NOTICES OF THE 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 organizers of special sessions.

Meetings

Meeting #		Date	Place	Abstract Deadline	Program Issue
864	††	March 15–16, 1991	South Bend, Indiana	Expired	March
865	*	March 22–23,1991	Tampa, Florida	Expired	March
866	*	June 13–15, 1991	Portland, Oregon	March 26	May/June
867	*	August 8–10, 1991 (94th Summer Meeting)	Orono, Maine	May 22†	July/August
868	*	October 12–13, 1991	Philadelphia, Pennsylvania	August 1	October
869	*	October 25–26, 1991	Fargo, North Dakota	August 1	October
870	*	November 9–11, 1991	Santa Barbara, California	August 1	October
871	*	January 8–11, 1992 (98th Annual Meeting)	Baltimore, Maryland	October 2	December
872		March 13–14, 1992	Tuscaloosa, Alabama		
873	††	March 20–21, 1992	Springfield, Missouri		
874		April 11–12, 1992	Bethlehem, Pennsylvania		
		June 29–July 1, 1992 (Joint Meeting with the London Mathematical Society)	Cambridge, England		
		October 30–November 1, 1992	Dayton, Ohio		
		January 13–16, 1993 (99th Annual Meeting)	San Antonio, Texas		
		August 15–19, 1993 (96th Summer Meeting) (Joint Meeting with the Canadian Mathematical Society)	Vancouver, British Columbia		
		January 12–15, 1994 (100th Annual Meeting)	Cincinnati, Ohio		
		January 25–28, 1995 (101st Annual Meeting)	Denver, Colorado		
		January 10–13, 1996 (102nd Annual Meeting)	Orlando, Florida		

* Please refer to page 227 for listing of Special Sessions.
† This deadline is earlier than previously published.
†† These dates are earlier than previously published.

Conferences

June 22–August 2, 1991: Joint Summer Research Conferences in the Mathematical Sciences, University of Washington, Seattle, Washington.

July 7–26, 1991: AMS Summer Research Institute on Algebraic Groups and their Generalizations, Pennsylvania State University, University Park, Pennsylvania.

August, 1991: AMS-SIAM-SMB Symposium on Some Mathematical Questions in Biology, Theoretical approaches for predicting spatial effects in ecological systems, San Antonio Texas.

August 6–7: AMS Short Course on Diverse Applications of Number Theory, University of Maine, Orono, Maine.

Deadlines

	May/June Issue	July/August Issue	September Issue	October Issue
Classified Ads*	April 25, 1991	June 17, 1991	August 1, 1991	August 27, 1991
News Items	April 15, 1991	June 10, 1991	July 17, 1991	August 12, 1991
Meeting Announcements**	April 15, 1991	June 13,1991	July 18, 1991	August 15, 1991

* 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

FEATURE COLUMNS

DEPARTMENTS

NOTICES
OF THE
AMERICAN MATHEMATICAL SOCIETY

SUBSCRIPTION INFORMATION
Subscription prices for Volume 38 (1991) are $121 list; $97 institutional member; $73 individual member. (The subscription price for members is included in the annual dues.) A late charge of 10% of the subscription price will be imposed upon orders received from nonmembers after January 1 of the subscription year. Add for postage: Surface delivery outside the United States and India—$15; to India—$27; expedited delivery to destinations in North America—$28; elsewhere—$67. Subscriptions and orders for AMS publications should be addressed to the American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571. All orders must be prepaid.

ADVERTISING
Notices publishes situations wanted and classified advertising, and display advertising for publishers and academic or scientific organizations.

The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability. ♾ Most of this publication was typeset using the TEX typesetting system.

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From the Executive Director ...

FUTURE DIRECTIONS

The January 1991 *Notices* carried an article in the section "Inside the AMS" announcing that the Society is engaged in strategic planning. Strategic (or long range) planning entails both a process and a product. The product is a document, the strategic plan, which usually sets forth specific goals and sometimes includes strategies and timelines for achieving the goals. The process varies, and as might be expected, determines both the quality of the product and its acceptance. Strategic planning is a regular undertaking in business and is, as well, quite common in not-for-profits. The strategic plan itself is a template for action. It is not "written in concrete," but lends itself to constant revision, often with changes in strategies, as well as in the goals themselves. For the AMS, engaging in strategic planning is both a timely and historic undertaking.

Many new forces are profoundly affecting the mathematics community, leaving it in a state of flux and with a need for examination and action. These forces have been created by national demographic changes, world economics and politics, computers, and applications of mathematics. These forces are calling for a change in the way mathematics is practiced, is taught, is learned, is communicated. In this environment, the Society is being called upon to take action on numerous issues. The issues range from reform in mathematics education to support for research, from increasing the involvement of women and minorities in the profession to human rights of mathematicians, from deterioration of the mathematical infrastructure in this country to the needs of mathematicians in currency poor countries, from improving the traditional methods of communicating mathematics to introducing new methods of communicating mathematics. Without some understanding of forces affecting mathematics and the needs of the community, and without well conceived, clearly stated, and accepted goals, the decision-making process and effectiveness of the Society is slowed or even stalled.

Strategic planning is a historic event for the AMS in two senses. First, it appears that the Society has not undertaken a review of its mission since its founding nor has it engaged in a formal long range plan. Second, the process involves a detailed audit of the Society's mission, its programs and services, its structure, its environment and its constituencies. The audit will explore the Society's values, its mandates and its aspirations, and will result in a set of goals eventually leading to strategies and action plans to achieve these goals. The leadership, the staff, and the membership of the Society, as well as others, will need to closely review the Society and to develop a clear and dynamic conception of its mission and a general acceptance of goals that are fundamental and sustaining. Hence, the process itself should lead to a more dynamic Society that continues to audit its mission, its goals, and its actions.

The Executive Committee of the Council and the Board of Trustees appointed a Strategic Planning Task Force to undertake this activity and to present a strategic plan by May 1991. The process will be open, involving the leadership, staff, and membership of the Society, along with representatives from the various constituencies of the Society. Reports will appear in *Notices* and at meetings. This column will also be used to communicate with the readers of *Notices*.

William Jaco

Letters to the Editor

Mathematics Job Market

When I received my Ph.D. in 1962, my thesis advisor (S. S. Cairns) told me that it was common courtesy to remove one's name from consideration for employment once a situation had been accepted. I have over the years served on many hiring committees and have noted that this courtesy is far from common anymore.

Allyn Jackson's article on the Mathematics Job Market (*Notices*, December 1990, pages 1349–1352) points out that many small departments are administratively overburdened by the unaccustomed large numbers of applications received. I am certain that many hundreds of hours of administrative time now spent in scrutinizing job applications which should have been withdrawn could be put to use more profitably if thesis advisors would also advise successful job hunters to be more considerate in this matter. With the increasing use of electronic mail, such notification has become much less onerous a task than it was just a few years go.

Daniel A. Moran
Michigan State University
(Received December 24, 1990)

Allyn Jackson's article in the December 1990 *Notices* struck a chord, especially when she told of the ways in which departments are being inundated with applications and of how applicants feel at times that they are being lost in the shuffle. We were part of that experience: for a position starting in the fall of 1987, we had about 180 applications, and we expected perhaps a few more than that for a slot which we had starting in the fall of 1990. Instead, we had around 400, and while it was possible to deal with the paperwork, it was extremely difficult to get a good sense of particular individuals among so many people. This year, for a position which will start in the fall of 1991, we have received nearly 400 applications, and there is at this writing almost a month to go before our closing date.

Given this deluge, how can applicants avoid getting lost in a process where, almost out of self-defense, departments start looking for reasons to exclude, rather than include? I have a few suggestions for jobseekers, which seem largely common sense, but are not always heeded. Readers should be warned that I am writing from a background of nineteen years at a four-year college, nine of them as chairman, and should take the usual precautions in attempting to generalize from what may after all be idiosyncrasies.

1. *Apply early* – if there are many applications, those arriving toward the deadline are going to run into hiring committees which have already seen lots of paper: there is a better chance of getting favorable attention early in the process.

2. *Proofread your letters carefully* – a carelessly written letter is death. Ask a friend to help.

3. *Tailor your letters* – a four-year college probably does not want the kind of detail on your research that a university might want; conversely, the college will probably want proportionately more information on teaching. If a school specifically asks for a statement on a given topic, either research or teaching, give it to them. Try to keep the amount of generalized boilerplate to a minimum; hiring committees can readily detect academic pietism.

4. *Don't send too much paper* – again, tailor what you send to the kind of place you are writing to. To ship everyone your latest several papers kills trees, very possibly to no purpose, and drives up your postage bills. If you decide that to enclose transcripts might help you, you can probably save some money by sending unofficial ones at the time of first writing.

I also have two other suggestions, for graduate departments and dissertation advisors. To departments: it might be helpful to your students if you were to run workshops on c.v. writing and application letter writing. To advisors: you are the people who know the candidates best. Please don't do them a disservice by writing a hasty, generic letter of the form "X is one of the N best students I have seen in K years. All the information I have about X's teaching indicates that he/she is distinctly above average in that area." A thoughtful letter from an advisor can definitely be the difference between making the first cut and not being noticed at all.

I hope that the above suggestions will help applicants in making their best case.

David A. Robbins
Trinity College
(Received December 24, 1990)

Mathematical Education

I am writing to disagree with William Thurston (*Notices*, September 1990, pages 844-850) and Marcia Greenwald (*Notices*, December 1990, page 1347) about teaching calculus in high school. They say that analytic geometry is more fun than calculus. I say that we should teach things that are useful to know and skills that are useful to have. It would

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 two to four months between receipt of the letter in Providence and publication of the earliest issue of *Notices* in which it could appear.

Publication decisions are ultimately made by majority vote of the Editorial Committee, with ample provision for prior discussion by committee members, by mail or at meetings. Because of this discussion period, some letters may require as much as seven months before a final decision is made. 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, and will be acknowledged on receipt.

be wrong to say that the fine points of elementary analytic geometry have *no* applications, but calculus is the language of science, technology, and now even economics and finance. The power of calculus can be appreciated by comparing the intricate geometric arguments in Newton's *Principia* to their trivial counterparts, using calculus, that can be found in any freshman physics book. Clearly aesthetics are personal and hard to disagree with, but the power and broad applicability of calculus appeals to me.

Jonathan Goodman
Courant Institute,
New York University
(Received December 24, 1990)

1991 Oswald Veblen Prize in Geometry Awarded in San Francisco

The 1991 Oswald Veblen Prize in Geometry was awarded at the Joint Mathematics Meetings in San Francisco to ANDREW J. CASSON of the University of California at Berkeley and to CLIFFORD H. TAUBES of Harvard University.

Oswald Veblen (1880-1960), who served as President of the Society in 1923 and 1924, was well known for his mathematical work in geometry and topology. In 1961, the Trustees of the Society established a fund in memory of Professor Veblen, contributed originally by former students and colleagues, and later doubled by his widow. Since 1964, the fund has been used for the award of the Oswald Veblen Prize in Geometry. Subsequent awards were made at five-year intervals. A total of ten awards have been made: Christos D. Papakyriakopolous (1964), Raoul H. Bott (1964), Stephen Smale (1966), Morton Brown and Barry Mazur (1966), Robion C. Kirby (1971), Dennis P. Sullivan (1971), William P. Thurston (1976), James Simons (1976), Mikhael Gromov (1981), Shing-Tung Yau (1981), and Michael H. Freedman (1986). At present, the award is supplemented from the Steele Prize Fund, bringing the value of the Veblen Prize to $4000, divided equally between this year's recipients.

The 1991 Veblen Prize was awarded by the AMS Council on the basis of a recommendation by a selection committee consisting of Edgar H. Brown, Jr., Michael H. Freedman (chair), and Mikhael Gromov.

The text that follows contains the committee's citation for each award, the recipients' responses at the prize session in San Francisco, and a brief biographical sketch of each recipient.

Andrew J. Casson

Citation

For his work on the topology of low dimensional manifolds and specifically for the discovery of an integer valued invariant of homology three spheres whose reduction mod(2) is the invariant of Rohlin. The mod(2) Rohlin invariant was extremely important in high dimensional topology. It is essentially the Kirby-Siebenmann obstruction to triangulating topological manifolds. Casson's integer lifting of this classical invariant has intimate connections with gauge theory, symplectic geometry, and representation varieties and has blossomed into a rich subject. This achievement stands among his many results and joint works in low dimensional topology.

Andrew J. Casson

Response

I am very grateful to the American Mathematical Society and its Veblen Prize Committee for this honor. I also want to thank the many mathematicians who guided me over the years, in particular Terry Wall, who introduced me to topology, and Cameron Gordon, who worked with me on knot cobordism and other questions.

My work in geometric topology has been concerned, directly or indirectly, with the classification problem for manifolds. Of course, spectacular progress has been made on this problem, particularly by previous winners of the Veblen Prize. In the past two decades, interest has centered on the classification of "low dimensional" manifolds, meaning manifolds of dimension three or four. For reasons which

seem at first sight purely technical, but turn out to be fundamental, low dimensional manifolds are radically different from the high dimensional manifold classified by Smale and others in the 1960s. In 1974 I introduced objects that I called "flexible handles" in an attempt to adapt Smale's methods to four-dimensional manifolds. I was fortunate indeed when Michael Freedman, by a superhuman effort, showed in 1981 that they do in fact play an important role in the topological classification of four-dimensional manifolds. Almost simultaneously, remarkable developments in gauge theory showed that the differentiable classification of four-manifolds is very different.

More recently, I have worked mainly on three-dimensional manifolds. Again this turns out to be a new subject, having surprising connections with classical geometry and analysis, especially Kleinian groups. These connections are made explicit in Thurston's famous "Geometrization Conjecture", which also holds out the exciting possibility of a classification of three-dimensional manifolds that could be implemented on a computer. Partly in an attempt to test special cases of Thurston's conjecture, I was led in 1985 to introduce a new invariant for (certain) three-dimensional manifolds. It was a pleasant surprise to me how many mathematicians and physicists have taken an interest in this work.

Geometric topologists are sometimes accused of failing to give rigorous proofs. Certainly, many major advances in geometric topology do not fit the popular notion of mathematics as a subject which proceeds by a sequence of small, logical steps. Rather, they depend on new ideas which are conceived geometrically, and not easily translated into words on a page. The function of the words is to communicate the geometrical pictures, so that the reader or listener can mentally recreate the complete argument. When one considers that most of the objects being studied cannot be pictured in full detail in three-dimensional space, it is remarkable that topologists are in fact able to reach agreement about the correctness of geometric proofs.

Biographical Sketch

Andrew John Casson was born January 22, 1943 in London, England. He received his B.A. degree from University of Cambridge in 1965. He was a research fellow (1967–1971), assistant lecturer, (1971–1976), and lecturer (1976–1981) at Trinity College, Cambridge University. From 1981 to 1986, he was a professor at the University of Texas, Austin before moving to his present position as professor, University of California at Berkeley.

Casson presented an address at the AMS Special Session on low dimensional topology at the Joint Mathematics Meetings in San Francisco (January 1981) and an AMS Invited Address at the Joint Mathematics Meetings in Pittsburgh (August 1981). He also presented invited addresses at the International Congress of Mathematicians in 1978 and in 1986.

Clifford H. Taubes

Citation

For his foundational work in Yang-Mills theory. Taubes, since the time of his Ph.D. thesis and book on vortices and monopoles (coauthored with Arthur Jaffe), has done as much as any individual to forge emerging physical concepts into powerful mathematical tools.

The harnessing of Yang-Mills theory by mathematicians began with Karen Uhlenbeck's work on the singularities of, and curvature estimates for, the solutions of these equations. From this beginning, Taubes laid a geometric and analytical foundation for the study of the Yang-Mills functional. His initial paper—"Self-dual Yang-Mills connections on non-self-dual 4-manifolds" (*J. Diff. Geom.*, **17**, 1982)—contained the technical basis for Simon Donaldson's first celebrated non-existence theorem. Similarly, antecedents of Andreas Floer's remarkable "homology theory" occur in Taubes' use of spectral flow to determine the signs in his paper, "Casson's invariant and gauge theories" (*J. Diff. Geom.*, **31**, 1990).

The understanding that solutions to the Yang-Mills equations could be constructed over metrically arbitrary 4-manifolds is due to Taubes. A fundamental tool in the analysis of Yang-Mills fields on manifolds is "neck-pulling," wherein the underlying manifold degenerates. The behavior of the Yang-Mills field is carefully tracked during the degeneration so that knowledge of the limit yields implications about the original fields. Taubes pioneered this method in his analysis of End periodic 4-manifolds ("Gauge theory on asymptotically periodic 4-manifolds," *J. Diff. Geom.*, **25**, 1987). Among the topological implications was a proof that there are uncountably many smooth structures on R^4.

Taubes' most recent work (unpublished) analyzes the behavior of Yang-Mills connections along ends which have nontrivial first homology. Important topological consequences of such connections have recently been discovered by his students Tom Mrowka and Bob Gompf.

Cliff Taubes laid much of the foundation for a remarkable decade of Yang-Mills theory.

Response

The muses of mathematics have been very good to me; I will try to repay them for their kindness. And, thank you to the American Mathematical Society for bestowing upon me such a great honor.

Biographical Sketch

Clifford Henry Taubes was born on February 21, 1954 in New York City. He received his B.A. from Cornell University (1975) and his M.S. (1978) and Ph.D. (1980) degrees from Harvard University. From 1980 to 1983, he was a junior fellow at Harvard University. After that, he held a position as acting associate professor at the University of California at Berkeley before returning to Harvard as professor of mathematics in 1985. He held a National Science Foundation (NSF) Mathematical Sciences Postdoctoral

Clifford H. Taubes

Fellowship (1984–1987). He is currently a member of the NSF Advisory Committee for the Mathematical Sciences. In 1990, he was elected to the American Academy of Arts and Sciences.

Taubes presented an address at the Special Session on Nonlinear Generalizations of Maxwell's Equations at the AMS Meeting at the University of Massachusetts at Amherst in October 1981; an AMS Invited Address at the Joint Mathematics Meetings in Eugene, Oregon in August 1984; and a 45-minute address at the International Congress of Mathematicians at Berkeley in 1986. He was also an invited speaker at the Symposium on the Mathematical Heritage of Hermann Weyl, held at Duke University in May 1987. His areas of research are differential geometry, nonlinear partial differential equations, and mathematical physics.

New Position

American Mathematical Society

ASSOCIATE EXECUTIVE DIRECTOR FOR PUBLICATION

The American Mathematical Society is seeking applications and nominations of candidates for the new position of Associate Executive Director (AED) for Publication.

The person filling this position will be responsible for planning and directing the preproduction activity associated with the Society's publication of nine primary journals, nine translation journals and approximately seventy-five books annually. The AED for Publication will be the principal individual involved in working with governing bodies and committees of the Society in setting the direction of the Society's primary publication program. In this capacity, the successful candidate will have the opportunity to help develop and then to direct the objectives of the publication program, including acquisition activity for new publications, oversight and maintenance of quality in existing publications and contracting sale-of-service to other publishers.

The AED for Publication will work in the Society's Providence office and oversee the Publication and Translation Departments, as well as work closely with the AED for Production and the Director of Marketing. The AED for Publication will report to the Executive Director of the Society.

The Society is seeking a candidate who is knowledgable of mathematics and has a keen interest in the communication of pure and applied mathematics research, exposition and professional information. Such a candidate should

- have earned a Ph.D. in the mathematical sciences,
- have a good command of the English language and be capable of writing well and easily, and
- have an interest for acquisitions and an ability to work harmoniously with mathematicians.

Experience in publication activity is desirable.

The initial appointment will be for two years and can be continued thereafter on an indefinitely renewable term or continuing basis.

Applications and nominations should be sent to:

Dr. William H. Jaco
Executive Director
American Mathematical Society
P.O. Box 6248
Providence, R.I. 02940

Completed applications and appropriate letters of reference received by **30 April 1991** will be assured of full consideration. It is desirable that duties begin as soon as possible and preferably before 1 July 1991.

The Society is an equal opportunity employer and has a generous fringe benefit program including TIAA/CREF. Salary for the position will be commensurate with the background of the appointee.

1991 Ruth Lyttle Satter Prize in Mathematics Awarded in San Francisco

The 1991 Ruth Lyttle Satter Prize in Mathematics was awarded at the Joint Mathematics Meetings in San Francisco to DUSA MCDUFF of the State University of New York at Stony Brook.

The prize was established in 1990 using funds donated to the AMS by Joan S. Birman of Columbia University in memory of her sister, Ruth Lyttle Satter. This is the first time the prize has been awarded. Professor Satter earned a bachelor's degree in mathematics and then joined the research staff at AT&T Bell Laboratories during World War II. After raising a family, she received a Ph.D. in botany at the age of forty-three from University of Connecticut at Storrs, where she later became a faculty member. Her research on the biological clocks in plants earned her recognition in the U.S. and abroad. Professor Birman requested that the prize be established to honor her sister's commitment to research and to encouraging women in science. The prize is awarded every two years to recognize an outstanding contribution to mathematics research by a woman in the previous five years.

The 1991 Satter Prize was awarded by the AMS Council on the recommendation of a selection committee consisting of Professor Birman, Linda Keen (chair), and Karen K. Uhlenbeck. The prize of $1200 was presented to Professor McDuff during the AMS Prize Session held on January 17, 1991, during the Joint Mathematics Meetings in San Francisco.

The text that follows contains the committee's citation for the award, the recipient's response at the prize session in San Francisco, and a brief biographical sketch of the recipient.

Dusa McDuff

Citation

The Committee for the Satter Prize unanimously recommends that the first Biennial Satter Prize in Mathematics be awarded to Dusa McDuff, for her outstanding work during the past five years on symplectic geometry.

A pervasive theme in that work has been the relationship between symplectic and complex geometry. She constructed the first examples of symplectic structures on a manifold which belonged to the same cohomology class and were homotopic as symplectic structures, but were not isotopic. These examples were sharp, because if the cohomology class had remained fixed during the homotopy, the forms would have to be equivalent. She went on to give other examples which put a limit to the analogy between symplectic manifolds with contact boundaries and complex manifolds with pseudo-convex boundaries. Among her outstanding work during the past two years has been a complete classification of compact symplectic manifolds which contain a symplectically embedded two-sphere with non-negative self-intersection number. Most recently, she established a beautiful and simple criterion for a symplectic four-manifold to be the blow-up of a rational or ruled complex surface and proved a surprising unicity theorem.

Dusa McDuff

Response

I am very honored to be the first recipient of this prize and want to thank Joan Birman on behalf of the whole mathematical community for instituting it. I am particularly happy to get this prize because it is for my research. I grew

up in a house in which creativity was very much valued but, despite the achievements of the women in the family, males were seen to be more truly creative than females and it has taken me a long time to find my own creative voice. My life as a young mathematician was much harder than it needed to be because I was so isolated. I had no role models, and my first attempts at inventing a life style were not very successful. One important way of combating such isolation is to make both the achievements of woman mathematicians and the different ways in which we live more visible. I hope that this will be one of the effects of the Satter Prize. I'll try to do my part by telling you something of my life.

I grew up in Edinburgh, Scotland, though my family was English. My father was a Professor of Genetics who travelled all over the world and wrote books on philosophy and art as well as on developmental biology and the uses of technology. My mother was an architect, who was also very talented, but who had to make do with a civil service job since that was the best position which she could find in Edinburgh. Her having a career was very unusual: none of the other families I knew had mothers with professional jobs of any kind. There were other women on my mother's side of the family who led interesting and productive lives. I identified most with my maternal grandmother since I had her name: Dusa was a nickname given to her by H. G. Wells. She was most notable for creating a great scandal in the London of her time by running away with H. G. (this was before she married my grandfather), but she later wrote books, on Confucianism for example, and was active in left-wing politics. Her mother (my great grandmother) was also distinguished: in 1911 she wrote a book about the working class poor in London which I was pleased to find being used in Stony Brook as a textbook. In discussing the women in my family I should also mention my sister, who was the first Western anthropologist allowed to go on a field trip to Soviet Central Asia, and is now a Fellow of King's College, Cambridge, with a lectureship at the university.

I went to a girls' school and, although it was inferior to the corresponding boys' school, it fortunately had a wonderful maths teacher. I always wanted to be a mathematician (apart from a time when I was eleven when I wanted to be a farmer's wife) and assumed that I would have a career, but I had no idea how to go about it: I didn't realise that the choices which one made about education were important and I had no idea that I might experience real difficulties and conflicts in reconciling the demands of a career with life as a woman.

When, as a teenager, I became more aware of my femininity, I rebelled *into* domesticity. I gladly started cooking for my boy-friend; I stayed in Edinburgh as an undergraduate to be with him instead of taking up my scholarship to Cambridge; and when I married I took his name. (My mother had kept her maiden name for professional purposes.) I did eventually go to Cambridge as a graduate student, this time followed by my husband. There I studied functional analysis with G. A. Reid and managed to solve a well-known problem about von Neumann algebras, constructing infinitely many different II_1 factors. This was published in the *Annals of Mathematics* and for a long time was my best work.

After this, I went to Moscow for six months since my husband had to visit the archives there. In Moscow, I had the great fortune to study with I. M. Gel′fand. This was not planned: it happened that his was the only name which came to mind when I had to fill out a form in the Inotdel office. The first thing that Gel′fand told me was that he was much more interested in the fact that my husband was studying the Russian Symbolist poet Innokenty Annensky than that I had found infinitely many II_1-factors, but then he proceeded to open my eyes to the world of mathematics. It was a wonderful education, in which reading Pushkin's "Mozart and Salieri" played as important a role as learning about Lie groups or reading Cartan and Eilenberg. Gel′fand amazed me by talking of mathematics as though it were poetry. He once said about a long paper bristling with formulas that it contained the vague beginnings of an idea which he could only hint at and which he had never managed to bring out more clearly. I had always thought of mathematics as being much more straightforward: a formula is a formula, and an algebra is an algebra, but Gel′fand found hedgehogs lurking in the rows of his spectral sequences!

When I came back to Cambridge, I went to Frank Adams's topology lectures, read the classics of algebraic topology, and had a baby. At the time, almost all the colleges in Cambridge were for men only, and there was no provision at all for married students. I was very isolated, with no-one to talk to, and found that after so much reading I had no idea how to begin to do research again. After my post-doc, I got a job at York University. I was the family breadwinner and housekeeper and diaper changer (my husband said that diapers were too geometric for him to manage). At about this time I started working with Graeme Segal, and essentially wrote a second Ph.D. with him. As this was nearing completion, I received an invitation to spend a year at M.I.T. to fill a visiting slot which they had reserved for a woman. This was a turning point. While there I realised how far away I was from being the mathematician I felt that I could be, but also realised that I could do something about it. For the first time, I met some other women whom I could relate to and who also were trying to become mathematicians. I became less passive: I applied to the Institute for Advanced Study and got in and even had a mathematical idea again, which grew into a joint paper with Segal on the group-completion theorem. When back home, I separated from my husband and, a little later, obtained a lectureship at Warwick. After two years at Warwick, I took an (untenured) assistant professorship at Stony Brook, so that I could live closer to Jack Milnor in Princeton. I went to Stony Brook sight unseen. I knew no-one there and have always thought myself extremely lucky to have landed in such a fine department, although very foolhardy to have given up a tenured job for an untenured one.

After that, I had to do the work that everyone has to do to become an independent mathematician, building

up on what one knows and following one's ideas. I spent a long time working on the relation between groups of diffeomorphisms and the classifying space for foliations: this grew out of my study of Gel'fand-Fuchs cohomology in Moscow and my work with Segal on classifying spaces of categories. I still worked very much in isolation and there are only a few people who are interested in what I did, but it was a necessary apprenticeship. I had some ideas and gained confidence in my technical abilities. Of course, I was influenced by the clarity of Jack Milnor's ideas and approach to mathematics, and was helped by his encouragement. I kept my job in Stony Brook, even though it meant a long commute to Princeton and a weekend relationship, since it was very important to me not to compromise on my job as my mother had done. After several years, I married Jack and had a second child.

For the past eight years or so, I have worked in symplectic topology. Here again I have been very lucky. Just after I started getting interested in the subject, it was revitalised with new ideas from several sources. Most important to me was Gromov's work on elliptic methods. I took advantage of a sabbatical to spend the spring of 1985 at I.H.E.S. in Paris so that I could learn about Gromov's techniques, and the work I did then has been the foundation of all my recent research. At the time, our child was a few months old. So I worked rather short days, but found it easy to cope since we had enough money to pay for good day care. Eventually he brought the family together. We didn't want to make him commute, and Jack did not like being left with him for the best part of each week. So Jack took a job at Stony Brook, where we are now enjoying life in one house.

In conclusion, I think that there is quite an element of luck in the fact that I have survived as a mathematician. I also got real help from the feminist movement, both emotionally and practically. I think things are somewhat easier now: there is at least a little more institutional support of the needs of women and families, and there are more women in mathematics so that one need not be so isolated. But I don't think that all the problems are solved.

Biographical Sketch

Dusa McDuff (née Margaret Dusa Waddington) was born on October 18, 1945 in London, England. She received her bachelor's degree from the University of Edinburgh in 1967 and her Ph.D. from the University of Cambridge in 1971. During her graduate school years she traveled to Moscow, where she was greatly influenced by I. M. Gel'fand.

After finishing her doctorate, she held a two-year Science Research Council Fellowship at Cambridge. She was then appointed lecturer at the University of York (1973–1976) and then at the University of Warwick (1976–1978). In 1978, she came to the United States to take a position at the State University of New York at Stony Brook, where she is currently professor of mathematics. She has held visiting positions at the Massachusetts Institute of Technology (1974-1975) and at the Institute for Advanced Study (1976-1977).

