graduate Fellowships.** Awarded for study or work leading to the master's or doctoral degrees, these fellowships are granted for periods of three years. They are open to U.S. citizens or nationals who are members of an ethnic minority group underrepresented in the advanced levels of the U.S. science personnel pool, i.e., American Indian, Native Alaskan (Eskimo or Aleut), Black, Hispanic, or Native Pacific Islander (Polynesian or Micronesian). The stipend is \$13,500 proposed for 1992-1993 for 12-month tenures. No dependency allowances. Education allowance paid to fellowship institution. The deadline for applications is November 8. Application materials may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, DC 20418; 202-334-2872.

**Office of Naval Research. Graduate Fellowship Program.** ONR will award up to 50 thirty-six month fellowships for study and research at U.S. institutions offering doctoral degrees in specified engineering science and engineering disciplines. Participants must be U.S. citizens. Fellows selected in 1992 will receive \$15,000 for the first year of tenure. ONR will pay the institution full tuition and fees and provide \$2,000 to the Fellow's department. ONR Fellowships awarded in this eleventh year of the program will be for study and research in eleven major disciplines: Electrical Engineering, Computer Science, Naval Architecture and Ocean Engineering, Materials Science, Applied Physics,

Aerospace/Mechanical Engineering, Biological/Biomedical Sciences, Cognitive/Neural Sciences, Mathematics, Chemistry, and Oceanography. Deadline for applications is January 15, 1992. Application materials may be obtained from the American Society for Engineering Education (ASEE), 11 Dupont Circle, Suite 200, Washington, DC 20036; 202-745-3616 or 202-293-7080.

**Purdue University.** *Andrews Fellowships, Black Fellowships, and Ethnic Minorities Fellowships.* The stipend is up to \$14,000 for twelve months with tuition and fees remitted except for \$190 per semester and \$95 for summer session. Fellowships are renewable upon satisfactory performance in coursework. Fellows may hold additional University employment up to one-quarter time, as teaching or research assistants. *Teaching Fellowships:* The stipend is \$15,000 for twelve months with tuition and fees remitted except for \$190 per semester and \$95 for summer session. Teaching fellows usually teach four hours per week and fellowships are renewable upon satisfactory performance in coursework. For application forms and information, write to Graduate Office, Department of Mathematics, Mathematical Sciences Building, Purdue University, West Lafayette, IN 47907; 317-494-1961.

**Sigma Delta Epsilon, Graduate Women in Science.** Awards of \$1,500 - \$4,000 for one year, nonrenewable, are available on a competitive basis to those who hold a degree from a recognized institution of higher learning in all the natural sciences (physical, environmental, mathematical, computer and life sciences), are currently involved in research or have an approved research proposal. Appointments will be made irrespective of race, nationality, creed or age. Applications from women are especially encouraged. Application deadline is December 1. Announcement of awards will be made by the following July 1. Further information and application forms may be obtained from Sigma Delta Epsilon, Graduate Women in Science, Inc., P.O. Box 4748, Ithaca, NY 14852.

**University of California, Los Angeles.** *Biostatistical Training in AIDS.* The UCLA Department of Biostatistics has traineeships in AIDS which pay all tuition fees and a monthly stipend. We offer support to both predoctoral and postdoctoral students. Training leading to the doctorate includes courses in Biostatistics, Mathematical Statistics, and AIDS and provides collaboration experiences with AIDS researchers. Postdoctoral fellowship training is arranged specifically for each fellow. Fellows with doctorates in Biostatistics or Statistics will take the AIDS courses, collaborate with AIDS researchers, and work on their own statistical research projects. Postdoctoral fellows with a doctorate in other fields will take biostatistics courses, AIDS courses, and work on their own research projects. This federally funded program requires permanent residence in the U.S. or U.S. citizenship. We encourage applications from qualified women and minority candidates. AA/EOE. Contact: Dr. Pe-

ter A. Lachenbruch, UCLA Department of Biostatistics, Los Angeles, CA 90024-1772.

**University of Toronto.** *Kenneth O. May Fellowship in the History of Mathematics.* The Institute for the History and Philosophy of Science and Technology at the University of Toronto offers programs of study leading to the Master of Arts and Doctor of Philosophy. A Masters in the history of mathematics may also include courses in the history of the physical sciences, history of the biological sciences, history of technology, and philosophy of science. The May Fellowship is awarded for one year to a graduate student studying toward a graduate degree in the history of mathematics at the Institute. A renewal for one additional year is automatically considered during the first year. The Fellow is eligible to apply for a second one-year renewal. The stipend is \$7750 plus Canadian tuition fees. Non-Canadians, for whom tuition is higher, may apply to the University for a tuition-fee waiver. Admission application forms are available from: Graduate Office, IHPST, Victoria College, Room 316, University of Toronto, Toronto, Canada M5S 1K7. Please indicate in your application that you wish to be considered for the May Fellowship. Next competition to be announced.

**Zonta International Foundation.** *Amelia Earhart Fellowship Awards.* Established in honor of Amelia Earhart, Zonta member from 1928-1937, the Fellowships recognize excellence and encourage and support women in aerospace related science and engineering. Forty \$6,000 grants to women for graduate study in aerospace-related science or engineering are awarded annually. Qualifications for the Fellowships are: An undergraduate or graduate degree preparatory for advanced study and research in a qualifying area of science or engineering; a superior academic record and evidence of potential; and an acceptance by an institution offering fully accredited graduate courses and degrees in aerospace-related sciences and engineering. Deadline for applications is December 31. Applications available after September. For more information: Zonta International, 557 W. Randolph St., Chicago, IL 60606-2284; 312-930-5848.

### Postdoctoral Support

**Air Force Office of Scientific Research.** *Research Contracts and Grants.* Mathematicians and computer scientists are encouraged to submit proposals through their organizations for research support. Research areas include mathematics of dynamics and control, physical mathematics and applied analysis, computational mathematics, optimization and discrete mathematics, signal processing, probability and statistics, software and systems, artificial intelligence, and neural computation systems. Research proposals should be forwarded to the Director of Mathematical and Computer Sciences, Air Force Office of Scientific Research (AFOSR/NM), Bolling AFB, Washington, DC 20332-6448.

**American Association for the Advancement of Science.** *1992-1993 Congressional Science and Engineering Fellowships.* Fellows spend one year working as special legislative assistants on the staffs of members of Congress or congressional committees, beginning in September 1992. The program includes an orientation on congressional and executive branch operations and a year-long seminar program on issues involving science and public policy. To provide a unique public policy learning experience, to demonstrate the value of such science-government interaction, and to make practical contributions to the more effective use of scientific and technical knowledge in government. A prospective fellow must demonstrate exceptional competence in some area of science or engineering; have a good scientific and technical background; and have a strong interest and some experience in applying personal knowledge toward the solution of societal problems. Candidates should be postdoctoral to mid-career scientists or engineers. AAAS will sponsor two Fellows. The stipend is \$38,000 plus an allowance for relocation and travel expenses. Deadline for receipt of applications by AAAS is January 15, 1992. American Association for the Advancement of Science, 1333 H. St., NW, Washington, DC 20005; 202-326-6600.

**American Association for the Advancement of Science.** *Science, Engineering and Diplomacy Fellowships.* One-year fellowships are available for work as staff officers in the State Department and in the Agency for International Development. The Fellow must demonstrate exceptional competence in some area of science or engineering, be flexible, and have a strong interest or some experience in applying knowledge toward the solution of problems in the area of foreign affairs. A secret security clearance must be obtained after selection. Salaries are at the GS12 level depending upon education and experience. Deadline for receipt of applications is January 15. For application materials and more specific information on assignment possibilities write to Science, Engineering and Diplomacy Fellows Program, AAAS, 1333 H Street, N.W., Washington, DC 20005.

**American Association for the Advancement of Science.** *Summer Environmental Science and Engineering Fellows Program.* Fellows will spend ten weeks working as special research consultants with the Office of Research and Development (ORD) of the U.S. Environmental Protection Agency (EPA) in Washington, DC. Fellows will undertake a detailed, future-oriented research project of mutual interest to the Fellow and one of EPA's research or program offices and prepare a report at the completion of the summer's work. The program includes a week-long orientation to EPA and relevant congressional and executive branch operations, as well as a weekly seminar program on environmental issues and science, technology and public policy. The purpose of the fellowship program is to assist ORD in identifying and assessing the significance of long-range environmental problems and opportunities. Prospective fellows must be

postdoctoral to mid-career professionals, show exceptional competence in a relevant professional area, have a broad professional background, and have a strong interest and some experience in applying scientific or other professional knowledge toward the identification and assessment of future environmental problems. Persons may apply from any physical, biological, or behavioral science field, any field of engineering, or any other relevant professional field. Applicants must be residents of the U.S. The stipend is \$900 per week plus nominal relocation and travel expenses. The deadline for receipt of applications is March 1, 1992. American Association for the Advancement of Science, 1333 H. St., NW, Washington, DC 20005; 202-326-6600.

**American Association of University Women (AAUW) Educational Foundation.** *American Fellowships.* See the listing in the Graduate Support section for information.

**American Association of University Women (AAUW) Educational Foundation.** *Career Development Grants.* See the listing in the Graduate Support section for information.

**American Mathematical Society Centennial Fellowships.** *Postdoctoral Fellowships.* These fellowships are intended to provide enhanced research opportunities to mathematicians who are several years past the Ph.D., who have a strong research record, but who have not had extensive postdoctoral research support in the past. Applicants should have received the Ph.D. degree between January 1, 1980, and December 31, 1985, and should not have had the equivalent of more than two years of full-time postdoctoral support. The stipend for fellowships awarded in 1992-1993 has been set by the Trustees of the Society at \$40,000 for nine months. In addition, there will be an expense allowance of \$1,300. Applicants must be citizens or permanent residents of a country in North America. The fellowship may be combined with other stipends and/or part-time teaching; this option can be used to extend the award to cover a period of up to two years. For further information about the acceptability of such arrangements, individuals should contact the Secretary of the Society. The number of fellowships to be awarded is small and depends on the amount of money contributed to the program. The Trustees have arranged a matching program from general funds in such fashion that funds for at least one fellowship are guaranteed. Because of the generosity of the AMS membership it was possible to award three fellowships a year for the past four years. The deadline for receipt of applications is **December 1, 1991**. Awards will be announced in February 1992, or earlier if possible. For application forms, write to the Executive Director, American Mathematical Society, P.O. Box 6248, Providence, RI 02940. (It should be noted that completed application and reference forms should NOT be sent to this address, but to the address given on the forms.)

**American Philosophical Society.** Postdoctoral research grants of up to \$4,000 (averaging \$2,000) for candidates

with Ph.D. for at least one year to aid specific research projects. Grants contribute toward travel expenses, food and lodging, photoduplication, and some other research costs. Tenable abroad and in U.S. The Committee on Research meets in February, April, June, October, and December. Respective *deadlines* for application and all supporting material are December 1, February 1, April 1, August 1, and October 1. For application forms, please briefly describe your project and proposed budget in a letter to: Committee on Research, American Philosophical Society, 104 South Fifth Street, Philadelphia, Pennsylvania 19106.

**American Society for Engineering Education.** *NASA-ASEE Summer Faculty Fellowships.* Programs in science and engineering research in collaboration with the National Aeronautics and Space Administration research centers; for U.S. citizens who are faculty or research members (with at least two years experience) of institutions of higher education. Stipends will be \$900/week for ten weeks, plus travel allowance. Application deadline is February 1. For published announcement write to NASA-ASEE Summer Faculty Fellowships, American Society for Engineering Education, Suite 200, Eleven Dupont Circle, N.W., Washington, DC 20036; 202-745-3616/202-293-7080.

**American Society for Engineering Education.** *Navy-ASEE Sabbatical Leave Program.* This program allows science and engineering faculty the opportunity to conduct research at Navy Laboratories while on sabbatical leave. Participants in the program will receive a monthly stipend making up the difference between salary and sabbatical leave pay from their home institution. In addition, participants will receive reimbursement for travel to and from the laboratory site and a relocation allowance for those who must relocate their residence during their sabbatical leave tenure. Appointments must be for at least one quarter or semester. Applications for the program will be accepted at any time throughout the year. For information, write to: Navy-ASEE Faculty Research Programs Director, Eleven Dupont Circle, Suite 200, Washington, DC 20036.

**American Society for Engineering Education.** *Navy-ASEE Summer Faculty Research Programs.* Programs in math, science and engineering research at the laboratories and R&D centers of the Navy; for U.S. citizens who are faculty or research members of institutions of higher education. Stipends will be given at various levels, plus travel and relocation allowances. Application deadline is January 15. For a program announcement write to Navy Summer Faculty Program, American Society for Engineering Education, Suite 200, Eleven Dupont Circle, N.W., Washington, DC 20036.

**American Statistical Association (ASA).** *Senior Research Fellowship Program.* The ASA/NSF/NIST Senior Research Fellowship Program, which is cosponsored by the National Science Foundation (NSF) and the National Institute of Standards and Technology (NIST), invites applications for

Fellowships and Associateships at NIST during the 1992–1993 academic year. The Fellowships are intended for senior researchers, while the Associateships are for advanced graduate students and recent Ph.D.s. In particular, the program seeks fellows with a strong interest in cross-disciplinary research in process modeling and optimization. Areas of research that fit NIST's research mission and facilities include: Statistical approaches in materials processing and measurement; on-line control in automated manufacturing; statistical computing, design, modeling, and simulation of measurement processes; design of experiments; graphical data analysis; and statistical image processing. Stipends of the Senior Research Fellows will be commensurate with qualifications and experience, and fringe benefits will be provided. Appointments will last three to nine months. Applications are due January 15, 1992 for Fellows and February 17, 1992 for Associates. For application information, contact Carolee Bush, ASA/NSF/NIST Research Program, American Statistical Association, 1429 Duke St., Alexandria, VA 22314-3402; 703-684-1221. For information on research topics and other aspects of the program, contact Ruth Varner, Coordinator, ASA/NSF/NIST Research Program, Statistical Engineering Division, National Institute of Standards and Technology, Administration Bldg., Room A337, Gaithersburg, MD 20899; 301-975-2839. Women and minorities are encouraged to apply.

- **Argonne National Laboratory.** The Mathematics and Computer Science (MCS) Division of Argonne National Laboratory offers visiting positions to mathematicians and computer scientists interested in advanced scientific computing. The division's research programs cover differential equations, optimization, automated reasoning, logic programming, and software engineering. The division operates Argonne's Advanced Computing Research Facility, which comprises a variety of advanced-computer architectures. Visiting positions of various durations are available for graduate students, postdocs, and faculty. Interested candidates should submit their resume to Nancy L. Griparis, Employment and Placement, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439.
- **Australian Institute of Nuclear Science and Engineering.** *Research Fellowships.* Fellowships are intended for scientists and engineers who have qualifications equivalent to the Ph.D. Stipends are in the range of \$30,140 to \$36,638 per annum (Australian currency), and the Institute may contribute to travel costs to and from Australia. A research project within the field of nuclear science and engineering of interest to the Institute must be proposed in the nomination after agreement between the candidate and the nominating organization. Further information can be obtained from the Scientific Secretary, Australian Institute of Nuclear Science and Engineering, Private Mail Bag No. 1, Post Office, Menai N.S.W. 2234, Australia. Candidates must be nominated by an Australian university, the ANSTO, or the Commonwealth Scientific and Industrial Research Organization. Closing

dates are February 28 and August 31 each year, and all nominations received after one closing date will be considered together after the next closing date.

**The Bunting Institute of Radcliffe College.** *Science Scholar Fellowships.* The Bunting Institute provides fellowships to postdoctoral scientists who have received the Ph.D. two years prior to appointment to work on projects that will make a contribution to their fields and advance their careers. Open to women scientists, who are U.S. citizens or permanent residents, in the fields: astronomy, molecular and cellular biology, biochemistry, chemistry, cognitive and neural science, computer science, electrical engineering, aerospace/mechanical engineering, geology, materials science, mathematics, physics, naval architecture and ocean engineering, oceanography, and all fields that relate to the study of oceans. Office and laboratory space; stipend \$29,000 plus research expenses; one-year appointment; access to Harvard/Radcliffe libraries and facilities. Deadline for applications is October 15, 1991 (postmarked). Write or call for application and information to: Science Scholar Fellowship Program, The Bunting Institute of Radcliffe College, 34 Concord Avenue, Cambridge, Massachusetts 02138; 617-495-8212.

**California Institute of Technology.** *Harry Bateman Research Instructorships.* Offered by Mathematics at the California Institute of Technology. Open to men and women (of any age) who have recently received their doctorate in mathematics. Appointments are for one year and are renewable for one additional year. The annual salary for academic year 1991-1992 is \$36,000. Duties include teaching one course for the full academic year. Please send applications by January 1 if possible. Inquiries or requests for application forms should be addressed to Professor D. B. Wales, Professor and Executive Officer for Mathematics, 253-37 Sloan Laboratory, Pasadena, California 91125. Caltech is an Affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.

**Cornell University.** Possible *H. C. Wang Assistant Professorship.* During one of the years, the holder of a Wang Assistant Professorship will have a teaching load of two courses in the first semester and one in the second; otherwise, it will be two courses per semester. Salary \$32,000. The Assistant Professorship is nonrenewable after a three-year term. Applications and letters of reference should be addressed to Recruiting Committee, Department of Mathematics, White Hall, Cornell University, Ithaca, New York 14853-7901.

**Courant Institute.** *Instructorships in Mathematics.* Open to mathematicians (of any age) who are recent recipients of doctoral degrees and who show strong promise in research. The teaching duty will consist of one course each term. Appointments are for two years. The academic salary for nine months will be at least \$34,000. In addition, the Courant Institute may be able to offer support for research

in residence during two summer months. (When longer term faculty positions are available, applicants for Instructorships will also be considered for them.) Inquiries and requests for application forms should be addressed to the Committee on Instructorships and Visiting Memberships, Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012. Applications should be filed no later than December 15, 1991. N.Y.U. is an Equal Opportunity/Affirmative Action Employer.

**Courant Institute.** *Postdoctoral Visiting Memberships.* The Courant Institute of Mathematical Sciences of New York University offers postdoctoral Visiting Memberships to mathematicians, scientists and engineers who are interested in its program of training and research in a broad range of pure and applied mathematics. Applications must be received by December 15, 1991. Inquiries and requests for application forms should be addressed to the Committee on Instructorships and Visiting Memberships, Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012. N.Y.U. is an Equal Opportunity/ Affirmative Action Employer.

**Dartmouth College.** *John Wesley Young Research Instructorships.* Two instructorships are normally awarded by Dartmouth College each year. Teaching duties are one course for two quarters and two courses for one quarter (or two courses for two quarters) and are of a varied and nonroutine nature. The academic-year salary of \$34,000 is supplemented by a two-month resident research stipend of \$7,556, for a total of \$41,556. Appointments are for two years and are not renewable. Applicants should write to Department of Mathematics and Computer Science, Dartmouth College, Hanover, New Hampshire 03755 (Attention: Recruiting). Applicants are advised to apply promptly, and no later than January 15, 1992.