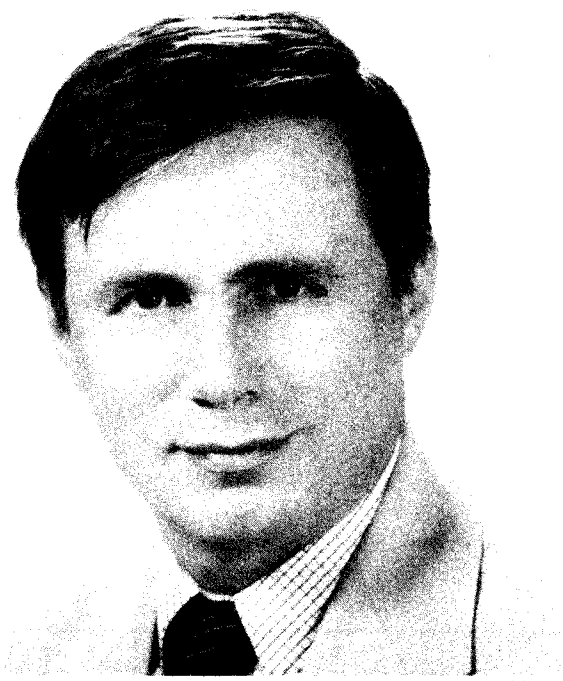
Professor McDuff gave an Invited Address at the International Congress of Mathematicians in Kyoto, 1990, and an Invited Address at the AMS Annual Meeting in Atlanta (1988). During the Joint Mathematics Meetings in Boulder in August 1989, she delivered the first AMS Progress in Mathematics lecture. For a long time McDuff's research centered on the relation between classifying spaces of groups of diffeomorphisms and the theory of foliations, concentrating particularly on the volume-preserving case. Recently, she has worked in global symplectic geometry.

1991 Citation for Public Service Awarded in San Francisco

Proper recognition for individuals who contribute valuable service to the mathematics profession is a matter of great importance to the Society. The continued growth and health of the discipline is greatly dependent on those individuals who contribute their time to public service activities in support of mathematics. To provide encouragement and recognition for such service, the AMS Council, in response to a recommendation of the Society's Committee on Science Policy, established the Citation for Public Service. One to three $500 awards are presented each year to individuals who have made notable contributions to the mathematics profession through public service.

The first such award, the 1991 Citation for Public Service, was presented at the Joint Mathematics Meetings in San Francisco to ANDRE Z. MANITIUS of George Mason University. The Award was made by the AMS Council on the recommendation of a selection committee consisting of Ronald G. Douglas, Robert M. Fossum (chair), John C. Polking, David P. Roselle, and David A. Sanchez.

The text that follows contains the committee's citation for the award, the recipient's response at the prize session in San Francisco, and a brief biographical sketch of the recipient.



Andre Z. Manitius

Andre Z. Manitius

Citation

A Citation for Public Service is presented to Andre Manitius for the contributions he made to the mathematical community while employed in the Division of Mathematical Sciences at the National Science Foundation (NSF).

Manitius spent three years at the Foundation, the first two as a Program Director for Applied Mathematics, and the last year as Deputy Division Director. As a Program Director, he gained the respect of his client mathematicians for the skill and conscientiousness with which he conducted his program. His tenure was marked by continued efforts to build bridges between mathematics and other disciplines within the Foundation. The result was increased support for mathematicians from other programs in the Foundation, but, more importantly, his efforts resulted in greater appreciation of the importance of mathematics throughout the Foundation.

Response

Thank you for this honor. I am delighted that the Society has introduced this Citation, which brings recognition not just to the individual recipient, but to the very activity of serving as a Program Director in one of the mathematical grant programs.

We have in this country one of the most developed research grant systems in the world, which successfully assisted careers of many mathematicians. The functioning of this system owes much to many outstanding individuals who worked or are working within it, and the importance of this human factor cannot be overstated. Perhaps the very existence of this Citation will be an encouragement to highly qualified mathematicians who contemplate working in one of the federal granting agencies, now or in the future.

The current grant system is not fully satisfactory, the main shortcoming being that too many good proposals compete for too few dollars. Attempts to make a dramatic improvement have focused on globally increasing the federal funding of mathematics by invoking the arguments presented in the first and the second David Reports. In spite of great efforts invested, these attempts were only partially successful because of such painful realities as the federal deficit and the strong competition for funds by other sciences. Attaining a major funding increase for mathematics remains a big challenge for the mathematicians working in the federal agencies.

During my three year work at the NSF, the important issues I faced were the expanding scope of interactions between mathematics and other sciences, and the role of mathematics in the new Science and Technology Centers. It gave me a great satisfaction to see that major projects I was involved with while at NSF met with success at the end of my term in 1988. Joint funding of proposals by the Division of Mathematical Sciences and other scientific divisions grew to the point where the net inflow of funds to mathematics from other programs, mainly from engineering and computer science, reached a level of about $1 million per year. A new initiative on developing the interactions between mathematical and biological sciences was formulated and the work on this program is being continued today, with good prospects of developing a substantial funding level. A first joint research program in mathematics and molecular biology was funded at the University of California at Berkeley. A new initiative of cooperation between NSF-funded researchers in mathematics, computer science and engineering and the French institute INRIA was introduced. A panel of experts led by Wendell Fleming, sponsored by NSF and three other agencies, produced a major report on the mathematics of control theory. And in 1988, one of the Science and Technology Centers awards was given to a proposal for a Center in discrete mathematics and computer science. All of these developments were a result of efforts of many people, and some among them may equally deserve the honor of this Citation.

As someone who always did research at the interface of mathematics and engineering, I am deeply honored by a citation by this Society. My wish for the Society is that some time in the future, hopefully quite soon, a similar award be given to someone whose work will have led to further improvement of research funding for U.S. mathematics.

Biographical Sketch

Andre Z. Manitius was born in Warsaw, Poland. He received his Ph.D. from Technical University (Polytechnic) of Warsaw in 1968 for a thesis on optimal control of systems governed by differential-difference equations. He was affiliated with the Institute of Automatics, Technical University of Warsaw from the early 1960s until 1974. In 1972 he came to the U.S. on invitation of the Center for Control Sciences, University of Minnesota, and the Lefschetz Center for Dynamical Systems, Brown University. During that time, his research colleagues included E. Bruce Lee and Lawrence Markus at Minnesota, and H. Tom Banks and Jack Hale at Brown. In 1974, he accepted a research position with the Centre de Recherches Mathématiques at the Université de Montréal, in Montréal, Quebec, Canada, where he collaborated with Michel Delfour of the Centre, Roberto Triggiani (currently at the University of Virginia), and other mathematicians. The product of these collaborations was a sequence of results on some fundamental properties of functional-differential equations that are important in control theory problems. Among these were results on the function-space controllability of retarded functional-differential equations, on structural operators, and on the completeness of eigenfunctions associated with these equations. In 1981, Manitius became Professor of Mathematical Sciences at Rennselaer Polytechnic Institute in Troy, New York. Continuing his previous line of work, he collaborated with Irena Lasiecka (currently at the University of Virginia) on approximation of semigroups, and with Dietmar Salamon and Fritz Colonius (both from Universitat Bremen in Germany) on generalization of structural operators to non-autonomous functional-differential equations.

Manitius took a leave from Rensselaer in 1985 to serve as Program Director for Applied Mathematics at the Division of Mathematical Sciences (DMS), National Science Foundation in Washington, DC. In 1987, he was appointed Deputy Division Director of DMS and also became one of the coordinators in the Science and Technology Centers Program at NSF. Upon completing the three-year NSF assignment in 1988, he left Rensselaer and became Professor of Electrical and Computer Engineering at George Mason University in Fairfax, Virginia. Currently, he is actively involved in the development of a new Ph.D. program in computational sciences and he is a core faculty member of the newly established Institute of Computational Science and Informatics at George Mason.

In 1972, at an early stage of his career, Manitius received an award from the Polish Academy of Sciences for his work on the optimal control of systems with time delays. He also received an NSF "Outstanding Performance Award and Sustained Superior Performance" in 1987. He is a member of the American Mathematical Society, Society of Industrial and Applied Mathematics (SIAM), and Institute of Electrical and Electronic Engineers. He served as chair of the Program Committee for the 1990 Annual meeting of SIAM and he is currently chair of the SIAM Activity Group in Control and Systems Theory.

Computers and Mathematics

Edited by Keith Devlin

Editorial

Why "Computers and Mathematics?"

This column is surely just a passing fad that will die away before long. Not because mathematics will cease to have much connection with computers, but rather, quite the reverse: the use of computers by mathematicians will become so commonplace that no one thinks to mention it any more.

As far as the use of scientific text processors to write papers and books is concerned, that state of affairs is probably here already, or at least very close, with Donald Knuth's TEX clearly the favored tool. As J. I. Hall of Michigan State University reported in this column in January, "virtually all of the larger math departments which responded to the survey have converted their technical typing staff to TEX, in one of its many configurations." And yet it was only four years ago, in 1987, that Richard Palais of Brandeis University organized the series of articles in *Notices*, describing the various mathematical word processing systems available, that for many of us was the first real introduction to the range of products becoming available for the preparation of mathematical documents. And I suspect that for most of us it was only then, if not a bit later, that our departments began to acquire desktop computers in sufficient numbers to make the preparation of technical papers *by the author* a genuine option. Today the question is not whether a manuscript is prepared on a word processor; it is what format is used, plain TEX, LATEX, T^3, *ChiWriter*, *Word*, or whatever.

Likewise, the use of electronic mail by the mathematical community is now widespread and no longer merits much attention. This column operates almost entirely by electronic means. Indeed, my appointment as the new editor to succeed Jon Barwise was made as a result of an electronic ballot of the *Notices* editorial committee and the process of "handing over" was carried out almost entirely by means of electronic exchanges between Barwise in Indiana, the AMS staff in Providence, and myself in Maine.

But when it comes to the use of computers within mathematics itself, be it for teaching or research, we are clearly not yet at the same stage of "acceptance." Of the 177 abstracts of talks published in the program for the recent Joint AMS/MAA Meeting in San Francisco this past January (discounting the 17 contributions to a session on the history of mathematics), fully 48 either directly concerned the use of computers in mathematics or else the author of the abstract felt it important to make explicit reference to computer use. Computer use is still something to be mentioned, a feature in itself. At the AMS meeting in Tampa, Florida this month, there is an entire special session devoted to computers and mathematics, involving such well known mathematicians as Albert Marden, David Hoffman, Thomas Banchoff, and Dana Scott. A number of fairly recent mathematical journals are focused in large part around the use of computers.

What this column does then is reflect a phase in the development of mathematics. The introduction of the computer into the research laboratory and the classroom has changed the subject in ways that I suspect are far more fundamental and wide-reaching than any of us really appreciate. By "us" I probably mean the present generation of mathematics faculty. Our students might have a different view. So, here is my first invitation as new editor. To all graduate students of mathematics, and maybe even some undergraduates as well: how do you regard the issue of computers and mathematics? Do you see it as an "issue" at all, in fact? Write and let me know (preferably by email!) for possible inclusion in a future edition of this column.

The New Math?

When I talk in the above paragraph about fundamental changes in mathematics, I don't just mean the power to crunch more and bigger numbers faster and more accurately, though that is certainly one change the computer has brought to mathematics (and other disciplines). Nor am I thinking solely of the use of computers to handle the large number of cases or huge amounts of data involved in constructing a particular proof, such as happened with the Four Color Theorem. In some sense these developments just push mathematics further along its existing path, they do not lead in a completely different direction.

Intrinsically, computational subjects such as computational number theory or graph theory are, I think, a bit different. Though these fields have their origins in the pre-computer days of Fermat, Euler, Gauss, and the like, their algorithmic nature sets them apart from other branches of mathematics. In primality testing, for instance, proving theorems (by classical means) is still a mainstay of the subject, but the criterion for success has changed. It is not a logically elegant solution that is sought, but a computationally efficient one.

Still further along the radical line are subjects such as dynamical systems and cellular automata that have large graphical and experimental components, subjects that could hardly get off the ground without modern computer technology.

And then there are the mathematical subjects that emerge from computer science, such as complexity theory or the study of nonmonotonic logics.

But even here I don't think you will find the major change the computer will bring to mathematics. My guess is that the next thirty of forty years are going to witness a profound change not only in mathematics but many other disciplines as well because, increasingly, people with quite different skills will take the helm. (Whether these will be more or less the same people that would have formed the core of the profession had the computer revolution not taken place is another question altogether, though a quite fascinating one.)

The first filter through which most of the current senior members of the profession had to pass, those of us over thirty or so, was algorithmic skill at arithmetic and school algebra. Fail at that hurdle and in all likelihood you never got an opportunity to see if you were good at anything else in the mathematical realm. The arrival of the pocket calculator changed that a bit: a good facility with numbers no longer

presented an insurmountable hurdle. And the development of computer algebra systems and "graphing calculators" is in the process of taking this a significant step further by reducing the algorithm-performing requirements still further. Algorithmic skills of the sort vaunted by the hugely controversial Saxon program of school mathematics education (part of the "back-to-basics" movement) may indeed have some value in developing a good citizen for the Twenty-First Century, but an absence of such skills will surely no longer prevent someone from becoming a highly successful mathematician. And of course underlying all these algorithmic skills was the necessity to be able to absorb and transmit information in an essentially linear fashion using the written word.

Imagine then the kind of person coming into our graduate schools, if not today, then certainly tomorrow. Brought up from early childhood on a diet involving MTV, Nintendo, graphical calculators packed with algorithms, Macintosh-style computers, and, in the not-too-distant future, hypermedia educational tools as well. Such a person is going to enter mathematics with an outlook and a range of mental abilities quite different from their instructors—in fact I see no *a priori* reason why they should be the same people who would have become successful mathematicians had they come along a generation earlier.* Such a profound change in outlook and skills, and probably also personnel-type, will surely send mathematics into directions few of us can presently foresee.

Just before Christmas, I was discussing a particular proof with one of the sophomore undergraduates in my course on abstraction and proofs. Much to my surprise, the way the student described the entire proof process, in a quite matter of fact way, was as the unification (or amalgamation) of different pieces of information. (He did not use the word "unification," but he did keep referring to "information" and the merging of different information.) The *linearity* of the proof, which always seemed so important to me when I was a student, hardly came into the picture at all as far as this young mathematician was concerned. "Oh sure you could write it all down linearly, but so what?" seemed to be his attitude. Given that one of the aims (at least my aims) of the course was to develop the skills required to communicate mathematics by the written word, I could have answered the unspoken "so what?" in a way I felt comfortable with, but in the long run I suspect the future is on his side. The conception of a proof as "unification of information" that had come to me as an insight long after I had become "good" at constructing proofs, was the "natural" way to approach the notion for my young student.

Provide such "non-linear" people with the range of non-linear, graphically-interfaced, multimedia-structured mathematical systems available today, plus those that will be developed in the near future, and it seems to me inevitable that mathematics will advance in some quite striking, and in all probability, unforeseen ways.

To reiterate what I said at the start, as I see it, this column is a product not so much of a particular subject but of its time. What justifies a column devoted to computers and mathematics is that these changes are going on right now.

This Column

By and large, the "Computers and Mathematics" column will continue much as it did under Barwise's excellent stewardship, a mixture of editorials (usually not as long as this opening one), feature articles describing recent research work involving (or concerning) computers, and reviews of mathematical software. Book reviews would not normally appear here unless the book concerned was of particular relevance to the topic of this column. Letters from readers in response to items that appear are always welcome, and will be published or excerpted where appropriate. I am currently assembling a small group of editorial advisors to assist with the running of the column. So far Ronald Graham and David Mumford have agreed to serve in this capacity.

Ultimately, the continued success of the column depends upon submissions from the readership of *Notices*. All submissions are referreed, but the process is very rapid, and publication will normally be swift, at the moment within two months of submission. So this is a good format to get information out fairly quickly. As a rough guideline, feature articles may be anything from 1,500 to 5,000 words in length. Submission by electronic mail is best, since both the *Notices* staff in Providence and I work almost exclusively in electronic form. The preferred format is a straight ASCII file, then plain TEX, after that LATEX. If you do not have access to email, the next best thing is a 3.5 inch Macintosh-formatted disk. In addition to the electronic version, please also send a hard copy, along with any diagrams or figures referred to in the text.

After a rapid build-up of software submitted to Barwise for review, the supply has slowed down somewhat of late, so now is an opportune time to send in software packages you would like to see featured in this column.

I have inherited from Barwise a list of people who have volunteered to review software, but the list is particularly short on people using NeXT equipment. Any NeXT users out there who would be willing to review software, please contact me as soon as possible.

Send email to me at:

kjdevlin@colby.edu

and regular mail to:

Keith Devlin
Department of Mathematics
Colby College
Waterville, Maine 04901

This Months' Contributions

Two items complete this month's column. First of all, Clifford Pickover of IBM Watson Research Center presents some results of computer graphics work involving two areas of mathematics, dynamical systems and tilings. It is characteristic of these fields that their highly visual aspects make them accessible not just to mathematics undergraduates but high school students and non-mathematicians. This accessibility is of course superficial, but once you have aroused the interest of a bright person, the depth can follow on from there. (How many of today's professionals were first hooked by Martin Gardner's *Scientific American* column?) Certainly I was not surprised to note that Pickover chose to present his article in the form of experiments for students to perform.

Is it just "pretty pictures?" Is the only lasting value of this kind of work that of a pedagogical device to entice the next generation of mathematicians into the profession—the Nintendo generation I mentioned earlier? My own view is that there is considerably more going on than that and we are seeing a fundamental broadening of what classifies as "mathematics." If you have strong views on the matter, write and let me know. This is just the forum to air such opinions.

Then, Walter D. Neumann of Ohio State University sends a brief update to his review of UBASIC (Version 7), which appeared in this column in the May/June 1989 *Notices*, Volume 36, pages 557–559.

*Indeed, it could well be that the present large drop-out rate among students who enter colleges and universities intending to major in mathematics is a simple consequence of the mismatch between the skills currently required to succeed at school mathematics (still largely algorithmic) and those skills required to succeed at college-level mathematics (analytic thought, problem-solving, understanding and constructing proofs, and coping with abstraction).

Mathematics and Beauty: Several Short Classroom Experiments

Clifford A. Pickover*

I would like to propose an informal educational exercise which may benefit mathematics students in both a college and secondary school setting. The exercise involves computing and rendering two classes of complicated mathematical shapes—tiling patterns and chaotic attractors—and will no doubt involve classroom research and lively discussions. First I'll describe mathematical attractors and leave the tile patterns for the end of the article. Examples of some famous chaotic attractors can be found in the list of references (**1**, **2**, **3**). Here my purpose is to illustrate some simple new algorithms whereby artistic chaotic patterns can be clearly visualized. After some experimenting on the computer, I finally chose the algorithms because they exhibit mathematically complicated behavior, but for convenience, they also require only simple numerical operations. The first attractor which embodies these two properties is a function of two real discrete variables defined implicitly by the recurrence:

$$x_{m+1} = F(x_m, y_m) \quad m = 1, 2, 3, \ldots$$

$$y_{m+1} = G(x_m, y_m) \quad m = 1, 2, 3, \ldots$$

You can interpret these equations as a mapping of a surface onto itself. Starting from a single initial point (x_0, y_0) the successive iterates (x_m, y_m) are generated. **Figure 1** (see next page) shows a typical pattern obtained for two simple forms of F and G expressed as:

$$X_{m+1} = \sum_{n=1}^{\infty} \sin^n \beta_n f_n(x, y)$$

[1]

$$Y_{m+1} = \sum_{n=1}^{\infty} \sin^n \alpha_n f_n(y, x)$$

where $f(u, v) = lu + (1 - l)v$, and l is either 0 or 1. Students need use only a few terms of the summation series to produce interesting dynamics. I've found these simple mappings of a surface onto itself particularly useful in demonstrating chaos and producing artistic sculpture-like forms. The point $(x_0, y_0 = 0)$ is a fixed point. When $\alpha = \beta = 1$, points of the form $(x_0, y_0 = m\pi, m = 0, 1, 2, \ldots)$ map to zero–so these will not produce interesting patterns. If $\alpha = \beta$ we have the interesting map symmetry:

$$M(x,y) = M\left(x + \frac{2i\pi}{\beta}, y + \frac{2j\pi}{\beta}\right), i = 0, 1, 2, \ldots, j = 0, 1, 2, \ldots$$

Simple rational ratios of α_n/β_n such as 2/1 or 1/1 produce aesthetically pleasing plots. For one-million iterations of Equation 1, computation time varied between 8 seconds on an IBM RISC System/6000 to a minute or two on a Stellar GS 2000 or Silicon Graphics IRIS 4D/120GTX).

The kaleidoscopic form shown in **Figure 2** (see next page) is generated by the Chossat-Golubitsky formula:

$$f(\zeta, \lambda) = (\alpha u + \beta v + \lambda)\zeta + \gamma \bar{\zeta}^{m-1}$$

where $u = \zeta\bar{\zeta}$ and $v = (\zeta^m + \bar{\zeta}^m)/2$ and ζ is complex. The mapping $f : V \to V$ is equivariant with respect to the group Γ acting on V since $f(\gamma v) = \gamma f(v)$ (ref. 4). I generated the figures with $m = 5$. λ can be considered a bifurcation parameter, and low values of λ generally correspond to smaller sized attractors having less symmetry than the figures shown here. Have students add a symmetry-breaking term ϕ which I have found to produce interesting dynamics.

The computational recipe for **Figure 3** (see next page) allows students to illustrate chaotic attractors which resemble the path a fly might take as it dives around a room. The computer pseudocode lists the equations used (see below).

```
ALGORITHM 3-D Strange Attractor Generator
(The Electronic Fly)
TYPICAL PARAMETER VALUES:
xxmin=-2; xxmax=2, yymin=-2, yymax=2
(* picture boundaries *)
pres = 1600
(* picture resolution *)
iter1 = 1000; iter2 = 5000;
(* iter1*iter2 = total number of iterations *)
METHOD: A 5-parameter Dynamical System
OUTPUT: Pixel array containing the output
picture intensities.
NOTES: Try experimenting with different
values of e which can control the degree
of randomness of the system.
xinc=pres/(xxmax-xxmin);
(* controls x-pixel position *)
yinc=pres/(yymax-yymin);
(* controls y-pixel position *)
a=2.24;b=.43;c=-.65;d=-2.43;e=1;
(* control parameters *)
p(*,*)=0; (* initialize p array *)
x,y,z=0; (* starting point *)
do j = 1 to iter1;
do i = 1 to iter2;
xx = sin(a*y) -z*cos(b*x);
yy = z*sin(c*x)-cos(d*y);
zz = e*sin(x);
```

*Clifford A. Pickover is a research staff member at the IBM T. J. Watson Research Center in Yorktown Heights, NY. He received his Ph.D. from Yale University's Department of Molecular Biophysics and Biochemistry, and his current primary interest is scientific visualization. He is the author of the popular book *Computers, Pattern, Chaos, and Beauty* (St. Martin's Press, New York, 1990). Pickover is currently an associate editor for *Computers and Graphics* and an editorial board member and guest editor for *Computers in Physics*. His email address is: cliff@ibm.com.

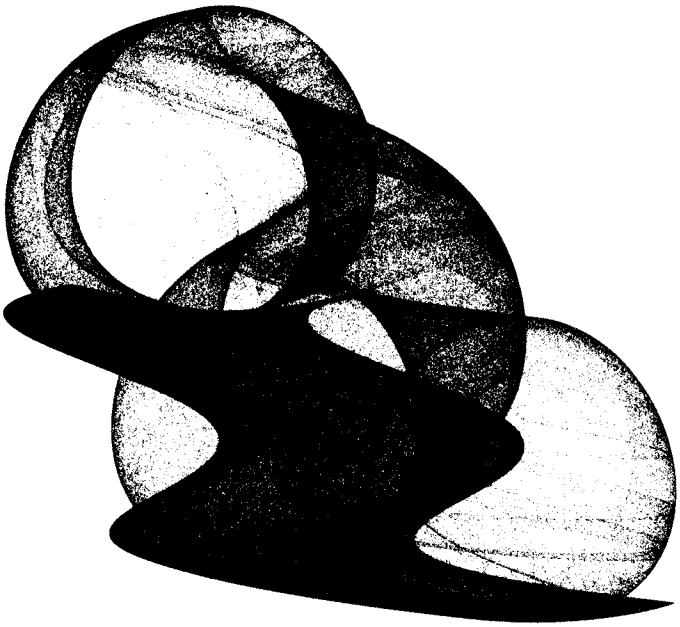


Figure 1. Attractor produced by iterating Equation 1 one-million times.

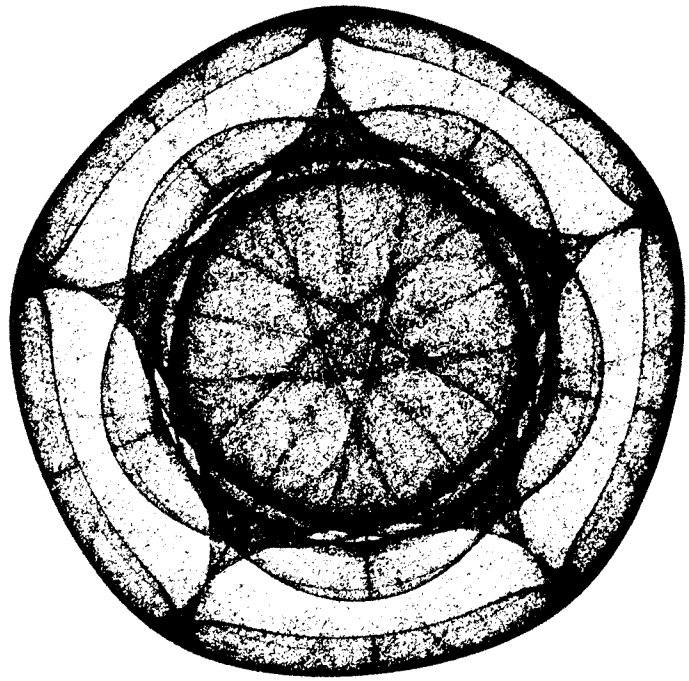


Figure 2. Pentagonal chaotic attractor for $f(\zeta, \lambda) = (\alpha u + \beta v + \lambda)\zeta + \gamma \bar{z}^{m-1} + \phi$. ($\gamma = 1, \lambda = -2.6, m = 9, \alpha = 4, \beta = 2, \phi = 0$). Other parameters yield additional beautiful patterns.

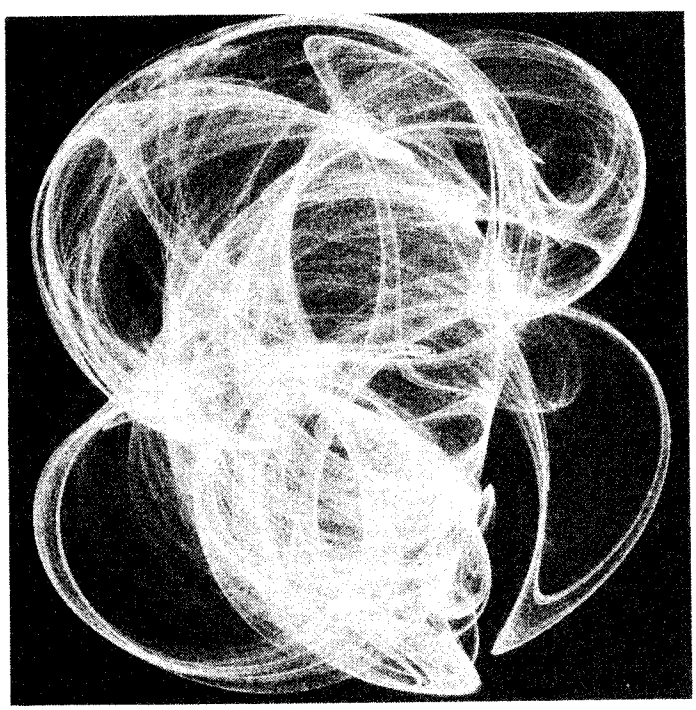


Figure 3. The path of an electronic fly.

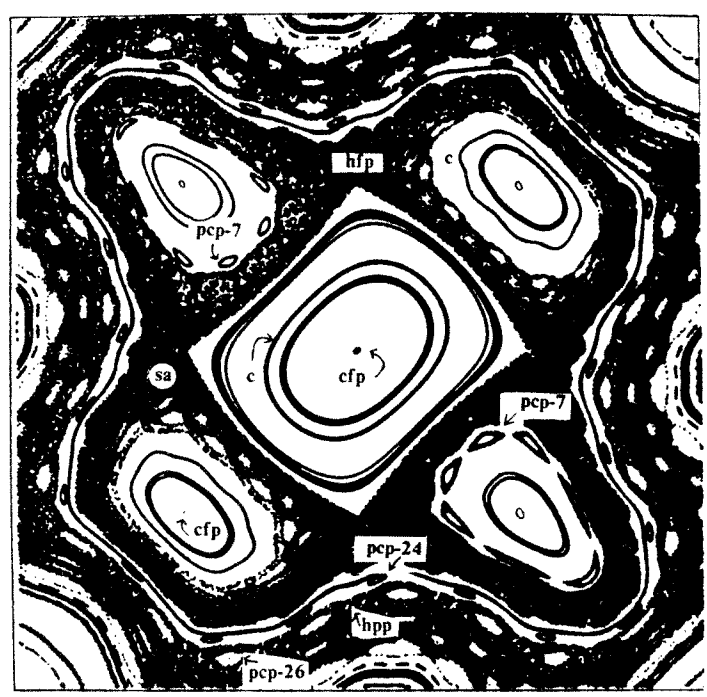


Figure 4. Time-discrete dynamical system for $f(x) = \sin[x + \sin(3x)]$. Limit points and cycles are distributed through the state space. Abbreviations: cfp (center fixed points), pcp (periodic center points), sa (strange attractor), hpp (hyperbolic periodic points), c (cycle).

```
   x = xx; y=yy; z=zz;
   if xx<xxmax & xx>xxmin & yy < yymax & yy >
yymin then do;
   xxx= (xx-xxmin)*xinc;
   (* scale to range (0, pres) *)
   yyy= (yy-yymin)*yinc;
   (* scale to range (0, pres) *)
   p(xxx,yyy) = p(xxx,yyy) + 1;
   end; /* then do */
   end; (* i *)
   end; (* j *)
   (*P now contains the intensities for each pixel
in the picture*)
```

An initial point $(0,0,0)$ is selected and the equations are iterated 5 million times. Figure 3 is an $x-y$ projection of the resultant points' trajectory. The intensity of a region of the graph relates to how many times a trajectory crosses a particular pixel in the display. Note that if the dynamical system producing this plot led to totally random output, then the plot would be a diffuse random scattering of points in 3-space. If the system were absolutely periodic (like a sine wave), then the figure would consist of a thin curve in 3-space. This curve is delicately poised somewhere between the two extremes and has a potential infinity of values. Although $(x,y,z) = (0,0,0)$ was used as a starting point, the starting point makes little difference; this indicates that the resulting figures are attractors for the dynamics. As long as you're somewhere near the attractor, the next few points will quickly converge to the attractor. An array p is filled with the "intensity" of the trajectory. This intensity depends on how many times the "fly" passes through a point. The intensity can be represented by a gray level. However, if students don't have access to gray level printing, they can compute a picture by plotting dots at the positions in the "p" array where $p(x,y) > 0$.

Have your students watch the electronic fly as it paints a chaotic figure on the screen or printer. Can they see any long term regularity? Have them imagine the plight of a scientist looking for regularity in weather systems.

To compute the form in **Figure 4** (see previous page), I used time-discrete phase planes associated with the cyclic systems:

$$\begin{cases} \dot{x}(t) = -f(y(t)) \\ \dot{y}(t) = f(x(t)) \end{cases}$$

This system of differential equations was studied in Nussbaum and Peitgen's paper (5) where the authors restricted their f to functions which have two positive zeros. You can have your students extend the range of functions to include more general nonlinearities, i.e. oscillating functions with more than two positive zeros. The functions I used are of the form often found in frequency modulation (acoustic) synthesis applications:

$$f(x) = \sin[x + \sin(\rho x)]$$

By modulating a sine wave (often called the "carrier") by another with a different frequency (controlled by ρ), a large variety of complex waveforms can be generated. The resulting trajectories reveal a visually striking and intricate class of patterns ranging from stable points and manifolds, to a hierarchy of stable cycles, to apparently random fluctuations. To discretize this system for implementation on a computer, you can use an implicit Euler approximation:

$$\begin{cases} x_{t+1} - x_t = -hf(y_t + hf(x_t)) \\ y_{t+1} - y_t = hf(x_t) \end{cases}$$

where $h > 0$ is the step size. I have used values of h between 0.2 - 0.4. See (**4**) for a motivation of the particular discretization given in **Eq. 3**. As **Figure 4** indicates, a variety of limit points and cycles may be distributed through the state space. **Fig. 4** is an (x,y) diagram when $f(x) = \sin[x + \sin(3x)]$. The picture boundaries are $(1.6 < x_t < 4.7, 1.6 < y_t < 4.7)$, and $h = 0.4$. The number of iterations, N, is 2000, and the resolution is also 10 (which means the range (1.6, 4.7) is divided into 10 intervals). On the plot are five prominent center fixed points (cfp), two of which are labelled. Smooth concentric cycles appear around these cfp's, and some cycles are denoted by "c". In the top left and bottom right ellipsoid are periodic center points (pcp) (of period 7). There are four major hyperbolic fixed points, the top one denoted by "hfp". The thick dark regions are "strange attractors" (sa). Surrounding the prominent large cycle (which itself surrounds the 5 cfp's) are periodic center points (pcp) of period 24. Going outward, we encounter a twisted structure consisting of hyperbolic periodic points (hpp) and periodic center points (pcp) (of period 26).

By using other discretizations for similar types of equations your students can obtain a variety of shapes and behaviors. For example, try

$$[2] \qquad \begin{cases} x_{t+1} - x_t = -hf(y_t) \\ y_{t+1} - y_t = hf(x_t) \end{cases}$$

(see **Fig. 5** next page). Some students may wonder why *scientists* and *mathematicians* use computer graphics to display mathematical results. Science writer James Gleick said it best in his 1987 book:

> *"Graphic images are the key. It's masochism for a mathematician to do without pictures... [Otherwise] how can they see the relationship between that motion and this. How can they develop intuition?"*

As a final class-room exercise, I present two tiling patterns. Various papers in the past discuss the use of computer graphics to represent noisy data (e.g. see (**6**)). One method I've employed makes use of a pattern from Dutch artist M. C. Escher. To produce **Figure 6** (see next page)

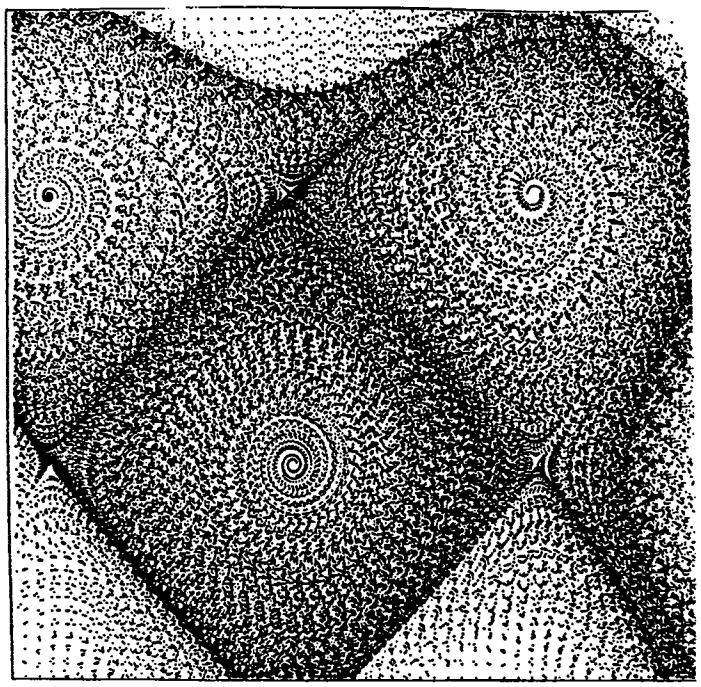


Figure 5. Portrait for Equation 2.

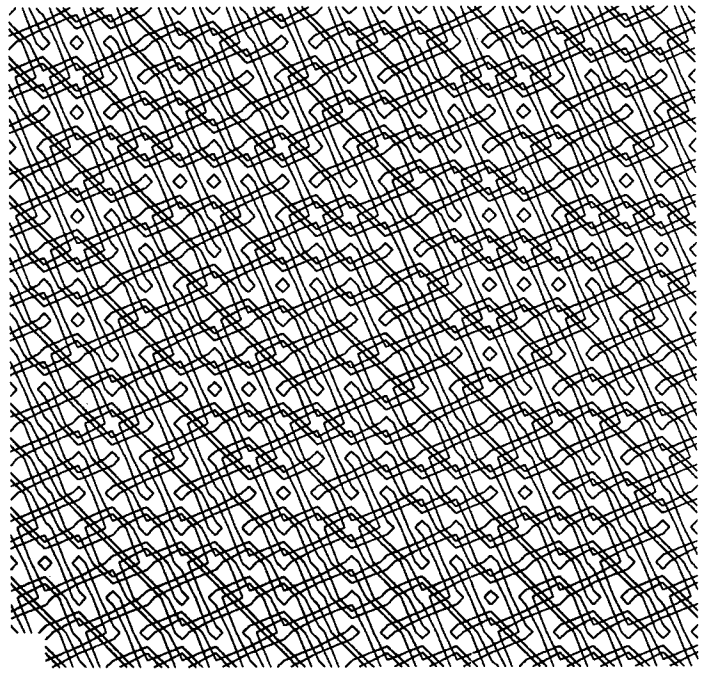


Figure 6. Escher-tile characterization of random data.

```
1    TGTAGTGGGT GGAAGGGCTA ATTCACTCCC AACGAAGACA AGATATCCTT
51    GATCTGTGGA TCTACCACAC ACAAGGCTAC TTCCCTGATT GGCAGAACTA
101    CACACCAGGA CCAGGGATCA GATATCCACT GACCTTTGGA TGGTGCTACA
151    AGCTAGTACC AGTTGAGCCA GATAAGGTAG AAGAGGCCAA CAAAGGAGAG
201    AACACCAGCT TGTTACACCC TGTGAGCCTG CATGGAATGG ATGACCCGGA
251    GAGAGAAGTG TTAGAGTGGA GGTTTGACAG CCGCCTAGCA TTTCATCACG
301    TGGCCCGAGA GCTGCATCCG GAGTACTTCA AGAACTGCTG ATATCGAGCT
351    TGCTACAAGG GACTTTCCGC TGGGGACTTT CCAGGGAGGC GTGGCCTGGG
401    CGGGACTGGG GAGTGGCGAG CCCTCAGATG CTGCATATAA GCAGCTGCTT
451    TTTGCCTGTA CTGGGTCTCT CTGGTTAGAC CAGATCTGAG CCTGGGAGCT
501    CTCTGGCTAA CTAGGGAACC CACTGCTTAA GCCTCAATAA AGCTTGCCTT
551    GAGTGCTTCA AGTAGTGTGT GCCCGTCTGT TGTGTGACTC TGGTAACTAG
601    AGATCCCTCA GACCCTTTTA GTCAGTGTGG AAAATCTCTA GCAGTGGCGC
651    CCGAACAGGG ACTTGAAAGC GAAAGGGAAA CCAGAGGAGC TCTCTCGACG
701    CAGGACTCGG CTTGCTGAAG CGCGCACGGC AAGAGGCGAG GGGCGGCGAC
751    TGGTGAGTAC GCCAAAAATT TTGACTAGCG GAGGCTAGAA GGAGAGAGAT
801    GGGTGCGAGA GCGTCAGTAT TAAGCGGGGG AGAATTAGAT CGATGGGAAA
851    AAATTCGGTT AAGGCCAGGG GGAAAGAAAA AATATAAATT AAAACATATA
901    GTATGGGCAA GCAGGGAGCT AGAACGATTC GCAGTTAATC CTGGCCTGTT
951    AGAAACATCA GAAGGCTGTA GACAAATACT GGGACAGCTA CAACCATCCC
1001    TTCAGACAGG ATCAGAAGAA CTTAGATCAT TATATAATAC AGTAGCAACC
```

Figure 7. AIDS virus sequence. Shown here are the first 1000 bases of the human immunodeficiency virus type 1. Use these data as input to the Escher-tile characterization described in the text. (Source for sequence: Muesing, M.A., Smith, D.H., Cabradilla, C.D., Benton, C.V., Lasky, L.A. and Capon, D.J. (1985) Nucleic acid structure and expression of the human AIDS/lymphadenopathy retrovirus. *Nature* **313**: 450–458.)

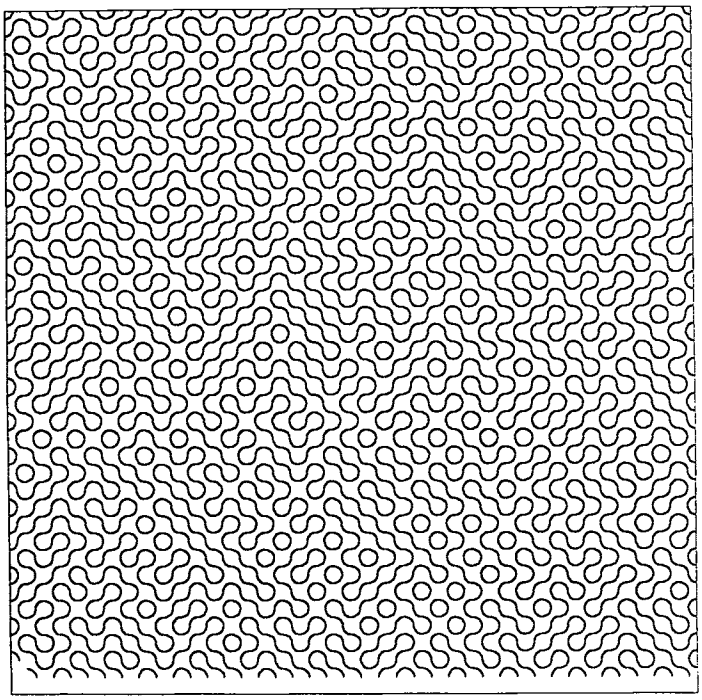
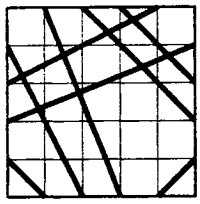


Figure 8. Truchet-tile characterization of random data.

simply draw the generating tile (shown here) with a random

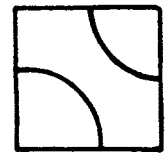


orientation, and place it within the corner of a large square lattice. Successive adjacent tiles are added to the lattice for a particular row until it is filled, and a new row is started. When the tile is printed in any of its positions to fill out a grid of squares, a seamless plane-filling pattern is created. I used just two orientations of the tile to create **Figure 6**. The tiling is easily achieved with a computer program using binary values $\{B_i, i = 1,2,3,\ldots N\}$, with random values of 0 and 1 for B_i. Simply map B_i to two different orientations of the tiles. The tile pattern in **Figure 6** can be used to represent different kinds of noise distributions or experimental data. In particular, by using this approach, certain subtle differences in the noise distributions becomes visually apparent. For example, consider binary data where the 0/1 sequence is not "completely random" but can be described as a stationary Markov process with the transition matrix P:

$$P = \begin{bmatrix} P_0 & 1-P_0 \\ 1-P_1 & P_1 \end{bmatrix} \tag{3}$$

P_0 and P_1 are the probabilities that B_i is equal to zero or one, respectively, if B_{i-1} is equal to zero. P_1 and $1-P_1$ are the probabilities that B_i is equal to one or zero, respectively, if B_{i-1} is equal to one. **Figure 6** shows characteristic diamond shapes and stubs. For random orientations, the *diamond fraction* is approximately 5% (number of closed diamonds in the pattern divided by the number of tiles). The diamond fraction gradually reduces to zero as the correlations in your data become higher. Since the values of B_i depend on the values at B_{i-1}, even small deviations from randomness ($P_0, P_1 \neq 0.5$) are visually manifested in patterns in the tiles. Have your students compute an Eschergram using a very strong correlation ($P_1, P_1 \neq 0.9$) and watch the diamonds disappear. Try using this tile to represent the genetic sequence data in **Figure 7** (see previous page). The sequence, symbolized by the four different letters G, C, A, and T, can be represented by a collection of tiles with four different orientations. What does the resulting tile pattern ("Eschergram") tell you about the patterns, and degree of randomness, within the first 1000 bases of the AIDS virus (**Figure 7**)?

Figure 8 (see previous page) shows a similar approach applied to Truchet tiles, using two different orientations of the tile shown. For random orientations, the *circle fraction* is



approximately 0.054 (number of closed circles in the pattern divided by the number of tiles). The *dumbbell fraction* is approximately 0.0125 (number of closed bilobed shapes divided by the number of tiles). In this figure, the eye perceives no particular trends in the design; however, as data correlations are increased, the tile pattern increasingly reveals a diagonal trend in the dumbbell shapes. This kind of pattern is reminiscent of the tiles of Sebastien Truchet. Truchet's paper, written in 1704, shows that numerous patterns can be generated by the assembly of single half-colored tiles in various orientations. For more information on Escher tiles see (**7**). For information on the use of tiles to represent noisy data see (**8, 9**).

For Further Reading

1. Gleick, J. (1987) *Chaos: Making a New Science*, Viking: New York.
2. Moon, F. (1987) *Chaotic Vibrations*, John Wiley and Sons, New York. (Moon gives many practical examples of chaos in real physical systems.)
3. Shaw, A. (1984) *The Dripping Faucet as a Model Chaotic System*, Aerial Press: California.
4. P. Chossat and M. Golubitsky (1988) Symmetry-increasing bifurcations of chaotic attractors. *Physica D* **32**, 423-426.
5. Nussbaum, R. and Peitgen, O. (1984) Special and spurious solutions of $\dot{x}(t) = -\alpha f(x(t-1))$. *Memoirs of the American Mathematical Society*. **51**: 1–129.
6. Pickover, C. (1990) Picturing randomness on a graphics supercomputer. *IBM Journal of Research and Development*, **34**(6), in press.
7. Schattschneider, D. (1990) *Visions of Symmetry*, Freeman: New York.
8. Pickover, C. (1989) Picturing randomness with Truchet tiles. *Journal of Recreational Math.* **21**(4): 256–259.
9. Pickover, C. (1990) *Computers, Pattern, Chaos, and Beauty*, St. Martin's Press: New York.

Reviews of Mathematical Software

UBASIC Update

Reviewed by Walter D. Neumann*

Version 8 of Yuji Kida's *UBASIC* is available. *UBASIC* is a high-precision BASIC for IBM compatible PC's. Version

*Walter Neumann is a Professor of Mathematics at the Ohio State University. He can be reached at Fax: 614-292-3639 to Neumann, Math Dept; tel: 614-292-4886 (office), 614-292-4975 (messages); and by email: neumann@mps.ohio-state.edu or neumann@ohstpy.bitnet.

7 was reviewed in the May/June 1989 issue of *Notices* (Volume 36, pages 557–559). Its features included:

- fast variable precision complex arithmetic (up to 1084 bytes—about 2600 digits—for integers and reals, 1084 bytes total for real and imaginary parts of complex numbers);
- a very complete collection of built-in algebraic, transcendental and arithmetic functions;
- good support for structured programming including many commands for program flow control, named subroutines and functions, local and global variables, the ability to pass parameters to functions or subroutines by value or address, and the ability to pass functions or subroutines to other functions or subroutines;
- good built-in editing and debugging facilities;
- a large number of useful sample programs, including some of the latest prime factorization algorithms.

The new version (Version 8.15) adds exact rational arithmetic, polynomial arithmetic with integral, rational, complex, or modulo p coefficients, string variables, and limited list handling capabilities. Polynomials admit the standard operations, including division with remainder, greatest common divisor, and differentiation.

The size limits on these new objects are as for numbers, e.g., a rational number permits up to about 2600 digits total for its numerator and denominator, and strings can be up to 1084 bytes long.

In addition to their usual uses, strings can be used to manipulate program code which will be executed by the program. For example, a program can ask the user to input a function and integration limits and then pass this information to a numerical integration subroutine.

Unlike most BASIC's, a variable can hold any kind of data, so the same routine can sort an array of real numbers or an array of strings, for example.

Note: If you run *UBASIC* under DosWindows on a SUN, be warned that you must tell DosWindows that your SUN has only 4Meg of memory—otherwise DosWindows loads extra optimization code that causes problems for *UBASIC* and some other MSDOS software. Sun does not seem to be publicizing this problem.

By the time this announcement is in print, *UBASIC* 8.15 will be available by anonymous ftp from several sites, including wsmr-simtel20.army.mil and (temporarily) shape.mps.ohio-state.edu.

News and Announcements

MAA Prizes Awarded in San Francisco

The Mathematical Association of America (MAA) awarded a number of prizes during the Joint Mathematics Meetings in San Francisco in January 1991.

The MAA's Chauvenet Prize went to W. B. RAYMOND LICKORISH of the University of Cambridge in England and KENNETH C. MILLETT of the University of California at Santa Barbara, for "The New Polynomial Invariants of Knots and Links," published in the *Mathematics Magazine* in 1988. The Committee on the Chauvenet Prize noted that "this paper is a beautifully written account of the fundamental and unexpected developments stemming from V. F. R. Jones' discovery that trace functions on operator algebras give rise to new and amazingly simple invariant polynomials for knots and links." Presented for a noteworthy expository survey paper, the prize includes a cash award of $1000 for each recipient.

The Yueh-Gin Gung & Dr. Charles Y. Hu Award for Distinguished Service to Mathematics went to SHIRLEY A. HILL, Curator's Professor of Education and Mathematics at the University of Missouri, Kansas City. Hill has been president of the National Council of Teachers of Mathematics and chair of the Mathematical Sciences Education Board. She was instrumental in the development of the Board and the publication of its major 1989 report, *Everybody Counts*. The award consists of $4000 and a gold cup.

Louise Hay Award

At the Joint Mathematics Meetings in January 1991, the Association for Women in Mathematics (AWM) presented the first annual Louise Hay Award for Contributions to Mathematics Education to SHIRLEY M. FRYE, Past President of the National Council of Teachers of Mathematics (NCTM).

The AWM established the annual award last year "to highlight the importance of mathematics education and evoke the memory of all that Louise Hay exemplified as a teacher, scholar, administrator, and human being." Hay was professor of mathematics at the University of Illinois at Chicago until her death in 1989.

Shirley Frye received her B.A. from Thiel College and her master's degree from Arizona State University. She has been a classroom teacher for more than twenty years and served as director of curriculum and instruction for grades K-12 in the Scottsdale, Arizona school district. As president of the NCTM during 1988-1989, Frye gave strong leadership and great energy to the national presentation of the NCTM *Standards for School Mathematics*.

1991 Naylor Prize and Lectureship

The London Mathematical Society's 1991 Naylor Prize and Lectureship in Applied Mathematics has been awarded to ROGER PENROSE, Rouse Ball Professor of Mathematics at the University of Oxford, for his lasting contributions to various fields of mathematics and mathematical physics, especially general relativity, the application of global differential geometry to relativity theory, and twistor theory.

Graduate Student Fulbrights Awarded

The United States Information Agency and the Institute of International Education have announced the names of U.S. graduate students who have received Fulbright awards for 1990-1991. Those receiving awards in mathematics are listed below, together with their home institutions and the countries in which they will use the awards. BRAD HAGEN, Macalester College, Germany; MARGARET HOLEN, University of Chicago, United Kingdom; JEFFREY HUMPHREY, Brown University, Australia; ISAAC KLAPPER, New York University, Germany.

Exxon Grant Supports Strategic Plan

The Exxon Education Foundation recently awarded the American Mathematical Society a grant of $25,000 to support it's work in producing a strategic plan. The grant will help to underwrite a significant portion of the costs associated with the planning process including the cost of membership surveys, meetings and professional facilitators.

AMS Executive Director William H. Jaco said, "We are grateful for the Exxon Education Foundation's continuing investment in the work of the Society. Within the last year, the AMS has received $40,000 in support from Exxon to assist in defining the Society's role in the effort to renew mathematics in the United States. These gifts represent the largest investment made by a private foundation in our work."

NSF Travel Advisory

The National Science Foundation (NSF) has been instructed to notify principal investigators travelling on NSF-funded grants that trips to areas such as the Middle East, North Africa, and South Asia should be delayed or deferred. More specific information can be obtained from the appropriate NSF program directors.

Funding Information for the Mathematical Sciences

Proposals for the NSF's Division of Mathematical Sciences

Research proposals made to the Division of Mathematical Sciences (DMS) of the National Science Foundation should be submitted six to nine months prior to the expected start date. The DMS will accept such proposals at any time of the year. The DMS program officers are listed below.

Algebra and Number Theory	
Ann K. Boyle	202-357-3695
Gary Cornell	
Applied Mathematics	
Alfonso Castro	202-357-3686
Fred Howes	
Classical Analysis	
John V. Ryff	202-357-3455
Computational Mathematics	
Michael Steuerwalt	202-357-3691
Alvin Thaler	
Geometric Analysis	
Robert Molson	202-357-3451
Modern Analysis	
Ira Herbst	202-357-3697
Special Projects	
Bernard R. McDonald (Head)	202-357-3453
Deborah F. Lockhart	
Ann Steiner	
Statistics and Probability	
Peter W. Arzberger	202-357-3693
Nell Sedransk	
Topology and Foundations	
Ralph M. Krause	202-357-3457
Division Director	
Judith S. Sunley	202-357-9669
Deputy Division Director	
Bernard R. McDonald	202-357-9669

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

Mittag-Leffler Institute Grants

The Mittag-Leffler Institute announces a number of grants available to recent doctorates or advanced graduate students for the 1991-1992 year. The grants amount to 9500 Swedish crowns per month, or 95,000 for those who attend for the duration of the program. The Institute's program begins on September 1, 1991, and ends on May 31, 1992. Housing at the Institute can be offered to some of the participants.

The subject for the year is combinatorics, with emphasis on the algebraic and geometric aspects. The following experts have agreed to take part in the program for an extended period: L. Billera, H. Crapo, P. Diaconis, A. Dress, A. Garsia, I. Gessel, J. E. Goodman, M. Goresky, C. Greene, M. Haiman, P. Hanlon, G. Kalai, V. Klee, P. Kleinschmidt, A. Lascoux, C. Lee, L. Lovász, I. G. Macdonald, R. MacPherson, P. Mani, N. Mnev, P. Orlik, R. Pollack, C. Reutnenauer, K. S. Sarkaria, V. Serganova, L. Solomon, R. Stanley, D. Stanton, J. Stembridge, B. Sturmfels, J. Tits, H. Tverberg, A. Vershik, G. X. Viennot, M. Wachs, N. White, A. Zelevinsky, and G. Ziegler. The participation of others (such as P. Frankl and I. M. Gel′fand) is also foreseen. The program will be directed by Anders Björner, KTH, Stockholm.

Applications should be sent to: The Board of the Mittag-Leffler Institute, Auravägen 17, S-182 62 Djursholm, Sweden before **March 31, 1991**. For more information, contact the Institute at the above address, or by telephone ((int.+46)08-755-1809), fax ((int.+46)08-755-9971), or electronic mail (leffler@math.kth.se).

1992-1993 Competition Opens for Fulbright Scholar Awards

The Fulbright Scholar Program for 1992-1993 includes some 1000 grants for research, combined research and lecturing, and university lecturing. Opportunities range from two months to a full academic year, and many assignments are flexible to the needs of the grantee. Nearly one-third of Fulbright grants are targeted for research and many lecturing awards offer research opportunities. There are openings in over 100 countries, and, in many regions, multicountry research is possible.

Virtually all disciplines and subfields participate in the Fulbright awards. Scholars in all academic ranks are elegible to apply, from junior faculty to professors emeriti. Applications are also encouraged from professionals outside academe and from independent scholars. Fulbright seeks good teachers as well as active researchers.

The basic eligibility requirements for a Fulbright award are U.S. citizenship and Ph.D. or comparable professional qualifications. For lecturing awards, university or college teaching

experience is expected. Language skills are needed for some countries, but most lecturing assignments are in English.

The deadline is **June 15, 1991** for awards in Australasia, South Asia, most of Latin America, and the USSR; and **August 1, 1991** for awards in Africa, Asia, Europe, the Middle East, and Canada, and for lecturing awards in the Caribbean, Mexico, and Venezuela. Other deadlines are in place for special programs.

Application materials are now available from: Council for International Exchange of Scholars, 3007 Tilden Street, NW, Suite 5M, Box NEWS, Washington, DC, 20008-3009; telephone 202-686-7877.

Support Available to Attend ICIAM 91

The Society for Industrial and Applied Mathematics (SIAM) is hosting the International Conference on Industrial and Applied Mathematics (ICIAM 91), to be held in Washington, DC, July 8–12, 1991. SIAM has applied for a grant to help young professionals in mathematics, applied mathematics, and mathematical sciences departments attend ICIAM. The grant would cover partial reimbursement for conference expenses for a limited number of researchers who have received Ph.D.s since January 1988 and mathematics graduate students in good standing.

The conference will feature sessions covering virtually all areas of applied and computational mathematics, including applications in engineering and the biological, chemical, and physical sciences. There will be speakers from academia, government, and industry, and more than 2000 mathematicians, engineers, and scientists from more than sixty countries are expected to attend.

SIAM encourages women and minorities to apply. Selection will be based on academic records and recommendations from faculty advisers. For young researchers, research records and postdoctoral experience will also be considered. Awards are contingent on SIAM's receipt of the requsted support.

The deadline for receipt of applications at the SIAM office is **April 15, 1991**. Each applicant should send a resume, latest transcript or summary of postdoctoral experience (if applicable), and recommendation of faculty adviser. All materials should be sent to: ICIAM 91 Travel Grants, SIAM, 3600 University City Science Center, Philadelphia, PA 19104-2688. For more information, contact SIAM at the address above, or by telephone (215-382-9800), fax (215-386-7999), or electronic mail (iciam@wharton.upenn.edu).

1992-1993 Advanced Research Fellowships in India

The Indo-U.S. Subcommission on Education and Culture is offering twelve long-term (six to ten months) and short-term (two to three months) awards for research in India during the 1992-1993 year. These grants will be available in all academic disciplines except clinical medicine.

The fellowship program seeks 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. The program is sponsored by the Indo-U.S. Subcommission on Education and Culture and funded by the United States Information Agency, the National Science Foundation, the Smithsonian Institution, and the Government of India.

An applicant must be a U.S. citizen with a Ph.D. or comparable professional qualifications. The application deadline is **June 15, 1991**. Application forms and further information are available from: Council for International Exchange of Scholars, Attn: Indo-American Fellowship Program, 3007 Tilden Street, NW, Suite 5M, Washington, DC 20008-3009; telephone 202-686-4017.

South Bend, Indiana
Indiana University at South Bend
March 15–16

Program

The eight-hundred-and-sixty-fourth meeting of the American Mathematical Society will be held at Indiana University at South Bend, South Bend, Indiana on Friday, March 15, and Saturday, March 16, 1991. All special sessions will be held in Northside Hall and all invited addresses will be in Room 113 of Northside Hall.