**Fellowships in Mathematics and Molecular Biology.** See listing in the Graduate Support section for information.

**Fellowships in Residence at the Smithsonian Institution.** Smithsonian Fellowships support research in residence at the Smithsonian Institution, in association with the staff, using the Institution's resources. Early contact with the potential advisor is strongly recommended. Awards are based upon merit and are open to all qualified individuals, without reference to race, color, religion, sex, national origin, age, or condition of handicap of any applicant. Deadline for Smithsonian Fellowships: January 15, 1992. Senior Postdoctoral Fellowships for postdoctoral scholars more than seven years beyond the degree. Term: three to twelve months. Annual stipend: \$26,000 plus allowances. Postdoctoral Fellowships for postdoctoral scholars up to seven years beyond the degree. Term: six to twelve months. Annual stipend: \$21,000 plus allowances. Predoctoral Fellowships for doctoral candidates to conduct dissertation research. Term: six

to twelve months. Annual stipend: \$13,000 plus allowances. Ten-week Graduate Student Fellowships for graduate students to conduct independent research. Stipend: \$3,000. For more information about Smithsonian Fellowships and academic appointments, write or call: Office of Fellowships and Grants, Smithsonian Institution, Desk P, Suite 7300 L'Enfant Plaza, Washington, DC 20560; 202-287-3271. Please include area of study, dates of graduate degrees received and/or expected.

**Ford Foundation Postdoctoral Fellowships for Minorities.** Administered by the National Research Council, these fellowships are sponsored by the Ford Foundation. Applicants must be U.S. citizens who are members of one of the designated minority groups: American Indians and Alaskan Natives (Eskimo or Aleut), Black Americans, Mexican Americans/Chicanos, Native Pacific Islanders (Micronesians and Polynesians), or Puerto Ricans, who are engaged in college or university teaching, and hold a doctoral degree. Tenure of the one-year fellowship provides postdoctoral research experience at an appropriate nonprofit institution of the Fellow's choice. The deadline for the submission of applications is January 1992. Further information and application materials may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418; 202-334-2860.

**Fulbright Scholar Program.** The Fulbright Scholar Program include 300 grants in research and 700 grants in university lecturing for periods ranging from two months to a full academic year. There are openings in over 100 countries with some opportunity for multi-country research. Fulbright awards are granted in virtually all disciplines. Scholars in all academic ranks, retired faculty and independent scholars are eligible to apply. Benefits include round-trip travel; maintenance allowance to cover living costs of grantee and family; and other supplemental allowances. Basic eligibility requirements are U.S. citizenship; Ph.D. or comparable professional qualifications; university or college teaching experience; and, for selected assignments, proficiency in a foreign language. Application deadlines vary. For more information and applications, call or write Council for International Exchange of Scholars, 3007 Tilden St., N.W., Suite M-500, Washington, DC 20008-3009; 202-686-7866.

**John Simon Guggenheim Memorial Foundation Fellowships.** Fellowships are on an advanced professional level. U.S. or Canadian citizenship or permanent residence is required. Fellowships are also offered to citizens or permanent residents of Latin America and the Caribbean. Application deadline: October 1 for the U.S. and Canada competition; December 1 for the Latin American and Caribbean competition. Approximately 170 awards are made, averaging approximately \$25,500 in 1991. For more information write to John Simon Guggenheim Memorial Foundation, 90 Park Avenue, New York, New York 10016.

**Harvard University. Benjamin Peirce Lectureships.** Rank of Assistant Professor. The appointments are for three years with a starting salary of approximately \$39,700 (for the nine-month academic year) which can be augmented by teaching in the summer school or by working on a research contract if funds are available. The teaching commitment is six hours per week of lectures including a half course on any topic of the lecturer's choice. Application forms may be obtained by writing to: Benjamin Peirce Lectureships, Department of Mathematics, Harvard University, One Oxford Street, Cambridge, Massachusetts 02138. Applications must be filed by December 27, 1991. Harvard is an Equal Opportunity/Affirmative Action Employer, and particularly encourages applications from women and minority candidates.

**IBM Thomas J. Watson Research Center. Mathematical Sciences Department Postdoctoral Research Fellowships.** These fellowships provide an opportunity for scientists of outstanding ability to pursue their own research interests in pure or applied mathematics while interacting closely with Department members in an atmosphere in which basic research is combined with exposure to technical problems arising in a mathematically oriented industry. Candidates (of any age) must have no more than five years of postdoctoral professional experience when the fellowship commences. Fellowships have a period of one year, extendable to two years depending on mutual interest in continuation. The stipend will be generally in the range of \$58,000 to \$63,000 per year, depending on experience. To apply, submit the following by *December 15, 1991*: résumé; thesis summary; thesis or reprints of publications based on thesis, if available; bibliography with reprints of principal papers; research proposal containing an abstract of approximately 200 words for the period of the fellowship; and three or more letters of reference, including one from your thesis adviser. The letters of reference should arrive separately, but must be received by the above date. Résumé must list applicant's visa status. Direct all material to Committee on Postdoctoral Fellowships, Department of Mathematical Sciences, IBM Research Center, Post Office Box 218, Yorktown Heights, New York 10598. Applicants will be notified individually as soon as the Committee has reached a decision on the application. The Research Center is located in Westchester County about thirty miles north of New York City.

**Indiana University, Bloomington. Václav Hlavatý Research Assistant Professorships.** This position is intended for mathematicians with recent doctorates who show definite promise in research and teaching. Inquiries and requests for application forms should be addressed to Allan Edmonds, Chairman, Department of Mathematics, Indiana University, Bloomington, Indiana 47405. Preference will be given to applications received before January 1, 1992. Indiana University is an Equal Opportunity/Affirmative Action Employer.

**Institute for Advanced Study Memberships.** The School of Mathematics will grant a limited number of memberships, some with financial support, for research in mathematics at the Institute during the academic year 1992-1993. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree. Application blanks may be obtained from The School of Mathematics, Institute for Advanced Study, Princeton, New Jersey 08540, and should be returned (whether or not funds are expected from some other source) by December 1, 1991. An Equal Opportunity/Affirmative Action Employer.

**Institute for Mathematics and its Applications (IMA). Postdoctoral Memberships.** The IMA will award up to 15 12-month research memberships with starting date approximately September 1, 1992. The postdoctoral terms will include the academic year program on Control Theory and its Applications, September 1992 to June 1993. All requirements for a doctorate should be completed by September 1, 1992. Applicants must show evidence of mathematical excellence, but they do not need to be specialists in the field. The following materials must be submitted: (1) personal statement of scientific interest, research plans, and reasons for wishing to participate in the Control Theory program. (This is an essential part of the application.); (2) Curriculum vitae and a list of publications; (3) Three letters of recommendation, to be sent directly to the IMA. All material should arrive by January 15, 1992. *Senior memberships* are also available. Preference will be given to supplementary support for persons with sabbatical leaves, fellowships, or other stipends. *All correspondence* should be sent to: Visiting Membership Committee, Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, MN 55455-0436 U.S.A. The University of Minnesota is an equal opportunity educator and employer.

**Institute for Mathematics and its Applications (IMA). Postdoctorates in Industrial Mathematics.** The IMA will award up to 8 one-to-two year positions in Industrial Mathematics, effective September 1, 1992. These appointments are in addition to the regular IMA postdoctoral program and are funded jointly by the NSF and by industry. They are designed to prepare mathematicians for research careers involving industrial interaction. Applicants should have received their Ph.D. in Mathematics or Applied Mathematics by September 1, 1992. Familiarity with pde and/or numerical analysis is desired, but no knowledge in engineering is required. Postdoctorates will spend 50% effort in the IMA program and 50% effort working with scientists from industry on one of the following topics: (A) Signal processing and computational ocean acoustics; (B) Diffractive optics; Maxwell equations in periodic structure; (C) Computational fluid mechanics - viscous free-surface flows; (D) Scattering of electromagnetic waves from complex objects; (E) Magneto-optic recording media; the writing process. The following materials must be submitted: (1) Personal state-

ment of scientific interest, research plans and reasons for wishing to participate in the program. (This is an essential part of the application.) (2) Curriculum vitae and a list of publications. (3) Three letters of recommendation, to be sent directly to the IMA. All material should arrive by January 15, 1992. *All correspondence* should be sent to: Industrial Mathematics Postdoctorate Membership Committee, Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, MN 55455-0436 U.S.A. The University of Minnesota is an equal opportunity educator and employer.

- **Los Alamos National Laboratory.** Research opportunities in computer science, natural sciences, engineering, applied mathematics, and physics. Postdoctoral appointments are available for two years, subject to renewal for a third year. Los Alamos National Laboratory is an Equal Opportunity Employer. Write to Ronnie Cohen, Mail Stop P-290, Los Alamos National Laboratory, Los Alamos, New Mexico 87545.
- **Los Alamos National Laboratory. J. Robert Oppenheimer Research Fellowship.** Candidates must be recipients of a doctorate in the physical sciences, natural sciences, mathematics or engineering, and must show clear and definite promise of becoming outstanding leaders in scientific research. Two-to three-year appointments; salary: \$55,000/year; application deadline: mid-November each year. For additional information write to Ronnie Cohen, Mail Stop P-290, Los Alamos National Laboratory, Los Alamos, New Mexico 87545. An Affirmative Action/Equal Opportunity Employer.

**Massachusetts Institute of Technology. C.L.E. Moore Instructorships in Mathematics.** Offered by the Department of Mathematics at the Massachusetts Institute of Technology. Open to mathematicians with doctorates who show definite promise in research. The base salary will be at least \$33,700, and the teaching load is six hours per week in one semester and three hours per week in the other. Appointments are for one year and are renewable for two additional years. Applicants please send (a) a vita; (b) a description of the research in your thesis and other work you have done (1-3 pages); and (c) the research which you plan for next year. Application should be sent, by December 31 if possible, to the Department of Mathematics, Room 2-263, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139. M.I.T. is an Equal Opportunity Employer.

**Mathematical Sciences Institute (MSI) at Cornell University.** The MSI is beginning its search for postdoctoral visitors for the academic year beginning August 1992. The Institute supports research in the following areas: Symbolic Methods in Algorithmic Mathematics, Stochastic Analysis, and the Mathematics of Nonlinear Systems. For information about the Institute and about the research in algorithmic mathematics and stochastic analysis, please contact: MSI,



409 College Avenue, Ithaca, NY 14850; 607-255-8005. For information about research in nonlinear systems, please contact: J.G. Glimm, Dept. of Applied Mathematics and Statistics, SUNY Stony Brook, Stony Brook, NY 11794-3600; 516-632-8370. MSI prefers scientists who are not more than five years beyond the doctoral degree. Women and minority candidates are encouraged to apply. Candidates are eligible for academic year appointments with possible extension to a second year. The salary is \$34,500 for nine months, plus benefits. The deadline for 1992-1993 applications is January 6, 1992, and awards will be made February 15, 1992. In addition to a curriculum vitae, three letters of recommendation are required. One letter should come from the thesis advisor. Reprints of published articles are appreciated. MSI is partially funded by the U.S. Army Research Office. Cornell University is an equal opportunity, affirmative action employer.

**Mathematical Sciences Research Institute (MSRI).** *Research Fellowships.* The Institute will award about 20 yearlong research fellowships with starting date September 1992 for new and recent Ph.D.s. The stipend will be at least \$30,000. The year 1992-1993 features a yearlong program in Algebraic Geometry, a program in Symbolic Dynamics during the first half, and a program in Transcendence and Diophantine Approximation during the second half; but some awards will be made in other areas, so applications from candidates in all fields are welcome. Formal application forms are not used, but a sheet giving suggestions on how to apply is available on request. Write to the Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, California 94720; 510-642-0143. Files must be complete by November 30, 1991.

**Mathematical Sciences Research Institute (MSRI).** *Research Professorships.* These awards are intended for mid-career mathematicians; the applicant's Ph.D. should be 1986 or earlier. An award for a full academic year will be limited to a ceiling of \$30,000 and normally will not exceed half the applicant's salary. Appointments can be made for a portion of the year; the \$30,000 ceiling and half salary limit would then be prorated. It is anticipated that between six and ten awards will be made. In addition to the basic stipend, there will be an award for round trip travel to MSRI. In 1993-1994, MSRI will feature two programs: Differential Geometry and Integrable and Non-integrable Partial Differential Equations. Research Professorships are directed to applicants in all fields of the mathematical sciences. There are also Senior Memberships, which normally offer smaller awards. An applicant can apply for both (but only one award will be made per applicant). Women and minority applicants are especially encouraged to apply. MSRI does not use formal application forms. An application should include a vita, a bibliography, a plan of research, and a statement concerning financial requirements. Two letters of reference are required. Candidates are asked to make sure that their application materials and the two letters arrive by

October 1, 1992. Late applications cannot be assured a complete consideration. Send applications to the Mathematical Sciences Research Institute, 1000 Centennial Dr., Berkeley, CA 94720; 510-642-0143.

**The Michigan Society of Fellows.** *Horace H. Rackham School of Graduate Studies, The University of Michigan.* The Michigan Society of Fellows was founded in 1970 through grants from the Ford Foundation and Horace H. Rackham Graduate School for the purpose of promoting academic and creative excellence in the arts, sciences and professions. The objective of the program is to support individuals selected for outstanding achievement, professional promise, and interdisciplinary interests. We invite applications from qualified candidates for 4 three-year postdoctoral fellowships at The University of Michigan. Candidates should be near the beginning of their professional careers, not more than three years beyond completion of their degrees. The Ph.D. degree or comparable professional degree, received prior to appointment, is required. Fellows are appointed as Assistant Professors/Postdoctoral Scholars with departmental affiliations. They spend the equivalent of one academic year teaching; the balance of time is devoted to their own scholarly research and creative work. Applications will be screened by faculty in relevant University of Michigan departments. Final selections will be made by the Senior Fellows of the Society. Four new Fellows will be selected for three-year terms beginning September 1992. The initial stipend will be \$26,000. Completed applications are due October 15, 1991. Please send requests for application materials to Michigan Society of Fellows, 3030 Rackham Building, The University of Michigan, Ann Arbor, Michigan 48109-1070; 313-763-1259.

**Michigan State University.** *MSU Postdoctoral Research Positions in Mathematics.* One or more two-year positions will be available for new or recent Ph.D.s who show strong promise in research and teaching. These positions will begin in the Fall of 1992, with a starting salary of at least \$32,000. Teaching duties will be kept to a minimum to maximize research time and interaction with faculty. The teaching load is two semester courses per year, and it may be possible to arrange these courses in a 2-0 or like manner to leave a semester entirely free for research. NSF postdoctoral fellowships or other awards may be held concurrently for a further reduction in teaching load. An applicant should send a vita as well as a brief statement of research interests (include Mathematics Subject Classification Numbers) and should arrange to have sent three letters of recommendation commenting on the applicant's research and teaching abilities. All application materials should be addressed to The Chairperson, Department of Mathematics, Michigan State University, East Lansing, MI 48824; email: 21144chr@msu.bitnet. The deadline for applications is January 4, 1992. MSU is an Equal Opportunity/Affirmative Action Employer.

**National Center for Atmospheric Research.** *Advanced Study Program.* Postdoctoral Fellowships are offered for highly qualified atmospheric scientists, and scientists from related disciplines, who wish to continue basic research in the atmospheric sciences. Appointments are for a one-year period with a possible extension for an additional year. Stipends are \$29,800 for recent recipients of the Ph.D. and are adjusted annually in June. The application deadline is January 10, 1992. Inquiries should be sent to Barbara McDonald, Advanced Study Program, NCAR, P.O. Box 3000, Boulder, Colorado 80307-3000.

**National Institute of Standards and Technology (NIST) and American Society for Engineering Education (ASEE).** *NIST/ASEE Engineering Postdoctoral Research Fellowships.* NIST/ASEE will award postdoctoral fellowships at the NIST Laboratories in Gaithersburg, Maryland and Boulder, Colorado. Although primarily focused on engineering, the program does sponsor fellowships in several mathematical and computer science areas: applied mathematics and scientific computing, computer and telecommunications systems, manufacturing engineering (data modeling and data interfaces), fire safety research (computer modeling and applied mathematics). The stipend will range from \$36,000 to \$42,000 depending on experience and field of study. Travel and transportation of goods to NIST will be paid. The normal term of appointments will be two years. Applicants must be citizens or permanent residents of the United States with a Ph.D., Sc.D. or other earned doctoral degree recognized in U.S. academic circles as equivalent to the Ph.D. (Degree must have been awarded within 7 years of date of application or acceptable evidence of having completed all formal academic requirements for one of these degrees before appointment.) Application deadline dates are January 1, April 1, July 1, October 1. For more information: NIST/ASEE Postdoctoral Fellowship Program, American Society for Engineering Education, Eleven Dupont Circle, N.W., Suite 200, Washington, DC 20036; 202-745-3616/202-293-7080.

**National Research Council.** *Research Associateship Programs.* These programs provide scientists and engineers opportunities for postdoctoral research, free from administrative duties, in a variety of scientific disciplines and fields of specialization. The programs are conducted in cooperation with thirty selected federal organizations with one hundred laboratories at approximately sixty geographic locations in the United States. Many programs are open to senior investigators as well as recent Ph.D.s. Most are also open to foreign nationals as well as U.S. citizens. Applications for these competitive awards will be received by the National Research Council until January 15, 1992, (December 15, 1991 for NASA awards). Appointments will be made in the spring. In some programs additional deadlines are April 15 and August 15 with awards announced in July and November respectively. Annual stipends range from \$27,150 to \$42,000, depending on laboratory of application. Further information and application materials can be obtained from

Associateship Programs (GR430/M1), National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418; Fax: 202-334-2759.

**National Science Foundation.** *Career Advancement Awards.* The goal of these awards is to support activities that can expand a promising applicants research career potential. All women who are eligible to receive standard NSF research grants can apply for Career Advancement Awards. It is expected that applicants will have had prior research support, federal or otherwise. Awards are limited to a maximum of \$50,000 for a period of 12 months with an additional \$10,000 for equipment, if needed. Up to 10% of these funds may be used to defray administrative expenses in lieu of direct costs. These awards are not renewable. Proposals must be received by December 1 of each year. Ten copies of the proposal should be submitted to NSF disciplinary programs through standard institutional channels. For more information write to: Women's Program, Human Resources Development, National Science Foundation, Washington, DC 20550; 202-357-7456.

**National Science Foundation.** *Computer Science Research.* Grants support research concerned with such topics as theoretical foundations of computer science, software systems science, programming languages and compilers, software engineering, numeric, symbolic, and geometric computation, and computer systems, which includes graphics. Guidelines on eligibility and proposal preparation are available in "Grants for Scientific and Engineering Research." For this brochure and additional information write: Division of Computer and Computational Research, National Science Foundation, 1800 G Street, N.W., Washington, DC 20550.

**National Science Foundation.** *Mathematical Sciences Postdoctoral Research Fellowships.* (With Research Instructorship Option). The format of the 1992 Fellowship program has not been significantly changed from that of 1991. The stipend portion of the awards will consist of support for two nine-month academic years and six summer months, for a total of 24 months of support. The awardee will have two options for the academic years' stipend: as full-time support for any eighteen academic-year months in a three-year period, in intervals not shorter than three consecutive months (the Research Fellowship Option), or as a combination of full-time and half-time support over a period of three academic years, usually as one academic year full-time and two academic years half-time (the Research Instructorship Option). The stipend will be paid at the rate of \$2,750 per full-time month or \$1,375 per half-time month, for a total of \$66,000 for the eighteen academic months and six summer months. Deadline for applications is October 15, 1991; awards will be announced on or about February 15, 1992. For further details write to the Office of Special Projects, Room 339, Division of Mathematical Sciences, National Science Foundation, 1800 G Street, N.W., Washington, DC 20550 or call 202-357-3453.

• **National Science Foundation.** *Postdoctoral Fellowships in Japan.* In an effort to strengthen ties between U.S. and Japanese researchers in science and engineering, the National Science Foundation (NSF) established in 1988 a "Japan Initiative." The initiative includes a number of programs designed to increase the number of American researchers who can operate with ease in Japan's research community and follow developments in the Japanese research literature. As part of the program, the NSF coordinates two postdoctoral fellowship programs. The first, sponsored by the Japan Society for the Promotion of Science, will award 25 fellowships to conduct research in Japanese university laboratories or at other institutions affiliated with the Japanese Ministry of Education, Sciences, and Culture. The 12-month research visits are open to U.S. citizens or nationals not more than 35 years of age. The program provides airfare for the awardee, a monthly stipend, a modest housing allowance, medical insurance, and a language-training allowance. Through the second program, sponsored by the Science and Technology Agency of Japan, approximately 35 young American researchers will have the opportunity to collaborate with Japanese colleagues at nonacademic research facilities in Japan. The awards may be held for 6 - 24 months and provide a monthly stipend, travel, housing, medical insurance, and research-related expenses. The Research Development Corporation of Japan will provide language training for the participants at Tsukuba Science City. To be eligible, applicants must be no more than 35 years of age. The deadline for both programs is November 1. For more information, request NSF publications 88-52 and 88-98 from Forms and Publications Unit, Room 232, National Science Foundation, Washington, DC 20550, or electronically through either Bitnet (pubs@NSF) or Internet (pubs@note.nsf.gov). Include the publication numbers, your name, and a complete mailing address.

**National Science Foundation.** *Research Planning Grants for Women.* These awards are made to help increase the number of new women investigators participating in NSF's Research Programs and to assist those who have not previously developed a successful independent proposal for federally funded research to develop a more competitive NSF disciplinary research proposal. The grantee is expected to submit a full research proposal to NSF subsequent to the completion of the research planning grant. The grants are limited to \$18,000 up to 18 months. Up to 10% of these funds may be used to defray administrative expenses in lieu of direct costs. Eligibility is limited to women who have not served as principle or coprinciple investigators on independent federal research awards or to women whose careers have been interrupted for at least two of the past five years. For more information write to: Women's Program, Human Resources Development, National Science Foundation, Washington, DC 20550; 202-357-7456.

**National Science Foundation.** *Visiting Professorships for Women (VPW).* This program enables women scientists and

engineers experienced in independent research to undertake advanced research at a university or research institution. In addition to research, the visiting professor undertakes lecturing, counseling, and other interactive activities. These may be done at the graduate or undergraduate level, be directed to the community at large, or involve some combination of such activities. Applicants must hold a doctorate (or have equivalent experience) in a field of research supported by NSF, and have independent research experience. The usual award is for twelve months for a full- or part-time professorship. Awards for one academic semester will be considered, as will proposals for periods of up to 24 months. The amount of the award will be determined by the work to be performed; past VPW awards have ranged from approximately \$30,000 to \$235,000. Proposals must be submitted by November 15 of each year. For more information contact the VPW Program Director at 202-357-7456 or write to obtain a Visiting Professorship Program announcement (NSF 90-42) to: Program Director, Visiting Professorships for Women, National Science Foundation, Washington, DC 20550.

**Office of Naval Technology (ONT).** *Postdoctoral Fellowship Program.* The ONT sponsors this program at a number of Naval R&D centers and laboratories. The program is designed to significantly increase the involvement of creative and highly trained scientists and engineers from academia and industry in scientific and technical areas of interest and relevance to the Navy. Scientific research and technological developments are pursued to address problems such as: Hydrodynamics, aerodynamics, acoustics, electronic devices, biotechnology, oceanography, computer hardware and software, material science, target detection and surveillance, weaponry, directed energy, biomedicine, signal processing, simulation, training, construction, and logistics. The ONT Program provides approximately forty new postdoctoral appointments per year. Fellowship awards will be based upon the technical quality and relevance of the proposed research, recommendations by the Navy laboratories or centers, academic qualifications, reference reports, and availability of funds. Application deadlines are January 1, April 1, July 1, or October 1. Anyone interested must contact the research facility at which they are interested in working in order to develop a suitable research proposal. Proposals developed with the host facility stand the greatest chance of success in the selection process. The awards are for one year and are renewable for a second year, given satisfactory performance and availability of funds. The stipend for the first year is \$36,000 (minimal experience). A travel and relocation allowance will be paid. To be eligible, participants must be citizens of the U.S. and have received their Ph.D., Sc.D., or equivalent within seven years of the date of application. For information, write to ONT Postdoctoral Program, Projects Office, ASEE, Eleven Dupont Circle, Suite 2000, Washington, DC 20036.

**OTA Morris K. Udall Congressional Fellowship Program.** The Office of Technology Assessment is seeking qualified

candidates from academia, private industry, and the public sector for its Congressional Fellowship Program. Up to six Fellows will be selected for a 1-year appointment in Washington, DC beginning in September 1992. The program is open to men and women of all disciplines who have demonstrated exceptional competency in the physical or biological sciences, engineering, law, economics, environmental and social sciences, or public policy. Candidates must have completed research and training at the *doctoral level*, or have equivalent experience. Salaries will range from \$32,000–\$55,000 per year, based on the Fellow's current salary and/or training and experience. In some instances a Fellow may accept a salary supplement from his or her parent institution. Applications and letters of reference must be postmarked by January 31, 1992. For application information, contact Morris K. Udall Congressional Fellowship, Personnel Office, Office of Technology Assessment, 600 Pennsylvania Ave., S.E., Washington, DC 20003; 202-224-8713.

**President's Commission on White House Fellowships.**

The White House Fellowships offer outstanding Americans early in their careers the opportunity to serve for one year, September through August, as special assistants to Cabinet Officers, to the Vice-President, or to members of the President's senior staff. The Fellowships are open to all U.S. citizens, with the exception of civilian employees of the Federal Government. Applications for the 1992-1993 Fellowships may be obtained from The President's Commission on White House Fellowships, 712 Jackson Place, N.W., Washington, DC 20503. Telephone 202-395-4522. The application deadline is December 15, 1991.

**Purdue University.** *Research Assistant Professorship.* These positions are intended for recent Ph.D.'s who can benefit from and contribute to an active research environment. Appointments are for the two academic years 1992–1994, and are nonrenewable. The normal teaching load is two courses per semester; there will be a one course reduction during the spring semester of 1993. Advanced courses are encouraged; the Department presently has 180 graduate students. The beginning academic year salary will be \$36,000. In addition, a stipend of \$7,200 will be available for research in residence during the summer of 1993. Candidates are expected to have a Ph.D. degree in mathematics prior to September 1992. Selection will be based primarily on outstanding research potential in an area where some interaction with present faculty seems likely. **APPLICANTS MUST MENTION AT LEAST ONE PURDUE FACULTY MEMBER WITH WHOM THEY EXPECT TO HAVE INTERESTS IN COMMON.** Applications, including a vita, brief description of research interests, and three letters of recommendation, one of which addresses teaching, should be sent to Joseph Lipman, Head, Department of Mathematics, Purdue University, West Lafayette, Indiana 47907. The deadline for applications is January 10, 1992. Purdue University is an Equal Opportunity/Affirmative Action Employer.

**Rice University.** *Griffith Conrad Evans Instructorships.* Postdoctoral appointments for two to three years for promising research mathematicians with research interests in common with the active research areas at Rice. Applications received by December 31, 1991 will receive thorough consideration. Rice University encourages applications from women and minority group members. Inquiries and applications should be addressed to Chairman, Evans Committee, Department of Mathematics, Rice University, Box 1892, Houston, Texas 77251.

**Rutgers, The State University of New Jersey.** Department of Mathematics, New Brunswick, NJ, anticipates the following open positions beginning September 1992. *Hill Assistant Professorships.* These are three-year non-renewable positions. Candidates should have recently received the Ph.D., show outstanding promise in research ability in pure or applied mathematics, and have concern for teaching. Normal course load approx. 6 hours per semester but one course teaching reduction provided in two of the three years, resources permitting. Send resume and at least three letters of recommendation to Search Committee, Department of Mathematics, Rutgers University, New Brunswick, NJ 08903 as soon as possible. Indicate position desired and give # of your area of specialty according to AMS Mathematics Subject Classification. Rutgers University is an Equal Opportunity/Affirmative Action Employer.

**Sigma Delta Epsilon, Graduate Women in Science.** See the listing in the Graduate Support section for information.

**Sloan Foundation.** *Research Fellowships.* Unrestricted grants made to selected university scientists in the physical sciences, mathematics, applied mathematics, economics, and in neuroscience. Candidates must be members of the regular faculty, though not necessarily in a tenured position, at a recognized college or university in the United States or Canada. Candidates do not apply but are nominated by their department chairmen or other scientists. For information write to the Sloan Research Fellowships, Alfred P. Sloan Foundation, 630 Fifth Avenue, New York, New York 10111.

**U.S. Department of Energy (DOE).** *Special University-Laboratory Cooperation.* Participants engage in laboratory-approved projects in a program designed to increase the interactions and flow of information between universities and DOE laboratories. Included is research in applied mathematics and computer science. Inquiries should be addressed to the Director at any of the following organizations: Associated Western Universities, 4190 South Highland Drive, Suite 211, Salt Lake City, UT 84124. Argonne Division of Education Programs, 9700 South Cass Avenue, Argonne, Illinois 60439; Brookhaven National Laboratory, Upton, New York 11973; Northwest College and University Association for Science (NORCUS), 390 Hanford St., Richland, Washington 99352-1620; Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, Tennessee 37831-0117.

**U.S. Department of Health and Human Services, National Institutes of Health.** supports postdoctoral training in specified areas of biomedical and behavioral research. Applicant must have earned an appropriate degree and arranged for appointment to an institution and acceptance by a sponsor who will supervise the training research experience. U.S. citizenship or lawful admittance to the U.S. for permanent residence is required. Announcements and application kits available from Office of Grants Inquiries, Division of Research Grants, National Institutes of Health, Bethesda, Maryland 20892. An enclosed self-addressed gummed mailing label will expedite handling.

**University of California. President's Fellowship Program.** The University of California offers postdoctoral fellowships to enhance the competitiveness of outstanding minority and women scholars for academic appointments at major research universities such as the University of California. Awards are for one academic year with the possibility of renewal for a second year pending demonstration of satisfactory progress. Stipends are \$26,000–\$29,000 plus health benefits and up to \$4,000 for research expenses. Applicants must be U.S. citizens or permanent residents, and hold a Ph.D. degree from an accredited University. Preference is given to minority and women candidates historically underrepresented in higher education. Applications are encouraged from African-Americans, American Indians, Asian Americans, Filipinos, Mexican-Americans and Latinos, and from white women in Physical Sciences, Mathematics and Engineering. Further information and application materials may be obtained from: University of California, 300 Lakeside Drive, 18th Floor, Oakland, CA 94612-3550; 415-987-9500. Application and information materials will be available in the Fall. The application deadline is December 13, 1991. An Equal Opportunity, Affirmative Action Employer.

**University of California, Los Angeles. Biostatistical Training in AIDS.** See listing in the Graduate Support section for more information.

**University of California, Los Angeles. Earle Raymond Hedrick Assistant Professorships in Mathematics.** The Department of Mathematics, University of California, Los Angeles, announces the availability of two appointments for the year 1992-1993. These awards will be made to mathematicians with recent Ph.D.'s who show strong promise in research. The appointment will be for three years, at an annual salary of \$39,600 in the first year. The teaching load will be three hours per week for two quarters and six hours per week for one quarter. One course may be an advanced course in the candidate's research area. Requests for application forms should be sent to Thomas W. Liggett, Chair, Department of Mathematics, University of California, 405 Hilgard Avenue, Los Angeles, California 90024-1555, Attn: Staff Search. Preference will be given to applications completed by January 1, 1992. UCLA is an Equal Opportunity/Affirmative Action Employer.

**University of California, San Diego. S. E. Warschawski Assistant Professorship.** The S. E. Warschawski Assistant Professorship is a special two-year position. The nine-month salary is \$340,000. Candidates (of any age) should possess a recent Ph.D. degree (received no earlier than 1989) in mathematics or expect to receive one prior to July 1992. All areas of specialization will be considered. Selection will be based primarily on demonstrated research achievement. Teaching experience is desirable. To apply, please submit your placement file including at least three letters of reference, vitae and publications to the "Faculty Search Committee," Department of Mathematics, 0112, University of California, San Diego, 9500 Gilman Dr., La Jolla, California 92093-0112. Please indicate primary research area (field and #) using the AMS Mathematical Review Classification List. All applications received by January 3, 1992 will receive thorough consideration. All supporting material must be received no later than January 10, 1992. In compliance with the Immigration Reform and Control Act of 1986, individuals offered employment by the University of California will be required to show documentation to prove identity and authorization to work in the United States before hiring can occur. UCSD is an equal opportunity/affirmative action employer.

**University of Chicago. Assistant Professorships and Leonard Eugene Dickson Instructorships in Mathematics.** The Dickson Instructorships are intended for new or recent Ph.D.'s. Appointment is for two years with an annual salary of at least \$37,000. The Assistant Professorships are intended for people with two or more years of postdoctoral experience. Appointment is for three years with an annual salary of at least \$40,000. Application deadline is January 1, 1992. Further information and application forms may be obtained from the Appointments Secretary, Department of Mathematics, University of Chicago, 5734 S. University Avenue, Chicago, Illinois 60637.

**University of Cincinnati. Charles Phelps Taft Postdoctoral Fellowships.** These fellowships are intended to afford scholars who have demonstrated unusual ability for creative research the opportunity to enhance their education through additional study and research. Applicants must have been awarded the Ph.D. degree during the past five years or have completed all degree requirements by September 1 of the year in which the tenure will begin. Applications must include a research plan and the name of a University of Cincinnati faculty member, if known, with whom the applicant would like to study. Ten departments, including the Department of Mathematical Sciences, compete for three awards. Tenure is for one academic year and involves no teaching duties; however, teaching is allowed for additional compensation. The award carries an annual stipend of \$25,000, plus moving expenses up to \$500, and a research allowance of \$1,000. Health insurance, single coverage, is included. Deadline is February 1, 1992. Inquiries should be sent to the University Dean for Advanced Studies, Mail Lo-

cation 627, University of Cincinnati, Cincinnati, Ohio 45221. The deadline for the complete application is February 1.

**University of Illinois at Urbana-Champaign.** *The Chancellor's Postdoctoral Fellowship Program.* Purpose: To train more underrepresented minorities for research careers. Awards: One year (possibly a second year) to promising applicants in all academic fields. Stipends: \$25,000 and up, some transportation costs, health coverage funds, and some research-related expenses. Eligibility: U.S. citizens or permanent residents; appropriate terminal degree in hand or before appointment begins; preference to high achievers in disciplines of limited postdoctoral opportunities. Application: Curriculum vitae; statement of proposed research; sample publications/dissertation chapters; letters of reference from three evaluators. Deadline: Application and letters by December 1, 1991; announcement of awards before March 25, 1992.

**University of Michigan, Ann Arbor.** *Assistant Professorships and T. H. Hildebrandt Research Assistant Professorships.* Designed to provide mathematicians with favorable circumstances for the development of their research talents. Preference is given to persons of any age having their Ph.D. less than two years. The teaching load is two courses per term for Assistant Professorships and one and one-half courses per term for the Hildebrandt Professorships. The stipend for the academic year 1992-1993 will be competitive and determined later; there is a good possibility of additional income during the summer. Appointments are for three years. NSF postdoctoral fellowships may be held simultaneously providing a reduction in teaching load. Applicants should submit completed application form and request at least three letters of recommendation. Letters should contain comments on applicant's mathematical promise, teaching ability, and personality. First preference will be given to applications completed, and supported by three or more letters, prior to January 3. Applications should be made to D.J. Lewis, Chairman, Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48109-1003. Affirmative Action Employer.

**University of Minnesota. Army High Performance Computing Research Center (AHPARC).** The AHPARC is an interdisciplinary research program in high performance computing. The Center research activities are carried out by faculty interested in scientific computing from various fields in engineering, physical sciences, computer science, and mathematics. The current computational resources include a 32,000-node Connection Machine and a Graphics and Visualization Laboratory; and there is access to a Cray-2/4-512 and a Cray X-MP/4-16. Those interested in participating in the research activities of the center as postdoctoral or senior fellows are invited to apply. **Postdoctoral Fellows.** We are currently inviting applications for appointments beginning September 1992, but alternative starting dates may be requested. All requirements for a doctorate must be

completed prior to the starting date. The materials listed below must be received by January 15, 1992: 1). Description (maximum 2 pages) of research background and plans for participating in an AHPARC research project (a description of project opportunities available at the AHPARC can be requested); 2). Curriculum vitae including list of publications; 3). Three letters of recommendation to be sent directly to the AHPARC. **Senior Fellows.** Preference will be given to providing supplementary support for those with sabbaticals, fellowships, or other stipends. All correspondence should be directed to: Visiting Fellows Coordinator, University of Minnesota, Army High Performance Computing Research Center, FMC Technology Center, 1300 South Second St., Minneapolis, MN 55455.

**University of Pennsylvania.** *Hans Rademacher Instructorship.* This post-doctoral position has been instituted in the Mathematics Department in honor of Hans Rademacher, a member of the department from 1934 to 1962. Appointment will be for two years, beginning July 1, 1992. Applicants should have received a Ph.D. in mathematics before start of the appointment, but no earlier than 1990, and are expected to show promise of significant accomplishment. The position carries a reduced academic year teaching load of one course each semester. Salary will be at least \$34,000 and there is an additional discretionary research fund of \$1,500. A letter of application, vitae and publications, and three letters of recommendation should be received by January 1, 1992. Write to: Personnel Committee, Department of Mathematics, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6395. The University of Pennsylvania is an Equal Opportunity/Affirmative Action Employer.

**University of Pittsburgh.** *Andrew Mellon Postdoctoral Fellowships.* Intended to support the research and foster the professional development of scholars who give promise of achieving distinction in their fields. Applicants should submit a completed application form, a research proposal, three to ten pages long, a list of publications, and three letters of recommendation by January 15. The applicant is responsible for soliciting all relevant documents, including letters of recommendation, and ensuring their timely submission. The Fellows are expected to be in Pittsburgh throughout the period of their appointment and to be engaged in research and writing during this period; they have no other formal responsibilities. Preference will be given to applicants who have completed all doctoral degree requirements by January 15 and to those applicants whose projects are relevant to the interests and expertise of specific faculty at the University of Pittsburgh in the arts and sciences. A basic stipend of \$22,000 for eleven months, plus supplements: traveling expenses, up to \$200, from the Fellow's home to Pittsburgh and return and incidental costs of research. Nine-month appointments are available for a stipend of \$18,000 plus supplements. Applications may be obtained from the Director of Graduate Programs, Faculty of Arts and Sciences, University of Pittsburgh, Pittsburgh, Pennsylvania 15260.

**University of Texas at Austin.** *R H Bing Faculty Fellowships.* One or two Fellowships will be available at The University of Texas at Austin with terms beginning September 1, 1992. Each Fellow will hold an Instructorship in the Mathematics Department, with a teaching load of two courses in one semester and one course in the other. The beginning salary will be \$36,000 with a travel supplement of \$1,000 per year. The Fellowships are not renewable after three years. Applicants must show outstanding promise in research, and preference will be given to those having doctorates conferred in 1991 or 1992. There are no restrictions on applicants' fields of interest. To apply, send a vita and have three letters of recommendation submitted by January 1, 1992, to R H Bing Faculty Fellowships, Department of Mathematics, The University of Texas, Austin, Texas 78712.