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 are:

Leonid G. Makar-Limanov, Wayne State University, *Infinite-dimensional skew fields.*

Donald G. Saari, Northwestern University, *Dynamics and symmetry: Explanation of paradoxes from statistics, voting, and economics.*

Stephen D. Smith, University of Illinois at Chicago and California Institute of Technology, *Simplicial complexes associated to finite groups and their representations.*

Deane Yang, Columbia University, *Questions relating Riemannian geometry and the topology of 3-manifolds.*

Special Sessions

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

Mathematical economics and dynamical systems, **C. D. Aliprantis**, Indiana University and Purdue University, and **Carl P. Simon**, University of Michigan, Ann Arbor.

Simplicial complexes associated to finite groups and their representations, **Jonathan L. Alperin**, University of Chicago, and **Stephen D. Smith**.

Model theory, **Steven A. Buechler**, University of Notre Dame.

Geometric topology, **Frank X. Connolly**, University of Notre Dame.

Algebraic topology, **William G. Dwyer**, University of Notre Dame, and **Anthony D. Elmendorf**, Indiana University at South Bend.

Noncommutative ring theory, **Gail R. Letzter**, **Peter Malcolmson**, and **Frank Okoh**, Wayne State University.

Hilbert spaces of analytic function, **John E. McCarthy**, Indiana University at Bloomington.

Probability and prediction theory, **Mohsen Pourahmadi**, Northern Illinois University.

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 the south wing (main entrance) of Northside Hall and will be open from 8:00 a.m. to 5:00 p.m. on Friday, March 15, and from 8:00 a.m. to noon on Saturday, March 16. 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 San Francisco meeting announcement in the October 1990 issue of *Notices*.

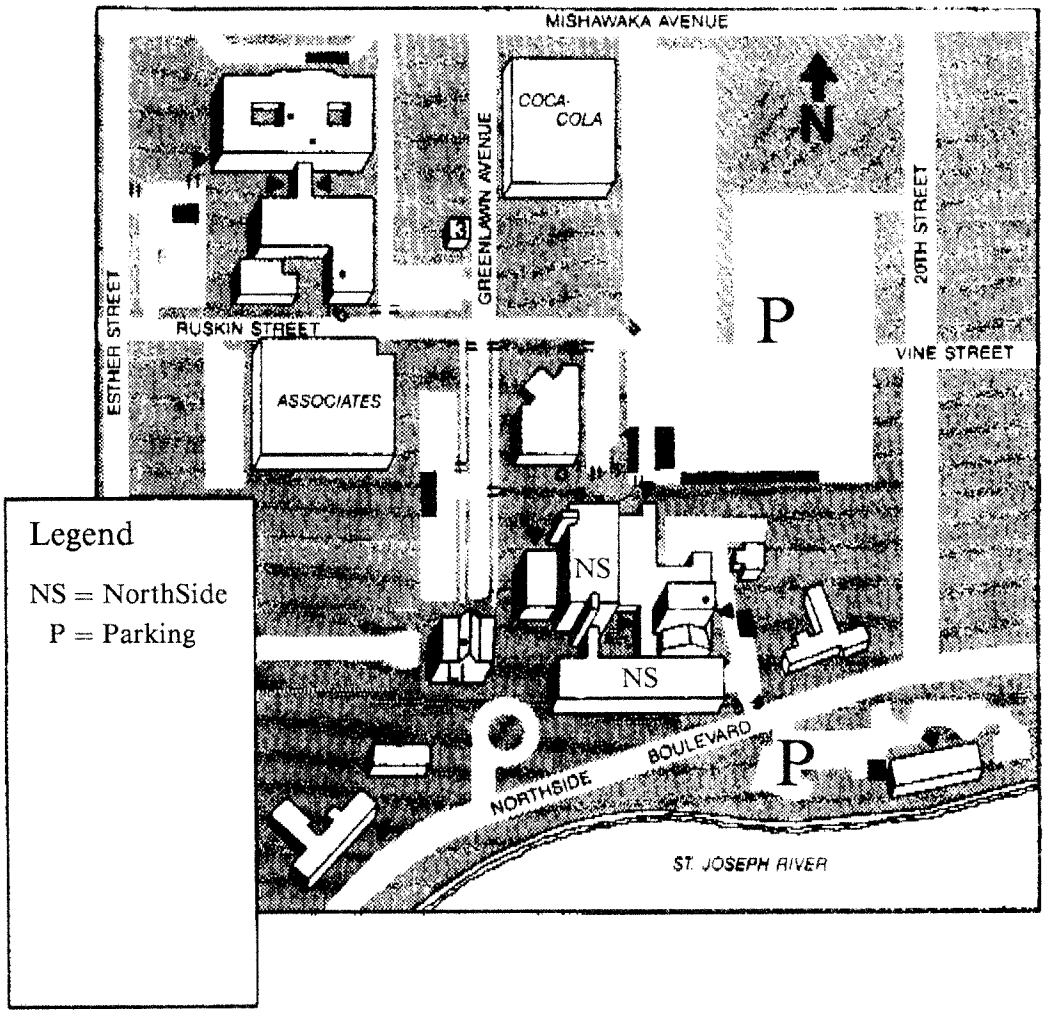
Accommodations

Rooms have been blocked for participants at The Works Hotel, the Holiday Inn - Downtown, and the Ramada Inn. Participants should make their own reservations and directly mention the AMS meeting to obtain the rates listed below. All rates are subject to a ten percent tax. **The AMS is not responsible for rate changes or the accommodations offered by these hotels/motels.**

Other motels located on U.S. Route 31/33 North near the Ramada Inn are: Budgeteer Motor Inn (219-272-9000); Best Inns of America (219-277-7000); Days Inn (219-277-0510); Knights Inn (219-277-2960); and Motel 6 (219-277-2960).

Holiday Inn - Downtown (2.8 miles from campus)
213 W. Washington Street, South Bend, IN 46601

IUSB Campus Map



Legend

NS = NorthSide

P = Parking

Telephone: 219-232-3941
The deadline for reservations was February 27.

Flat rate $55 Single, Double, Triple
Restaurant/lounge, indoor pool, and free parking. For free van transportation from airport, dial 6 from courtesy phone located at baggage pick-up.

The Works Hotel (2.5 miles from campus)
475 N. Niles Avenue, South Bend, IN 46617
Telephone: 219-234-1954
Deadline for reservations was March 1.

Single $48 Each additional adult $7
Free continental breakfast, restaurant adjacent, and free parking. For free van transportation from airport, call motel.

The Ramada Inn (6.3 miles from campus)
52890 U.S. Route 33 North, South Bend, IN 46637
Telephone: 219-272-5220
The deadline for reservations was February 22.

Single $51 Double $59
Restaurant/lounge, indoor pools, sauna, jacuzzi.

Food Service

The IUSB Cafeteria (UC2) will be serving breakfast and lunch on Friday, March 15. Other restaurants are located within 1.5 miles of the campus. Complete listings will be available at the meeting registration desk.

Parking

Free parking will be available in the student lot (P1) located north of Northside Hall.

Travel and Local Information

Michiana Regional Airport is served by several major airlines. Free shuttle service is available to the Holiday Inn - Downtown and the Works Hotel. Transportation to the Ramada Inn or other accommodations can be arranged through United Limo or cab service at the airport.

TRANSPO buses serve the IUSB campus from the downtown area of South Bend. Bus #9 leaves the downtown transfer center at approximately ten minutes before the hour (Monday – Friday), and every half-hour (Monday – Saturday) beginning at 5:00 a.m. The bus ride from downtown to the IUSB bus stop at Mishawaka Avenue and Greenlawn Avenue takes about ten minutes. Bus #10 for the return trip leaves the corner of Mishawaka and Greenlawn Avenues at approximately five minutes before the hour (Monday – Saturday). TRANSPO bus service back to the downtown area ends at 9:33 p.m. on Friday and 6:26 p.m. on Saturday. TRANSPO service is not available to or from the Ramada Inn area.

Weather

A wide range of weather is possible in the Michiana area in March. Participants are advised to note regional forecasts near the time of the meeting.

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 March 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, March 15

Special Session on Mathematical Economics and Dynamical Systems, I

9:00 a.m.–10:50 a.m. Room 01, Northside Hall

9:00 a.m. (1) *New methods for the analysis of broad band time series.*
Robert Savit, University of Michigan, Ann Arbor (864-90-134) (Sponsored by C. D. Aliprantis)

9:30 a.m. (2) *Learning while playing via classifier systems.* Preliminary report.
Carl P. Simon, University of Michigan, Ann Arbor (864-90-143)

10:00 a.m. (3) *Comparative statics of dynamic programming.* Preliminary report.
Mark Feldman, University of Illinois, Urbana-Champaign, and **Andrew McLennan***, University of Minnesota, Minneapolis (864-90-142) (Sponsored by Carl P. Simon)

10:30 a.m. (4) *Privacy preserving mechanisms.*
Kenneth R. Mount, Northwestern University (864-90-147)

Special Session on Geometric Topology, I

9:00 a.m.–10:50 a.m. Room 06, Northside Hall

9:00 a.m. (5) *Coverings of singular spaces.* Preliminary report.
Mathew Timm, Bradley University (864-57-70)

9:30 a.m. (6) *Psuedofree orbifolds of low rank.*
Dariusz M. Wilczynski, University of Notre Dame (864-57-108)

10:00 a.m. (7) *Intersection homology and topological quantum field theory.*
Charles Frohman*, University of Iowa, and **A. Nicas**, McMaster University (864-57-85)

10:30 a.m. (8) *On exotic smoothings of 4-manifolds.* Preliminary report.
Žarko Bižaca, University of Notre Dame (864-57-88)

Special Session on Non-commutative Ring Theory, I

9:00 a.m.–10:50 a.m. Room 05, Northside Hall

9:00 a.m. (9) *Dubrovin valuation rings in crossed product algebras.*
Darrell Haile*, Indiana University, Bloomington, and **Patrick Morandi**, New Mexico State University, Las Cruces (864-16-112)

9:30 a.m. (10) *Valuations on group rings in nonzero characteristic.*
Alexander Lichtman, University of Wisconsin, Parkside (864-16-118)

10:00 a.m. (11) *Remarks on graded and filtered algebras.*
E. Behr, Illinois State University (864-16-117)

10:30 a.m. (12) *Noncommutative algebraic geometry and representations.*
Alexander L. Rosenberg, Harvard University (864-13-119) (Sponsored by Peter Malcolmson)

Special Session on Hilbert Spaces of Analytic Functions, I

9:00 a.m.–10:50 a.m. Room 107, Northside Hall

9:00 a.m. (13) *Interpolation by multipliers of the Dirichlet space.* Preliminary report.
Sheldon Axler, Michigan State University (864-46-56)

9:30 a.m. (14) *The n-width of the unit ball of $H^2(\Omega)$.* Preliminary report.
Stephen D. Fisher, Northwestern University (864-30-33)

10:00 a.m. (15) *Proper holomorphic mappings and the Cowen-Douglas class.* Preliminary report.
Norberto Salinas, University of Kansas (864-47-41)

10:30 a.m. (16) *Multiplication operators on functional Hilbert spaces in several variables.*
Raul E. Curto, University of Iowa (864-47-60)

Special Session on Probability and Prediction Theory, I

9:00 a.m.–10:50 a.m. Room 013, Northside Hall

9:00 a.m. (17) *On mixing conditions and Markov representation.* Preliminary report.
Richard C. Bradley, Indiana University, Bloomington (864-60-08)

9:30 a.m. (18) *Necessary and sufficient conditions for a second-order Wiener-Ito integral process to be mixing.*
Daniel W. Chambers, Boston College (864-60-36)

10:00 a.m. (19) *Limit theorems for non-linear functions of a stationary vector-valued Gaussian process.*
Tae-Il Jeon and **Tze-Chien Sun***, Wayne State University (864-60-62)

10:30 a.m. (20) *Prediction for I.D. processes: Some recent developments.*
Balram S. Rajput, University of Tennessee, Knoxville (864-60-18)

Invited Address

11:00 a.m.–11:50 a.m. Room 113, Northside Hall

(21) *Infinite-dimensional skew fields.*
Leonid G. Makar-Limanov, Wayne State University (864-16-144)

Invited Address

1:30 p.m.–2:20 p.m. Room 113, Northside Hall

(22) *Simplicial complexes associated to finite groups and their representations.*
Stephen D. Smith, University of Illinois, Chicago and California Institute of Technology (864-20-145)

Special Session on Mathematical Economics and Dynamical Systems, II

3:00 p.m.–6:20 p.m. Room 01, Northside Hall

3:00 p.m. (23) *A game-theoretic characterization of competitive economies.*
Myrna H. Wooders, University of Toronto (864-90-23) (Sponsored by C. D. Aliprantis)

3:30 p.m. (24) *On the mathematical structure of large games with imperfect information.*
M. Ali Khan, Johns Hopkins University, Baltimore (864-90-48) (Sponsored by C. D. Aliprantis)

4:00 p.m. (25) *A characterization of random matching schemes.*
Richard Boylan, Washington University (864-90-25) (Sponsored by C. D. Aliprantis)

4:30 p.m. (26) *Recursive utility: Discrete time theory.*
R. A. Becker*, Indiana University, Bloomington, and **J. H. Boyd, III**, University of Rochester (864-90-47) (Sponsored by C. D. Aliprantis)

5:00 p.m. (27) *Intermediation, bubbles, and Pareto efficiency in economies with production.*
Mark Pingle, University of Nevada, and **Leigh Tesfatsion***, Iowa State University (864-90-79) (Sponsored by C. D. Aliprantis)

5:30 p.m. (28) *Projection and aggregation paradoxes in statistical rankings.* Preliminary report.
Deanna B. Haunsperger, Northwestern University and University of Delaware (864-90-22)

6:00 p.m. (29) *Some aspects of information σ-fields in general equilibrium theory.*
Beth Allen, University of Pennsylvania (864-90-02) (Sponsored by C. D. Aliprantis)

Special Session on Simplicial Complexes Associated to Finite Groups and their Representations, I

3:00 p.m.–4:50 p.m. Room 106, Northside Hall

3:00 p.m. (30) *The local determination of Mackey functors.*
Peter J. Webb, University of Minnesota, Minneapolis (864-20-128)

3:30 p.m. (31) *Complexes in block theory.* Preliminary report.
Geoffrey Robinson, University of Florida (864-20-96)

4:00 p.m. (32) *On the topology of conjugacy classes.*
J. L. Alperin, University of Chicago (864-20-32)

4:30 p.m. (33) *Permutation complexes and homology representations.*
Amir H. Assadi, University of Wisconsin, Madison (864-57-95)

Special Session on Model Theory, I

3:00 p.m.–4:20 p.m. Room 09, Northside Hall

3:00 p.m. (34) *Definability over definable sets.*
David W. Kueker, University of Maryland, College Park, and **Philip W. Steitz***, Beloit College (864-03-106)

3:30 p.m. (35) *Projective planes associated with algebraically closed fields.*
Kitty L. Holland, University of Illinois, Chicago (864-03-83)

4:00 p.m. (36) *Uncountable weakly minimal theories.*
Philipp Rothmaler, Univeristy of Kiel, Federal Republic of Germany (864-03-111) (Sponsored by Steven A. Buechler)

Special Session on Geometric Topology, II

3:00 p.m.–5:20 p.m. Room 06, Northside Hall

3:00 p.m. (37) *Groups with infinite virtual cohomological dimension which act freely on $R^m \times S^{n-1}$.*
Stratos Prassidis, McMaster University (864-57-109) (Sponsored by Frank X. Connolly)

3:30 p.m. (38) *Asymptotic aspects of group actions.*
Christopher W. Stark, University of Florida (864-57-133)

Friday, March 15 (cont'd)

4:00 p.m. (39) *Nil groups in K-theory and surgery.*
Frank X. Connolly and **Tadeusz Koźniewski***, University of Notre Dame (864-57-135)

4:30 p.m. (40) *Counting simple-homotopy types.* Preliminary report.
Steven C. Ferry, State University of New York, Binghamton (864-57-139)

5:00 p.m. Informal Discussion

Special Session on Algebraic Topology, I

3:00 p.m.–5:20 p.m. Room 08, Northside Hall

3:00 p.m. (41) *Divisibility properties of the integral cohomology ring of $B\mathrm{Spin}(n)$.* Preliminary report.
Jay A. Wood, Purdue University, Calumet Campus (864-55-10)

3:30 p.m. (42) *On the homotopy theory of structured ring spectra.* Preliminary report.
Thomas Hunter, University of Kentucky (864-55-30)

4:00 p.m. (43) *The Adams spectral sequence for the homotopy of spheres.*
Robert R. Bruner, Wayne State University (864-55-71)

4:30 p.m. (44) *Constructing homology theories from group theory.* Preliminary report.
K. Lesh, Brandeis University (864-55-15)

5:00 p.m. (45) *The bar construction for spectra.* Preliminary report.
Anthony D. Elmendorf, Indiana University, South Bend (864-55-19)

Special Session on Non-commutative Ring Theory, II

3:00 p.m.–4:50 p.m. Room 05, Northside Hall

3:00 p.m. (46) *Monomorphisms of the Weyl algebra.* Preliminary report.
Carolyn Dean*, University of Michigan, Ann Arbor, and **Jeanne Wald Kerr**, Michigan State University (864-16-114)

3:30 p.m. (47) *Commutativity techniques in the Weyl algebra.* Preliminary report.
Jeanne Wald Kerr*, Michigan State University, and **Carolyn Dean**, University of Michigan, Ann Arbor (864-16-113)

4:00 p.m. (48) *Mappings on skew polynomial rings.* Preliminary report.
Jerry D. Rosen* and **Mary P. Rosen**, California State University, Northridge (864-16-102)

4:30 p.m. (49) *A criterion for a module to be injective and some applications.*
Ian M. Musson, University of Wisconsin, Milwaukee (864-16-104)

Special Session on Hilbert Spaces of Analytic Functions, II

3:00 p.m.–5:20 p.m. Room 107, Northside Hall

3:00 p.m. (50) *Commutants of subnormal operators.*
W. R. Wogen, University of North Carolina, Chapel Hill (864-47-09)

3:30 p.m. (51) *The factorization of functions in the polydisc.*
Hari Bercovici, Indiana University, Bloomington, and **Derek Westwood***, Wright State University (864-32-61)

4:00 p.m. (52) *Julia operators and complementation in Krein spaces.*
Michael A. Dritschel*, Purdue University, West Lafayette, and **James Rovnyak**, University of Virginia (864-47-82)

4:30 p.m. (53) *Toeplitz operators on weighted Hardy spaces.*
B. Mark Davis, University of California, Berkeley, and **John E. McCarthy***, Indiana University, Bloomington (864-46-37)

5:00 p.m. (54) *Nevanlinna-Pick interpolation on multiply connected domains.*
Joseph A. Ball*, Virginia Polytechnic Institute and State University, and **Kevin F. Clancey**, University of Georgia (864-30-27)

Special Session on Probability and Prediction Theory, II

3:00 p.m.–6:20 p.m. Room 013, Northside Hall

3:00 p.m. (55) *Deconvolutions and the commutant lifting theorem.*
Ciprian Foias, Indiana University, Bloomington (864-47-100)

3:30 p.m. (56) *Infinite dimensional stationary sequences with multipicity one.*
A. Makagon and **H. Salehi***, Michigan State University (864-60-53)

4:00 p.m. (57) *Continuous time periodically correlated processes: Spectrum and prediction.*
A. Makagon*, Technical University of Wroclaw, Poland and Michigan State University, **A. G. Miamee**, Hampton University, and **H. Salehi**, Michigan State University (864-60-72)

4:30 p.m. (58) *Correlation autoregressive processes.*
A. G. Miamee, Hampton University (864-60-73)

5:00 p.m. (59) *J. von Neumann alternating projections and interpolation of stationary processes.*
Mohsen Pourahmadi, Northern Illinois University (864-60-101)

5:30 p.m. Informal Discussion

6:00 p.m. (60) *Unrestrained relative entropy.* Preliminary report.
P. R. Masani, University of Pittsburgh, Pittsburgh (864-60-99)

Session on Foundations, Combinatorics, and Algebra

3:00 p.m.–5:10 p.m. Room 105, Northside Hall

3:00 p.m. (61) *The relative strength of two union theorems without AC.*
Paul Howard, Eastern Michigan University (864-03-127)

3:15 p.m. (62) *t-wise balanced design.* Preliminary report.
D. K. Ray-Chaudhuri and **Tianbao Zhu***, Ohio State University, Columbus (864-05-03)

3:30 p.m. (63) *Dependence systems.*
Marcin Schroeder, Southern Illinois University, Carbondale (864-06-141)

3:45 p.m. (64) *Filets in autometrized algebras.*
Mary Hansen, Indiana University, Kokomo (864-06-97)

4:00 p.m. (65) *Rings whose cyclics have finite Goldie dimension.*
A. H. Al-Huzali, **S. K. Jain** and **S. R. Lopez-Permouth***, Ohio University, Athens (864-16-92)

4:15 p.m. (66) *Constructing injective hulls for sums of injectives.*
A. H. Al-Huzali*, **S. K. Jain** and **S. R. Lopez-Permouth**, Ohio University, Athens (864-16-64)

4:30 p.m. (67) *On nearness algebras.*
Vijaya Gompa, Ball State University (864-18-126) (Sponsored by Raghu R. Gompa)

4:45 p.m. (68) *Cayley algebras and the isomorphisms of orthogonal groups in characteristic two.* Preliminary report.
Mary T. Treanor, Valparaiso University (864-20-130)

5:00 p.m. (69) *On the near Frattini subgroups of ordinary free products of groups.*
Mohammad K. Azarian, University of Evansville (864-20-42)

Saturday, March 16

Special Session on Probability and Prediction Theory, III

8:00 a.m.–10:50 a.m. Room 013, Northside Hall

8:00 a.m. (70) *Level crossings, multiple Wiener integrals, and prediction.*
Eric V. Slud, University of Maryland, College Park (864-60-39)

8:30 a.m. (71) *Stability in distribution for a class of singular diffusions.*
Gopal Basak, University of California, Berkeley, and **Rabi Bhattacharya***, Indiana University, Bloomington (864-60-54)

9:00 a.m. (72) *On the a.s. convergence in the sampling theorem.*
Christian Houdré, University of Maryland, College Park (864-60-38)

9:30 a.m. (73) *Central limit theorems for classical fiber bundles.* Preliminary report.
Joseph Yukich, Lehigh University (864-60-29)

10:00 a.m. (74) *Simulations of solutions of stochastic differential equations.* Preliminary report.
Philip Protter, Purdue University, West Lafayette (864-60-55)

10:30 a.m. (75) *Logistic prediction of exceedances.*
Benjamin Kedem, University of Maryland, College Park (864-62-52) (Sponsored by Mohsen Pourahmadi)

Special Session on Mathematical Economics and Dynamical Systems, III

8:30 a.m.–10:50 a.m. Room 01, Northside Hall

8:30 a.m. (76) *Semialgebraic economies.* Preliminary report.
Donald J. Brown*, Stanford University, and **Rosa L. Matzkin**, Yale University (864-90-146) (Sponsored by C. D. Aliprantis)

9:00 a.m. (77) *A survey of equilibrium methods in incomplete market models.*
Wayne J. Shafer, University of Illinois, Urbana-Champaign (864-90-49) (Sponsored by C. D. Aliprantis)

9:30 a.m. (78) *Existence of equilibrium in infinite horizon economies with taxes.*
Larry E. Jones*, Northwestern University, and **Rodolfo E. Manuelli**, Stanford University (864-90-26) (Sponsored by C. D. Aliprantis)

10:00 a.m. (79) *Core equivalence and the overlapping generations model.*
C. D. Aliprantis and **Owen Burkinshaw***, Indiana University-Purdue University, Indianapolis (864-90-20)

10:30 a.m. (80) *A dynamical system in the study of Ramsey equilibria.*
Ciprian Foias* and **Robert A. Becker**, Indiana University, Bloomington (864-90-21)

Special Session on Algebraic Topology, II

8:30 a.m.–10:50 a.m. Room 08, Northside Hall

8:30 a.m. (81) *Decomposition theorems in the K-theory of simplicial rings.* Preliminary report.
Ross E. Staffeldt, New Mexico State University, Las Cruces (864-19-06)

9:00 a.m. (82) *Clones of spaces and maps in homotopy theory.*
C. A. McGibbon*, Wayne State University, and **Jesper Moller**, Mathematical Institute, University of Copenhagen, Denmark (864-55-66)

9:30 a.m. (83) *The equivariant suspension theorem.* Preliminary report.
L. Gaunce Lewis, Jr., Syracuse University (864-55-07)

10:00 a.m. (84) *Completions of G-spectra at ideals of the Burnside ring.*
J. P. May, University of Chicago (864-55-16)

10:30 a.m. (85) *The Lin tower and v_i-periodicity in Brown Peterson homology.*
Hal Sadofsky, Johns Hopkins University, Baltimore (864-55-13)

Saturday, March 16 (cont'd)

Special Session on Simplicial Complexes Associated to Finite Groups and their Representations, II

9:00 a.m.–10:50 a.m. Room 106, Northside Hall

9:00 a.m. (86) *Simple connectivity of p-group complexes.*
Michael Aschbacher, California Institute of Technology (864-20-91)

9:30 a.m. (87) *A structure theorem for groups of weak characteristic p-type.*
Alberto L. Delgado, Kansas State University (864-20-63)

10:00 a.m. (88) *Some projective modules determined by sporadic geometries.*
A. J. E. Ryba*, Marquette University, **Stephen D. Smith**, University of Illinois, Chicago, and **Satoshi Yoshiara**, Hirosaki University, Japan (864-20-129)

10:30 a.m. (89) *Subgroup complexes and cohomology of sporadic simple groups.* Preliminary report.
Alejandro Adem, University of Wisconsin, Madison (864-55-14)

Special Session on Geometric Topology, III

9:00 a.m.–10:50 a.m. Room 06, Northside Hall

9:00 a.m. (90) *Periodicity in equivariant surgery.* Preliminary report.
Min Yan, University of Chicago and Pennsylvania State University, University Park (864-57-93)

9:30 a.m. (91) *Torsion invariants and algebraic K-theory of von Neumann algebras.*
Wolfgang Lück, University of Kentucky (864-46-90) (Sponsored by Frank X. Connolly)

10:00 a.m. (92) *Classification of simply connected six dimensional manifolds.* Preliminary report.
Herman J. Serrano, University of Notre Dame (864-57-138)

10:30 a.m. (93) *HP^2-bundles and elliptic homology.*
Matthias Kreck, University of Mainz, Federal Republic of Germany, and **Stephan Stolz***, University of Notre Dame (864-57-136)

Special Session on Non-commutative Ring Theory, III

9:00 a.m.–10:50 a.m. Room 05, Northside Hall

9:00 a.m. (94) *On the theory of Frobenius extensions and its application to Lie superalgebras.*
Allen D. Bell* and **Rolf Farnsteiner**, University of Wisconsin, Milwaukee (864-16-116)

9:30 a.m. (95) *Examples of rings with computable finitistic dimension.* Preliminary report.
Ellen Kirkman, Wake Forest University (864-16-51)

10:00 a.m. (96) *Universal localization and indecomposable modules of $\widetilde{A_n}$.* Preliminary report.
Mike May, S.J., Cambridge, Massachusetts (864-16-67)

10:30 a.m. (97) *Hidden matrices.*
L. S. Levy, University of Wisconsin, Madison, **J. C. Robson**, University of Leeds, England, and **J. T. Stafford***, University of Michigan, Ann Arbor (864-16-121)

Special Session on Hilbert Spaces of Analytic Functions, III

9:00 a.m.–10:50 a.m. Room 107, Northside Hall

9:00 a.m. (98) *Levy-Hincin type theorems for multiplicative and additive free convolution.* Preliminary report.
Hari Bercovici*, Indiana University, Bloomington, and **Dan Voiculescu**, University of California, Berkeley (864-30-75)

9:30 a.m. (99) *Index theory of Toeplitz algebras on flows.*
Efton Park, Indiana University-Purdue University, Indianapolis (864-47-58)

10:00 a.m. (100) *The invariant subspaces that lie between two Bergman spaces.*
William T. Ross, University of Virginia (864-47-59)

10:30 a.m. (101) *Spectra of some composition operators.*
Carl C. Cowen*, Purdue University, West Lafayette, and **Barbara D. MacCluer**, University of Richmond (864-47-35)

Session on Geometry, Analysis, and Probability

9:00 a.m.–10:55 a.m. Room 105, Northside Hall

9:00 a.m. (102) *Lie algebras and Lagrangian mechanics.*
Jerzy Kocik, Southern Illinois University, Carbondale (864-53-140)

9:15 a.m. (103) *The topological product structure of systems of Lebesque spaces.*
Jan J. Dijkstra, University of Alabama, and **Jerzy Mogilski***, Bradley University (864-54-69)

9:30 a.m. (104) *On topological R^4-bundles.* Preliminary report.
Duane Randall, Loyola University (864-55-98)

9:45 a.m. (105) *Gysin sequence in intersection cohomology.*
Martin Saralegi*, University of Illinois, Urbana-Champaign, and **Gilbert Hector**, Université Claude-Bernard, France (864-55-45)

10:00 a.m. (106) *A natural decomposition for second-order stationary random fields.*
Ray Cheng, University of Louisville (864-60-124)

10:15 a.m. (107) *UMVU estimators for bivariate families.*
Kandasamy Selvavel, Claflin College (864-62-74)

10:30 a.m. (108) *A unimodal hazard rate and its failure distribution functions.* Preliminary report.
Michael Greenwich, Purdue University, Calumet Campus (864-62-01) (Sponsored by John Coffey)

10:45 a.m. (109) *Gromov-Hausdorff convergence to non-manifolds.*
Teresa Engel Moore, Ithaca College (864-53-123)

Special Session on Model Theory, II

9:30 a.m.–10:50 a.m. Room 09, Northside Hall

9:30 a.m. (110) *A remark on the cohomology of locally finite groups.*
Alexandre V. Borovik, University of California, Irvine (864-03-68) (Sponsored by Donna M. Testerman)

10:00 a.m. (111) *A proof of Vaught's conjecture for varieties.*
B. Hart*, McMaster University, **S. Starchenko**, McMaster University,, and **M. Valeriote**, McMaster University (864-03-84) (Sponsored by Steven A. Buechler)

10:30 a.m. (112) *Definable properties of sets and elimination of imaginaries.* Preliminary report.
Jan Hutson, University of Illinois, Urbana-Champaign (864-03-81)

Invited Address

11:00 a.m.–11:50 a.m. Room 113, Northside Hall

(113) *Questions relating Riemannian geometry and the topology of 3-manifolds.*
Deane Yang, Columbia University (864-16-120)

Invited Address

1:30 p.m.–2:20 p.m. Room 113, Northside Hall

(114) *Dynamics and symmetry: Explanation of paradoxes from statistics, voting, and economics.*
Donald G. Saari, Northwestern University (864-58-132)

Special Session on Mathematical Economics and Dynamical Systems, IV

3:00 p.m.–5:20 p.m. Room 01, Northside Hall

3:00 p.m. (115) *Core and equilibria in economies with a continuum of agents and commodities.*
Nicholas C. Yannelis, University of Illinois, Urbana-Champaign (864-90-24) (Sponsored by C. D. Aliprantis)

3:30 p.m. (116) *Existence of Radner equilibrium with a continuum of states.* Preliminary report.
Andreu Mas-Colell, Harvard University, and **William R. Zame***, Johns Hopkins University, Baltimore (864-90-50)

4:00 p.m. (117) *Equilibria in double auctions.*
Steven R. Williams, Northwestern University (864-90-137)

4:30 p.m. (118) *Special α-limit point for mappings of the interval.*
Michael W. Hero, Bradley University (864-90-78)

5:00 p.m. Informal Discussion

Special Session on Simplicial Complexes Associated to Finite Groups and their Representations, III

3:00 p.m.–4:50 p.m. Room 106, Northside Hall

3:00 p.m. (119) *A general homotopy complementation formula.* Preliminary report.
Anders Björner, Royal Institute of Technology, Sweden (864-05-131)

3:30 p.m. (120) *Order analogues and Betti polynomials.*
Lynne M. Butler, Princeton University (864-06-94)

4:00 p.m. (121) *The topology of posets and its orbit posets.*
Volkmar Welker, University of Erlangen, Federal Republic of Germany (864-20-76) (Sponsored by Stephen D. Smith)

4:30 p.m. Informal Discussion

Special Session on Model Theory, III

3:00 p.m.–4:20 p.m. Room 09, Northside Hall

3:00 p.m. (122) *Stable actions of periodic abelian groups on abelian groups.*
Andreas Baudisch, Karl Weiserstrass Institute, German Democratic Republic (864-03-110) (Sponsored by Steven A. Buechler)

3:30 p.m. (123) *Prime existentially complete commutative rings.*
Dan Saracino, Colgate University (864-03-87) (Sponsored by Steven A. Buechler)

4:00 p.m. (124) *Reducts of structures over $\mathbb{R}$.* Preliminary report.
Ya'acov Peterzil, University of California, Berkeley (864-03-86)

Special Session on Geometric Topology, IV

3:00 p.m.–4:50 p.m. Room 06, Northside Hall

3:00 p.m. (125) *The group $NK_0(Z\pi)$ is a Noetherian M_1-module if π is a finite group.*
Frank X. Connolly, University of Notre Dame, and **Mário Da Silva***, Indiana University, South Bend, and University of Federal Fluminense, Brazil (864-55-122)

3:30 p.m. (126) *Algebraic L-theory assembly.*
Andrew A. Ranicki, Edinburgh University, Scotland (864-57-77) (Sponsored by Frank X. Connolly)

4:00 p.m. (127) *Hochschild homology traces and an n-parameter Lefschetz fixed point theorem.*
Ross Geoghegan*, State University of New York, Binghamton, and **Andrew Nicas**, McMaster University (864-57-89)

4:30 p.m. Informal Discussion

Saturday, March 16 (cont'd)

Special Session on Algebraic Topology, III

3:00 p.m.–5:20 p.m. Room 08, Northside Hall

3:00 p.m. (128) *The fibre of secondary suspension.*
B. Gray, University of Illinois, Chicago, **M. Mahowald** and **R. Thompson***, Northwestern University (864-55-11)

3:30 p.m. (129) *A Hopf type construction for iterated loop spaces.* Preliminary report.
Michael Slack*, University of Virginia, and **Frank Williams**, New Mexico State University, Las Cruces (864-55-05)

4:00 p.m. (130) *Higher Reidemeister torsion and parametrized Morse theory.* Preliminary report.
John R. Klein, University of Siegen, Federal Republic of Germany (864-57-107) (Sponsored by Anthony D. Elmendorf)

4:30 p.m. (131) *$\mathbf{Z}\Sigma_*$-Hopf algebras and unstable homotopy classes of maps.* Preliminary report.
Christopher Stover, University of Chicago (864-55-12)

5:00 p.m. (132) *Functors of homotopy groups and composite functors.* Preliminary report.
David Blanc, Northwestern University (864-55-04)

Special Session on Non-commutative Ring Theory, IV

3:00 p.m.–4:20 p.m. Room 05, Northside Hall

3:00 p.m. (133) *A Galois correspondence for modules over Hopf algebras.* Preliminary report.
Jeffrey Bergen, DePaul University (864-16-115)

3:30 p.m. (134) *Nonabelian group actions and the Connes spectrum.*
James Osterburg*, University of Cincinnati, and **D. S. Passman**, University of Wisconsin, Madison (864-16-105)

4:00 p.m. (135) *A Connes spectrum for Hopf algebras.*
James Osterburg, University of Cincinnati, **D. S. Passman**, University of Wisconsin, Madison, and **Declan Quinn***, Syracuse University (864-16-103)

Special Session on Hilbert Spaces of Analytic Functions, IV

3:00 p.m.–5:20 p.m. Room 107, Northside Hall

3:00 p.m. (136) *Cyclic and chaotic properties of composition operators.*
Paul S. Bourdon, Washington & Lee University, and **Joel H. Shapiro***, Michigan State University (864-47-31)

3:30 p.m. (137) *Hermitian geometry of invariant subspaces.* Preliminary report.
Keren Yan, Indiana University-Purdue University, Indianapolis (864-47-43)

4:00 p.m. (138) *The commutant of multiplication by z on the closure of polynomials in $L^t(\mu)$.*
Robert Olin* and **Liming Yang**, Virginia Polytechnic Institute and State University (864-47-80)

4:30 p.m. (139) *Removable sets and Sobolev spaces.*
Robert Kaufman, University of Illinois, Urbana-Champaign (864-30-34)

5:00 p.m. (140) *A space of analytic functions.* Preliminary report.
Thomas L. Kriete, III, University of Virginia (864-46-57)

Special Session on Probability and Prediction Theory, IV

3:00 p.m.–5:50 p.m. Room 013, Northside Hall

3:00 p.m. (141) *On the law of large numbers for the bootstrap mean.*
Sándor Csörgő, University of Michigan, Ann Arbor (864-60-46) (Sponsored by Mohsen Pourahmadi)

3:30 p.m. (142) *Inequalities for partial sums of multi-dimensional arrays of independent random vectors.*
Nasrollah Etemadi, University of Illinois, Chicago (864-60-65)

4:00 p.m. (143) *Marcinkiewicz strong laws of large numbers for random fields in Banach spaces.*
Robert L. Taylor, University of Georgia (864-60-40)

4:30 p.m. (144) *Some strong laws of large numbers for sums of random elements.*
André Adler, Illinois Institute of Technology, **Andrew Rosalsky***, University of Florida, and **Robert L. Taylor**, University of Georgia (864-60-28)

5:00 p.m. (145) *Almost sure limit theorems for normalized sums of random variables.*
Andre Adler, Illinois Institute of Technology (864-60-44)

5:30 p.m. (146) *Symmetry groups for random vectors.*
Mark M. Meerschaert, Albion College (864-60-17) (Sponsored by John A. Wenzel)

Andy Roy Magid
Associate Secretary
Norman, Oklahoma

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.
• AMS Invited Lecturer * AMS Special Session Speaker

Tampa, Florida
University of South Florida, Tampa
March 22–23

Program

The eight-hundred-and-sixty-fifth meeting of the American Mathematical Society will be held at the University of South Florida (USF), Tampa, Florida, on Friday, March 22, and Saturday, March 23, 1991. All scientific sessions will be held in the Chemistry, Engineering and Math/Physics buildings.

Invited Addresses

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

Josefina Alvarez, New Mexico State University, *The Weyl functional calculus.*

Ronald A. DeVore, University of South Carolina, Columbia, *Wavelet compression.*

Michel L. Lapidus, University of California, Riverside and Yale University, *Can one hear the shape of a fractal drum? From the Weyl-Berry conjecture to the Riemann hypothesis.*

Donald St. P. Richards, University of Virginia, *Hypergeometric functions on domains of positivity and applications.*

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:

Harmonic analysis and applications, **Josefina Alvarez**.

Mathematical issues in biologically motivated computing, **W. Edwin Clark**, **Joseph L. Liang**, **Gregory L. McColm**, **John F. Pedersen**, and **W. Richard Stark**, University of South Florida, Tampa.

Approximation theory, **Ronald A. Devore**; **Edward B. Saff** and **B. Shekhtman**, University of South Florida, Tampa.

Finite groups and related topics, **David A. Drake**, **Chat Yin Ho**, and **Geoffrey R. Robinson**, University of Florida.

Differential geometry and mathematical physics, **Paul E. Ehrlich** and **Stephen J. Summers**, University of Florida.

Several complex variables, **Paul M. Gauthier**, University of Montreal.

Microcomputers and workstations in mathematics: Teaching and research, **Ladnor D. Geissinger**, **William H. Graves**, and **L. Senechal**, Institute for Academic Computing, University of North Carolina, Chapel Hill.

Probability on algebraic and topological structures, **Joseph Glover** and **Arunava Mukherjea**, University of South Florida, Tampa.

Fractal and spectral geometry, **Michel L. Lapidus**; and **Robert S. Strichartz**, Cornell University.

Operator methods for control problems, **Sung J. Lee** and **Y. C. You**, University of South Florida, Tampa.

Nonlinear boundary value problems, **R. Kent Nagle** and **Mary E. Parrott**, University of South Florida, Tampa.

Hypergeometric functions on domains of positivity, Jack, polynomials, and applications, **Donald St. P. Richards**.

Contributed Papers

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

Council

The Council of the Society will meet at 7:00 p.m. on Thursday, March 21, 1991, at the Holiday Inn - Busch Gardens, 2701 E. Fowler Avenue, Tampa, FL 33612.

Registration

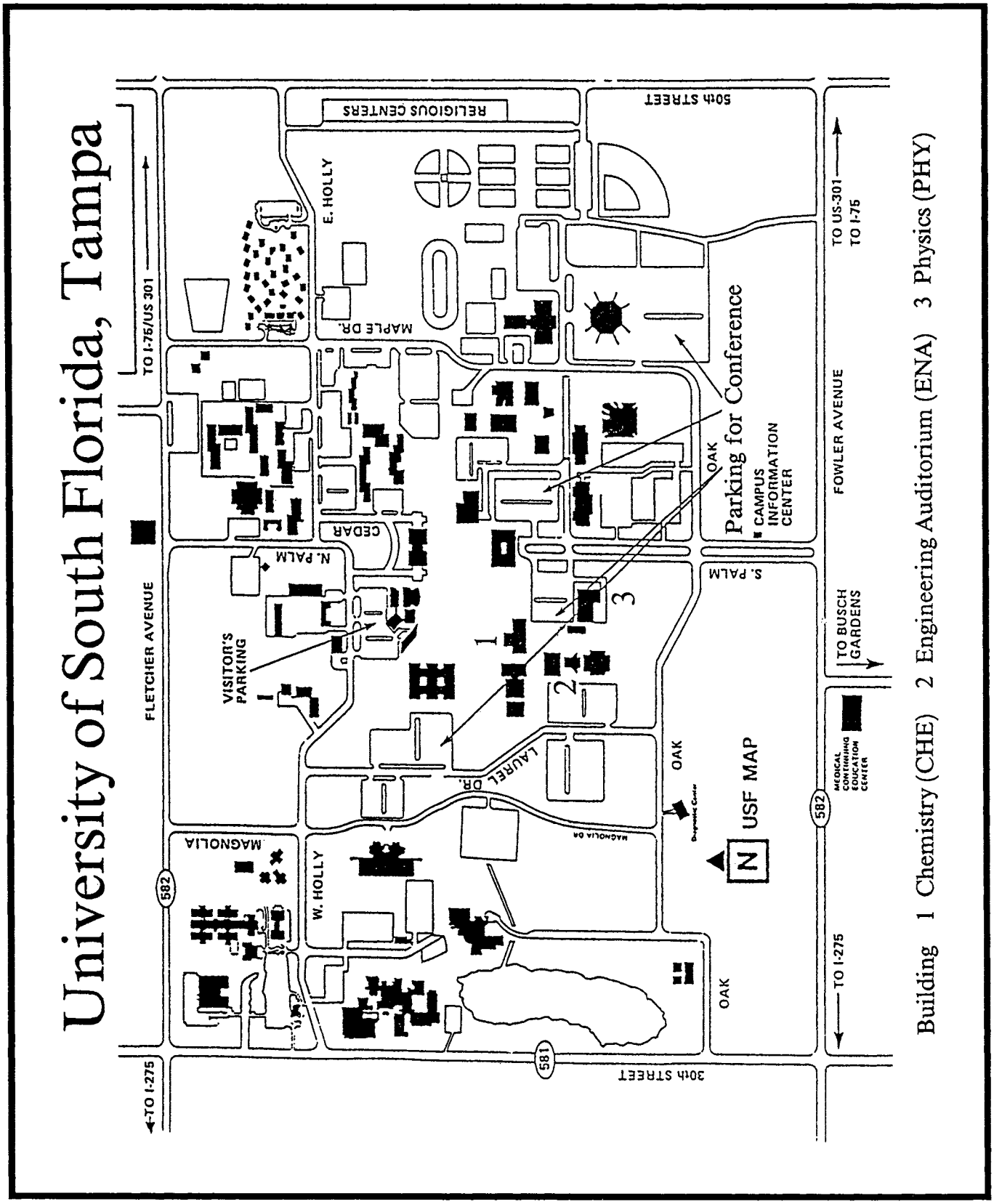
The registration desk will be located in the lobby of the Math/Physics building and will be open from 8:00 a.m. to 5:00 p.m. on Friday, March 22, and from 8:00 a.m. to noon on Saturday, March 23. The registration fees are $30 for members of the AMS, $45 for nonmembers, and $10 for students or unemployed 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 San Francisco meeting announcement in the October 1990 issue of *Notices*.

Accommodations

Rooms have been blocked for participants at the following hotels or motels in the area. Because of the large number of tourists during the winter months, hotel/motel reservations



Building 1 Chemistry (CHE) 2 Engineering Auditorium (ENA) 3 Physics (PHY)

should be made as soon as possible. Participants should make their own reservations directly and mention the AMS meeting. **The AMS is not responsible for rate changes or the accommodations offered by these hotels.** All rates are subject to a ten percent sales tax.

Embassy Suites Hotel (.5 miles from campus)
11310 North 30th Street, Tampa, FL 33612
Telephone: 1-800-EMBASSY
Deadline for reservations is March 7.

Single $79 Double $89
Complimentary full breakfast and cocktail reception, pool and jacuzzi, free shuttle service up to a three mile radius, and free parking.

Holiday Inn - Busch Gardens (1/4 mile from campus)
2701 E. Fowler Avenue, Tampa, FL 33612
Telephone: 1-800-99-BUSCH
Deadline for reservations is March 1.

Single $65 Double $65

Shoney's Inn - Tampa (2.5 miles from campus)
8602 Morris Bridge Road, Tampa, FL 33617
Telephone: 1-800-222-2222
Deadline for reservations is March 5.

One-Four People $43 – $45
Complimentary coffee and cocktail reception, pool, and free parking.

Quality Suites Busch Gardens (1/2 mile from campus)
3001 University Center Drive, Tampa, FL 33612
Telephone: 1-800-228-5151
Deadline date for reservations is March 1.

Suites (One-Four persons) $69
Complimentary buffet breakfast and cocktail reception, pool, and free parking.

Food Service

The University Center Food Service will keep the Empty Keg open from 11:00 a.m. to 2:00 p.m. for conference participants. The Empty Keg is located in the basement of the University Center which is within short walking distance of the meeting rooms. The Empty Keg offers a soup and salad bar, pizza, and various sandwich platters. Also open in the University Center from 7:30 a.m until 3:00 p.m. will be Sweet Sensations, a pastry and coffee shop. Complete listings of other restaurants will be available at the meeting registration desk.

Parking

Free parking will be available to conference participants in lots 8A and 8B on the campus of USF. These lots are in close proximity to the conference site.

Travel and Local Information

Tampa International Airport (TIA) is served by all major airlines and located 15 miles from the USF campus. Travel to the campus can be secured by calling Tampa Tours (telephone 813-621-6667) prior to arrival and giving the date, airline, flight number, and estimated time of arrival. The cost is $9 for one person one-way, $7 each for two to four persons one-way, and $30 for five to ten people one-way. Other transportation from TIA to USF can be obtained through limousine service (Mannone's Limousine Service @ 813-932-1797 or Limo Inc. @ 1-800-282-6817) or taxi. The cost of a taxi is approximately $24. Most major car rental companies have agencies at Tampa International Airport. Directions for participants driving to the meeting are as follow:

If traveling by automobile, participants should take I-75 around Tampa and exit west at either the Fletcher Avenue or the Fowler Avenue exit. The university is approximately three miles west. The campus can also be reached by taking I-275 through Tampa and exiting east on either Fletcher Avenue or Fowler Avenue. The university is approximately one-and-one-half miles to the east. Bus service is available around the university by Hartline and bus schedules will be made available at the meeting registration desk.

FROM THE AIRPORT: Participants should take Memorial Highway south to Interstate 275 and exit north to Fowler Avenue directly to USF.

Weather and Local Attractions

The weather in Tampa in March is usually mild. The average maximum temperature is 76.1°F and the average minimum temperature is 57.2°F. The average rainfall for March is three inches.

Beaches, golf courses, Busch Gardens, Disney World, and many other attractions are located within an hour's drive of the Tampa area.

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 March 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, March 22

Special Session on Harmonic Analysis and Applications, I

8:00 a.m.–10:30 a.m. Room 202, Chemistry Building

8:00 a.m. (1) *Some dimension results.* Preliminary report.
Anca Deliu, Georgia Institute of Technology (865-41-132)

8:40 a.m. (2) *Extension domains for A_p weights.*
Peter Holden, Florida International University (865-42-08)

9:20 a.m. (3) *Local solvability of first order linear operators with Lipschitz coefficients.*
Jorge Hounie, Universidade Federal de Pernambuco, Cidade Universitaria, Brasil (865-35-92)

10:00 a.m. (4) *A marriage theorem with Lebesque measure.* Preliminary report.
Steve Hudson, Florida International University (865-42-02)

Special Session on Approximation Theory, I

8:00 a.m.–10:20 a.m. Room 205, Chemistry Building

8:00 a.m. (5) *Approximation of functions by polynomials in $C[-1,1]$.*
Z. Ditzian* and **D. Jiang**, University of Alberta (865-41-151)

8:30 a.m. (6) *Monotone polynomial approximation in L_p, $0 < p < 1$.*
D. Leviatan, Tel Aviv University, Israel (865-41-39)

9:00 a.m. (7) *On blending-type K-functionals.* Preliminary report.
Claudia Cottin, University of Duisburg, Federal Republic of Germany (865-41-69) (Sponsored by Ronald A. DeVore)

9:30 a.m. (8) *Recent results on global smoothness preservation.* Preliminary report.
Claudia Cottin, University of Duisburg, Federal Republic of Germany, and **Heinz H. Gonska***, European Business School, Federal Republic of Germany (865-41-189)

10:00 a.m. (9) *Best uniform appproximation by solutions of elliptic differential equations.* Preliminary report.
Paul M. Gauthier, University of Montreal, and **D. Zwick***, University of Vermont (865-41-191)

Special Session on Finite Groups and Related Topics, I

8:00 a.m.–10:50 a.m. Room 130, Physics Building

8:00 a.m. (10) *Divisible codes and representations.*
Harold N. Ward, University of Virginia (865-94-100)

8:30 a.m. (11) *Hermitian and Ree unitals and their codes.*
E. F. Assmus, Jr., Lehigh University (865-20-53)

9:00 a.m. (12) *The Jamison method in Galois geometries.*
A. A. Bruen*, University of Western Ontario, and **J. C. Fisher**, University of Regina (865-05-144) (Sponsored by Chat Yan Ho)

9:30 a.m. (13) *Hyperplanes and embeddings of point-line geometries.* Preliminary report.
E. E. Shult, Kansas State University (865-51-140)

10:00 a.m. (14) *Primitive permutation characters.*
Robert M. Guralnick*, University of Southern California, and **Jan Saxl**, Princeton University (865-20-97)

10:30 a.m. (15) *The absolute Galois group of a Hilbertian PRC-field.* Preliminary report.
Helmut Völklein*, University of Florida, and **Michael Fried**, University of California, Irvine (865-11-89)

Special Session on Operator Methods for Control Problems, I

8:00 a.m.–10:50 a.m. Room 120, Physics Building

8:00 a.m. (16) *Controllability of distributed systems.* Preliminary report.
Lawrence Markus, University of Minnesota, Minneapolis (865-93-05) (Sponsored by Yuncheng You)

9:00 a.m. (17) *Mathematical controllability theory of capital growth of nations.*
E. N. Chukwu, North Carolina State University (865-93-173)

9:40 a.m. (18) *RKH space methods for identification of linear stochastic systems: A factorization approach.* Preliminary report.
Robert E. Fennell* and **James A. Reneke**, Clemson University (865-93-83)

10:20 a.m. (19) *Exact controllability of dynamic von Karman plates.*
John E. Lagnese, Georgetown University (865-93-43)

Friday, March 22 (cont'd)

Special Session on Hypergeometric Functions on Domains of Positivity, Jack Polynomials, and Applications, I

8:00 a.m.–10:30 a.m. Room 105, Chemistry Building

8:00 a.m. (20) *Multivariate statistics in polymer physics.*
Bruce Eichinger, Biosym Technologies, Inc., San Diego and University of Washington (865-33-139)
(Sponsored by Donald St. P. Richards)

8:40 a.m. (21) *Positive bilinear forms on polynomials with a reflection group invariance property.*
Charles F. Dunkl, University of Virginia (865-33-84)
(Sponsored by Donald St. P. Richards)

9:20 a.m. (22) *Analytic continuation of the hypergeometric function of a matrix variable.*
Jacques Faraut, Universite Pierre et Marie Curie, France (865-33-91)

10:00 a.m. (23) *A Markov chain on the symmetric group and Jack's symmetric functions.*
Phil Hanlon, University of Michigan, Ann Arbor (865-05-87)

Special Session on Differential Geometry and Mathematical Physics, I

9:00 a.m.–10:10 a.m. Room 118, Physics Building

9:00 a.m. (24) *Null geodesics in cosmic censorship.* Preliminary report.
John K. Beem*, University of Missouri, Columbia, and **Andrzej Krolak**, Polish Academy of Sciences, Poland (865-53-01)

9:40 a.m. (25) *Phase space symmetries and geometric quantization.*
Gerard G. Emch, University of Florida (865-53-104)

Special Session on Several Complex Variables, I

9:00 a.m.–10:50 a.m. Room 109, Physics Building

9:00 a.m. (26) *Ends of varieties.* Preliminary report.
H. Alexander, University of Illinois, Chicago (865-32-67)

9:30 a.m. (27) *On an example of Ahern and Rudin.*
John T. Anderson, College of the Holy Cross (865-32-23)

10:00 a.m. (28) *Approximation on thin sets.* Preliminary report.
Thomas Bagby*, Indiana University, Bloomington, and **P. M. Gauthier**, Université de Montréal (865-32-37)

10:30 a.m. (29) *Levi-flat hypersurfaces and averaging problems.*
David E. Barrett, University of Michigan, Ann Arbor (865-32-44)

Special Session on Probability on Algebraic and Topological Structures, I

9:00 a.m.–10:50 a.m. Room 108, Physics Building

9:00 a.m. (30) *Multiplicative symmetry groups of Markov processes.*
Joseph Glover and **Renming Song***, University of Florida (865-60-28)

9:30 a.m. (31) *Symmetry groups of Markov processes.* Preliminary report.
Ming Liao, Auburn University, Auburn (865-60-16)
(Sponsored by Jerry A. Veeh)

10:00 a.m. (32) *A multidimensional Feller program.*
Joseph C. Watkins, University of Southern California (865-60-107)

10:30 a.m. (33) *Markov functions.*
Joseph Glover, University of Florida (865-60-52)

Special Session on Fractal and Spectral Geometry, I

9:00 a.m.–10:50 a.m. Room 101, Chemistry Building

9:00 a.m. (34) *IFS's, compact semigroups, and topological contractions.*
P. F. Duvall, Jr., University of North Carolina, Greensboro, **J. W. Emert**, Ball State University, and **L. S. Husch***, University of North Carolina, Greensboro (865-54-26)

9:40 a.m. (35) *Iterated function systems with applications to wavelet bases and the inverse fractal probelm.*
J. S. Geronimo, Georgia Institute of Technology (865-54-174)

10:20 a.m. (36) *Fractal functions and multiresolution analyses.*
Douglas Hardin, **Bruce Kessler** and **Peter R. Massopust***, Vanderbilt University (865-41-74)

Special Session on Nonlinear Boundary Value Problems, I

9:00 a.m.–10:20 a.m. Room 102, Chemistry Building

9:00 a.m. (37) *Permanence in some reaction-diffusion models from ecology.* Preliminary report.
R. S. Cantrell, **C. Cosner***, University of Miami, and **V. C. L. Hutson**, University of Sheffield, United Kingdom (865-35-114)

9:30 a.m. (38) *A singular parabolic problem.* Preliminary report.
Jerome A. Goldstein, Tulane University and Mathematical Sciences Research Institute, Berkeley (865-35-116)

10:00 a.m. (39) *Existence and regularity for a singular parabolic problem.*
Gisele Ruiz Rieder* and **J. R. Dorroh**, Louisiana State University, Baton Rouge (865-35-178)

Special Session on Mathematical Issues in Biologically Motivated Computing, I

9:00 a.m.–10:50 a.m. Room 104, Chemistry Building

9:00 a.m. (40) *Controlling chaos in distributed systems.*
Bernado Huberman, Xerox PARC, Palo Alto, California and Stanford University (865-68-159) (Sponsored by W. Richard Stark)

10:00 a.m. (41) *The possible role of ascendency in neural networks.*
Ken Bosworth* and **Bob Ulanowicz**, Chesapeake Biological Laboratory, University of Maryland, Solomons (865-68-169) (Sponsored by W. Richard Stark)

10:30 a.m. (42) *Evolving transformation systems: A new symbiosis of the discrete and the continuous.*
Lev Goldfarb, University of New Brunswick, Fredericton (865-68-35) (Sponsored by Joseph J. Liang)

Invited Address

11:00 a.m.–noon Room 101, Chemistry Building

(43) *Can one hear the shape of a fractal drum? From the Weyl-Berry conjecture to the Riemann hypothesis.*
Michel L. Lapidus, University of California, Riverside and Yale University (865-35-45)

Invited Address

1:00 p.m.–2:00 p.m. Room 101, Chemistry Building

(44) *The Weyl functional calculus.*
Josefina Alvarez, New Mexico State University (865-47-46)

Special Session on Harmonic Analysis and Applications, II

2:10 p.m.–4:00 p.m. Room 202, Chemistry Building

2:10 p.m. (45) *Weighted inequalities for the Fourier transform.* Preliminary report.
H. Heinig, McMaster University, and **R. Johnson***, University of Maryland, College Park (865-42-133)

2:50 p.m. (46) *On the continuity of solutions to certain elliptic equations.* Preliminary report.
Craig A. Nolder, Florida State University (865-35-131) (Sponsored by Josefina Alvarez)

3:30 p.m. (47) *Some operators on the classical Hardy spaces.*
Aristomenis Siskakis, University of Thessaloniki, Greece and New Mexico State University, Las Cruces (865-30-59)

Special Session on Approximation Theory, II

2:10 p.m.–4:30 p.m. Room 205, Chemistry Building

2:10 p.m. (48) *Sub-exponential growth of solutions of difference equations.*
Doron S. Lubinsky, University of Witwatersrand, Republic of South Africa, and **Paul Nevai***, Ohio State University, Columbus (865-39-96)

2:40 p.m. (49) *Zeros of orthogonal polynomials.*
Vilmos Totik, University of South Florida (865-33-190)

3:10 p.m. (50) *Polynomials orthogonal on the unit circle with random reflection coefficients.*
J. S. Geronimo, Georgia Institute of Technology (865-30-175)

3:40 p.m. (51) *On Markov's inequality on* **R** *for the Hermite weight.*
X. Li*, **R. N. Mohapatra** and **R. S. Rodriguez**, University of Central Florida (865-41-120)

4:10 p.m. (52) *Müntz theorem on closed sets with positive measure.*
Peter Borwein, Dalhousie University, and **Tamás Erdélyi***, Ohio State University, Columbus (865-41-124)