**University of Utah.** *Instructorship in Mathematics.* Two or more nonrenewable three-year Instructorships are offered. Persons of any age receiving Ph.D. degrees in 1991 or 1992 are eligible. Applicants will be selected on the basis of ability and potential in teaching and research. Starting salary will be \$32,200; future cost of living increases are contingent on action by the State Legislature. Duties consist of teaching five courses during the three quarter academic year. *C.R. Wylie Instructorship.* The term of this instructorship is one year, but it may be renewed for up to three years. It will be awarded either to an incoming Instructor or to one of the Instructors already in residence on the basis of ability and potential in teaching and research. The stipend is \$36,200. Duties consist of teaching four courses during the three quarter academic year. Please send application to Instructorship Committee, Department of Mathematics, University of Utah, Salt Lake City, Utah 84112. Offers are expected to be made beginning January 1, 1992, but applications will continue to be accepted until all positions are filled. The University of Utah is an Equal Opportunity/Affirmative Action Employer and encourages nominations and applications from women and minorities.

**Yale University.** *Josiah Willard Gibbs Instructorships/Assistant Professorships.* Offered to men and women with the doctorate who show definite promise in research in pure mathematics. Applications from women and members of minority groups are welcome. Appointments are for two/three years. The 1991-1992 salary is \$36,000/\$37,000, an increase is expected for 1992-1993. The teaching load is kept light to allow ample time for research. This will consist of two one-semester courses of undergraduate and another semester course of your choice. If desired, part of the teaching duties may consist of a one-semester course at the graduate level in the general area of the instructor's research. Inquiries and applications should be addressed to the Gibbs Committee, Department of Mathematics, Yale University, Box 2155 Yale Station, New Haven, Connecticut 06520. Deadline for applications and supporting materials is January 1, 1992.

## Travel and Study Abroad

**The African-American Institute.** Seeks to further African development and to strengthen understanding between the United States and Africa. For information about the several programs write the African-American Institute program representatives in twenty-two African countries, relevant African ministries or universities, or the Division of Education, African-American Institute, 833 United Nations Plaza, New York, New York 10017.

**American-Scandinavian Foundation.** Grants and Fellowships for study or research in Scandinavia (Denmark, Finland, Iceland, Norway, and Sweden). Applicants must be U.S. citizens or permanent residents and have completed their undergraduate education by the time the overseas project is to begin. Necessary language competence, financial need, and merit in pursuing the study program in Scandinavia are considered in making these awards. The deadline for completed applications is November 1. Write to the Exchange Division, The American-Scandinavian Foundation, 725 Park Avenue, New York, New York 10021.

**Centro de Investigación y de Estudios Avanzados del IPN.** *Solomon Lefschetz Research Instructorships.* Offered to young mathematicians with doctorates who show definite promise in research. Appointments are for one year. Salary equivalent to that of Assistant Professor in the Mathematics Department. An allowance for moving expenses. Teaching duties generally include one course per semester; knowledge of Spanish is desirable. Deadline for applications is February 28 but late applications may be considered. Inquiries should be addressed to: Solomon Lefschetz Instructorships, Mathematics Department, Centro de Investigación del IPN, Apartado Postal 14-740, 07000, México, D.F., México, Phone (905) 7-54-44-66, Telex 017-72826 PPTME, Fax (905) 7-54-87-07; Bitnet CINVES@UNAMVM1.

**Winston Churchill Foundation.** A scholarship program for graduate work in engineering, mathematics and science at Churchill College, Cambridge University. Tuition and living allowance worth \$18,000. Application forms are available from representatives on campuses of colleges and universities participating in the program. For further information write to The Winston Churchill Foundation, P.O. Box 1240, Gracie Station, New York, New York 10028.

**Lady Davis Fellowship Trust.** Fellowships for study and/or research at graduate or postdoctoral levels at the Hebrew University of Jerusalem and the Technion-Israel Institute of Technology, Haifa. Lady Davis Fellows will be selected on the basis of demonstrated excellence in their studies, promise of distinction in their chosen fields of specialization and qualities of mind, intellect, and character. The Fellowships are tenable for a period of one year. They may be renewed for a second year and in special circumstances extended for a third year. They are intended to defray travel and tuition

fees and to meet reasonable living expenses. Deadline for completed applications is December 1, 1991. Application forms can be obtained from the Lady Davis Fellowship Trust, P.O. Box 1255, Jerusalem, Israel.

**Lady Davis Visiting Professorships.** Lady Davis Visiting Professorships, for periods from one semester to a full academic year, are intended for candidates with the rank of Full or Associate Professor at their own institution. Such Visiting Professors are appointed after consultation with the appropriate Faculties of the Hebrew University of Jerusalem or the Technion-Israel Institute of Technology, Haifa. The grant includes a professorial salary and cost of travel. Deadline for completed applications is December 1, 1991. Application forms can be obtained from the Lady Davis Fellowship Trust, P.O. Box 1255, Jerusalem, Israel.

**Fulbright-Hays Program.** *Fulbright and Other Grants for Graduate Study Abroad.* For graduate study or research in any field in which the project can be profitably undertaken abroad. Applicant must be a U.S. citizen, hold a B.A. degree or the equivalent, and have language proficiency sufficient to carry out the proposed study and to communicate with the host country. If an applicant is already enrolled in a U.S. university, he must apply directly to the Fulbright Program Adviser on his campus. Unenrolled students may apply to the Institute of International Education. Further details may be obtained from the U.S. Student Programs Division, Institute of International Education, 809 United Nations Plaza, New York, New York 10017, 212-984-5330.

**Fulbright Teacher Exchange Program.** *Opportunities Abroad.* Opportunities are available for college faculty and secondary/elementary level teachers and administrators to attend seminars and teach in schools/colleges abroad. Eligibility requirements: 1). U.S. citizenship, 2). Bachelor's degree, 3). Three years of full-time teaching experience for teaching positions, two years of full-time teaching experience for seminar positions, 4). Current full-time employment in appropriate subject areas and at appropriate teaching level, and 5). Foreign language fluency for teaching positions in select non-speaking countries (indicated by \* below). Under this program, U.S. and foreign educators exchange teaching positions for one academic year (semester-long and six week programs in Argentina and Mexico, respectively). Exchanges exist between the U.S. and \*Argentina, \*Belgium/Luxembourg, Bulgaria, Canada (\*Quebec), \*Chile, \*Columbia, Cyprus, Czechoslovakia, Denmark, Egypt, Finland, \*France, \*Germany, Hungary, Iceland, \*Italy, \*Mexico, Netherlands, Norway, Philippines, Poland, Portugal, Romania, \*Senegal, South Africa, \*Switzerland, Turkey, U.K., and the \*USSR. Exchange teachers continue to receive their salaries from their home institutions. A grant to teach abroad may include round-trip transportation for the participants (except Canada, Switzerland, U.K.). Applications must be postmarked by October 15 for the following summer or academic year's Program. The application packet should be

requested from Fulbright Teacher Exchange Program, 600 Maryland Ave., S.W., Room 142, Washington, DC 20024; 202-382-8586.

**Alexander von Humboldt Foundation.** *Research Fellowships.* Provides postdoctoral scholars with the opportunity of carrying out research at a university or other research institute within the Federal Republic of Germany. Scholars of all nationalities and disciplines may apply. Selection is based exclusively on academic merit. Applicants must have completed their academic studies, have evidence of a degree equivalent to the doctorate (Ph.D., C.Sc., etc.), have scholarly publications, and for research in the humanities, have adequate knowledge of German. Period of fellowship: 6 to 12 months (extension possible up to 24 months). Applications may be obtained from and returned directly to the Alexander von Humboldt-Stiftung, Jean-Paul-Strasse 12, D-5300 Bonn 2, Federal Republic of Germany. Additional scholarships for a German language course are available.

**Indo-American Fellowship Program.** Approximately 12 grants to be awarded to U.S. citizens for advanced research in India, for six- to ten-month periods during the academic year. In addition to a basic grant there are travel, dependent and research allowances. Also up to nine shorter grants (two- to three-months) for research and/or professional activity. Applications are encouraged from non-Indian specialists and for projects which include collaboration with Indian colleagues. Deadline for applications June 15 each year. For details write the Council for International Exchange of Scholars, Attention: Indo-American Fellowships Program, 3400 International Drive, N.W., Suite M-500, Washington, DC 20008-3097.

**International Research and Exchanges Board (IREX).** IREX administers academic exchange programs, open to advanced graduate students, postdoctoral scholars, and faculty members in all fields of study who are United States citizens, and who are affiliated with a North American college or university. Exchange agreements are in effect with Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, the Mongolian People's Republic, Poland, Romania, Yugoslavia, and the USSR. Placements are made for one to ten months at universities or academy institutes. For more detailed information, write to the International Research & Exchanges Board, 126 Alexander Street, Princeton, NJ 08540-7102; 609-683-9500.

**Italian National Research Council Fellowships.** The Italian National Research Council (*Consiglio Nazionale delle Ricerche*) will offer, in 1992, some fellowships for foreign mathematicians. The stipend is 2,200,000 Italian *lire* per month, for a maximum of twelve months, plus travel expenses to and from the country of residence. Prospective applicants may write for details to: Prof. Carlo M. Scoppola, C.N.R., via Santa Marta 13A, 50139 Firenze, Italy, including short information about their curriculum and their proposed



research program, as well as the name(s) of the Italian mathematician(s) they would like to work with. A copy of the application form will be sent when the scholarships are officially announced.

**Japan Society for the Promotion of Science (JSPS).** The JSPS Fellowship for Research in Japan was established in 1959 to promote international cooperation and mutual understanding in scientific research, and is operated under a Japanese government subsidy. The program presupposes existing contact between scientists in Japan and their fellow scientists overseas, a condition considered auspicious for future scientific cooperation and exchange. The JSPS sponsors three types of Research Fellowship Programs for the invitation of foreign researchers by Japanese scientists. *Type I Short-Term Program:* To invite senior and junior scientists for discussion and observation, as well as attending seminars and giving lectures, etc. Duration 14-90 days. *Type II Long-Term Program (Senior):* To invite senior scientists for cooperative research work with scientists at Japanese universities or research institutes. Duration 6-10 months. *Type III Postdoctoral Fellowships Program:* To invite postdoctoral researchers for cooperative research work at Japanese universities or research institutes. Duration 12 months. Enquiries should be addressed to: Head, Exchange of Persons Division, Japan Society for the Promotion of Science, Yamato Bldg, 5-3-1 Kojimachi, Chiyoda-ku, Tokyo 102, Japan.

**Kosciuszko Foundation.** *Graduate and Postgraduate Exchange with Poland.* Open to U.S. citizens who have at least a master's degree and a knowledge of the Polish language. Apply by October 15 for the following academic year. Write to Scholarship and Exchange Programs, Kosciuszko Foundation, 15 East 65th Street, New York, New York 10021.

**Marshall Scholarships.** Up to forty scholarships are offered by the British Government to U.S. graduates; tenable at any university in the United Kingdom. Recipients of awards are required to take a degree at their British university. Fields unrestricted. Deadline: October 15; to commence the following September; Age Limit: 25 years. Apply through British Consulates-General in the following regions (1) Northeast: Federal Reserve Plaza, 25th Floor, 600 Atlantic Avenue, Boston, Massachusetts 02210; (2) Mideast: British Embassy Cultural Dept., 3100 Massachusetts Avenue, N.W., Washington, DC 20008; (3) South: Marquis One Tower, Suite 2700, 245 Peachtree Center Avenue, Atlanta, Georgia 30303; (4) Midwest: 33 North Dearborn Street, Chicago, Illinois 60602; (5) Pacific: 1 Sansome Street, San Francisco, California 94104.

**National Academy of Sciences (NAS).** *Individual Exchange and Project Development Visits.* The NAS invites applications from American scientists who wish to make visits to the USSR, Bulgaria, Czechoslovakia, Hungary, Poland, Ro-

mania, and Yugoslavia. The program of individual exchanges will support one- to 12-month research visits during calendar year 1993. The program of two-week project development visits will support two cycles of visits: April through August 1992 and August through December 1992. Applicants for the project development visits need to demonstrate that a joint proposal for collaborative research will be prepared during their visit for submission to the National Science Foundation for funding. There is special emphasis on young investigators in each program. Applicants must be U.S. citizens and have doctoral degrees or their equivalent six months prior to the requested beginning date of their visit in physics; chemistry; mathematics and computer sciences; earth, atmospheric, and oceanographic sciences; agricultural, forestry, fishery, and plant sciences; biological sciences; environmental sciences; engineering; archaeology and anthropology; geography; psychology; science and technology policy; or the history and philosophy of science. Projects in the economic and social sciences that involve development of new analytical methodologies will be considered on a case-by-case basis. Necessary expenses will be met by the NAS and the foreign academy, including reimbursement for long-term visitors for salary lost up to a predetermined maximum and expenses for family members accompanying the scientist for more than six months. Requests for applications for the first round of the project development visits should reach the National Academy of Sciences no later than November 15, 1991. **Applications for this program must be postmarked no later than November 30, 1991.** Requests for applications for the individual exchange program should reach the National Academy of Sciences no later than February 15, 1992. **Applications for this program must be postmarked by February 28, 1992.** Requests for applications for the second round of the project development visits should reach the National Academy of Sciences no later than February 15, 1992. **Applications for this program must be postmarked by February 28, 1992.** Address application requests to: Soviet and East European Affairs, National Academy of Sciences, 2101 Constitution Ave., N.W., (HA-166), Washington, DC 20418; 202-334-3884.

**National Science Foundation.** Travel awards for U.S. citizens (or permanent resident aliens) who are either pre-doctoral students or individuals who have held a doctoral degree for three years or less as of the starting date of the Institute, to attend North Atlantic Treaty Organization (NATO) Advanced Study Institutes in Europe. Applications are made to the appropriate NATO Institute Director who nominates eligible candidates. Information may be obtained by writing to the Advanced Institute Travel Awards Program, Division of Research Career Development, National Science Foundation, Washington, DC 20550; 202-357-7536.

**National Science Foundation (NSF).** The International Division of the National Science Foundation supports projects involving U.S. scientists and engineers cooperating with those of other countries in mutually beneficial research,

education, and related activities. Support is available for the following activities: (1) Cooperative research projects designed and conducted jointly by principle investigators from the United States and the foreign country. Deadlines for cooperative research vary widely according to the country program. Joint submissions of parallel proposals to NSF and to a counterpart agency in the foreign country are often required. (2) Long and medium term research visits for younger researchers of three to twelve months duration to foreign centers of excellence. Applications for this program must be submitted by November 1. (3) Research oriented seminars or workshops to exchange information, review the current status of a specific field of science or engineering, and plan cooperative research. Meetings of small groups of researchers are encouraged to increase communication; workshops for the most part are bilateral in nature and jointly organized by the U.S. investigator and a foreign counterpart. (4) Short-term visits for planning cooperative activities, including workshops. This last category is not supported by the Western Europe programs but otherwise is supported by several programs, including Latin America, Southeast Asia, and the USSR. Specific information about country programs, including guidelines, deadlines, and special forms may be obtained by writing to the Division of International Programs, National Science Foundation, Washington, DC 20550; or by calling the following numbers: Western Europe programs 202-357-7554; Latin America programs 202-357-9564; Southeast Asia and Pacific programs (excluding the Japan programs) 202-357-7393; Japan programs 202-357-9558; Asia and Africa programs 202-357-9550; Eastern Europe and USSR programs 202-357-7494. In addition, all program officers may be reached via fax at 202-357-5839 or by email via Internet at [int@nsf.gov](mailto:int@nsf.gov) or through Bitnet at [int@nsf](mailto:int@nsf).

**Natural Sciences and Engineering Research Council of Canada.** *Visiting Fellowships.* The Government of Canada offers Fellowships on behalf of the following Canadian Government Departments and Agencies: Agriculture Canada; Canadian Space Agency; Communications Canada; National Defence; Energy, Mines and Resources Canada; Environment Canada; Fisheries and Oceans; Forestry Canada; Health and Welfare Canada; National Research Council Canada; Transport Canada; Public Service Commission; AECL Research; Canadian Museum of Nature. The annual value of the fellowships is \$32,626 effective May 1, 1991, subject to Canadian income tax. The initial appointment is for one year, with a possibility of renewal for a second year. The applicant should hold a recent doctoral degree (within the last five years) or its equivalent, plus appropriate research experience. The closing date for applications is November 15 each year. Write to the Visiting Fellowships Office, Natural Sciences and Engineering Research Council of Canada, 200 Kent Street, Ottawa, Ontario, Canada K1A 1H5.

**North Atlantic Treaty Organization.** The NATO Science Committee has a Programme of Grants for Collaborative

Research which provides financial aid for research projects aimed at stimulating, encouraging, and facilitating scientific research in collaboration between scientists working in different member countries of the Alliance, thus promoting the flow of ideas and of experimental and theoretical methods across frontiers. Projects are supported for a limited period usually not exceeding five years, covering mainly travel and living expenses abroad for principal investigators visiting partner laboratories or for staff members collaborating on specific projects with laboratories abroad. Deadlines for applications are 31 March, 15 August and 30 November. Application forms and details of the awards together with information about the Science Committee's other programmes can be obtained from: Scientific Affairs Division, NATO, B-1110 Brussels, Belgium.

**North Atlantic Treaty Organization.** *Postdoctoral Fellowships in Science and Engineering.* Awarded for a tenure of 6 to 12 months, for scientific study or work at appropriate nonprofit institutions in NATO countries, other than the U.S., or neighboring countries that cooperate with NATO. This program is for citizens or nationals of the U.S. Fellows receive a stipend of \$27,600 for twelve-month tenure, plus dependency and travel allowances. Application deadline is approximately November 2, 1991. Applications will be available in late August 1990. For information and application material, write to NATO Program, Division of Research Career Development, National Science Foundation, Washington, DC 20550.

**Research Fellowships in India.** The Council for International Exchange of Scholars has announced the availability of twelve long-term (6-10 months) and nine short-term (2-3 months) awards for research in India during 1992-1993. These grants are available in all academic disciplines except clinical medicine. The purpose of the program is to open new channels of communication between academic and professional groups in the U.S. and India and to encourage a wider range of research activity between the two countries than currently exists. Scholars and professionals with limited or no prior experience in India are especially encouraged to apply. Applicants must be U.S. citizens at the postdoctoral or equivalent level. The terms of the fellowships include \$1500 per month, of which \$350 per month is payable in dollars and the balance in rupees, and an allowance for books, study and travel in India, and international travel for the grantee. Long term grantees receive additional allowances, including funds for dependents. The program is sponsored by the Indo-U.S. Subcommission on Education and Culture and is funded by the United States Information Agency, the National Science Foundation, the Smithsonian Institution, and the Government of India. The application deadline is June 15, 1992. Application forms and further information are available from: Council for International Exchange of Scholars, Attn: Indo-American Fellowship Program, 3400 International Drive, Suite M-500, Washington, DC 20008-3097; 202-686-4013.

**Royal Norwegian Council for Scientific and Industrial Research.** *Postdoctoral Fellowships.* Fields: engineering and applied sciences. Studies can be carried out at the Universities of Oslo, Bergen, Trondheim or Tromsø, and at institutes for applied research in the same areas. English may be used at all institutes. Deadline is September 1 and March 1. Write to Royal Norwegian Council for Scientific and Industrial Research, P.O. Box 70, Tåsen, 0801 Oslo 8, Norway.

**Social Sciences Research Council.** *International Dissertation Research Fellowship Program.* The program provides support to advanced doctoral candidates at U.S. universities for dissertation research in Africa; the Near and Middle East; East, South, and Southeast Asia; Western Europe; Latin America, and the Caribbean. Full information on this program may be obtained by writing to the Social Science Research Council, Fellowships and Grants, 605 Third Avenue, New York, New York 10158.