Special Session on Finite Groups and Related Topics, II

2:10 p.m.–4:20 p.m. Room 130, Physics Building

2:10 p.m. (53) *Nielsen separation: Distinct orbits of $G(\overline{\mathbb{Q}}/\mathbb{Q})$ actions detected by representation theory.*
Michael D. Fried, University of California, Irvine (865-20-179)

2:40 p.m. (54) *Extended generalized polygons.*
Richard M. Weiss, Tufts University (865-20-78)

3:10 p.m. (55) *On loop rings and codes of nets.* Preliminary report.
G. Eric Moorhouse, University of Wyoming (865-17-79) (Sponsored by Chat Yan Ho)

3:40 p.m. (56) *Projective planes with regular collineation group and a question of prime power.* Preliminary report.
Chat Yin Ho, University of Florida (865-20-122)

Special Session on Differential Geometry and Mathematical Physics, II

2:10 p.m.–4:40 p.m. Room 118, Physics Building

2:10 p.m. (57) *On the topology of black holes.*
Gregory J. Galloway, University of Miami (865-83-167)

2:50 p.m. (58) *Control theory and centro-affine geometry.* Preliminary report.
Robert Gardner, University of North Carolina, Chapel Hill (865-93-102)

3:30 p.m. (59) *Geometry near the boundary of some Yang-Mills moduli spaces.* Preliminary report.
David Groisser, University of Florida (865-53-76)

4:10 p.m. (60) *A bosonic version of the Krichever correspondence.* Preliminary report.
Mitchell Rothstein, University of Georgia (865-35-171)

Friday, March 22 (cont'd)

Special Session on Several Complex Variables, II

2:10 p.m.–3:30 p.m. Room 109, Physics Building

2:10 p.m. (61) *Contact geometry and CR structures on S^3.*
John Bland, University of Toronto (865-32-68)

2:40 p.m. (62) *Holomorphic approximation of CR functions on tubular submanifolds of $\mathbb{C}^2$.*
Andre Boivin, University of Western Ontario, and **Roman Dwilewicz***, University of Warsaw, Poland (865-32-42)

3:10 p.m. Informal Discussion

Special Session on Probability on Algebraic and Topological Structures, II

2:10 p.m.–3:30 p.m. Room 108, Physics Building

2:10 p.m. (63) *Eigenvalue bounds on convergence to stationarity for nonreversible Markov chains, with an application to the exclusion process.*
James Allen Fill, Johns Hopkins University, Baltimore (865-60-94)

2:40 p.m. (64) *Symmetries on random arrays and set-indexed process.* Preliminary report.
Olav Kallenberg, Auburn University, Auburn (865-60-19) (Sponsored by Jerry A. Veeh)

3:10 p.m. (65) *Weak convergence of probability measures on semigroups.* Preliminary report.
Gregory Budzban, Martin Marietta Aerospace, Orlando, Florida (865-60-117)

Special Session on Fractal and Spectral Geometry, II

2:10 p.m.–5:20 p.m. Room 101, Chemistry Building

2:10 p.m. (66) *On negative dimensions for fractal sets and for multifractal measures.*
Benoit B. Mandelbrot, IBM T.J. Watson Research Center, Yorktown Heights, New York and Yale University (865-28-186)

2:50 p.m. (67) *The Riemann zeta function and the one-dimensional Weyl-Berry conjecture for fractal drums.*
Michel Lapidus, University of California, Riverside, and **Carl Pomerance***, University of Georgia (865-11-73)

3:30 p.m. (68) *The Riemann hypothesis, vibrating fractal strings and the modified Weyl-Berry conjecture.* Preliminary report.
Michel L. Lapidus, University of California, Riverside, and **Helmut Maier***, University of Georgia (865-11-50)

4:10 p.m. (69) *Integration on continuously embedded manifolds.* Preliminary report.
Jenny Harrison, Mathematical Sciences Research Institute, Berkeley (865-58-129)

4:50 p.m. (70) *Counting and distribution problems in fractal geometry.*
Steven P. Lalley, Purdue University, West Lafayette (865-30-181) (Sponsored by Robert S. Strichartz)

Special Session on Operator Methods for Control Problems, II

2:10 p.m.–4:40 p.m. Room 102, Chemistry Building

2:10 p.m. (71) *Uniform decay rates for the solutions of semilinear wave equation with nonlinear boundary damping.*
Irena Lasiecka, University of Virginia (865-35-58)

2:50 p.m. (72) *Rational approximations of infinite dimensional systems.* Preliminary report.
E. B. Lee, University of Minnesota, Minneapolis (865-49-177) (Sponsored by Yuncheng You)

3:30 p.m. (73) *A minimax problem for semilinear nonlocal competitive systems.*
Suzanne Lenhart*, University of Tennessee, Knoxville, **Vladimir Protopopescu**, Oak Ridge National Laboratory, Tennessee, and **Srdjan Stojanovic**, University of Cincinnati (865-35-14)

4:10 p.m. (74) *What's new in boundary control theory of PDE's.*
Walter Littman, University of Minnesota, Minneapolis (865-35-82)

Special Session on Hypergeometric Functions on Domains of Positivity, Jack Polynomials, and Applications, II

2:10 p.m.–6:40 p.m. Room 105, Chemistry Building

2:10 p.m. (75) *Operator-valued Bessel functions on symmetric cones.*
Hongming Ding and **Kenneth I. Gross***, University of Vermont (865-33-152)

2:50 p.m. (76) *Finite field analogues of Bessel and Legendre functions for $GL(n)$ and applications in graph theory.*
Audrey Terras, University of California at San Diego, La Jolla (865-11-03)

3:30 p.m. (77) *Identitites for generalized hypergeometric coefficients.* Preliminary report.
L. C. Biedenharn, Duke University (865-33-153)

4:10 p.m. (78) *Degenerate principal series on tube type domains.* Preliminary report.
Kenneth D. Johnson, University of Georgia (865-22-86)

4:50 p.m. (79) *A constant term orthogonality for the Jack symmetric functions.* Preliminary report.
Kevin W. J. Kadell, Arizona State University (865-33-154) (Sponsored by Donald St. P. Richards)

5:30 p.m. (80) *Variation on a theme of Macdonald.*
G. J. Heckman, Catholic University, The Netherlands, **R. Brussee** and **E. M. Opdam***, University of Leiden, The Netherlands (865-33-25) (Sponsored by Donald St. P. Richards)

6:10 p.m. (81) *Associated continuous Hahn polynomials.*
David R. Masson, University of Toronto (865-33-127)

General Session, I

2:10 p.m.–4:35 p.m. Room 120, Physics Building

2:10 p.m. (82) *C^∞ functions with convergent Taylor series.* Preliminary report.
T. I. Ramsamujh, Florida International University (865-04-15)

2:25 p.m. (83) *On the constructions of designs.* Preliminary report.
D. K. Ray-Chaudhuri and **Tianbao Zhu***, Ohio State University, Columbus (865-05-06)

2:40 p.m. (84) *On double stirling asymptotic formula.*
R. Y. Song* and **J. R. Quine**, Florida State University (865-11-12)

2:55 p.m. (85) *Some remarks on primal ideals of the polynomial ring and power series ring.* Preliminary report.
J. H. Kim, East Carolina University (865-13-57)

3:10 p.m. (86) *A new look at the rationals.* Preliminary report.
Anthony J. D'Aristotile*, State University of New York, College at Plattsburgh, and **Orrin Frink**, Kennebunkport, Maine (865-16-63)

3:25 p.m. (87) *On the number of conjugacy classes in finite groups.* Preliminary report.
Edward A. Bertram, University of Hawaii, Manoa (865-20-123)

3:40 p.m. (88) *Support points of subordination families.*
Shelton Perera, Union College (865-30-135)

3:55 p.m. (89) *The solution of a boundary value problem for a differential equation of nth order in a weighted Lebesque class.*
Salah A. Emara, American University in Cairo, Egypt (865-34-119)

4:10 p.m. (90) *Bound and tight extensions of a normed space.*
N. V. Rao, University of Toledo (865-46-182)

4:25 p.m. (91) *Equivalent composition operators.*
Randall K. Campbell-Wright, University of Tampa (865-47-62)

Special Session on Mathematical Issues in Biologically Motivated Computing, II

2:40 p.m.–4:00 p.m. Room 104, Chemistry Building

2:40 p.m. (92) *Emergent computation, genetic algorithms, and the immune system.*
Stephanie Forrest, University of New Mexico (865-68-168) (Sponsored by W. Richard Stark)

3:10 p.m. (93) *Periodic behaviors of deterministic interactionless Lindenmayer systems.*
Tom Head, State University of New York, Binghamton (865-68-166)

3:40 p.m. (94) *Evolution as a theme in artificial life.*
David Jefferson, University of California, Los Angeles (865-68-165) (Sponsored by John F. Pedersen)

Saturday, March 23

Special Session on Harmonic Analysis and Applications, III

8:00 a.m.–10:30 a.m. Room 202, Chemistry Building

8:00 a.m. (95) *Week type* (1, 1) *estimates for some extension operators related to rough maximal functions.*
Peter Sjögren, Chalmers University of Technology, Sweden, and **Fernando Soria***, Institute for Advanced Study (865-42-60)

8:40 a.m. (96) *Absolute continuity of elliptic-caloric measure.* Preliminary report.
Caroline Sweezy, New Mexico State University, Las Cruces (865-42-61)

9:20 a.m. (97) *Robust quantities in partial differential equations.*
Luc Tartar, Carnegie Mellon University (865-35-134) (Sponsored by Irene Fonseca)

10:00 a.m. (98) *The Winer test for semi-linear elliptic PDE.* Preliminary report.
David R. Adams, University of Kentucky (865-35-11)

Special Session on Finite Groups and Related Topics, III

8:00 a.m.–10:50 a.m. Room 130, Physics Building

8:00 a.m. (99) *Goupoids and buildings.*
Curtis Bennett, Michigan State University (865-20-101)

8:30 a.m. (100) *Chains of subgroups in Lie type groups.*
Douglas Brozovic, Ohio State University, Columbus (865-20-27)

9:00 a.m. (101) *Character degree divisibility in the Glauberman correspondence.* Preliminary report.
B. Hartley, University of Manchester, England, and **A. Turull***, University of Florida (865-20-145)

9:30 a.m. (102) *Finite subgroups of Lie groups.*
Robert L. Griess, Jr., University of Michigan, Ann Arbor (865-20-158)

10:00 a.m. (103) *Block-theoretic invariants.* Preliminary report.
Geoffrey Robinson, University of Florida (865-20-77)

10:30 a.m. (104) *Quadratic modules in even characteristic.*
Ulrich Meierfrankenfeld*, Michigan State University, and **G. Stroth**, Free University of Berlin, Federal Republic of Germany (865-20-172)

Special Session on Hypergeometric Functions on Domains of Positivity, Jack Polynomials, and Applications, III

8:00 a.m.–10:30 a.m. Room 105, Chemistry Building

8:00 a.m. (105) *Generalized hypergeometric functions in several variables.*
Zhimin Yan, University of California, Irvine (865-33-85)

8:40 a.m. (106) *Combinatorial properties of Jack symmetric functions.*
Richard P. Stanley, Massachusetts Institute of Technology (865-33-51)

9:20 a.m. (107) *Operator-valued Bessel functions on Schroedinger-Fock spaces and Siegel domains of type* II, *and applications to representation theory.*
Hongming Ding, University of Vermont (865-33-148)

10:00 a.m. (108) *Random walks and zonal polynomials.*
Persi Diaconis, Harvard University (865-60-146) (Sponsored by Donald St. P. Richards)

Saturday, March 23 (cont'd)

Special Session on Approximation Theory, III

9:00 a.m.–10:50 a.m. Room 205, Chemistry Building

9:00 a.m. (109) *Interpolation by periodic radial functions.*
Yuan Xu and **E. W. Cheney***, University of Texas, Austin (865-41-185)

9:30 a.m. (110) *Robustness of scattered-data interpolation matrices.*
Joseph D. Ward, Texas A & M University, College Station (865-41-99)

10:00 a.m. (111) *On the 4/3 conjecture.*
B. L. Chalmers*, **F. T. Metcalf**, University of California, Riverside, **B. Shekhtman**, University of South Florida, and **Y. Shekhtman**, Los Angeles, California (865-41-70)

10:30 a.m. (112) *The Pólya algorithm as a metric selection.*
Robert Huotari, Idaho State University (865-41-55)

Special Session on Differential Geometry and Mathematical Physics, III

9:00 a.m.–10:10 a.m. Room 118, Physics Building

9:00 a.m. (113) *Local cohomology in gauge theories, BRST transformations and anomalies.*
Rudolf Schmid, Emory University (865-81-121)

9:40 a.m. (114) *Quasi-Hopf algebras, differential analogs and beyond.*
Jim Stasheff, University of North Carolina, Chapel Hill (865-81-188)

Special Session on Several Complex Variables, III

9:00 a.m.–10:50 a.m. Room 109, Physics Building

9:00 a.m. (115) *Kernels for the $\overline{\partial}$-Neumann problem.* Preliminary report.
Kyoko Kimura, University of South Carolina, Columbia (865-35-192)

9:30 a.m. (116) *Harmonic analysis on domains.*
Steven G. Krantz, Washington University (865-31-10)

10:00 a.m. (117) *Multi-dimensional manifolds in uniform algebra spectra.*
Toma Tonev, University of Toledo (865-32-18)

10:30 a.m. (118) *Pick interpolation on a uniform algebra.*
Brian Cole, **Keith Lewis** and **John Wermer***, Brown University (865-46-22)

Special Session on Microcomputers and Workstations in Mathematics: Teaching and Research, I

9:00 a.m.–10:50 a.m. Room 203, Chemistry Building

9:00 a.m. (119) *New software for interactive computer graphics in introductory differential geometry.*
Thomas Banchoff, Brown University (865-53-98)

9:40 a.m. (120) *Adding a laboratory component to elementary differential equations.*
Andrew G. Bennett, Kansas State University (865-98-105)

10:20 a.m. (121) *Mathematics, micros and undergraduate courses.*
James William Bruce, Mount Holyoke College and University of Liverpool, United Kingdom (865-98-115) (Sponsored by Lester J. Senechal)

Special Session on Probability on Algebraic and Topological Structures, III

9:00 a.m.–10:50 a.m. Room 108, Physics Building

9:00 a.m. (122) *Semigroups, attractors and random matrices: An interplay.* Preliminary report.
Arunava Mukherjea, University of South Florida (865-60-137)

9:30 a.m. (123) *Order independence and factor convergence in iterative scaling.*
A. O. Pittenger, University of Maryland, Baltimore County (865-60-66)

10:00 a.m. (124) *Martingales in manifolds: Dimension-free estimates of first passage times.*
R. W. R. Darling, University of South Florida (865-60-65) (Sponsored by Gregory L. McColm)

10:30 a.m. (125) *Some classical inequalities revisited.*
Murali Rao, University of Florida, and **Hrvoje Šikić***, University of Florida and University of Zagreb, Yugoslavia (865-26-64)

Special Session on Fractal and Spectral Geometry, III

9:00 a.m.–10:50 a.m. Room 101, Chemistry Building

9:00 a.m. (126) *Local connectivity results in complex dynamics.*
John H. Hubbard, Cornell University (865-58-180)

9:40 a.m. (127) *The scenery flow for hyperbolic Julia sets.* Preliminary report.
Tim Bedford, Delft University of Technology, Netherlands, **Albert Fisher***, Yale University, and **Mariusz Urbanski**, University of Gottingen, Federal Republic of Germany (865-28-130) (Sponsored by Michel L. Lapidus)

10:20 a.m. (128) *Dimension results and problems for deterministic and random sets.*
R. Daniel Mauldin, University of North Texas (865-28-176)

Special Session on Operator Methods for Control Problems, III

9:00 a.m.–10:50 a.m. Room 120, Physics Building

9:00 a.m. (129) *Multivalued adjoints in optimal control theory.*
M. Zuhair Nashed, University of Delaware (865-49-184)

9:40 a.m. (130) *A question of well-posedness for certain control systems.* Preliminary report.
Richard Datko, Georgetown University (865-93-21) (Sponsored by Sung J. Lee)

10:20 a.m. (131) *Stochastic differential games with a small parameter.* Preliminary report.
K. M. Ramachandran*, University of South Florida, and **G. Yin**, Wayne State University (865-93-110)

Special Session on Nonlinear Boundary Value Problems, II

9:00 a.m.–10:50 a.m. Room 102, Chemistry Building

9:00 a.m. (132) *Boundness and decay results.* Preliminary report.
W. E. Fitzgibbon, University of Houston, University Park (865-35-56)

9:30 a.m. (133) *Stable steady-state solutions on catalyst surfaces.*
Nela Lakos* and **David Terman**, Ohio State University, Columbus (865-35-32)

10:00 a.m. (134) *Boundedness and asymptotic convergence for a class of autocatalytic chemical systems.*
Sheila J. Waggoner, Furman University (865-35-72)

10:30 a.m. (135) *Linear and semilinear eigenvalue problems in R^n.* Preliminary report.
Allan L. Edelson* and **Adolfo Rumbos**, University of California, Davis (865-35-71)

Special Session on Mathematical Issues in Biologically Motivated Computing, III

9:00 a.m.–10:50 a.m. Room 104, Chemistry Building

9:00 a.m. (136) *Computation at the edge of chaos: Phase transition and emergent computation.*
Christopher Langton, Los Alamos National Laboratory (865-68-170) (Sponsored by John F. Pedersen)

10:00 a.m. (137) *Evolution of communication in a population of simple machines.*
Bruce MacLennan, University of Tennessee, Knoxville (865-68-164) (Sponsored by W. Richard Stark)

10:30 a.m. (138) *The computational complexity of discrete feedforward neural networks.*
Ian Parberry, Univesity of North Texas (865-68-163) (Sponsored by Gregory L. McColm)

Invited Address

11:00 a.m.– noon Room 101, Chemistry Building

(139) *Hypergeometric functions on domains of positivity, and applications.*
Donald St. P. Richards, University of Virginia (865-33-17)

Invited Address

1:00 p.m.–2:00 p.m. Room 101, Chemistry Building

(140) *Wavelet compression.*
Ronald A. DeVore, University of South Carolina, Columbia (865-41-93)

Special Session on Harmonic Analysis and Applications, IV

2:10 p.m.–4:10 p.m. Room 202, Chemistry Building

2:10 p.m. (141) *Multipliers for Hardy spaces on locally compact Vilenkin groups.*
Kees Onneweer, University of New Mexico (865-43-34)

2:50 p.m. (142) *Spaces of sequences, sampling theorem, and functions of exponential type.*
Rodolfo H. Torres, Courant Institute of Mathematical Sciences, New York University (865-46-29)

3:30 p.m. Informal Discussion

Special Session on Approximation Theory, IV

2:10 p.m.–4:30 p.m. Room 205, Chemistry Building

2:10 p.m. (143) *Wavelets in low dimension.*
Sherman D. Riemenschneider* and **Zuowei Shen**, University of Alberta (865-41-150)

2:40 p.m. (144) *A direct application of wavelets to differential equations.*
R. A. Lorentz*, Gesellschaft für Mathematik und Datenverarbeitung, Federal Republic of Germany, and **W. Madych**, University of Connecticut, Storrs (865-65-30)

3:10 p.m. (145) *Convex and coconvex-probabilistic wavelet approximation.* Preliminary report.
George A. Anastassiou and **Xiang Ming Yu***, Memphis State University (865-41-183)

3:40 p.m. (146) *Splines and multiresolution analyses.*
W. R. Madych, University of Connecticut, Storrs (865-41-31) (Sponsored by Ronald A. DeVore)

4:10 p.m. (147) *The approximation order of box spline spaces.*
Amos Ron*, University of Wisconsin, Madison, and **N. Sivakumar**, Texas A & M University, College Station (865-41-141)

Saturday, March 23 (cont'd)

Special Session on Finite Groups and Related Topics, IV

2:10 p.m.–4:30 p.m. Room 130, Physics Building

2:10 p.m. (148) *Extensions of simple modules for $G_2(3^n)$ and Ree groups of type G_2.* Preliminary report.
Peter Sin, University of Florida (865-20-147)
(Sponsored by Geoffrey R. Robinson)

2:40 p.m. (149) *Vector-space embeddings of finite geometries.* Preliminary report.
Stephen D. Smith, University of Illinois, Chicago (865-20-90)

3:10 p.m. (150) *On affine planes with a 2-transitive orbit on ℓ_∞.* Preliminary report.
Yutaka Hiramine, Osaka University, Japan and University of Iowa (865-51-118) (Sponsored by Chat Yan Ho)

3:40 p.m. (151) *Bounded automorphisms of groups.*
Renfang Jiang, Washington University (865-20-156)

4:10 p.m. (152) *t-regulus nets and their collineation groups.*
Norman L. Johnson*, University of Iowa, and **Yutaka Hiramine**, Osaka University, Japan (865-05-80)
(Sponsored by Chat Yan Ho)

Special Session on Differential Geometry and Mathematical Physics, IV

2:10 p.m.–4:00 p.m. Room 118, Physics Building

2:10 p.m. (153) *The C-boundary of the final singularity.*
Frank J. Tipler, Tulane University (865-83-103)
(Sponsored by John Dauns)

2:50 p.m. (154) *Higher casual relations and nonlinear electrodynamics.*
Geoffrey Martin, University of Toledo (865-83-41)

3:30 p.m. (155) *Riemann metrics with prescribed Ricci curvature.*
Georgi I. Kamberov, Rice University (865-53-38)

Special Session on Microcomputers and Workstations in Mathematics: Teaching and Research, II

2:10 p.m.–5:20 p.m. Room 203, Chemistry Building

2:10 p.m. (156) *Exploring small groups in the classroom.*
Ladnor Geissinger, University of North Carolina, Chapel Hill (865-98-142)

2:50 p.m. (157) *Work of the geometry supercomputer project.*
Albert Marden, University of Minnesota, Minneapolis (865-98-143)

3:30 p.m. (158) *Computationally based algebraic geometry and commutative algebra.*
Donal O'Shea, Mount Holyoke College (865-13-138)

4:10 p.m. (159) *NSF-REU students get results in group theory – say CALEY essential.*
Gary J. Sherman, Rose-Hulman Institute of Technology (865-20-49)

4:50 p.m. Informal Discussion

Special Session on Probability on Algebraic and Topological Structures, IV

2:10 p.m.–3:30 p.m. Room 108, Physics Building

2:10 p.m. (160) *Markov chains with stochastically stationary transition probabilities.* Preliminary report.
Steven Orey, University of Minnesota, Minneapolis (865-60-106)

2:40 p.m. (161) *Generalized Orlicz spaces, non L_2 U-statistics, and multiple stochastic integrals.*
Jerzy Szulga, Auburn University, Auburn (865-60-108)
(Sponsored by Joseph Glover)

3:10 p.m. (162) *Stucture and moving average representation for strongly harmonizable processes.*
Marc H. Mehlman, University of Pittsburgh, Johnstown (865-60-36)

Special Session on Fractal and Spectral Geometry, IV

2:10 p.m.–5:20 p.m. Room 101, Chemistry Building

2:10 p.m. (163) *Fractal spectral asymptotics.*
Robert S. Strichartz, Cornell University (865-42-20)

2:50 p.m. (164) *Fractal measures and mean quadratic variations.* Preliminary report.
Ka-Sing Lau, University of Pittsburgh, Pittsburgh (865-45-75)

3:30 p.m. (165) *Hardy's inequality and fractal measures.*
Steve Hudson and **Mark Leckband***, Florida International University (865-42-109)

4:10 p.m. (166) *Gaussian estimates for the Laplacian with lower order terms with applications to spectral asymptotics of certain fractal measures.*
Alberto G. Setti, Cornell University (865-58-47)

4:50 p.m. (167) *Harmonic calculus on fractals.*
Jun Kigami, Osaka University, Japan (865-58-193)
(Sponsored by Michel L. Lapidus)

Special Session on Operator Methods for Control Problems, IV

2:10 p.m.–4:40 p.m. Room 102, Chemistry Building

2:10 p.m. (168) *Periodic solutions for nonlinearly coupled control problems.* Preliminary report.
Emilio O. Roxin, University of Rhode Island (865-49-112)

2:50 p.m. (169) *Riccati operator differential equations and hyperbolic mixed problems.*
R. Triggiani* and **I. Lasiecka**, University of Virginia (865-35-187)

3:30 p.m. (170) *Exponential stabilization of a nonlinear beam equation via the approach of inertial manifolds.* Preliminary report.
Yuncheng You, University of South Florida (865-35-81)

4:10 p.m. (171) *Pertubation of domains in optimal control systems.* **Bingyu Zhang**, University of Cincinnati (865-93-111)

Special Session on Nonlinear Boundary Value Problems, III

2:10 p.m.–4:00 p.m. Room 109, Physics Building

2:10 p.m. (172) *Homotopy continuation methods and bounded solutions of non-autonomous equations.* **James R. Ward**, University of Alabama, Birmingham (865-34-95)

2:40 p.m. (173) *Psuedo monotone dynamical systems on function spaces and applications.* **M. N. Nkashama**, University of Alabama, Birmingham (865-34-113)

3:10 p.m. Informal Discussion

3:40 p.m. (174) *Singular right focal boundary value problems.* **Johnny Henderson***, Auburn University, Auburn, and **Paul Eloe**, University of Dayton (865-34-04)

Special Session on Hypergeometric Functions on Domains of Positivity, Jack Polynomials, and Applications, IV

2:10 p.m.–6:00 p.m. Room 105, Chemistry Building

2:10 p.m. (175) *Special functions and representations in the Fock space.* **Ray A. Kunze**, University of Georgia (865-33-126)

2:50 p.m. (176) *Root systems and Jack polynomials.* **I. G. Macdonald**, University of California at San Diego, La Jolla (865-17-157)

3:30 p.m. (177) *Askey-Wilson polynomials for root systems of type* BC. Preliminary report. **Tom H. Koornwinder**, Centrum voor Wiskunde en Informatica, The Netherlands (865-33-88)

4:10 p.m. (178) *Unification of two types of hypergeometric functions and the related Jacobi polynomials.* **Rene J. Beerends*** and **Eric M. Opdam**, University of Leiden, Netherlands (865-33-07) (Sponsored by Donald St. P. Richards)

4:50 p.m. (179) *Analysis in nonconvex homogeneous domains and* $\bar{\partial}$*-cohomological extensions of spherical functions.* Preliminary report. **Simon G. Gindikin**, Moscow University, USSR and Rutgers University, New Brunswick (865-33-155)

5:30 p.m. (180) *The Hall-Littlewood polynomials and graded representations of* S_n. **Adriano M. Garsia**, University of California at San Diego, La Jolla (865-17-128)

General Session, II

2:10 p.m.–4:05 p.m. Room 120, Physics Building

2:10 p.m. (181) *Variational and quasi variational inequalities.* **A. H. Siddiqui**, Aligarh M. University, India (865-49-24) (Sponsored by A. K. Gaur)

2:25 p.m. (182) *Simplexes in Riemannian manifolds.* **Boris V. Dekster**, Mount Allison University (865-53-09)

2:40 p.m. (183) *Unimodality with vertex at the origin.* **Shashanka Mitra**, Pennsylvania State University, DuBois Campus (865-60-13) (Sponsored by Brian L. Weiner)

2:55 p.m. (184) *The bounded law of the iterated logarithm in Banach spaces.* Preliminary report. **Anant P. Godbole**, University of California, Santa Barbara (865-60-33)

3:10 p.m. (185) *On probabilistic transformations.* Preliminary report. **Morgan Phillips**, University of Central Florida (865-60-54) (Sponsored by Howard Sherwood)

3:25 p.m. (186) *Exchangeable trees and random distributions.* Preliminary report. **Tomasz Downarowicz**, **R. Daniel Mauldin** and **Michael G. Monticino***, University of North Texas (865-60-136)

3:40 p.m. (187) *Functions efficiently computable in parallel and distributed models.* **John Pedersen**, University of South Florida (865-68-149)

3:55 p.m. (188) *Fixedpoint logics defined by pebble games.* **Gregory L. McColm**, University of South Florida (865-68-125)

Special Session on Mathematical Issues in Biologically Motivated Computing, IV

2:40 p.m.–4:00 p.m. Room 104, Chemistry Building

2:40 p.m. (189) *Asynchronous distributed computation: A topological approach to proving generic properties.* **Richard Stark**, University of South Florida (865-68-162)

3:10 p.m. (190) *Cellular dynamics and information content: Issues arising in theoretical and computational gerentology.* **Matthew Witten**, University of Texas, Austin (865-68-161)

3:40 p.m. (191) *Evolutions of cellular automata configurations.* **Sheng Yu**, University of Western Ontario (865-68-160) (Sponsored by John F. Pedersen)

Joseph A. Cima
Associate Secretary
Chapel Hill, North Carolina

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.
• AMS Invited Lecturer * AMS Special Session Speaker

Portland, Oregon
Portland State University
June 13–15

First Announcement

The eight-hundred-and-sixty-sixth meeting of the American Mathematical Society will be held at Portland State University, Portland, Oregon on Friday, June 14, and Saturday, June 15, 1991. All special sessions and sessions for contributed papers will be held in Newberger Hall, and invited addresses will be in Room 190 of the School of Business Administration.

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 are:

Dinakar Ramakrishnan, California Institute of Technology, *The Tate conjectures: introduction and examples.*

Gunther A. Uhlmann, University of Washington, *Inverse boundary value problems and applications.*

V. S. Varadarajan, University of California, Los Angeles, *Recent progress in meromorphic differential equations.*

Special Sessions

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

Meromorphic differential equations, **Donald G. Babbitt**, University of California, Los Angeles.

Combinatorial group theory and low dimensional topology, **M. Paul Latiolais**, Portland State University.

Harmonic mappings and their applications, **M. Sergei Prishepionok**, Portland State University.

Cycles and poles of L-functions, **Dinakar Ramakrishnan**.