**Weizmann Institute of Science.** *Feinberg Graduate School Postdoctoral Fellowships.* The Fellowships are intended mainly for scientists who have recently obtained their Ph.D. degree. The Fellowships provide a 12-month stipend (with possible renewal for a second year), a small relocation allowance and a one-way air ticket. Round-trip airfare is provided if the Fellowship is extended for a second year. The annual stipend is adjusted periodically in accordance with living costs. Application forms and additional information may be obtained from the Feinberg Graduate School, The Weizmann Institute of Science, P.O. Box 26, Rehovot 76100, Israel. The review of applications is held twice a year, on January 1 and May 15.

**Weizmann Institute of Science.** *Openings for Scientists.* The Weizmann Institute of Science is now offering a limited number of temporary appointments to the position of Scientist. Candidates must have completed two years of post-doctoral work. Appointments will be made in all the areas of scientific research at the Institute: Biology, Chemistry, Biochemistry-Biophysics, Physics, Mathematics, and Science teaching. Appointments are for a period of one year, however, they may be extended for a period not to exceed 5 years from receipt of Ph.D. degree (or equivalent). Successful appointees will be eligible to apply for promotion to the position of Senior Scientist. Financial remuneration for a Scientist is at the level of Lecturer and includes all of the associated benefits. In addition, a relocation stipend is provided. Applications and additional information may be obtained from The Feinberg Graduate School, The Weizmann Institute of Science, Rehovot, 76100 Israel. Applications are reviewed each year on January 1 and May 15.

### Study in the U.S. for Foreign Nationals

Many of the programs in the Graduate Support and Postgraduate Support sections are also applicable to Foreign Nationals.

**American-Scandinavian Foundation.** Scandinavian scholars are awarded graduate fellowships to study in the U.S. For information write to the appropriate society in Scandinavia cooperating with The American-Scandinavian Foundation (Danmark-Amerika Fondet, Dronningens Tvaergade 44, DK-1302, Copenhagen K, Denmark; Suomi-Amerikka Yhdistysten Liitto, Mechelininkatu 10, SF-001 00 Helsinki, Finland; Íslenzk-Ameríska Félagid, P.O. Box 7051, Reykjavík, Iceland; Norge-Amerika Foreningen, Drammensveien 20C, 0255 Oslo 2, Norway; Sverige-Amerika Stiftelsen, Box 5280, S-102 46 Stockholm, Sweden), or to the Exchange Division, The American-Scandinavian Foundation, 725 Park Avenue, New York, New York 10021.

**American Association of University Women (AAUW) Educational Foundation.** *International Fellowships.* These are awarded to women of outstanding academic ability, who are not citizens or permanent residents of the U.S., for full-time graduate or post-graduate study in the U.S. Applicants must hold the equivalent of a U.S. bachelor's degree by December 1. Upon completion of studies, fellowship recipients must return to their home countries to pursue professional careers. Previous and current recipients of AAUW fellowships are not eligible. The fellowships provide \$13,000 each. The deadline is December 1. For more information, contact: AAUW Educational Foundation, International Fellowships, 1111 16th St., NW, Washington, DC 20036; 202-728-7603.

**Fulbright Program.** Grants under the Fulbright Act for study, research, teaching, and lecturing in the United States are available to nationals of many countries. Information regarding these opportunities may be secured from the Cultural Affairs Officer of the United States Embassy or from the binational Educational Commission or Foundation if there is one in the inquirer's own country. The number of grants for each academic year will depend on funds available.

**Institute of International Education.** Grants for study, training and research in the U.S. Open to nationals of most countries. IIE develops and administers exchange programs for a number of organizations and corporations, and administers U.S. Government grants under the Fulbright and other educational exchange programs of the U.S. Information Service. Information regarding these opportunities may be secured from the Cultural Affairs Officer of the U.S. Embassy or from the Binational Commission or Foundation if there is one in the inquirer's own country.

**Kennedy Scholarships.** For citizens of the United Kingdom, these grants are for postgraduate study at Harvard University or the Massachusetts Institute of Technology. Application deadline is October 18. Write to Secretary, Kennedy Memorial Trust, 16 Great College Street, London SW1P 3RX, England.

**Kosciuszko Foundation.** One-year grants to doctoral and postdoctoral students. Applicants must be Polish citizens and have excellent command of English. Apply by October 15 for the following academic year. Write to Scholarship and Exchange Programs, the Kosciuszko Foundation, 15 East 65th Street, New York, New York 10021.

### Sources of Fellowship Information

Some of the publications listed below are available at school, or college and university libraries, or in the reference room of a good public library.

**Academic Year Abroad.** Sara Steen (ed.). Describes over 1800 study-abroad programs, both undergraduate and graduate, conducted during the academic year in countries around the world. Information on courses, costs, credits, housing, scholarships, and language of instruction. 1991/92. Annual. \$31.95 (plus \$3.00 postage and handling). IIE Books, Institute of International Education, 809 United Nations Plaza, New York, New York 10017.

**American Association of University Women Educational Foundation.** Programs Office, 1111 16th St., N.W., Washington, DC 20036, or call 202-785-7700 and ask for the foundation.

**Annual Register of Grant Support, 1992.** National Register Publishing Co., 3004 Glenview Road, Wilmette, IL 60091. Directory of fellowships, grant support programs of government agencies, foundations, corporations and business and professional organizations. Annual. \$149.00 plus \$6.75 postage and handling.

**Basic Facts on Foreign Study.** A fact sheet on what to expect from a study-abroad program and where to find pertinent information; 1990, 32 pp.; single copies free, \$35 per 100. IIE Books, Institute of International Education, 809 United Nations Plaza, New York, New York 10017.

**Chronicle Financial Aid Guide, 1991/92.** Catalog No. 502A. \$19.97 plus \$2.00 postage and handling. (Price subject to change after January 1, 1992.) Revised annually. Chronicle Guidance Publications, Inc., 66 Aurora Street, P.O. Box 1190, Moravia, New York 13118-1190. Provides information on over 2,050 financial aid programs available to undergraduate, graduate, and postgraduate students, including programs sponsored by private organizations and foundations, state and federal government sources, and national and international labor unions, both AFL-CIO affiliated and independent. A Cross Reference to Programs gives easy access to programs for which a student may be eligible. Other financial aid sources are also listed.

**CIEE Student Travel Catalog.** \$1 postage and handling. CIEE Publications, 205 East 42nd Street, New York, NY 10017.

**Directory of Computer and High Technology Grants.** Richard M. Eckstein, Publisher. This directory lists 640 funding sources for computers, software, and high-tech related grants and provides extensive profiles on foundations, corporations, and federal programs. First Edition cost is \$44.50 (add \$4.00 for handling). Research Grant Guides, Dept. 4B, P.O. Box 1214, Loxahatchee, FL 33470; 407-795-6129.

**Directory of Graduate Programs, 13th Edition.** Four volumes categorized by discipline, \$17.00 each. Volume A: Natural Sciences, or Volume B: Engineering • Business. Educational Testing Service, P.O. Box 6014, Princeton, New Jersey 08541-6014.

**Directory of Special Programs for Minority Group Members.** Career Information Services, Employment Skills Banks Financial Aid Sources (5th Edition, 1990, 348 pages), Garrett Park Press, Garrett Park, Maryland 20896. \$30.

**Financial Aid for Minorities in Engineering and Science.** Financial assistance, scholarship and fellowship programs, resources for further information, 1990, Garrett Park Press, P.O. Box 190, Garrett Park, MD 20896. \$4.

**Financial Resources for International Study: A Guide for U.S. Nationals.** The book describes awards offered by governments, foundations, international organizations, research institutes and other organizations in the U.S. and abroad and provides informative grant descriptions, key facts on amount of award, what it covers, number offered, duration, purpose, and eligibility. Peterson's Guides, Box 2123, Princeton, NJ 08543-2123 (800-EDU-DATA). 250 pp. book. \$36.95 Plus \$5.75 Shipping.

**The Foundation Center.** The Foundation Center, 79 Fifth Avenue, New York, New York 10003, provides free library service through over 180 libraries across the country and publishes information about U.S. foundations and the grants they award, including the biennial publication, *Foundation Grants to Individuals*, (7th edition, 1991, \$40). Call toll-free 800-424-9836 for further information.

**Fulbright Scholar Program Grants for Faculty and Professionals: Research and Lecturing Awards.** (Current Edition) Available from the Council for International Exchange of Scholars, 3007 Tilden St., N.W., Suite M-500, Washington, DC 20008-3009; 202-686-4000.

**Fulbright and Other Grants for Graduate Study Abroad.** List of grants for graduate study and research abroad, administered by the I.I.E. for U.S. citizens. Request copy of brochure from U.S. Student Programs, Institute of International Education, 809 United Nations Plaza, New York, New York 10017, 212-984-5330.

• **Funding for U.S. Study: A Guide for Foreign Nationals.**

The book lists awards offered by governments, foundations, international organizations, research institutes, and other organizations in the U.S. and abroad. It provides informative descriptions, facts on size and educational costs covered by the grant, eligibility, application, quantity of awards, duration and purpose. 250 pp. book. \$39.95 (includes U.S. postage).

**Graduate School and You: A Guide for Prospective Graduate Students.** Council of Graduate Schools, 2nd Edition, 1991. Available from the Council of Graduate Schools, 1 Dupont Circle, N.W., Suite 430, Washington, DC 20036-1173, or call 202-223-3791.

**The Grants Register.** 1991-1993. Lisa Williams, (ed.), St. Martin's Press, 175 Fifth Avenue, New York, New York 10010. Lists scholarships, fellowships, and grants at all levels of graduate study, all over the world, available from government agencies and international, national and private organizations. List Price \$85.00. Biennial.

**International Research and Exchanges Board (IREX).** Programs administered by IREX include exchanges for a semester or an academic year with the USSR and socialist countries of Eastern Europe, grants to promote new exchanges, collaborative projects in the social sciences and humanities, developmental fellowships, short-term travel grants, and language programs. The IREX programs provide access at the predoctoral and postdoctoral levels to East European and Soviet universities and academies of sciences. For a program announcement describing the full range of IREX programs, write to the International Research & Exchanges Board, 126 Alexander Street, Princeton, New Jersey 08540-7102; 609-683-9500.

**Office of Naval Research.** Supports research over a wide range of areas including applied mathematics, numerical analysis, discrete mathematics, operations research, signal analysis, statistics and probability. Proposals for research grants and requests for information on ONR Programs should be addressed to: Mathematical Sciences Division,

Office of Naval Research, Arlington, Virginia 22217-5000. Information on ONR Fellowships is available from the Special Programs Office at the same address.

**Study Abroad, XXVII, 1992-1993.** Presents study programs world-wide for the years 1988-1993. Approximately 4,000 entries for more than 100 countries are included, covering a wide variety of fields. Trilingual (English/French/Spanish). 1,350 pp, pbk, 22cm x 11.5cm, \$24.00, Order No. U7145. Contact UNIPUB, 4611-F Assembly Drive, Lanham, MD 20706-4391, (301) 459-7666; in Europe, UNESCO, Place de Fontenay, Paris 7, France.

**U.K. Central Bureau Publications.** The Central Bureau is the agency funded by the education ministries of the U.K. to provide the most-needed information on international education. IIE is the U.S. distributor for the two Central Bureau books most widely used by U.K. students, librarians and campus professionals in planning study and work abroad. IIE Books, Institute of International Education, 809 United Nations Plaza, New York, NY 10017.

**U.S. Information Agency (USIA).** For information on USIA's international educational and cultural exchange programs, including the Fulbright Program, write the Office of Public Liaison, U.S. Information Agency, 301 Fourth Street, S.W., Washington, DC 20547.

**Vacation Study Abroad.** Sara Steen (ed.). A guide to over 1,300 summer and short-term study programs conducted around the world by U.S. colleges and universities, foreign institutions, and private organizations. Contains information on courses, costs, scholarships, and accommodations. 1991. Annual. \$26.95 (plus \$3.00 postage and handling). IIE Books, Institute of International Education, 809 United Nations Plaza, New York, New York 10017.

**Work, Study, Travel Abroad: The Whole World Handbook 1990/1991.** \$10.95 plus \$1.00 postage and handling. CIEE Publications, 205 East 42nd Street, New York, NY 10017.

# Classified Advertisements

**SUGGESTED USES** for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

**THE 1991 RATE IS** \$55.00 per inch on a single column (one-inch minimum), calculated from the top of the type; \$25 for each additional  $\frac{1}{2}$  inch or fraction thereof. No discounts for multiple ads or the same ad in consecutive issues. For an additional \$10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Advertisements in other sections of the classified pages will be set according to the advertisement insertion. Headlines will be centered in boldface at no extra charge. Classified rates are calculated from top of type in headline to bottom of type in body copy, including lines and spaces within. Any fractional text will be charged at the next  $\frac{1}{2}$  inch rate. Ads will appear in the language in which they are submitted.

Prepayment is required of individuals but not of institutions. There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified advertising.

**DEADLINES** are listed on the inside front cover or may be obtained from the AMS Advertising Department.

**U. S. LAWS PROHIBIT** discrimination in employment on the basis of color, age, sex, race, religion or national origin. "Positions Available" advertisements from institutions outside the U. S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U. S. laws. Details and specific wording may be found near the Classified Advertisements in the January and July/August issues of the *Notices*.

**SITUATIONS WANTED ADVERTISEMENTS** from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada for further information.

**SEND AD AND CHECK TO:** Advertising Department, AMS, P. O. Box 6248, Providence, Rhode Island 02940. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02904. Individuals are requested to pay in advance, institutions are not required to do so. AMS FAX 401-455-4004.

portunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

## MILLS COLLEGE Department of Mathematics and Computer Science Oakland, California 94613

Mills College is seeking outstanding candidates for two tenure-track positions, commencing Fall 1992. The first is Assistant Professor of Computer Science. A Ph.D. in Computer Science is required. The second is Assistant Professor of Computer Science and Director of the Interdisciplinary Computer Science Master's Degree Program. A strong computer science background, a Ph.D. in a related field, and the ability to guide students, with quite diverse backgrounds, in a master's degree program are required. Candidates for both positions must submit evidence of superior teaching and research abilities. Salary will depend on experience and qualifications. The initial contract will be for three years, subject to final administrative approval. Please send vita, and direct three letters of reference, to:

Chair, Computer Science Search  
Committee  
Mills College  
Oakland, California 94613

The deadline for applications is January 10, 1992. Mills College is an Equal Opportunity Employer.

## POSITIONS AVAILABLE

### ALABAMA

#### UNIVERSITY OF SOUTH ALABAMA Department of Mathematics and Statistics

Applications are invited for tenure-track appointments effective Sept. 1, 1992. Appointments will be made at the asst. prof. or assoc. prof. level. Applicants must have a Ph.D. in mathematics, earned or anticipated by 9/1/92. Strong research potential and a commitment to excellence in teaching are required. Significant research accomplishments and a record of versatile and effective teaching is expected of successful applicants for appointment at the assoc. prof. level. Applicants in all areas of mathematics will be considered; however, preference will be given to areas complementing existing research specialties. Applications will be accepted until positions are filled, but should be completed by Dec. 16, 1991 to ensure consideration. Interested applicants should submit a letter of application, current resume, statement of research and teaching interests, undergraduate and graduate transcripts (student copies will suffice initially) and arrange to have three letters of recommendation sent directly to Dr. Suzanne McGill, Chair, Dept. of Math/Stat, Univ. of South Alabama, Mobile, AL 36688. An equal Opportunity/Affirmative Action Employer.

## CALIFORNIA

### CALIFORNIA INSTITUTE OF TECHNOLOGY Applied Mathematics

Postdoctoral positions as Research Fellow for one or possibly two years doing joint research under the direction of senior faculty are available. The research is sponsored and frequently involves large scale computations in some area of continuum mechanics and fluid dynamics. Research in numerical analysis and parallel computing is also active. Current salaries are about \$30,000 for 11 months. Send detailed vita, bibliography and three letters of reference to The Executive Officer, Applied Mathematics 217-50, Caltech, Pasadena, CA 91125. Caltech is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

### CALIFORNIA INSTITUTE OF TECHNOLOGY Applied Mathematics

The Applied Mathematics program at Caltech invites applications for a tenure-track or possibly tenured appointment in the case of exceptionally well-qualified applicants. Candidates should have a demonstrated ability to carry out high quality research in their fields of Applied Mathematics and be willing to participate in the teaching program at graduate and undergraduate levels. Applicants should submit a detailed curriculum vitae and list of publications with at least three letters of recommendation or the names of referees to The Executive Officer, Applied Mathematics 217-50, Caltech, Pasadena, CA 91125. Caltech is an Equal Op-

### UNIVERSITY OF CALIFORNIA, LOS ANGELES Department of Mathematics

#### TEMPORARY POSITIONS

(1) One or two E. R. Hedrick Assistant Professorships. Applicants must show very strong promise in research and teaching. Salary \$39,600. Three year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by January 1, 1992.

(2) Subject to administrative approval, several Research Assistant Professorships in Computational and Applied Mathematics. Applicants must show very strong promise in research and teaching. Salary \$39,600. One year appointment, probably renewable up to two times. Teaching load: at most four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by January 1, 1992.

(3) Subject to administrative approval, one or two Adjunct Assistant Professorships in the Program in Computing (PIC). Applicants must show very strong promise in teaching and research, preferably in the general area of logic and computation. Teaching load: four quarter programming courses and an advanced quarter course of the candidate's choice per year. Two-year appointment, possibly renewable once. Salary range \$39,600-\$47,000. Preference will

## Classified Advertisements

be given to applications completed by February 1, 1992.

(4) Subject to administrative approval, a Lectureship in the Program in Computing (PIC). Applicants must show very strong promise in the teaching of programming. M.S. in Computer Science or equivalent degree preferred. Teaching load: five quarter programming courses per year. One-year appointment, possibly renewable up to five times, depending on the needs of the program. Salary is based on experience and begins at \$34,248. Preference will be given to applications completed by February 1, 1992.

(5) Subject to administrative approval, a few Adjunct Assistant Professorships. One year appointments, probably renewable once. Strong research and teaching background required. Salary \$35,900–\$40,500. Teaching load: five quarter courses per year.

(6) Subject to administrative approval, several positions for visitors and lecturers.

To apply, write to Thomas M. Liggett, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555. Attn: Staff Search. UCLA is an equal opportunity/affirmative action employer.

### UNIVERSITY OF CALIFORNIA, LOS ANGELES Department of Mathematics

#### REGULAR POSITIONS IN PURE AND APPLIED MATHEMATICS

Subject to administrative approval, one or two regular positions in pure and applied mathematics. The six specific search areas are as follows: 1) statistics; 2) applied and computational mathematics; 3) logic and mathematical computer science; 4) geometry and topology (including dynamical systems and geometric partial differential equations); 5) analysis and differential equations (including Lie groups, mathematical physics, probability and game theory); 6) algebra, number theory and combinatorics (including algebraic geometry and representation theory). Very strong promise in research and teaching required. Positions initially budgeted at the assistant professor level. Sufficiently outstanding candidates at higher levels will also be considered. Teaching load: averaging 1.5 courses per quarter, or 4.5 quarter courses per year. To apply, write to Thomas M. Liggett, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555. Attn: Staff Search. UCLA is an equal opportunity/affirmative action employer.