Fourier analysis, **Kenneth A. Ross**, University of Oregon.

Inverse problems and applications, **John Sylvester**, University of Washington; and **Gunther A. Uhlmann**.

Abstracts for consideration for these sessions should have been submitted by the **March 5, 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. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in Departments of Mathematics. Abstracts should be sent to the Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, **so as to arrive before the March 26, 1991, abstract deadline**. Participants are reminded that a charge of $16 is imposed for retyping abstracts that are not in camera-ready form. Late papers will not be accommodated.

Electronic Submission of Abstracts

This service is available to those who use the TEX typesetting system and can be used with abstracts of papers to be presented at the sectional meetings of the AMS. Requests to obtain the package of files may be sent electronically on 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: 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 TEX, AMS-TEX, or the LATEX package.

Registration

The meeting registration desk will be located in the third floor Atrium of Newberger Hall and will be open from 8:00 a.m. to 5:00 p.m. on Friday, June 14, and from 8:00 a.m. to noon on Saturday, June 15. 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 San Francisco meeting announcement in the October 1990 issue of *Notices*.

Accommodations

A block of rooms is being held in the Portland Student Services dormitory in Montgomery Hall on the Portland State University (PSU) campus. Montgomery Hall is directly across the Park Blocks from the meeting site. All rooms are single occupancy and arrangements can be made to stay longer than the time of the conference. **After May 15, 1991, reservations at Montgomery Hall will be accepted only on a space available basis.** Montgomery Hall offers meal service to its residents. Rates are $32 per night, per person with three meals; $30 per night, per person with two meals; and $28 per night, per person with one meal. Portland Student Services can be reached at the toll free number 800-547-8887 extension 4333 between the hours of 9:00 a.m. and 5:00 p.m. Pacific Standard Time (PST). After hours, housing registration and check-in must be arranged in advance. Participants should make their own reservations and directly mention the AMS meeting. **Participants are advised to make reservations for accommodations as early as possible since the meeting is being held at the same time as Portland's Rose Festival.**

Although rooms have not been blocked at the following locations, they are included for participants' information. Rates are subject to change and a nine percent tax. Participants should identify themselves with the AMS meeting. All hotels listed are within a ten-minute walk or a five-minute free bus ride to the PSU campus. **The AMS is not responsible for rate changes or the accommodations offered by these hotels/motels.**

Mallory Motor Hotel
729 SW 15th Street, Portland, OR 97207
Telephone: 800-232-8650

Single $40 Double $45

Portland Inn
1414 SW 6th Street, Portland, OR 97207
Telephone: 800-648-6440

Single $55 Double $45

Red Lion Inn-Portland Center
310 SW Lincoln, Portland, OR 97207
Telephone: 503-221-0450

Single $97 Double $112

Food Service

The Smith Memorial Center adjacent to Newberger Hall offers the usual university fare at reasonable prices. Campus environs and Portland's downtown feature many excellent restaurants, brew pubs, and fast food establishments, all within a short walk or free bus ride from the meeting location. Complete listings will be available at the meeting registration desk.

Parking

Free parking will be available in the Portland State parking structure located at 6th Street and Hall.

Travel and Local Information

To reach the PSU campus at the south end of Portland's downtown: FROM PORTLAND INTERNATIONAL AIRPORT: Take any of several airport buses to one of the major downtown hotels (e.g. the Hilton or Heathman). PSU is then a short walk (less than ten minutes) south on Broadway Ave. Alternately, take the Tri-Met #12 (Sandy Blvd) bus directly to the PSU campus south of the downtown transit mall, disembarking at the 5th and Hall stop. Newberger Hall is two blocks west at Broadway and Hall. By taxi, PSU is approximately seven miles from the airport. FROM UNION STATION (AMTRAK) AND THE TRAILWAYS/GREYHOUND BUS TERMINAL: Take any Tri-Met bus downtown to the 5th Street transit mall and transfer to any bus servicing a "rose" stop. All of these buses come to the PSU campus south of the downtown transit mall, disembark at the 5th and Hall stop. Newberger Hall is now two blocks west at Broadway and Hall. All Tri-Met buses and Portland's light rail system (MAX) are free in the downtown area. BY AUTOMOBILE: If arriving on I-5 from either the north or south, take I-405 to exit 1C (6th Ave.). The PSU campus is one block west. If arriving from the east on I-84, proceed to the western terminus of I-84 at the interchange with I-5 and proceed south on I-5 approximately one mile to the junction of I-405. Take I-405 to exit 1C (6th Ave.). The PSU campus is one block west. If arriving on Hwy. 26 from the west, take I-405 one-half mile south from the interchange with Hwy. 26 to exit 1C (6th Ave.). The PSU campus is one block west.

Weather and Local Attractions

Portland's weather in mid-June is usually balmy with daily highs in the mid 70's and lows in the mid 50's (Fahrenheit). Participants should be aware that it can be cool and rainy at any time.

Portland's world famous Rose Festival will be in full swing during the time of the meeting featuring parades and cultural events, as well as a family fun center along Portland's river front. Saturday Market, the Northwest's premier showcase of arts and crafts, is a free five-minute MAX ride from downtown Portland. Portland also enjoys a well established micro-brewing industry. Several well known critics have pronounced the local beers "the best in North America". Many local breweries feature attached pubs.

A half-hour drive from Portland will take one to Oregon's wine country or the Columbia Gorge. An hour drive will take one to the Oregon coast or to the Cascade Mountains.

Lance W. Small
Associate Secretary
La Jolla, California

Invited Speakers and Special Sessions

Invited Speakers 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.

Portland, OR, June 1991

Dinakar Ramakrishnan
Gunther A. Uhlmann
V. S. Varadarajan

Orono, ME, August 1991

H. W. Lenstra (Progress in Mathematics Lecture)
George W. Mackey (History of Mathematics Lecture)
Richard M. Schoen (Progress in Mathematics Lecture)

Philadelphia, PA, October 1991

Michael T. Anderson
Abbas Bahri
Marjorie Senechal
Panagiotis E. Souganidis

Fargo, ND, October 1991

Ian D. Macdonald
Harald Upmeier
Henry C. Wente
Sylvia M. Wiegand

Baltimore, MD, January 1992

Michael E. Fisher (Gibbs Lecture)

Cambridge, England, June 1992

(Joint meeting with the London Mathematical Society)

John M. Ball
Lawrence Craig Evans
Benedict H. Gross
Nigel J. Hitchin

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.

June 1991 Meeting in Portland, Oregon

Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: March 5, 1991

Donald G. Babbitt, *Meromorphic differential equations*
M. Paul Latiolais, *Combinatorial group theory and low dimensional topology*
M. Sergei Prishepionok, *Harmonic mappings and their applications*
Dinakar Ramakrishnan, *Cycles and poles of L-functions*
Kenneth A. Ross, *Fourier analysis*
John Sylvester and Gunther A. Uhlmann, *Inverse problems and applications*

August 1991 Meeting in Orono, Maine

Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: May 1, 1991
(Please note that this deadline has changed)

Joseph Arkin, *Number theory*
Edward Bierstone and Gerald W. Schwarz, *Symmetry and differential analysis*
Frank Curtis and Andrew R. Kustin, *Commutative Noetherian rings with applications in algebraic geometry*
John C. Mayer, *Continuum theory and dynamical systems*
Ali E. Ozluk and William M. Snyder, *Analytic number theory*
Stanley Rabinowtiz, *Geometric inequalities for polytopes*
Chuu-Lian Terng and Karen Uhlenbeck, *Variational methods and symmetry*
Toma V. Tonev and Keith Yale, *Function algebras and function spaces*

October 1991 Meeting in Philadelphia, Pennsylvania

Eastern Section
Associate Secretary: W. Wistar Comfort
Deadline for organizers: Expired
Deadline for consideration: July 11, 1991

Michael T. Anderson and Jeff Cheeger, *Recent progress in Ricci curvature and related topics*
Boris A. Datskovsky and Marvin I. Knopp, *Modular forms, arithmetic algebraic geometry*
James F. Davis, Ronnie Lee, and Julius L. Shaneson, *Surgery theory and singular spaces*
Leon Ehrenpreis and Eric L. Grinberg, *Geometric analysis*
Janos Galambos, *Extreme value theory*
David R. Hill, *Computational experiments for numerical analysis instruction*
Nicholas Hanges and A. Alexandrou Himonas, *Applications of microlocal analysis to partial differential equations*
Bruce A. Kleiner and Robert B. Kusner, *Variational problems in low dimensional geometry*
Martin Lorenz and Shari A. Prevost, *Rings and representations*
Doris Schattschneider and Marjorie Senechal, *Tilings*
Halil Mete Soner and Panagiotis E. Souganidis, *Phase transitions and/or front propogation*
Daniel B. Szyld, *Numerical linear algebra*

October 1991 Meeting in Fargo, North Dakota
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: Expired
Deadline for consideration: July 11, 1991

Joseph P. Brennan and Sylvia M. Wiegand, *Commutative algebra*
Dogan Comez, *Ergodic theory*
Robert D. Gulliver and Henry C. Wente, *The geometry of equilibrium configurations*
David B. Jaffe, *Algebraic geometry*
Satyanad Kichenassamy, *Nonlinear wave equations*
Kendall E. Nygard, *Operations research*
James H. Olsen and Mark Pavicic, *Mathematical foundations of computer graphics*
Justin R. Peters III and Warren R. Wogen, *Nonselfadjoint operator algebras*
Norberto Salinas and Harald Upmeier, *Multidimensional complex analysis and operator theory*
Warren E. Shreve, *Graph theory*
Vasant A. Ubhaya, *Approximation theory*
Abraham Ungar, *Lorentz transformations and spacetime geometry*

November 1991 Meeting in Santa Barbara, California
Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: July 11, 1991

January 1992 Meeting in Baltimore, Maryland
Associate Secretary: Lance W. Small
Deadline for organizers: April 8, 1991
Deadline for consideration: September 11, 1991

March 1992 Meeting in Tuscaloosa, Alabama
Southeast Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: June 13, 1991
Deadline for consideration: To be announced

March 1992 Meeting in Springfield, Missouri
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 26, 1991
Deadline for consideration: To be announced

April 1992 Meeting in Bethlehem, Pennsylvania
Eastern Section
Associate Secretary: W. Wistar Comfort
Deadline for organizers: July 11, 1991
Deadline for consideration: To be announced

June 1992 Meeting in Cambridge, England
(Joint Meeting with the London Mathematical Society)
Associate Secretary: Robert M. Fossum
Deadline for organizers: September 28, 1991
Deadline for consideration: 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: To be announced

January 1993 Meeting in San Antonio, Texas
Associate Secretary: W. Wistar Comfort
Deadline for organizers: April 13, 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

January 1994 Meeting in Cincinnati, Ohio
Associate Secretary: Joseph A. Cima
Deadline for organizers: April 5, 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

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 Invited Speakers are selected. 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 Invited Speaker 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)

Central Section

Andy R. Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
601 Elm PHSC 423
Norman, OK 73019
Electronic mail: g_magid@math.ams.com
(Telephone 405-325-6711)

Eastern Section

W. Wistar Comfort, Associate Secretary
Department of Mathematics
Wesleyan University
Middletown, CT 06457
Electronic mail: g_comfort@math.ams.com
(Telephone 203-347-9411)

Southeastern Section

Joseph A. Cima, Associate Secretary
Department of Mathematics
University of North Carolina, Chapel Hill
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: rmf@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 TEX typesetting system. Requests to obtain the package of files may be sent electronically via 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: 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 TEX, AMS-TEX, or the LATEX 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.

Orono Mathfest
AMS Special Sessions and Contributed Papers
MAA Contributed Papers

The AMS-MAA Joint Meetings Committee is taking a *New Look* at summer Mathematics Meetings and is offering an experimental, all-new format for the first time this year. This is an effort to make our joint summer meetings even more attractive. The first Mathfest will be held at the University of Maine, Orono, August 8–10 (Thursday–Saturday), 1991. The first full announcement of the meeting will appear in the April 1991 issues of *Notices* and *Focus*. This preliminary announcement is made to encourage members' participation and to provide lead time for submission of abstracts for consideration in AMS Special Sessions and for submission of abstracts for AMS and MAA Contributed Paper Sessions.

AMS Special Sessions

A list of Special Sessions for this meeting can be found in the **Invited Speakers and Special Sessions** section of this issue.

Most of the papers to be presented at these Special Sessions will be by invitation; however, anyone contributing an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these sessions should indicate this clearly on the abstract, **and should submit it by May 1, 1991, three weeks earlier than the normal deadline for contributed papers,** in order that it be considered for inclusion.

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, Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940. A charge of $16 is imposed for retyping abstracts that are not in camera-ready form.

AMS Contributed Paper Sessions

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, Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, **so as to arrive by the abstract deadline of May 22, 1991.** A charge of $16 is imposed for retyping abstracts that are not in camera-ready form. **Late papers will not be accepted.**

Electronic Submission of AMS Abstracts

This service is available to those who use the TEX 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 TEX, AMS-TEX, or the LATEX package. Again, late papers will not be accepted.

MAA Contributed Papers

Contributed papers are being accepted on the following topics for presentation during MAA contributed paper sessions in Orono.

- *Computer software for classroom use*, **Clayton Dodge**, University of Maine, Orono. Presentations are invited that include demonstrations of software actually used in a classroom for instruction. Equipment available is Zenith 386 computer with VGA and with 27" monitors for viewing by the audience. It takes both 5 1/4 and 3 1/2 inch disks.

- *Relating mathematics to the real world: applications of mathematics for classroom use*, **Rogers Newman**, Southern University and **James R. C. Leitzel**, Ohio State University. Presentations are invited that illustrate applications of mathematics that are suitable for classroom use, especially by those who have solved problems arising in industry, business or government, problems whose resolutions made extensive use of mathematics. Talks should not be highly theoretical, but should be of such a nature that teachers can make use of them in their classes.

- *Using student projects in the first two years of the curriculum*, **John Maceli** and **Eric Robinson**, Ithaca College. Student projects are used in many places in the undergraduate curriculum in courses ranging from liberal arts courses for the non-science major to required courses for the mathematics major. Projects can be used to introduce or enhance material and can range from individual to group work. Papers are invited that discuss actual projects considering such aspects as their design, purpose and/or results from use.

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

minutes. Individuals wishing to submit papers for any of these sessions should send the following information to the MAA Washington office at 1529 Eighteenth Street, NW, Washington, DC 20036 **by May 8**:

1. A page giving the author's name, author's address, the intended session, and a one-paragraph abstract (for distribution at the meeting);
2. A one-page outline of the presentation.

Rooms where sessions of contributed papers will be held are equipped with overhead projector and screen. Persons having other equipment needs should contact the MAA Associate Secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403) as soon as possible, but in any case **prior to June 5**. Upon request, the following can be made available: one additional overhead projector/screen, 35mm carousel slide projector, 16mm film projector, or VHS video cassette recorder with color monitor.

Summer Meeting of the Canadian Mathematical Society May 30–June 1, 1991

Tentative Program

The Canadian Mathematical Society (CMS) and the Université de Sherbrooke cordially invite all mathematicians to the 1991 Summer Meeting of the Society. The Scientific Program will take place at the university.

Scientific Program

Principal Speakers

The names and affiliations of the principal speakers are as follows:

Francis Clarke, Université de Montréal
Dale Peterson, University of British Columbia
Paul H. Rabinowitz, University of Wisconsin, Madison
Raymond M. Redheffer, University of California, Los Angeles
Alexander Schrijver, Math. Centre, Amsterdam

Jeffery-Williams Lecture

The Jeffery-Williams Lecture will be given by **Peter Lancaster**, University of Calgary, on Friday, May 31, at 2:15 p.m. in Room A2-101.

Symposia

Symposia in five domains will take place. The organizers and invited speakers are:

Functional equations, **János D. Aczél**, University of Waterloo, organizer

John A. Baker, University of Waterloo; **Walter A. Benz**, University of Hamburg; **Thomas M.K. Davison**, McMaster University; **Dwayne H. Dicks**, Simon Fraser University; **Serge Dubuc**, Université de Montréal; **Bruce R. Ebanks**, University of Louisville; **Pal Fischer**, University of Guelph; **Bruno Forte**, University of Waterloo; **Anthony A.J. Marley**, McGill University; **Che Tat Ng**, University of Waterloo; **Jürg Rätz**, University of Bern; **Raymond M. Redheffer**, University of California, Los Angeles; **Berthold Schweizer**, University of Massachusetts, Amherst; **Howard Sherwood**, University of Central Florida; and **Mark A. Taylor**, Acadia University.

Geometry of algebraic groups, **Lex E. Renner**, University of Western Ontario, organizer

Robert Bédard, Université du Québec à Montréal; **James B. Carrell**, University of British Columbia; **Vinay V. Deodhar**, Indiana University, Bloomington; **Frank D. Grosshans**, West Chester University of Pennsylvania; **Erhard Neher**, University of Ottawa; **Dale Peterson**, University of British Columbia; **Mohan Putcha**, North Carolina State University; **Gerald W. Schwarz**, Brandeis University; **Louis Solomon**, University of Wisconsin, Madison; **Dennis M. Snow**, University of Notre Dame; and **David L. Wehlau**, University of Toronto.

Nonlinear analysis, **Gilles Fournier**, Université de Sherbrooke, organizer

Haïm Brézis, Université Pierre et Marie Curie; **Jean-Noël Corvellec**, Universita di Pisa; **Lynn H. Erbe**, University of Alberta; **Marlene Frigon**, Université de Montréal; **Massimo Furi**, Istituto Ulisse Dine; **Andrzej Granas**, Université de Montréal; **Zine L. Abdine Guennoun**, Université de Moncton; **Tomasz Kaczynski**, Université de Sherbrooke; **Wieslaw Krawcewicz**, University of Alberta; **Marc Lassonde**, Université de Clermont-Ferrand; **Mario U. Martelli**, California State University, Fullerton; **Jean L. Mawhin**, Louvain-la-Neuve; **Pedro A. Morales**, Université de Sherbrooke; **Paul H. Rabinowitz**, University of Wisconsin, Madison; **Sankatha P. Singh**, Memorial University of Newfoundland; **Andrzej Szulkin**, University of Stockholm; and **Michel Willem**, Louvain-la-Neuve.

Nonsmooth methods in dynamic optimization, **Philip D. Loewen**, University of British Columbia, organizer

Jonathan M. Borwein, Dalhousie University; **Francis Clarke**, Université de Montréal; **Barbara Kaskosz**, University of Rhode Island; **Philip D. Loewen**, University of British Columbia; **Boris S. Mordukhovic**, Wayne State University; **René A. Poliquin**, University of Alberta; **Richard B. Vinter**, Imperial College; **Doug E. Ward**, Miami University; **Peter R. Wolenski**, Louisiana State University; and **Vera M. Zeidan**, University of Waterloo.

Geometry, polyhedra and combinatorics, **William R. Pulleyblank**, University of Waterloo and IBM, Yorktown Heights, organizer

Francisco Barahona, University of Waterloo; **I. Barany**, Hungarian Academy; **Jean-Marie Bourjolly**, Concordia University; **Sylvia C. Boyd**, University of Ottawa; **William Cook**, Bell Communications; **Colette Coullard**, Purdue University; **William H. Cunningham**, Carleton University;

Ravi Kannan, Carnegie-Mellon University; and **Alexander Schrijver**, Math. Centre, Amsterdam.

A session on **Mathematics Education** has been organized by **Arthur S. Finbow**, St. Mary's University.

An impromptu session on potential theory will be organized by **Paul M. Gauthier**, Université de Montréal.

Contributed papers of 15 minutes' duration are invited.

University Residences

Up to 150 rooms have been reserved at the university residences at the following prices (given in Canadian dollars); (including GST)

Single Room:	1 night (32.10) 2 nights (53.50)
	3 nights (64.20) 4 nights (74.90)
Double Room:	1 night (48.15) 2 nights (69.55)
	3 nights (85.60) 4 nights (96.30)

Hotel Accommodations (including GST)

Rooms have been booked at the following hotels. Rates are given in Canadian dollars. **Reservations should be made directly with the hotel.**

Hôtel Delta, 2685 King O, Sherbrooke, 819-822-1989
single room (80.25) double (80.25)
Hôtel des Gouverneurs, 3131 King O, Sherbrooke, 819-565-0464
single room (63.13) double room (73.83)
Hôtel le Président, 3535 King O, Sherbrooke, 819-563-2941
single room (62.06) double room (72.76)
Hôtel Roussillon le Baron, 3200 King O, Sherbrooke, 819-567-3941
single room (62.06) double room (72.76)
Auberge Elite, 4206 King O, Sherbrooke, 819-563-4755
single room (54.00) double room (65.00)
Breakfast included
Motel l'Ermitage, 1888 King O, Sherbrooke, 819-569-5551
single room (53.50) double room (66.34)
Motel la Réserve, 4235 King O, Sherbrooke 819-566-6464
single room (57.78) double room (72.76)

Miscellaneous Information

Public bus transportation is available from the university to all the above mentioned hotels. Information will be available at the registration desk.

Social events include a welcoming reception and a banquet on Friday, May 31.

Preliminary activities will be held at the Delta Hotel on May 28 and at the cafeteria of the Université de Sherbrooke on May 29 as follows:

May 28, CMS Executive Meeting
May 29, Board of Directors Meeting
May 29, Evening Registration and cash bar

Meeting Headquarters: From Thursday on, the meeting will be held in the Faculty of Education of the Université de Sherbrooke. The Faculty of Education will house the reception area, book displays, coffee lounge, the auditorium for the plenary addresses, rooms for special sessions and contributed papers. Detailed directions and room numbers will be provided at the registration desk and in the programme booklet.

Travel directions: If you fly, plan on arriving at Dorval airport. If you arrive at Mirabel Airport, take the bus for Dorval Airport (approximate cost in Canadian dollars: 10). On Wednesday, May 29 at 6:00 p.m., a bus identified "CMS" will depart from Dorval Airport for the Université de Sherbrooke, where it will arrive around 8:00 p.m.

Further information about the meeting may be obtained from:

Michel Delfour, Chair, Scientific Programme Committee, Centre de Recherches Mathématiques, Université de Montréal, C.P. 6128 Succursale A, Montréal (Quebéc) H3C 3J7, Canada. Office: 514-343-7265 (sec. 7501), electronic mail: DELFOUR@CC.UMontreal.CA, Residence: 514-274-7212, FAX: 514-343-2254.

Pedro A. Morales, Chair, Local Organizing Committee, Département de Mathématiques et d'informatique, Université de Sherbrooke, Sherbrooke, Québec J1K 2R1, Canada. Office: 819-821-7035 (sec. 7030), electronic mail: SMC@terre.dmi.usherb.ca, FAX: 819-821-7921.

Registration Fees (in Canadian dollars)

	Prereg by April 19	After April 19
CMS/AMS/MAA Members with grants	135	165
CMS/AMS/MAA Members without grants	60	90
Non-Members with grants	185	210
Non-Members without grants	85	115
Grads/PDFs/Retired Faculty	30	55
Banquet Tickets for accompanying persons (including GST and QST)	35	35
One Day Fee		65

(The one day fee is intended for anyone who wishes to take part for only one day of the meeting. All fees except the one day fee and the Grads/PDFs/Retired Faculty include a ticket to the Friday night banquet.)

Send payment for university residences and registration to CMS Summer '91, Département de Mathématiques et d'informatique, Université de Sherbrooke, Sherbrooke, Québec J1K 2R1, Canada. **Checks should be made payable to CMS Summer '91.**

1991 Summer Research Institute

Algebraic Groups and Their Generalizations

Pennsylvania State University, University Park, July 8–26

The thirty-ninth Summer Research Institute sponsored by the American Mathematical Society will be devoted to *Algebraic groups and their generalizations* and will take place at the Pennsylvania State University, University Park, Pennsylvania. Members of the Organizing Committee are: **Igor Frankel**, Yale University; **Eric Friedlander**, Northwestern University; **William Haboush** (chair), University of Illinois, Urbana-Champaign; **Jens Jantzen**, University of Oregon, Eugene; and **Brian Parshall**, University of Virginia.

It is anticipated that the institute will be partially supported by a grant from the National Science Foundation. Proceedings of the institute will be published in the AMS series *Proceedings of Symposia in Pure Mathematics*.

This topic was selected by the 1989 AMS Committee on Summer Institutes and Special Symposia whose members at the time were: **Steven L. Kleiman** (chair), **Haynes R. Miller**, **Raghavan Narasimhan**, **Brian Parshall**, and **Thomas C. Spencer**.

While several recent conferences have been devoted to the theory of algebraic groups, it has been some time since there has been an extended conference devoted to the core subject itself. Meanwhile, the subject has undergone a most remarkable expansion and transformation.

The first of these developments is the one that began with observations by Jantzen and Deodhar that certain composition factors in Verma modules occurred with multiplicity. This led to the work of Kazhdan and Lusztig relating these multiplicities to the representation theory of Weyl groups and Hecke algebras and the intersection homology of generalized Schubert cells, work culminating in the Kazhdan-Lusztig conjectures. The solutions to these conjectures by Bernstein and Bielenson and by Kashiwara have made algebraic analysis and the theory of the derived category part of the substance of representation theory, a development which has led to a new way of understanding the subject as a whole.

The second major development begins with the observation by Kac and Moody that relaxation of the positivity conditions on the Cartan matrix leads to a new class of infinite dimensional simple Lie algebras and the subsequent exploitation of this fact by Kac, Lepowsky, and others to develop a representation theory and a group theory for these Lie algebras. This has led to the development of a meaningful infinite dimensional group theory by Kac, Peterson, Matthieu, and others.

The third major change begins with Woronowicz's discovery of a "non-commutative" deformation of the algebra of functions on a Lie group. This has inspired the development of the theory of quantum groups particularly by Drinfel′d. Lusztig has formulated arithmetic quantizations of the Kostant **Z**-forms of semi-simple Lie algebras which allow the formulation of statements concerning the representation theory of semi-simple groups which have the theory over fields of positive characteristic as a specialization.

Through these developments a major reformulation of the vocabulary of algebraic group theory has taken place. Though conferences on various aspects of the theory of algebraic groups have taken place, no conference has focused on the general theory for some time. The summer institute will attempt to present this new knowledge as a corpus stressing overall structure, both common elements and special features that mark off one area from another. Thus certain topics, such as Kazhdan-Lusztig theory and the idea of induced representation as well as the higher derived functions of induction viewed as expressions of the structure of homogeneous spaces, are common threads while other topics such as vertex operators and related matters are based on unique aspects of special situations. Both types of ideas should be studied and juxtaposed. Similarly, certain quantization theories couched in analytic terms can be compared to the Lusztig quantization. It is hoped that these juxtapositions can be organized to result in fertile exchanges of ideas.

There are plans for major lecture series on quantum groups, Kac-Moody Lie algebras and groups, Hecke algebras, and on the representation theories associated to these objects. In addition, a series of talks will be devoted to induction in its various guises and to the geometry of homogeneous spaces and their compactifications, especially as they relate to representation theory. Directly related topics such as transformation spaces and quotients might also be discussed particularly in so far as they can be applied to or viewed as applications of the main topics. For example, transformation spaces can be related to orbit methods and to questions concerning the intersection homology of homogeneous spaces which in turn might bear on the combinatoric aspects of representation theory.

A tentative list of the topics to be addressed follows. Please note, however, that the program is subject to change.

Week One:

Kac-Moody Lie algebras and root systems, Kac-Moody group theory, representations and characters for modules over infinite dimensional groups, vertex operators, loop groups, flag varieties and Schubert calculus for infinite dimensional

groups. Algebraic transformation spaces, quotient spaces and invariants, the structure of affine actions, the orbit method.

Week Two:

Quantum groups and quantized representation theory, arithmetic quantization (the Lusztig quantization), the Yang-Baxter equation, relations to the Kac-Moody theory. Kazhdan-Lusztig theory, intersection homology of Schubert cells and its relation to character formulae, the derived category, perverse sheaves and D-modules on flag varieties, cohomological induction.

Week Three:

Algebraic and finite dimensional representations, representations over fields of positive characteristic, Frobenius splitting, the derived category. The geometry of homogeneous and almost homogeneous spaces, symmetric homogeneous spaces and spherical varieties, the relation to the Schubert calculus.

Accommodations will be available in the campus residence halls for participants; cafeteria style meals will be available. All facilities will be accessible to the handicapped.

Information on housing, dining, travel, and the local area will be sent to invited participants in the spring. Each participant will pay a registration fee and a social fee to cover the costs of social events scheduled during the institute.

Those interested in receiving an invitation to participate in the institute should send the following information to Summer Institute Conference Coordinator, American Mathematical Society, Post Office Box 6887, Providence, RI 02940, **prior to April 1, 1991** or through electronic mail to WSD@MATH.AMS.COM.

Please type or print the following:

1. Full name;
2. Mailing address;
3. Telephone number and area code for office and home;
4. Which week or weeks you wish to attend;
5. Your scientific background relevant to the institute topic;
6. Financial assistance requested;
7. Indicate if support is not required, and if interested in attending even if support is not offered.

Requests for invitations will be forwarded to the Organizing Committee for consideration up to the deadline of April 1, and applicants selected will receive formal invitations and notification of financial assistance beginning in mid-May.

Mathematical Sciences Meetings and Conferences

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.

1991. **IMACS Symposium on Parallel and Distributed Computing in Engineering Systems**, Athens, Greece. (Jul./Aug. 1990, p. 741)

Spring 1991. **IMACS International Symposium on Iterative Methods in Linear Algebra**, Brussels Free Univ., Brussels, Belgium. (Mar. 1990, p. 334)

* 1991–1992. **Mittag-Leffler Institute Academic Program for 1991–1992: Combinatorics**, Djursholm, Sweden.