### UNIVERSITY OF CALIFORNIA, SANTA CRUZ

The Mathematics Department at the University of California, Santa Cruz, expects to have J. W. T. Youngs Assistant Professorships in Mathematics beginning Fall 1992. These recently established Assistant Professorships in Mathematics are named in honor of our founding chairman, J. W. T. Youngs. Appointees will be expected to teach, pursue their research, and perform some department or university service. These positions are available for a two-year

period with the possibility of an extension for a third year. Minimum Qualifications: Ph.D. in Mathematics and a demonstrated excellence in research and teaching or potential for excellence. Salary Range: \$35,900–\$37,400 commensurate with qualifications and experience. Available: Fall 1992. Application Deadline: December 15, 1991. Please refer to position #T91-04. Applicants should send vitae, three letters of reference, and information about their teaching and research experience to: Recruitment Committee, Mathematics Department, University of California, Santa Cruz, CA 95064. UCSC is an affirmative action/equal opportunity employer.

## FLORIDA

### STETSON UNIVERSITY Department of Mathematics and Computer Science

Applications are invited for a tenure track position in mathematics at the Assistant Professor level beginning Fall 1992. A Ph.D. in mathematics is required. Applicants should have a strong commitment to undergraduate teaching in a liberal arts environment. Teaching load: 9–10 hrs/wk. Responsibilities include teaching mathematics courses at all levels of the undergraduate curriculum, and continuing scholarly activity. The department currently has 10 full-time faculty members. Stetson University, located in Central Florida, is a small, private, comprehensive university of 2500 students. Its three schools—the College of Arts and Sciences, the School of Business, and the School of Music—are dedicated to excellence in teaching and are united by a commitment to the liberal arts. Send vitae and three letters of recommendation to: Professor Dennis Kletzing, Department of Mathematics and Computer Science, Stetson University, DeLand, Florida 32720. Deadline for applications is December 31, 1991, or until position is filled. Stetson University is an Equal Opportunity Employer and enthusiastically solicits applications from women and minority candidates.

## ILLINOIS

### NORTHWESTERN UNIVERSITY Department of Mathematics 2033 Sheridan Road Evanston, Illinois 60208–2730

Applications are invited for one or more anticipated tenure-track positions starting September 1992. Priority will be given to young, exceptional research mathematicians (no more than several years after the Ph.D.). However, more senior candidates with very exceptional credentials may be considered for a tenured position. Fields of interest within the department include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty, so women and minority candidates are especially encouraged to apply.

Candidates should arrange that at least three letters of recommendation be sent to Prof. D. G. Saari, Chair, Personnel Committee, Department of Mathematics, Northwestern University, Evanston, Illinois 60208–2730. Alternatively, applications and supporting documentation can be sent via email to "hiring@math.nwu.edu." In order to receive full consideration, applications should be received by February 15, 1992. Hiring is contingent upon eligibility to work in the United States.

### SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE Department of Mathematics Carbondale, Illinois 62901

Applications are invited from qualified candidates for a tenure-track position at the assistant professor level beginning on August 16, 1992. Ph.D. in mathematics with specialization in numerical analysis required. Candidates must have demonstrated excellence in research or potential for such. Evidence of teaching effectiveness is required (foreign applicants *must* provide evidence of ability to teach in English effectively). Send letter of application, resume, and three letters of recommendation to:

Numerical Analysis  
c/o Ronald B. Kirk, Chair  
Department of Mathematics  
Southern Illinois University at  
Carbondale  
Carbondale, Illinois 62901

The closing date for applications is December 10, 1991 or until the position is filled. SIUC IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

### SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE Department of Mathematics Carbondale, Illinois 62901

Applications are invited from qualified candidates for a tenure-track position at the assistant professor level beginning on August 16, 1992. Ph.D. in statistics or in mathematics with a concentration in statistics is required. Preference is for mathematical statistics and statistical inference with interest in applications. Candidates must have demonstrated excellence in research in research or potential for such. Evidence of teaching effectiveness is required (foreign applicants *must* provide evidence of ability to teach in English effectively). Send letter of application, resume, and three letters of recommendation to

Statistics  
c/o Ronald B. Kirk, Chair  
Department of Mathematics  
Southern Illinois University at  
Carbondale  
Carbondale, Illinois 62901

The closing date for applications is December 10, 1991 or until the position is filled. SIUC IS AN EQUAL OPPORTUNITY/AFFIRMATIVE

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## Classified Advertisements

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ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

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### UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN Department of Mathematics

Applications are invited for one or more tenure-track or tenured faculty positions commencing in August 1992. We are particularly interested in hiring in the areas of applied mathematics, combinatorics, optimization, partial differential equations, and probability. Outstanding candidates in all fields of mathematics are encouraged to apply and will be seriously considered. Some visiting appointments for the 1992-93 academic year are also anticipated. Salary and teaching load are competitive. Candidates must have completed the Ph.D. by the time the appointment begins. Candidates should send a letter of application, curriculum vitae and publication list, and arrange to have three letters of reference sent directly to

C. Ward Henson, Chair  
Department of Mathematics  
University of Illinois at  
Urbana-Champaign  
1409 W. Green St.  
Urbana, Illinois 61801  
tel. (217)333-3352

In order to ensure full consideration, all application materials including letters of reference should be received by December 2, 1991. Interviews may be conducted prior to December 2, but completed applications received by that date will receive full consideration. Candidates are expected to present evidence of excellence, or potential for excellence, in research and teaching. Applications from women and minority candidates are especially encouraged. The University of Illinois is an Affirmative Action/Equal Opportunity Employer.

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### MARYLAND

#### THE JOHNS HOPKINS UNIVERSITY Department of Mathematical Sciences

Applications are invited for a faculty position in OPERATIONS RESEARCH or OPTIMIZATION to begin in Fall 1992. Within these areas, either a stochastic or a deterministic emphasis is of interest. Applicants at all levels will be considered.

Selection is based on demonstration and promise of excellence in research, teaching, and innovative application. AA/EOE.

Applicants are asked to furnish a curriculum vitae, transcripts (junior applicants only), reprints (if available), a letter describing professional interests and aspirations, and to arrange for three letters of recommendation to be sent to:

John C. Wierman, Chair  
Department of Mathematical Sciences  
220 Maryland Hall  
The Johns Hopkins University  
Baltimore, MD 21218-2689

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### MASSACHUSETTS

#### WELLESLEY COLLEGE Department of Mathematics Wellesley, MA 02181

Two or three tenure-track positions at the Asst. Professor level beginning Fall 1992. The teaching load is currently four courses per year. Requirements include a Ph.D. in mathematics (completed, or expected by June 1992), excellence in and commitment to both undergraduate teaching and mathematical research in a liberal-arts environment. Candidates with research interests in any area of mathematics will be considered. Applicants should send a curriculum vitae and arrange for at least three letters of recommendation that address both teaching and research. Applications and recommendation letters should be sent to arrive by December 6, 1991, to ensure full consideration. Reply to: Search Committee, Dept. of Math., Wellesley College, Wellesley, MA 02181. Wellesley College is an Equal Opportunity/Affirmative Action Employer and particularly encourages applications from women and minority candidates.

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### MICHIGAN

#### MICHIGAN STATE UNIVERSITY Department of Mathematics East Lansing, MI 48824-1027

One or more Postdoctoral fellowships in Mathematics. The appointment is for two years. Duties include teaching one course each semester of the academic year with the expectation that the fellow will devote remaining time to research. These fellowships are normally offered to persons (regardless of age) who have had their doctorate less than two years. There will also be some positions available at the level of instructor. Please send a résumé and arrange to have three letters of recommendation sent to: Professor Richard E. Phillips, Chair, Department of Mathematics Michigan State University, East Lansing, MI 48824-1027; email 21144CHR@MSU.BITNET. It would be helpful if résumé includes appropriate Mathematics Subject Classification number(s) and (if possible) electronic address. Applications received by January 4, 1992 will be given more attention.

*MSU is an Affirmative Action/Equal Opportunity Institution.*

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#### MICHIGAN STATE UNIVERSITY Department of Mathematics East Lansing, MI 48824-1027

The Department is seeking applicants for several tenure-track positions; openings are available at each of the Assistant, Associate, and Full Professor levels. Excellence in research and teaching is essential and applicants in all areas of research will be considered. Please send a résumé and arrange to have three letters of recommendation sent to Professor Richard

E. Phillips, Chair, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027; Email 21144CHR@MSU.BITNET. It would be helpful if résumé includes appropriate Mathematics Subject Classification number(s) and (if possible) electronic address. Applications received by January 4, 1992 will be given more attention.

*MSU is an Affirmative Action/Equal Opportunity Institution.*

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### RESEARCH SCIENTIST

Research Scientist to design and implement algorithms that automatically perform Digital Surface Segmentation & Reconstruction (DSSR), i.e., construct surface primitives (compatible with the Initial Graphics Exchange Specification format) approximating a dense range image, integrate DSSR algorithms into existing signal processing system. Must have Master of Arts in Mathematics with Master's level coursework which included Computer Graphics; Computer Aided Geometric Design; Approximation and Optimization. Must demonstrate broad range of computer programming, image/signal processing, and computer aided design of mathematical representations by submitting at least two published articles in these topics. Salary \$1,038.46 per week, 40-hour work week. Send resumes to 7310 Woodward Avenue, Room 415, Detroit, Michigan 48202. Reference No. 54391. Employer paid ad. AA/EOE

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### MINNESOTA

#### PEW TEACHER-SCHOLAR FELLOWSHIPS

The University of Chicago and Washington University at St. Louis solicit applications from recent or expected Ph.D. recipients for 2-year teacher-scholar fellowships in biological sciences, biochemistry, chemistry, physics, mathematics and computer science, and geology and earth sciences, funded by the Pew Charitable Trusts. The successful applicants will spend one postdoctoral year of research (1992 to 1993) at either The University of Chicago or Washington University and a second postdoctoral year of research and teaching at one of ten distinguished Midstates Colleges (Beloit, Carleton, Grinnell, Hope, Kalamazoo, Knox, Macalester, Rhodes, and St. Olaf Colleges and Trinity University). The aim of this program is to provide capable scientists and mathematicians with unique opportunities for development as potential faculty members in liberal arts colleges. Candidates must be U. S. citizens or permanent residents with a commitment to excellence in teaching and research.

The fellowship includes an annual stipend of \$28,000 plus benefits and a research and travel allowance. *We encourage underrepresented minorities and women to apply.* The deadline for receipt of completed applications is 15 November 1991. For information, write: Dr. Daniel J. Hornbach, Acting Program Director, Pew Midstates Science and Mathematics Consortium, Macalester College, 1600 Grand

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Avenue, Saint Paul, MN 55105, or call: 612-696-6548. AA/EOE.

### NEW JERSEY

#### RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY Department of Mathematics

We anticipate the following open positions beginning September 1992. (1) **TENURE-TRACK AND TENURE POSITIONS.** Most appointments are expected to be tenure-track assistant professorships. However, depending on qualifications of the applicant, some appointments may be made to tenured positions at the rank of associate professor or higher. Candidates must have Ph.D., outstanding research ability in pure or applied mathematics, and concern for teaching. Semester course load now averages 5 hours. Strong candidates in all fields are encouraged to apply and will be given careful consideration. (2) **HILL ASSISTANT PROFESSORSHIPS.** The Hill Assistant Professorships are three-year non-renewable positions. Candidates should have recently received the Ph.D., show outstanding promise in research ability in pure or applied mathematics, and have concern for teaching. Semester course load is approximately 6 hours but a one course per year teaching reduction is provided in two of the three years. (3) **LECTURESHIPS** (at the assistant professor level and above). These have a semester course load of approximately 6 hours and are one or two year non-tenure-track positions. Candidates must have Ph.D., show outstanding promise in research ability in pure or applied mathematics, and have concern for teaching. (4) **INSTRUCTORSHIPS.** Responsible for teaching mainly at the level of precalculus and below. Semester course load is 12 hours. Candidates must have masters degree or equivalent related experience and provide evidence of teaching ability. These are one or two year non-tenure-track positions. (5) **FULL-TIME and PART-TIME VISITORS.** Full-time visitor positions are intended to permit individuals with regular appointments elsewhere to visit Rutgers for the purpose of engaging in joint research with members of the faculty. The semester full-time course load for visitors is approximately 6 hours. Part-time positions may be used both for candidates with primary responsibility for teaching and for candidates with outstanding promise in research activity. Candidates for positions involving research must have Ph.D., proven record of outstanding research accomplishments in pure or applied mathematics, and concern for teaching. These are one or two year non-renewable positions.

Applicants should send résumé and at least three letters of recommendation to the SEARCH COMMITTEE, Department of Mathematics, Rutgers University, New Brunswick, NJ 08903 as soon as possible. Please indicate the position desired and give the AMS Subject Classification number of your area(s) of specialization. Applicants who applied in 1990-91 may, if they wish, request to have their previous application reactivated and submit only such new materials as they choose. RUTGERS UNIVERSITY

IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

### NORTH CAROLINA

#### DUKE UNIVERSITY Department of Mathematics

Applications are invited for a tenure-track position in applied mathematics starting September 1, 1992. Rank and salary are open. Applicants should send a curriculum vitae, a research plan, and should arrange for three letters of recommendation to be sent. Complete applications received by November 15, 1991 will be guaranteed full consideration. Address correspondence to: Applied Mathematics Search Committee, Department of Mathematics, Duke University, Durham, NC 27706. Duke University is an Affirmative Action/Equal Opportunity Employer.

### OHIO

#### THE OHIO STATE UNIVERSITY Department of Mathematics

The Department of Mathematics of The Ohio State University hopes to have available several positions, both visiting and permanent, effective Autumn Quarter 1992. Candidates in all areas of applied and pure mathematics, including those with demonstrated interest in pedagogical matters, are invited to apply. Significant mathematical research accomplishments or exceptional promise, and evidence of good teaching ability, will be expected of successful applicants.

Please send credentials and have letters of recommendation sent to Professor Dijen Ray-Chaudhuri, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. Review of résumés will begin immediately.

The Ohio State University is an Equal Opportunity/Affirmative Action employer. Qualified women and minority candidates are encouraged to apply.

#### THE OHIO STATE UNIVERSITY Department of Mathematics Research Instructorships in Mathematics

The Department of Mathematics of The Ohio State University hopes to have available a few research instructor positions for the academic year 1992-93. Candidates should hold a Ph.D. (or equivalent) in mathematics and show strong research promise.

Please send credentials and have letters of recommendation sent to Professor Dijen Ray-Chaudhuri, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. The Ohio State University is an Equal Opportunity/Affirmative Action employer.

#### THE UNIVERSITY OF AKRON Head, Department of Mathematical Sciences

The Department of Mathematical Sciences invites applications and nominations for the position of department head. A Ph.D. in the mathematical sciences (mathematics, applied mathematics, statistics, or computer science) and a strong commitment to teaching and research are required. Some administrative and/or professional experience in a mathematical sciences Ph.D. program is desirable. The Department consists of thirty-seven full-time faculty members and offers B.S. degrees in mathematics, applied mathematics, statistics, and computer science, and M.S. degrees in mathematics, applied mathematics, and statistics. The department has proposed graduate programs for the M.S. in Computer Science and the Ph.D. in Applied Mathematics.

The University of Akron is the third largest state university in Ohio (30,000 day and evening students) and offers a multitude of associate, bachelors, masters, and doctorate degree programs in the physical and social sciences, engineering, and education.

Review of applications will begin November 18, 1991 and continue until the position is filled. Tentative inquiries are desirable and will be treated confidentially. Please send a curriculum vitae and names of at least three references to: Dr. Chand Midha, Chair, Search Committee, Department of Mathematical Sciences, The University of Akron, Akron, OH 44325-4002. The University of Akron is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.

#### THE AIR FORCE FLIGHT DYNAMICS LABORATORY and THE AIR FORCE INSTITUTE OF TECHNOLOGY 1992-1994 Flight Control Distinguished Visiting Professor Program

The Air Force Institute of Technology (AFIT) at Wright-Patterson Air Force Base, Dayton, Ohio announces the opportunity to join the AFIT graduate faculty as a Distinguished Visiting Professor in the Department of Electrical and Computer Engineering in the School of Engineering. **RESPONSIBILITIES:** The responsibilities of the AFIT Distinguished Visiting Professor include providing academic leadership in teaching and research in association with AFIT faculty and students, and initiating and conducting research and consultation with the Flight Dynamics Laboratory, Air Force Wright Research and Development Center. **QUALIFICATIONS:** The person appointed as Distinguished Visiting Professor should be an eminent faculty member at a prestigious university. Selection will be based upon the individual's experience, proposed teaching program, and research areas. Areas of special interest and activity at AFIT are: Flight Control Systems, Control Systems for Reconfigurable Aircraft, Design of Robust Multivariate Control Systems, Quantitative Feedback Theory Design, Output Digital Feedback Design Technique for Multivariable Tracking Systems,  $H_\infty$  Control Theory, and Adaptive Control and

Estimation. Applicants are expected to have a Ph.D and be a professional contributor in the area of flight control. Consideration will be given to applicants who have extensive flight control experience within industry and government. RESEARCH SUPPORT: Two powerful hybrid computers (EAI SIMSTARS) are the heart of AFIT's flight control laboratory. A high fidelity, full flight envelope, real-time aircraft simulator is developed for academic and research use. Overall, AFIT's computer resources equal or exceed those found at other universities. An office, laboratory, the use of modern computers, and other service support will be provided for the visiting professor and may include support for a limited number of the visiting professor's doctoral students. PERIOD OF APPOINTMENT AND SALARY: The initial period of appointment is for one full year. A shorter period and the starting date are negotiable, but should be prior to October 1, 1992. Extension for a second year may be possible. Salary is commensurate with qualifications. A per diem allowance is also paid. APPLICATION: A resume of qualifications and experience, including a list of significant publications and any need for support of Ph.D. students can be submitted anytime prior to December 31, 1991 to: DR. CHARLES J. BRIDGMAN, Associate Dean for Research, School of Engineering (AFIT/ENR), Air Force Institute of Technology, Wright-Patterson AFB, OH 45433-6583, Phone: 513-255-3633. The Flight Control Distinguished Visiting Professor Program is made possible through a grant from the Air Force Wright Research and Development Center's Flight Dynamics Laboratory. AFIT is an Equal Opportunity and Affirmative Action Employer.

**PENNSYLVANIA**

**CARNEGIE MELLON UNIVERSITY  
Department of Mathematics**

The Department expects to make four to five Post-doctoral appointments for 1992-1993 in the area of applied analysis. This is a one-year (twelve month) joint appointment by the Department and the Center for Nonlinear Analysis. Recipients will teach at most one course per semester. Applicants should send a vita, list of publications, a statement describing current and planned research, a statement of teaching experience, and arrange to have at least three letters of recommendation sent to the committee. All communications should be addressed to: Post-doctoral Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

**CARNEGIE MELLON UNIVERSITY  
Department of Mathematics**

The Department expects to make two tenure-track appointments, to begin in the Fall of 1992, at the Assistant Professor level. We seek candidates in areas of research which strongly intersect those of the current faculty of the

Department. Applicants should send a vita, list of publications, a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to the committee. All communications should be addressed to: Tenure-track Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

**CARNEGIE MELLON UNIVERSITY  
Department of Mathematics**

The Department invites applications for a senior level appointment in Computational Mathematics/Numerical Analysis. We are particularly interested in candidates who will enhance existing computational and analytical programs which involve continuum models in fluid dynamics, mechanics of solids including microstructure, phase transitions as well as other aspects of materials science. Applicants should send a vita, list of publications, a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to: Chairman, Computational Mathematics Search Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

**COMMUNITY COLLEGE OF PHILADELPHIA  
Department of Mathematics**

Mathematics Dept. invites applications for a tenure-track Asst. Professorship position beginning Fall 1992. The Dept. is actively engaged in course development. It has recently received grants from NSF and CASET. Teaching load is 12 credit hours per semester. Candidates must have a Ph.D. or Master's +3 years teaching in Mathematics, and a commitment to quality teaching, both remedial and college level. Demonstrated strength in course development is essential. Candidates should provide clear evidence of strong background in Mathematics, together with ability to bring to the first 2 years, mathematical topics usually delayed until later. Outstanding benefits. Send curriculum vitae with 3 letters of recommendation by January 31, 1992 to: Head, Dept. of Mathematics, COMMUNITY COLLEGE OF PHILADELPHIA, 1700 Spring Garden St., Phila., PA 19130. AA/EOE.

**GETTYSBURG COLLEGE  
Department of Mathematics  
and Computer Science**

The Department of Mathematics and Computer Science invites nominations and applications for the position of Chairperson of Mathematics. This is a tenure-track faculty appointment; the term as Chairperson is a five-year renewable appointment.

The Department seeks a dynamic individual who has demonstrated considerable contributions to the field of mathematics in both instruction and research, who is an experi-

enced teacher and leader, and who has proven administrative skills in higher education.

More specifically, the Chairperson will be responsible for continuing to develop an innovative program of mathematics instruction; provide leadership for a staff of six mathematicians and two computer scientists; and design the annual departmental budget.

Gettysburg College is a highly selective liberal arts college located within an hour and a half of the Washington/Baltimore area; it is an Equal Opportunity, Affirmative Action employer. Women and minorities are encouraged to apply. Consideration for this position will begin on October 15, 1991 and continue until the position is filled. Please send nominations or letters of application along with current vita and names, addresses and telephone numbers of three references to: Chair, Search Committee, Department of Mathematics and Computer Science, Gettysburg College, Gettysburg, PA 17325.

**LEHIGH UNIVERSITY**

The Department of Mathematics at Lehigh University invites applications and nominations for two tenure-track positions beginning with the Fall Semester 1992. Both positions are at the level of Assistant Professor. Preference will be given to researchers in the continuum from algebraic topology through differential geometry to global analysis and in algebra, specifically in an area overlapping combinatorics, discrete mathematics, and computational algebra.

Candidates for the positions must have an earned doctorate in mathematics and an excellent record in teaching and research. Applicants should send a curriculum vita, reprints of published papers (or accepted for publication), and at least three letters of recommendation to Search Committee, Department of Mathematics (Bldg 14), Lehigh University, Bethlehem, PA 18015. Applications from minorities and women are strongly encouraged. The selection process will begin in January 1992, and continue until the positions are filled.

Lehigh University is an equal opportunity and affirmative action employer.

**UNIVERSITY OF PITTSBURGH  
Department of Mathematics and Statistics**

The department invites applications for the following positions, which will be available for September 1992 if funding permits.

1. Assistant Professor in pure mathematics. We have a significant interest in someone in algebra, topology, or geometry.
2. Visiting Assistant Professor in mathematical biology. Here we have a preference for an individual with a strong computational aspect to their research. There is a possibility that the person appointed to this position will be considered for a tenure-track position for the following year.

Requirements include outstanding research accomplishment and potential commensurate

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with experience, and ability and interest in excellent teaching.

Applicants should send resume and arrange to have at least three letters of recommendation sent to: S. Hastings, Chairman, Department of Mathematics and Statistics, University of Pittsburgh, Pittsburgh, PA 15260.

The University of Pittsburgh is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

### VIRGINIA

#### MARY WASHINGTON COLLEGE Department of Mathematics

Applications are invited for at most two tenure-track Assistant Professor positions effective 8/15/92. Candidates should have a Ph.D. in Mathematics and be committed to teaching. Those who also desire to continue their research (in any area) or to make significant service contributions (to the Department and College) are particularly encouraged to apply. The Department has ten full-time faculty. The usual teaching load is four courses per semester with  $\approx 25$  students per lower-level course and  $\approx 14$  students per upper-level. Mary Washington College is a small ( $\approx 3500$ ) undergraduate liberal arts college, and the Department has 70+ majors. Areas of faculty (research) activity include semigroups, graph theory, topology, number theory, and differential geometry. Send vita to:

Marie Sheckels  
Department Search Committee  
Dept. of Mathematics  
Mary Washington College  
Fredericksburg, VA 22401

The review of applicants will begin in November 1991, and will continue until the positions are filled. Mary Washington College is an Equal Opportunity/Affirmative Action Employer.

#### VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY Department of Mathematics

The Department of Mathematics is actively seeking applications for a tenure-track position in the area of discrete mathematics, combinatorics, and graph theory beginning with the 1992-93 academic year. Candidates with an interest in computing are especially encouraged to apply. A Ph.D. and strong research potential are required. Preference will be given to candidates with postdoctoral experience. Applications will be accepted until March 15, 1992 or until the position is filled. Applicants should send a curriculum vitae and arrange to have three letters of reference submitted to Chair, Discrete Math Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Women and minorities are encouraged to apply. Virginia Tech is an Equal Opportunity/Affirmative Action Employer.

#### VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY Department of Mathematics

Applications are invited for a tenure-track appointment at the level of Assistant Professor in the general area of Dynamical Systems beginning with the 1992-93 academic year. A Ph.D. and strong research potential are required. A likelihood of productive interaction with current senior faculty members, such as the group in partial differential equations and continuum mechanics, would be helpful. Since the position involves teaching duties of approximately six hours per week, there should be strong indications that the candidate is or will become an effective teacher. Applicants should send a vita and arrange to have three letters of reference submitted to Kenneth B. Hannsgen, Chair, Dynamical Systems Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Applications will be accepted for as long as a position remains available but no later than May 1, 1992.

Virginia Tech is an Equal Opportunity, Affirmative Action Employer. In keeping with Virginia Tech's commitment to providing equal opportunity for all, women, minorities, and the disabled are especially encouraged to apply.

#### VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY Department of Mathematics

The Department of Mathematics at Virginia Tech is seeking qualified applicants for a tenure-track position at the rank of Assistant Professor in the area of Computational Mathematics/Numerical Analysis. The position should be available beginning with the 1992-1993 academic year. A Ph.D. and strong research potential are required.

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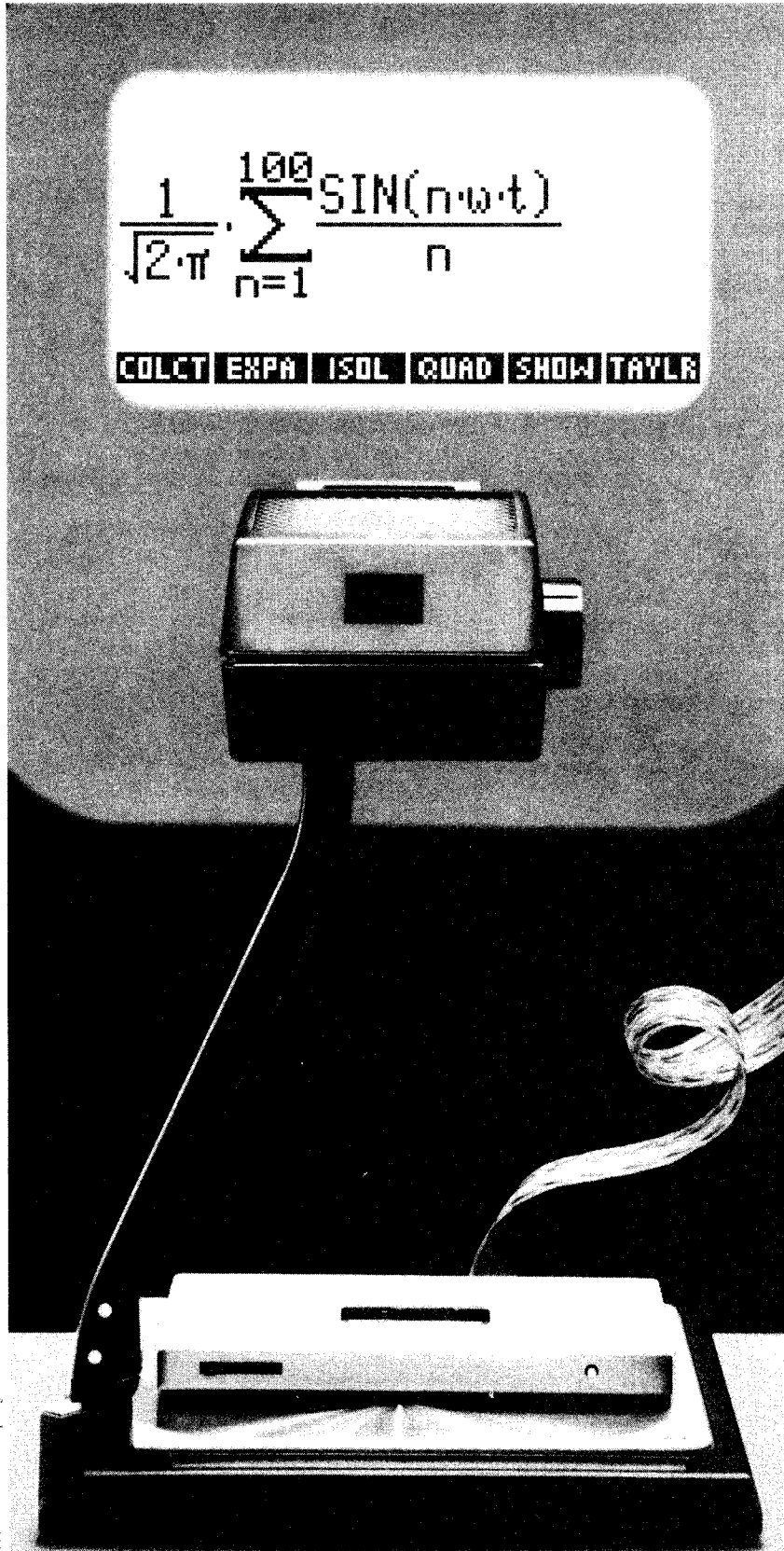
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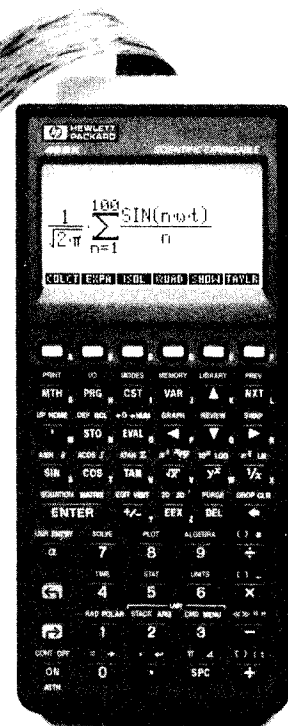
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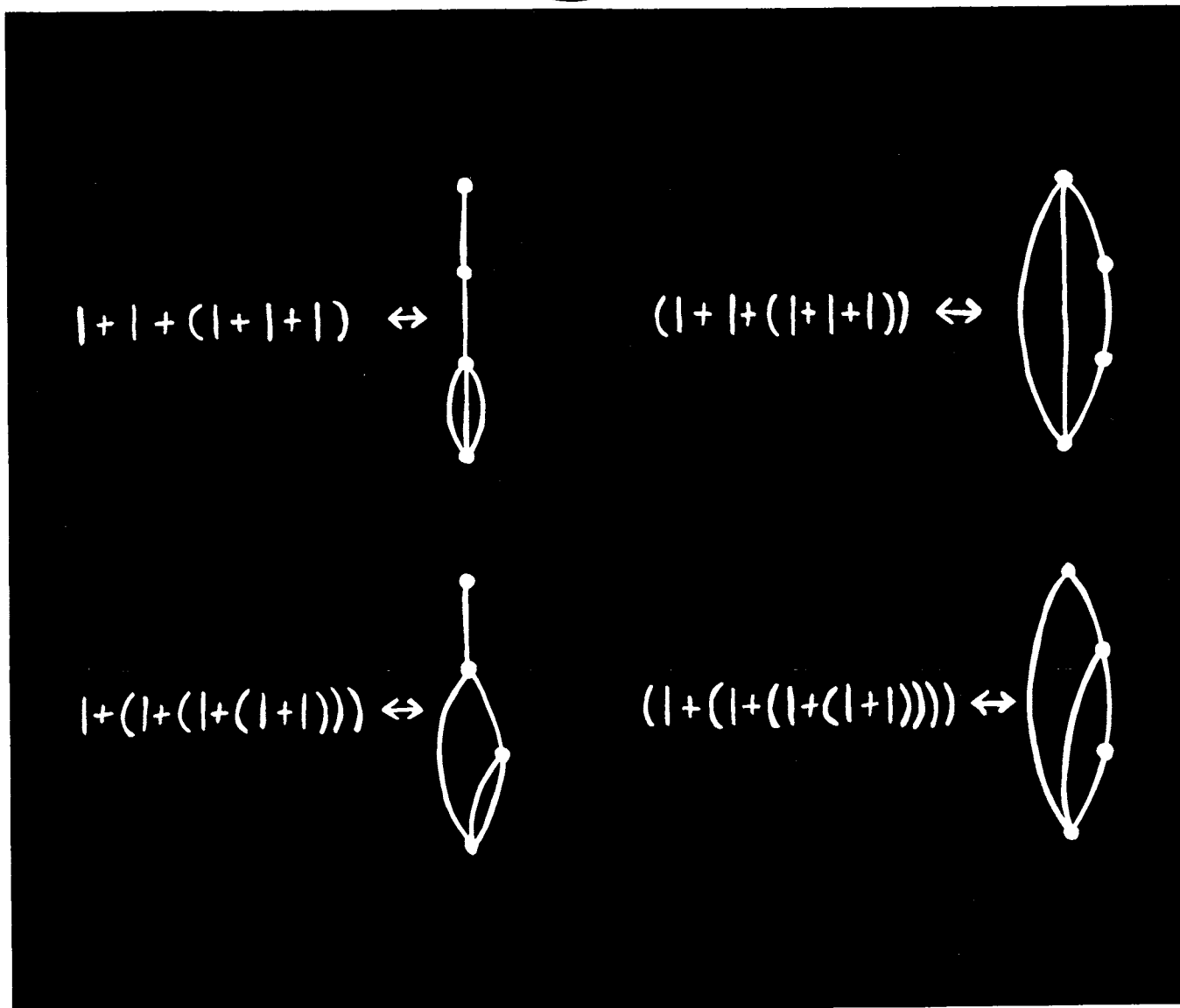
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1. Description (maximum two pages) of research background and plans for participating in one of the AHPARC focus areas. (A description of project opportunities in these focus areas is available from the AHPARC; please refer to "Research Opportunities for AHPARC Postdoctoral Fellows.")
2. Curriculum vitae including a list of publications.
3. Three letters of recommendations, to be sent directly to the AHPARC.

**All correspondence should be directed to:**

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The Department will place major emphasis on applications with an appropriate component of pure mathematics to preserve the integrity of the discipline. Research areas will be highly interdisciplinary and will include scientific computation, statistics, fluid and solid mechanics, mathematical physics, analysis, algebra, geometry, etc.

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# CRYPTOLOGY AND COMPUTATIONAL NUMBER THEORY

**Carl Pomerance, Editor**

**Proceedings of Symposia in Applied Mathematics, Volume 42**



In the past dozen or so years, cryptology and computational number theory have become increasingly intertwined. Because the primary cryptologic application of number theory is the apparent intractability of certain computations, these two fields could part in the future and again go their separate ways. But for now, their union is continuing to bring ferment and rapid change in both subjects.

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Astérisque, Number 187-188

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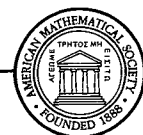
W. Parry and M. Pollicott

This book studies a variety of problems concerned with the distribution of closed orbits of hyperbolic flows. In addition to presenting basic material from the theory of shifts of finite type and their suspensions, the authors exploit the modeling role of these systems for hyperbolic flows. Spectral properties of the Ruelle operator are analyzed and used to establish analytic properties of a dynamical zeta function, which incorporates information about closed orbits. The authors then use classical techniques from number theory to establish their main theorems. The general theory is applied, in particular, to geodesic flows on surfaces of variable negative curvature.

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## CONTINUUM THEORY AND DYNAMICAL SYSTEMS

Contemporary Mathematics, Volume 117  
Morton Brown, Editor

This volume contains the proceedings of the AMS-IMS-SIAM Joint Summer Research Conference on Relationships between Continuum Theory and the Theory of Dynamical Systems, held at Humboldt State University in Arcata, California in June 1989. The conference reflected recent interactions between dynamical systems and continuum theory. Illustrating the increasing confluence of these two areas, this volume contains introductory papers accessible to mathematicians and graduate students in any area of mathematics, as well as papers aimed more at specialists. Most of the papers are concerned with the dynamics of surface homeomorphisms or of continua that occur as attractors for surface homeomorphisms.

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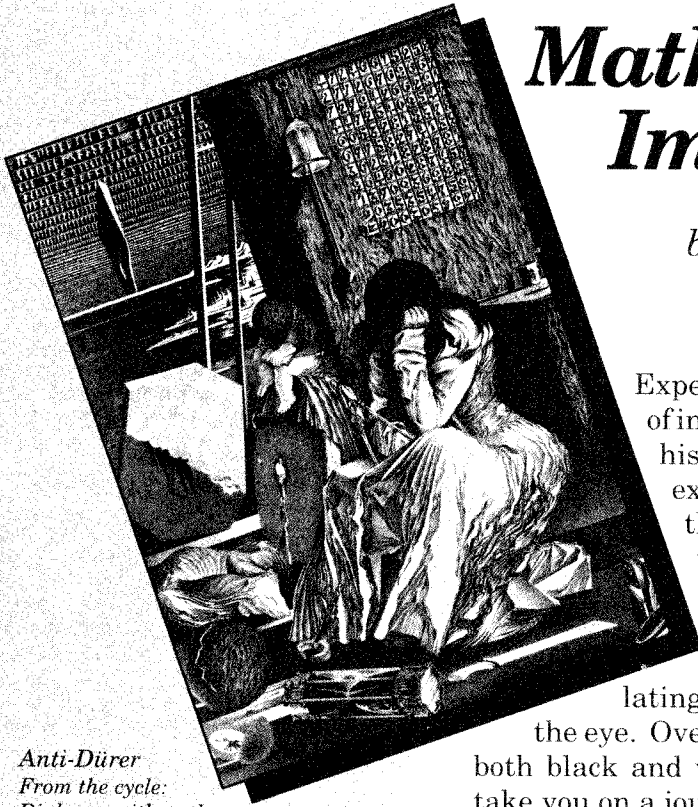
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## Change of Address

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Journal mailing lists must be printed four to six weeks before the issue date. Therefore, in order to avoid disruption of service, members are requested to provide the required notice well in advance.

Besides mailing addresses for members, the Society's records contain information about members' positions and their employers (for publication in the *Combined Membership List*). In addition, the AMS maintains records

of members' honors, awards, and information on Society service. Information of the latter kind appears regularly in *Notices*.

When changing their addresses, members are urged to cooperate by supplying the information requested below. The Society's records are of value only to the extent that they are current and accurate.

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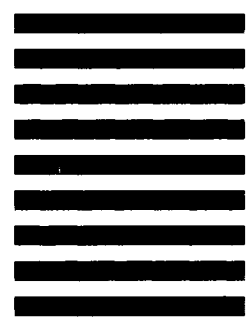


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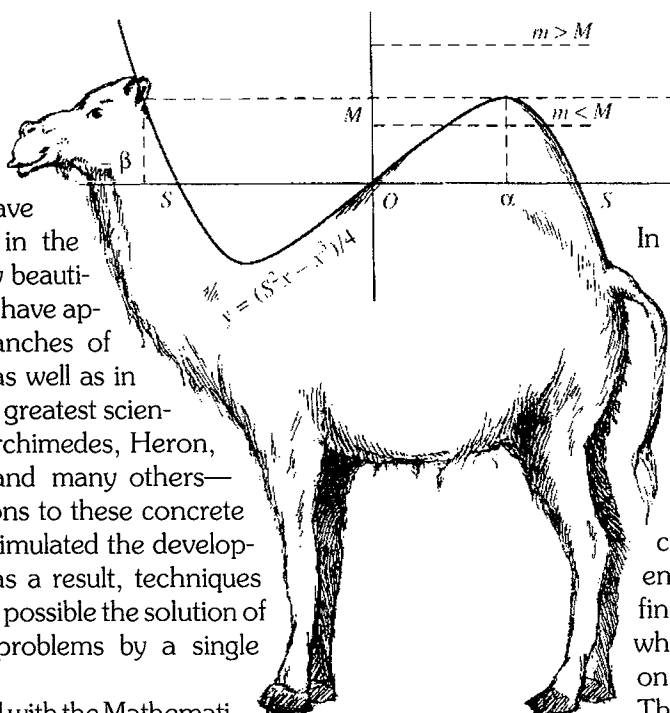
### Volume 1

## Stories about Maxima and Minima

V. M. Tikhomirov  
translated by Abe Shenitzer

Throughout the history of mathematics, maximum and minimum problems have played an important role in the evolution of the field. Many beautiful and important problems have appeared in a variety of branches of mathematics and physics, as well as in other fields of science. The greatest scientists of the past—Euclid, Archimedes, Heron, the Bernoullis, Newton, and many others—took part in seeking solutions to these concrete problems. The solutions stimulated the development of the theory, and, as a result, techniques were elaborated that made possible the solution of a tremendous variety of problems by a single method.

This book, copublished with the Mathematical Association of America (MAA), presents fifteen “stories” designed to acquaint readers with the central concepts of the theory of maxima and minima, as well as with its illustrious history. Unlike most AMS publications, the book is acces-



sible to high school students and would likely be of interest to a wide variety of readers.

In Part One, the author familiarizes readers with many concrete problems that lead to discussion of the work of some of the greatest mathematicians of all time. Part Two introduces a method for solving maximum and minimum problems that originated with Lagrange. While the content of this method has varied constantly, its basic conception has endured for over two centuries. The final story is addressed primarily to those who teach mathematics, for it impinges on the question of how and why to teach. Throughout the book, the author strives

to show how the analysis of diverse facts gives rise to a general idea, how this idea is transformed, how it is enriched by new content, and how it remains the same in spite of these changes.

1980 *Mathematics Subject Classifications*: 00, 01, 46, 49  
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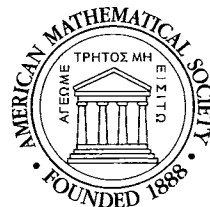
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# Mathematical Sciences Professional Directory

The Mathematical Sciences Professional Directory is a handy reference to a wide variety of organizations of interest to the mathematical sciences community. Updated annually, the Directory lists the officers and committee members of over thirty organizations. In addition to AMS, MAA, and SIAM, there are also listings for such organizations as the American Statistical Association, the Institute of Mathematical Statistics, the Association for Computing Machinery, the National Council of Teachers of Mathematics, the National Academy of Sciences, and the American Association for the Advancement of Science. Addresses and telephone numbers are provided, and, in many cases, the names of key staff are given. The Directory also lists names, addresses, and telephone numbers of mathematical sciences personnel of federal funding agencies. Rounding out the Directory are listings for departments of mathematical sciences in colleges and universities across the U.S. and Canada (including the names of department chairs), listings for mathematical units of nonacademic organizations, and an alphabetical listing of colleges and universities.

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# NEW SERIES



This new book series, to be published jointly with the Association for Computing Machinery, will contain proceedings of conferences and workshops held at the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS). DIMACS is located at Rutgers University and sponsored by Princeton University, Bell Laboratories, and Bell Communications Research. The topics to be covered in this series span a range of research areas, including discrete and computational geometry, discrete optimization, computational complexity, data structures and algorithms, graph theory, computational number theory and cryptology, finite groups and permutation groups, recursive function theory and mathematical logic, and boolean functions. This series will provide access to the newest developments in these exciting and useful areas of research.

## Proceedings of DIMACS Workshops

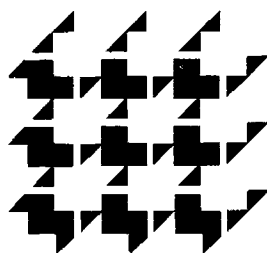
### Polyhedral Combinatorics

William Cook,  
and Paul D. Seymour, Editors  
**Volume 1**

This book, the first volume in the new DIMACS book series, contains the proceedings of the first DIMACS workshop. The workshop, which was held in June 1989 in Morristown, New Jersey, focused on polyhedral combinatorics. Two series of lectures were presented by L. Lovász and A. Schrijver and there were a number of shorter lectures. The topics covered included multicommodity flows, graph matchings and colorings, the traveling salesman problem, integer programming, and complexity theory. Aimed at researchers in combinatorics and combinatorial optimization, this book will provide readers with an overview of recent advances in combinatorial optimization.

1980 *Mathematics Subject Classifications*: 05, 90  
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### Distributed Computing and Cryptography

Joan Feigenbaum  
and Michael Merritt, Editors  
**Volume 2**

This book, the second volume in the new DIMACS book series, contains the proceedings of a workshop held in Princeton, New Jersey in October 1989. The workshop, which drew seventy-four participants from five countries, addressed a wide range of practical and theoretical questions arising in the overlap of distributed computation and cryptography. In addition to fifteen papers based on formal talks presented at the workshop, this volume also contains two contributed papers on related topics, and an extensive summary of informal discussions that took place during the workshop, including some open questions raised.

The book requires basic background in computer science and either a familiarity with the notation and terminology of distributed computing and cryptography, or a willingness to do some background reading. Students, researchers, and engineers interested in the theoretical and practical aspects of distributed computing and cryptography will appreciate the overview the book provides of some of the major questions at the forefront of research in these areas.

1980 *Mathematics Subject Classifications*: 68, 94; 03  
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# Operations Analysis in the United States Army Eighth Air Force in World War II

Charles W. McArthur

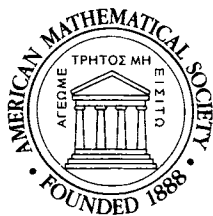
Operations research grew out of the application of the scientific method to certain problems of war during World War II. This book tells the story of how operations research became an important activity in the Eighth Air Force.

A small group of civilians, which began with four scientists and two lawyers, comprised the Operations Research Section, an advisory body attached to the Headquarters of the Eighth Bomber Command. During the course of the war in Europe, over forty operations analysts worked with the Eighth Air Force. By the end of 1943, the section had established itself as the authority on measurement and analysis of bombing accuracy, loss and battle damage, aerial gunnery, and general mission analysis, such as fuel consumption. In their dealings with visual bombing, radar, radio countermeasures, V-weapons, and flak analysis, these experts discovered that the air force could do a much better job with fewer bombs by using bombs of the correct size with the correct fuse settings. In addition, the section advised the commanding generals on major aspects of the strategic bombing campaign in Europe, including bombardment of German lines and support of Allied ground troops in the Normandy invasion, the isolation of Normandy by aerial destruction, and the demolition of the German synthetic oil industry.

The author emphasizes the people involved in these historical events, rather than the technical matters with which they dealt. Focusing on a time of great importance in the history of this century, the book reveals the vital role this group of civilian scientists played in the defeat of Germany.

1980 *Mathematics Subject Classifications*: 01A60  
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351 pages (hardcover), November 1990  
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## HISTORY OF MATHEMATICS Volume 4

AMERICAN MATHEMATICAL SOCIETY • LONDON MATHEMATICAL SOCIETY

# MAA Minicourse Preregistration Form, Baltimore, Maryland

January 8-11, 1992

**NOTE: This is NOT an AMS Short Course Form. Please use the Joint Meetings Preregistration/Housing Form to preregister for the AMS Short Course.**

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

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

---

(Please print) Surname \_\_\_\_\_ First \_\_\_\_\_ Middle \_\_\_\_\_ Telephone: \_\_\_\_\_

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Street address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

- Deadline for MAA Minicourse preregistration: November 18, 1991 (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: December 30, 1991
- 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 Linda Heineman 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 #\_\_\_\_\_

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4. Environmental Modeling	Robert McKelvey	\$36
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I plan on preregistering for the Baltimore, Maryland 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 Baltimore meetings preregistration fee will be made.

I would like to preregister for the free Student Workshop organized by the MAA Committee on Student Chapters and the Ad hoc Committee on Mathematics and the Environment.

# REARRANGEMENTS OF SERIES IN BANACH SPACES

V.M. Kadets and M.I. Kadets  
Translations of Mathematical Monographs,  
Volume 86

In a contemporary course in mathematical analysis, the concept of series arises as a natural generalization of the concept of a sum over finitely many elements, and the simplest properties of finite sums carry over to infinite series. Standing as an exception among these properties is the commutative law, for the sum of a series can change as a result of a rearrangement of its terms. This raises two central questions: for which series is the commutative law valid, and just how can a series change upon rearrangement of its terms? Both questions have been answered for all finite-dimensional spaces, but the study of rearrangements of a series in an infinite-dimensional space continues to this day.

In recent years, a close connection has been discovered between the theory of series and the so-called finite properties of Banach spaces, making it possible to create a unified theory from the numerous separate results. This book is the first attempt at such a unified exposition.

This book would be an ideal textbook for advanced courses, for it requires background only at the level of standard courses in mathematical analysis and linear algebra and some familiarity with elementary concepts and results in the theory of Banach spaces. The authors present the more advanced results with full proofs, and they have included a large number of exercises of varying difficulty. A separate section in the last chapter is devoted to a detailed survey of open questions. The book should prove useful and interesting both to beginning mathematicians and to specialists in functional analysis.

1980 *Mathematics Subject Classifications*: 46  
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**The form.** Applicants' forms submitted for the Employment Register by the November 18 deadline will be photographically reproduced in the December 1991 issue of *Employment Information in the Mathematical Sciences (EIMS)*. Résumés of only those attending will be posted at the meeting.

The forms **must 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. Do not erase—it causes smudges which reproduce when photographed. Use a correcting typewriter or correction tape or fluid if necessary. Submit the original typed version only. Copies will not reproduce properly and are not acceptable. **Hand lettered forms will be returned. Do not type outside the box.**

**Applicants' forms must be received by the Society by November 18, 1991 in order to appear in the special issue of *EIMS* and must be accompanied by the Preregistration/Housing Form printed in this issue, if attending the meeting.**

### (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

MATHEMATICAL SCIENCES EMPLOYMENT REGISTER

APPLICANT FORM

JANUARY 8-10, 1992

BALTIMORE, MARYLAND

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2. This form CANNOT be submitted by electronic mail.
3. Hand lettered forms will be returned. Do not type beyond the box
4. Please check if Preregistration/Housing Form previously sent
5. Return form with payment with your Preregistration/Housing Form by November 18 to AMS, P.O. Box 6887, Providence, RI 02940, to be included in the December issue of EIMS.

**APPLICANT:** Name \_\_\_\_\_

**CODE:** Mailing address (include zip code) \_\_\_\_\_

\_\_\_\_\_

(A) Specialties \_\_\_\_\_

(B) 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 \_\_\_\_\_

\_\_\_\_\_

(C) Degree	Year	Institution	(D) No. of abstracts, internal reports _____
_____	_____	_____	(E) No. of papers accepted _____
_____	_____	_____	(F) No. of books and patents _____

**EMPLOYMENT HISTORY:**

	Present	Previous	Previous
(G) Employer _____	_____	_____	_____
Position _____	_____	_____	_____
(H) Duties _____	_____	_____	_____
Years _____ to _____	_____ to _____	_____ to _____	_____ to _____

**DESIRED POSITION:** \_\_\_\_\_

(I) Duties \_\_\_\_\_

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(K) References (Name and Institution) \_\_\_\_\_

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

**(M) AVAILABLE FOR INTERVIEWS:**

(Interviews for Session 4 scheduled on the basis of employer's request only.)

Session 1 <input type="checkbox"/>	Session 2 <input type="checkbox"/>	Session 3 <input type="checkbox"/>	Session 4 <input type="checkbox"/>
Thurs. AM 9:00-11:15	Thurs. PM 12:45-4:30	Fri. AM 9:00-11:15	Fri. PM 12:45-4:30

I do not plan to attend the Baltimore meetings

This form CANNOT be submitted by electronic mail.

INSTRUCTIONS: Please read carefully before completing form below. Circled letters identify corresponding items in the FORM and the SUMMARY STRIP; abbreviations to be used are provided in the notes below. Please print or type in black ink. Block capitals are suggested. The FORM itself will be placed on display at the Register exactly as submitted. The SUMMARY STRIP (be sure to complete) will be used to prepare a computer printed list of summaries for distribution at the Register. Employers are encouraged to provide more than one interviewer when they are able to do so, in order to increase the number of interviews which may be scheduled. Please take care to indicate on the Form the number of interviewers for whom simultaneous interviews may be scheduled. (If all interviewers will be interviewing for the same position, or for the same set of positions, only one form should be submitted and only one employer code number will be assigned; therefore, each interviewer would then receive a separate computer schedule and separate table number.) More than one employer code will be required if some interviewers will not interview for all positions. Thus, if there are two disjoint sets of positions, two forms are required and two employer codes will be assigned. (Please refer to the section on the Employment Register following the Baltimore meeting announcement.) Return form with your preregistration/Housing form by November 18.

EMPLOYER CODE _____	Institution _____	Dept. _____			
	Name of Interviewer(s) 1. _____	2. _____			
	3. _____	4. _____			
	City, State, Zip _____				
A	Title(s) of Position(s) _____	B	Number of Positions _____		Number of People Supervised _____
C	Starting Date _____ / _____ yr.	D	Term of Appointment _____ yrs.	E	Renewal ( ) Possible ( ) Impossible ( ) No ( )
	Teaching hrs./wk _____	F	Specialties Sought _____		
G	Degree Preferred _____	H	Degree Accepted _____	I	Duties _____ J Experience _____ K Citizenship Restriction _____
L	Available for Interviews _____	Session 1 ( ) _____	Thurs. AM, 9:00-11:15	Session 2 ( ) _____	Fri. AM, 9:00-11:15
M	Number of Interviewers _____	Interviewers _____	Interviewers _____	Interviewers _____	Interviewers _____

Institution	City	State	A	Title of position	B	No.	C	Start
								mo. / yr.
D	E	F	G	H	I	J	K	L
Specialties sought			Duties		Experience			Sessions

NOTES: A Inst. Lect. Asst Prof. Dean, Open. MTS (Member Technical Staff), OPAN (Operations Analyst), PREN (Project Engineer), RESC (Research Scientist); C Date e.g. 01/92; E Possible=P, Impossible=I; F Algebra=AL, Analysis=AN, Biomathematics=BI, Biostatistics=BS, Combinatorics=CB, Communication=CM, Control=CN, Computer Science=CS, Circuits=CT, Differential Equations=DE, Economics=EC, Mathematical Education=ED, Functional Analysis=FA, Financial Mathematics=FI, Fluid Mechanics=FL, Geometry=GE, History of Mathematics=HM, Logic=LO, Mathematical Biology=MB, Mechanics=ME, Modeling=MO, Mathematical Physics=MP, Management Science=MS, Numerical Analysis=NA, Number Theory=NT, Operations Research=OR, Probability=PR, Systems Analysis=SA, Statistics=ST, Topology=TO; G H Bachelor=B, Master=M, Doctor=D; I J Teaching=T, Undergraduates=U, Graduates=G, Research=R, Consulting=C, Administration=A, Supervision=S, Industry=IND, Government=GOV, Data Processing=DP, no experience required=N; K U.S. Citizen or permanent resident=CP, No restriction=NR; L Periods available for interviews: Check 1, 2, 3, and/or 4, see the FORM above. \* Interviews are scheduled in this session on the basis of employers request only.



# Preregistration/Housing Form, Baltimore, Maryland

January 8-11, 1992

Please complete this form and return it with your payment to  
 Mathematics Meetings Service Bureau  
 P.O. Box 6887, Providence, Rhode Island 02940 - Telephone: (401) 455-4143-Telex: 797192

<b>DEADLINES:</b>	Room Lottery Qualification	October 29, 1991
	Joint Meetings & AMS Short Course Preregistration/Employment Register/Hotel Reservations/Tickets	November 18, 1991
	Final Preregistration ONLY (No housing, Employment Register, and/or tickets)	December 10, 1991
	Housing Changes/Cancellations	December 10, 1991
	50% Refund Preregistration/Employment Register/AMS Short Course	January 3, 1992 (no refunds after this date)
	Other Changes to Preregistration	December 30, 1991
	50% Refund on Tickets	December 30, 1991 (no refunds after this date)

### REGISTRATION FEES

#### JOINT MATHEMATICS MEETINGS

Member of AMS, CMS, MAA

Nonmember

\* Student, Unemployed, or Emeritus

#### AMS SHORT COURSE

Member/Nonmember

\* Student, Unemployed, or Emeritus

Preregistration by

December 10, 1991

\$

105

163

25

Preregistration by

November 18, 1991

125

60

30

30

#### EMPLOYMENT REGISTER

- Employer fee (1st Interviewer)

- Employer fee (2nd / 3rd Interviewer)

- Applicant fee

- Posting fee for job descriptions for noninterviewing employers

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

\* See section on "How to Preregister" in the *Notices* or *Focus* for definition of "student", "unemployed", or "emeritus" status.

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

Joint Meetings  AMS Short Course (January 6-7, 1992)  Employer  Co-Interviewer  Applicant  Posting

1) \_\_\_\_\_ Telephone: \_\_\_\_\_  
 (Please print) Surname First Middle

2) \_\_\_\_\_  
 (Mailing address) (E-mail address)

**I do not wish my badge, program, and/or Employment Register material to be mailed; however, the mailing address for my acknowledgement is given above.**

3) Badge information: Affiliation \_\_\_\_\_

4) I am a student at \_\_\_\_\_ 5) Emeritus member  Unemployed  MR Classification # \_\_\_\_\_

6) Member of AMS  CMS  MAA  Nonmember  Member of other organizations: AWM  NAM

7) Joint Meetings fee \$ \_\_\_\_\_ 8) AMS Short Course fee \$ \_\_\_\_\_ 9) Employer fee(s) \$ \_\_\_\_\_ 10) Co-Interviewer fee(s) \$ \_\_\_\_\_

11) Applicant fee \$ \_\_\_\_\_ 12) Posting fee \$ \_\_\_\_\_ 13) Hotel deposit \$ \_\_\_\_\_ (necessary ONLY if paying deposit by check)

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18) TOTAL AMOUNT ENCLOSED FOR 7 through 17 \$ \_\_\_\_\_ NOTE: May be paid by check payable to AMS (Canadian checks must be marked "U.S. Funds") or VISA or MasterCard credit cards.

original institutional purchase order attached

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 appropriate sections on the reverse.**

For office use only:

Codes:	Options:	Hotel:	Room type:
_____	_____	_____	_____
Dates:	Hotel Deposit	Total Amt. Paid:	
_____	_____	_____	
Special Remarks:			
_____			

# MATHEMATICS

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