PROGRAM: Emphasis will mainly be on algebraic and geometric aspects.
CALL FOR PAPERS: Application deadline for postdoctoral fellowships: April 1, 1991.
INFORMATION: A. Björner, Dept. of Mathematics, KTH, S-100 44 Stockholm, Sweden, or D. Laksov, Institut Mittag-Leffler, Auravägen 17, S-182 62 Djursholm, Sweden.

March 1991

15–16. **Central Section**, Indiana University, South Bend, IN.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

16–23. **Sixth Conference in Geometric Rigidity and Hyperbolic Dynamics**, Penn State Univ., State College, PA. (Jan. 1991, p. 44)

17–23. **Elementare und Analytische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 500)

17–24. **Sixth International Conference on Geometry**, University of Haifa, Israel. (May/Jun. 1990, p. 612)

21–28. **Mathematical Aspects of Human Diseases**, Erice (Trapani), Sicily, Italy. (Dec. 1990, p. 1453)

22–23. **Southeastern Section**, University of South Florida, Tampa, FL.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

22–24. **Fifth SIAM Conference on Parallel Processing for Scientific Computing**, Houston, TX. (Mar. 1990, p. 334)

24–29. **Mathematical Approaches to DNA II (The Genome: DNA to Protein Structure)**, Santa Fe, NM. (Dec. 1990, p. 1453)

24–30. **Gewöhnliche Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 500)

25–27. **Fifth SIAM Conference on Parallel Processing for Scientific Computing**, Houston, TX. (Jul./Aug. 1990, p. 742)

25–28. **International Conference on Mathematical Linguistics - ICML '91**, Barcelona, Spain. (Jul./Aug. 1990, p. 742)

25–29. **Forty-Third British Mathematical Colloquium**, Univ. of Bath, Claverton Down, Bath, U.K. (Jan. 1991, p. 44)

25–April 12. **Linear and Nonlinear Dispersive Waves**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (Jan. 1991, p. 45)

29–30. **1991 Association for Symbolic Logic Spring Meeting (in conjunction with a meeting of the American Philosophical Association)**, San Francisco, CA. (Dec. 1990, p. 1453)

31–April 6. **Arbeitsgemeinschaft mit Aktuellum Thema**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 500)

April 1991

1–4. **Eighth International Conference on Mathematical and Computer Modeling**, University of Maryland, College Park, MD. (Oct. 1990, p. 1137)

* 1–5. **GAMM '91 Wissenschaftliche Jahrestagung**, Cracow University of Technology, Cracow, Poland.

INFORMATION: J.W. Murzewski, Politechnika Krakowska, im. Tadeusza Kosciuszki, ul. Warszawska 24, tel. 33-03-00, 31-155 Krakow.

1–7. **JAMI Workshop and Conference on Algebraic and Complex Geometry**, Johns

Hopkins Univ., Baltimore, MD. (Jan. 1991, p. 45)

2–4. **IMACS International Symposium on Iterative Methods in Linear Algebra**, Brussels Free Universities, Belgium. (May/Jun. 1990, p. 612)

*3–5. **Second Annual Ulam Mathematics Conference**, Palm Beach Atlantic College, West Palm Beach, Florida. (Please note change from Feb. 1991, p. 139)

CALL FOR PAPERS: Deadline for Proposals: March 1, 1991.

*3–5. **Artificial Intelligence in Mathematics**, Strathclyde, United Kingdom.

INFORMATION: Y. May, Conference Officer, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2JY, England.

7–13. **Algebraische Gruppen**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 500)

8–12. **Seventh International Conference on Data Engineering**, Kobe, Japan. (Apr. 1990, p. 500)

8–12. **NASECODE VII, The Seventh International Conference on the Numerical Analysis of Semiconductor Devices and Integrated Circuits**, Copper Mountain, Colorado. (May/Jun. 1990, p. 612)

10–12. **Fourth International Conference on Rewriting Techniques and Applications (RTA-91)**, Como, Italy. (Jul./Aug. 1990, p. 743)

11–13. **Twenty-Fifth Annual Spring Topology Conference**, California State University, Sacramento, CA. (Oct. 1990, p. 1137)

11–16. **Assessment in Mathematics Education and Its Effects**, Calonge (Costa Brava), Spain. (Sep. 1990, p. 935)

*12–14. **Geometry Festival**, Duke University, Durham, NC.

PROGRAM: Seven hour talks on geometric topics.
INFORMATION: R. Bryant (919-684-8124), P. Eberlein (919-962-9624), and R. Gardner (919-962-9625).

13. **Workshop on Differential Geometry and Mathematical Physics**, Arkansas State University, Jonesboro, AR. (Feb. 1991, p. 139)

*13. **Ninety-first Ontario Mathematics and Thirty-fifth Colloque des Sciences Mathématiques du Québec**, University of Ottawa, Ottawa, Canada.

INVITED SPEAKERS: L. de Branges (Purdue; "Le lendemain de la conjecture de Bieberbach"), E. Zel'manov (Novosibirsk/Oxford; "On the Burnside and Kurosh problems").

CALL FOR PAPERS: Besides the invited lectures, contributed papers of 15 minutes duration can be presented by participants.
INFORMATION: E. Neher and M. Racine, Dept. of Mathematics, Univ. of Ottawa, Ottawa, Ontario K1N 6N5, Canada; email: uomaths@uottawa.bitnet.

14–20. **Brauer Groups and Representation Theory of Finite Groups**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 500)

15–19. **IMA Workshop on Variational Problems**, University of Minnesota, Minneapolis, MN. (Sep. 1990, p. 935)

17–18. **Workshop on Cellular Automata**, Center for Scientific Computing, Helsinki, Finland. (Feb. 1991, p. 139)

18–20. **Determinantal Ideals and Representation Theory**, University of Arkansas, Fayetteville, Arkansas. (Sep. 1990, p. 935)

20–21. **Wabash Extramural Modern Analysis Miniconference**, Indiana University-Purdue University, Indianapolis, IN. (Dec. 1990, p. 1453)

21–24. **SUPER!: Supercomputing by University People for Education and Research**, Park City, UT. (Nov. 1990, p. 1284)

21–27. **Numerical Linear Algebra**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 743)

21–May 4. **NATO ASI Finite and Infinite Combinatorics in Sets and Logic**, Banff, Canada. (Dec. 1990, p. 1453)

23–26. **Mathematical and Numerical Aspects of Wave Propagation Phenomena**, Strasbourg, France. (Jul./Aug. 1990, p. 743)

*25. **Mathematics as a Humanistic Discipline**, Newtonville, MA.

PROGRAM: The hope is the conference, which is cosponsored by Emmanuel College, Simmons College, and Newton North High School, will serve to bring together mathematics educators from all segments of education (secondary, college, and university) who want to explore this theme.
INFORMATION: Mary L. Sapienza, Mathematics Dept. Head, Newton North High School, 360 Lowell Ave., Newtonville, MA 02160.

26–28. **Similarity Solutions of Differential Equations**, University of Pittsburgh, PA. (Feb. 1991, p. 139)

26–28. **First Eugene Lukacs Symposium**, Bowling Green State University, Bowling Green, OH. (Dec. 1990, p. 1453)

28–May 4. **Deductive Systems**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 501)

29–May 2. **Joint U.S.-French Workshop on Applied Stochastic Analysis**, Rutgers University, New Brunswick, NJ. (Nov. 1990, p. 1285)

*29–May 9. **NATO - Advanced Study Institute: Approximation Theory, Spline Functions and Applications**, Maratea, Italy (South of Naples).

PROGRAM: Those who plan to present a short communication, please send a copy of the abstract to S.P. Singh at the address given below. A list of invited speakers will be sent to all participants soon. Partial financial support for a few participants might be available.
INFORMATION: S.P. Singh, Dept. of Math., Memorial Univ. of Newfoundland, St. John's, NF, Canada A1C 5S7; tel: 709-737-8795; FAX: 709-737-3010; email: spsingh@mun.bitnet.

29–May 10. **NATO Advanced Study Institute on Approximation Theory, Spline Functions and Applications**, Maratea, Italy. (Feb. 1991, p. 139)

May 1991

May/June 1991. **Summer Workshop on Calculus, Computer, Concepts, and Cooperative Learning**, Purdue University, West Lafayette, IN. (Nov. 1990, p. 1285)

May/June 1991. **IMACS Workshop on Decision Support Systems and Qualitative Reasoning**, Toulouse, France. (Mar. 1990, p. 334)

2–3. **Twenty-Second Annual Pittsburgh Conference on Modeling and Simulation**, University of Pittsburgh, PA. (Sep. 1990, p. 935)

2–4. **International Conference on Polynomials with concentration at low degrees: From Analysis and Number Theory to Computer Science and Symbolic Computation**, Paris, France. (Nov. 1990, p. 1285)

5–11. **Darstellungstheorie Endlich-Dimensionaler Algebren**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 743)

6–8. **Fifth SIAM International Symposium on Domain Decomposition Methods for Partial Differential Equations**, Norfolk, VA. (Jul./Aug. 1990, p. 743)

7–10. **IMACS Symposium on Modelling and Simulation of Control Systems**, Casablanca, Morocco. (Mar. 1990, p. 334)

7–14. **Singapore Number Theory Workshop**, National Univ. of Singapore, Kent Ridge, Singapore. (Jul./Aug. 1990, p. 743)

9–11. **A Conference on History, Geometry, and Pedagogy in honor of the 80th birthday of Howard Eves**, University of Central Florida, Orlando, FL. (Nov. 1990, p. 1285)

*10–12. **Conference on Multidimensional Complex Potential Theory**, Ste-Adèle (Québec).

ORGANIZERS: T.S. Bagby (Indiana Univ.), P.M. Gauthier (Univ. de Montréal).
INVITED SPEAKERS: B. Aupetit (Canada), E.D. Bedford (U.S.A.), T. Bloom (Canada), P.C. Greiner (Canada), S. Pinchuk (USSR), E. Poletsky (U.S.A.), A. Sadullaev (USSR), A. Sergeev (USSR), B.A. Taylor (U.S.A.), V. Zharinov (USSR).
INFORMATION: S. Chenevert (Scientific Activities Coordinator), CRM, Université de Montréal, C.P. 6128-A, Montréal, Québec, Canada H3C 3J7; Tel: 514-343-7501 or 514-343-2197; Fax: 514-343-2254; email: sylvie@cc.umontreal.ca.

12–18. **Nichtlineare Evolutionsgleichungen**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 501)

13–17. **Conference in Harmonic Analysis in Honor of E.M. Stein**, Princeton University, Princeton, NJ. (Mar. 1990, p. 334)

13–18. **IMA Workshop on Degenerate Diffusions**, University of Minnesota, Minneapolis, MN. (Sep. 1990, p. 935)

15–17. **Third IEEE Conference on Computer Workstations: Accomplishments and Challenges**, Falmouth (Cape Cod), MA. (Sep. 1990, p. 936)

15–18. **International Conference on Theory and Applications of Differential Equations**, University of Texas-Pan American, Edinburg, TX. (Dec. 1990, p. 1454)

*16–18. **International Conference on Computational Number Theory and Combinatorics, in Honor of J.L. Selfridge**, Northern Illinois University, DeKalb, IL.

PROGRAM: J.L. Selfridge will be retiring in the summer of 1991 after twenty-one years as a member of the faculty of Northern Illinois Univ. Over the course of his long and illustrious career as a mathematician and administrator, he has contributed greatly to the areas of computational number theory and combinatorial analysis. The topics of the conference will relate directly to his varied contributions to these areas of mathematics. There will be twelve one-hour and 9 half-hour invited lectures, and also sessions for contributed papers. Titles and/or abstracts for the contributed papers should be submitted by April 30.
ORGANIZING COMMITTEE: P. Bateman, B. Berndt, J. Brillhart, P. Erdös, R. Graham, C. Gupta, R. Guy.
INFORMATION: J. Wolfskill, Dept. of Math. Sci., Northern Illinois Univ., DeKalb, IL 60115-2888; email: wolfskil@cs.niu.edu.

16–21. **NSF-CBMS Regional Research Conferences in the Mathematical Sciences: New Trends in Nonlinear Control Theory**, Louisiana State University, LA. (Dec. 1990, p. 1454)

17–18. **Annual Regional Group Theory Conference**, Bucknell Univ., Lewisburg, PA. (Jan. 1991, p. 45)

17–20. **Conference/Workshop on Continuum Theory and Dynamical Systems**, University of Southwestern Louisianna, Lafayette, LA. (Dec. 1990, p. 1454)

*19–23. **1991 New Zealand Mathematics Colloquium**, University of Otago, Dunedin.

INFORMATION: Colloquium Secretary, Dept. of Math. and Stats., University of Otago, P.O. Box 56, Dunedin, New Zealand.

19–25. **Differentialgeometrie im Grossen**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 501)

20–24. **Eleventh International Conference on Distributed Computing Systems**, Arlington, TX. (Sep. 1990, p. 936)

21–24. **Quantization and Microlocal Analysis**, Reims, France. (Jan. 1991, p. 46)

22–24. **Second International Conference on Algebraic Methodology and Software Technology, (AMAST)**, Iowa City, Iowa. (Apr. 1990, p. 501)

23–24. **Thirteenth Symposium on Mathematical Programming with Data Perturbations**, George Washington Univ., Washington, DC. (Feb. 1991, p. 140)

23–25. **Sixth Annual Lehigh University Geometry and Topology Conference**, Bethlehem, PA. (Dec. 1990, p. 1454)

26–29. **Twenty-first International Symposium on Multi-Valued Logic**, Victoria, Canada. (Dec. 1990, p. 1454)

26–31. **Signal Theory and Image Processing**, Cetraro, Italy. (Sep. 1990, p. 936)

26–June 1. **Optimalsteuerung und Variationsrechnung-Optimal Control**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 501)

27–June 4. **Workshop on Probabilistic Methods in Differential Equations**, Technion, Haifa, Israel. (Feb. 1991, p. 140)

29–June 1. **Eighth Biennial Conference of the Association of Christians in the Mathematical Sciences**, Wheaton College, Wheaton, IL. (Jul./Aug. 1990, p. 743)

29–June 1. **Methods in Module Theory**, University of Colorado, Colorado Springs, CO. (Sep. 1990, p. 936)

30–31. **Special Session on Polymer Configurations: Nonlinear and Nonlocal Diffusion Problems**, University of Minnesota, Minneapolis, MN. (Nov. 1990, p. 1286)

*30–June 1. **CMS Summer Meeting 1991**, Université de Sherbrooke, Sherbrooke, Québec. (Please note date change from Dec. 1990, p. 1454)

*May 31–June 1. **Miniconference on Differential Equations**, Utah State University, Logan, UT.

PROGRAM: At-large topics in ordinary and partial differential equations.
CALL FOR PAPERS: Send title to J. Ridenhour at the address below to arrive on or before May 18, 1991.
INFORMATION: J. Ridenhour, Dept. of Math. and Stats., Utah State Univ., Logan, UT 84322-3900; 801-750-2651; email: jride@math.usu.edu.

June 1991

*1–5. **Seventh International Conference on Graph Theory, Combinatorics, Algorithms, and Applications**, Western Michigan University, Kalamazoo, MI.

DIRECTORS: Y. Alavi, R.L. Graham, J. McCanna, A.J. Schwenk, and A.T. White.
INFORMATION: Y. Alavi or A.J. Schwenk, Dept. of Math. and Stats., Western Michigan Univ., Kalamazoo, MI 49008-5152; 616-387-4510; FAX: 616-387-3999; email: schwenk@gw.wmich.edu.

2–8. **Diskrete Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 501)

3–7. **1991 Annual Meeting of the Statistical Society of Canada**, Toronto, Ontario, Canada. (Mar. 1990, p. 334)

3–7. **NSF-CBMS Regional Research Conferences in the Mathematical Sciences: Harmonic Analysis and Partial Differential Equations**, University of Missouri, St. Louis, MO. (Dec. 1990, p. 1455)

3–8. **International Singularity Conference**, Lille, France. (Nov. 1990, p. 1286)

*3–10. **Twenty-ninth International Symposium on Functional Equations**, Wolfville, N.S., Canada.

INFORMATION: M.A. Taylor, Dept. of Math., Acadia Univ., Wolfville, N.S. Canada, B0P 1X0; email: math@acadia.bitnet; FAX: 902-542-1454.

3–13. **Fifth International Workshop in Analysis and its Applications**, Kupari-Dubrovnik, Yugoslavia. (Nov. 1990, p. 1286)

5–7. **Conference in Honor of Moshe Zakai**, Haifa, Israel. (Jan. 1991, p. 46)

5–15. **A Normal Form for the Navier-Stokes Equations and Its Connection to Turbulence**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (Jan. 1991, p. 46)

9–12. **International Workshop on Elementary Operators and Applications**, Heinrich Fabri-Institut der Universität Tübingen, Blaubeuren/Ulm, Federal Republic of Germany. (Nov. 1990, p. 1286)

*9–12. **Eleventh International Symposium on Forecasting (ISF '91)**, New York.

INFORMATION: L. Shiao-Yen Wu, Math-

ematical Sciences Dept., IBM T.J. Watson Research Center, P.O. Box 218, Yorktown Heights, NY 10598.

9–14. **Second International Conference on Fixed Point Theory and Applications**, Dalhousie University, Halifax, Nova Scotia, Canada. (Oct. 1990, p. 1138)

9–15. **Singuläre Störungsrechnung**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 501)

9–28. **NSF Faculty Workshop on Computer-Aided Instruction in Linear Algebra and Differential Equations**, University of New Hampshire, Durham, NH. (Jan. 1991, p. 46)

10–14. **Bernoulli Society Twentieth Conference on Stochastic Processes and their Applications**, Nahariya, Israel. (Nov. 1989, p. 1254)

10–14. **Trent Homotopy Theory Conference**, Trent Univ., Peterborough, Ontario, Canada. (Jan. 1991, p. 46)

11–July 5. **Miniworkshop on Nonlinearity: Fractals, Pattern Formation**, Trieste, Italy. (Jan. 1991, p. 46)

13–15. **Western Sectional Meeting**, Portland State University, Portland, Oregon.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

* 13–19. **Symposium on the Current State and Prospects of Mathematics**, Barcelona, Spain.

INVITED SPEAKERS: A. Connes (IHES, Bures-sur-Yvette), G. Faltings (Inst. for Advanced Study, Princeton), V.F.R. Jones (Univ. of California, Berkeley), S. Novikov (Landau Inst. for Theoretical Physics, Moscow), S. Smale (Univ. of California, Berkeley), R. Thom (IHES, Bures-sur-Yvette), S.T. Yau (Harvard Univ.).
INFORMATION: Organizing Committee, Centre de Recerca Matematica, Apartado 50, 08193-Bellaterra (Barcelona), Espana.

* 14–15. **Eighth Auburn Miniconference on Harmonic Analysis and Related Areas**, Auburn University, AL.

PROGRAM: Principle speakers will deliver hour addresses and there will be two days of sessions for contributed 20-minute talks.
PRINCIPLE SPEAKERS: C. Fefferman, Princeton University, and R. Fefferman, University of Chicago.
INFORMATION: G. DeSouza (205-844-6565 or gdesouza@auducvax) or Division of Mathematics, Auburn University, AL 36849-5310.

14–17. **Symposium on Lattice Theory and its Applications, in Honor of the 80th Birthday of Garrett Birkhoff**, Darmstadt, Federal Republic of Germany. (Oct. 1990, p. 1138)

16–19. **Bar-Ilan Symposium on the Foundations of Artificial Intelligence**, Ramat Gan, Israel. (Nov. 1990, p. 1286)

16–22. **Mathematische Methoden in der Robotik**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 46)

17–19. **Seventeenth International Workshop on Graph-Theoretic Concepts in Computer Science**, Fischbachau near Munich, Federal Republic of Germany. (Jan. 1991, p. 46)

17–21. **1991 International Symposium on the Mathematical Theory of Networks and Systems (MTNS-91)**, International Conference Center Kobe, Kobe, Japan. (Nov. 1989, p. 1254)

17–21. **European Conference on Elliptic and Parabolic Problems**, Pont á Mousson, France. (May/Jun. 1990, p. 613)

* 17–24. **Conference on Extremal Problems for Finite Sets**, Visegrád, Hungary.

ORGANIZER: Janos Bolyai Mathematical Society.
INFORMATION: C. Szabados, Vice-Secretary General of the JBMS, Janos Bolyai Mathematical Society, Budapest, Anker Koz 1–3. I. 111., H-1061; Tel: 427-741.

19–21. **The Tenth Pacific Coast Resource Modeling Conference**, Humboldt State Univ., Arcata, CA. (Feb. 1991, p. 141)

19–July 1. **Nonsmooth Optimization–Methods and Applications**, Erice (Trapani), Sicily. (Jan. 1991, p. 47)

20–25. **Curves, Surfaces, CAGD, and Image Processing**, Biri, Norway. (Feb. 1991, p. 141)

20–27. **NP-Completeness: The First 20 Years**, Erice (Trapani), Sicily. (Jan. 1991, p. 47)

23–29. **Mathematische Methoden des VLSI-Entwurfs und des Distributed Computing**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 744)

23–30. **International Category Theory Meeting**, Montreal, Quebec, Canada. (Jan. 1991, p. 47)

24–27. **Barsotti Memorial Symposium on Algebraic Geometry**, Abano Terme, Italy. (Jan. 1991, p. 47)

24–28. **NSF-CBMS Regional Research Conferences in the Mathematical Sciences: Multigrid and Multilevel Adaptive Methods for Partial Differential Equations**, George Washington University, Washington, DC. (Dec. 1990, p. 1455)

24–29. **Geometry Conference in Honour of Claude Godbillon and Jean Martinet**, University of Strasbourg, France. (Dec. 1990, p. 1455)

24–29. **Workshop on Algebraic and Topological Methods in Graph Theory**, Slovenia, Yugoslavia. (Feb. 1991, p. 141)

24–July 2. **Topological Methods in the Theory of Ordinary Differential Equations in Finite and Infinite Dimensions**, Villa "La Querceta", Montecatini Terme. (Feb. 1991, p. 141)

24–July 2. **Arithmetic Algebraic Topology**, Villa "Madruzzo", Trento. (Feb. 1991, p. 141)

25–28. **Eighth International Conference on Logic Programming**, Paris, France. (Jan. 1991, p. 47)

26–28. **Third IMACS International Symposium on Computational Acoustics**, Harvard University, Cambridge, MA. (Jul./Aug. 1990, p. 744)

26–28. **Local Communications Systems: LAN and PBX**, Palma, Balearic Islands, Spain. (Jan. 1991, p. 47)

26–29. **Summer Conference on General Topology and Applications**, Univ. of Wisconsin, Madison. (Feb. 1991, p. 142)

29–July 5. **Nineteenth International Colloquium on "Group Theoretical Methods in Physics"**, Salamance, Spain. (Feb. 1991, p. 142)

30–July 3. **Sixth Annual Conference on Structure in Complexity Theory**, University of Chicago, Chicago, IL. (Nov. 1990, p. 1287)

30–July 3. **Chaos and Catastrophes**, Dynamical Systems Institute, Boston University, Boston, MA. (Feb. 1991, p. 142)

30–July 6. **Elliptische Operatoren auf Singulären und Nichtkompakten Mannigfaltigkeiten**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 501)

July 1991

1–5. **The Mathematics of Nonlinear Systems**, University of Bath, United Kingdom. (Dec. 1990, p. 1455)

1–19. **Symposium on Geometric Group Theory**, University of Sussex, Brighton, England. (Feb. 1991, p. 142)

1–26. **NSF Geometry Institute - Geometry in the Machine Age**, Mount Holyoke College, South Hadley, MA. (Jan. 1991, p. 47)

2–5. **European Control Conference**, Grenoble, France. (Jul./Aug. 1990, p. 744)

2–5. **International Conference on Complexity: Fractals, Spin Glasses and Neural Networks**, Trieste, Italy. (Jan. 1991, p. 47)

4–11. **International Conference on Algebraic Topology**, Oaxtepec, Mexico. (Nov. 1990, p. 1287)

6–13. **Transition to Chaos in Classical and Quantum Systems**, Villa "La Querceta", Montecatini Terme. (Feb. 1991, p. 142)

7–11. **Fractal Geometry**, Dynamical Systems Institute, Boston University, Boston, MA. (Feb. 1991, p. 142)

7–12. **Fifth Gregynog Symposium on Differential Equations**, University of Wales, UK. (Nov. 1990, p. 1287)

7–13. **Computational Number Theory**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 744)

7–20. **Eighth International Conference on Probability in Banach Spaces**, Bowdoin College, Brunswick, ME. (Jan. 1991, p. 47)

8–12. **Second International Conference on Industrial and Applied Mathematics**, Washington, DC. (Apr. 1990, p. 501)

8–12. **NATO Advanced Research Workshop: Approximation by Solutions of Partial Differential Equations, Quadrature Formulae, and Related Topics**, Hanstholm, Denmark. (Jan. 1991, p. 48)

8–12. **Thirty-Fifth Annual Conference of the Australian Mathematical Society**, Melbourne, Australia. (Oct. 1990, p. 1139)

8–12. **Thirteenth British Combinatorial Conference**, Guildford, England. (Feb. 1991, p. 142)

8–14. **ICOR '91 International Conference on Radicals**, Szekszárd, Hungary. (Apr. 1990, p. 502)

*8–14. **Seventeenth Australasian Conference on Combinatorial Mathematics and Combinatorial Computing**, Canberra, Australia.

INFORMATION: J. Seberry, Dept. of Comp. Sci., Australian Defence Force Academy, Canberra, ACT 2600; or B. McKay, Dept. of Comp. Sci., Australian Nat'l Univ., P.O. Box 4, Canberra, ACT 2601.

8–26. **1991 Summer Research Institute on Algebraic Groups and their Generalizations**, Pennsylvania State University, University Park, PA.

INFORMATION: W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

14–18. **Complex Analytic Dynamics**, Dynamical Systems Institute, Boston University, Boston, MA. (Feb. 1991, p. 142)

14–20. **Dynamische Systeme**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 502)

14–20. **International Conference on Near-rings and Near-fields**, Linz, Austria. (Jan. 1991, p. 48)

14–27. **1991 NATO Advanced Study Institute: Probabilistic and Stochastic Methods in Analysis, with Applications**, Castelvecchio Pascoli (Lucca), Italy. (Jan. 1991, p. 48)

15–17. **Fifth IFAC/IMACS Symposium on Computer Aided Design in Control and Engineering Systems**, Swansea, UK. (Mar. 1990, p. 334)

15–17. **International Symposium on Symbolic and Algebraic Computation (ISSAC '91)**, Bonn, Germany. (Jan. 1991, p. 48)

15–18. **Sixth Annual IEEE Symposium on Logic in Computer Science**, Amsterdam, The Netherlands. (Sep. 1990, p. 937)

15–18. **The Fourth Interdisciplinary Conference on Natural Resource Modelling and Analysis**, University of Barcelona, Spain. (Jan. 1991, p. 48)

15–August 2. **Conference on Recent Developments in Differential Equations and Ecological Modeling**, University of Wyoming, Laramie, WY. (Jan. 1991, p. 48)

15–August 9. **IMA Summer Program in Semiconductors**, University of Minnesota, Minneapolis, MN. (Dec. 1990, p. 1456)

20–21. **1991 Summer Institute of the Linguistics Society of America**, University of California, Santa Cruz. (Feb. 1991, p. 143)

21–25. **Renormalization and Rigidity**, Dynamical Systems Institute, Boston University, Boston, MA. (Feb. 1991, p. 143)

21–26. **SPIE's International Symposium on Optical Applied Science and Engineering**, San Diego, CA. (Jan. 1991, p. 49)

21–27. **Halbgruppentheorie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 744)

22–24. **First International Workshop on Logic Programming and Non-Monotonic Reasoning**, Washington, DC. (Feb. 1991, p. 143)

22–26. **Thirteenth IMACS World Congress on Computation and Applied Mathematics**, Trinity College, Dublin University, Dublin, Ireland. (Apr. 1990, p. 502)

28–August 2. **Conference on Symbolic Dynamics and its Applications**, Yale University, New Haven, CT. (Nov. 1990, p. 1287)

28–August 2. **SIGGRAPH-Eighteenth International Conference on Computer Graphics and Interactive Techniques**, Las Vegas, Nevada. (Jan. 1991, p. 49)

28–August 3. **Gruppen und Geometrien**, Oberwolfach, Federal Republic of Germany. (Apr. 1990, p. 502)

29–August 9. **SMS-NATO ASI: Universal Algebra and Orders**, Université de Montréal, Montréal, Canada. (Dec. 1990, p. 1456)

August 1991

August 1991. **AMS-SIAM-SMB Symposium on Some Mathematical Questions in Biology: Theoretical Approaches for Predicting Spatial Effects in Ecological Systems**, San Antonio, TX.

INFORMATION: B. Verducci, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

3–7. **Interamerican Conference on Mathematics Education**, Univ. of Miami, Coral Gables, FL. (Apr. 1990, p. 502)

4–10. **Effiziente Algorithmen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 744)

5–8. **ICMI-China Regional Conference on Mathematics Education**, Beijing, China. (Jul./Aug. 1990, p. 744)

5–9. **Fourteenth International Symposium on Mathematical Programming**, Amsterdam, The Netherlands. (Jul./Aug. 1990, p. 745)

5–10. **NSF-CBMS Regional Research Conferences in the Mathematical Sciences: K-Homology and Index Theory**, University of Colorado, CO. (Dec. 1990, p. 1456)

*5–11. **Working Conference on Mapping Class Groups and Moduli Spaces**, University of Washington, Seattle, WA.

ORGANIZING COMMITTEE: R. Hain (Seattle), J. Harer (Ann Arbor), J. Harris (Harvard).
INFORMATION: R. Hain, Dept. of Math., University of Washington, Seattle, WA 98195; 206-543-1150; email: hain@math.washington.edu; Fax: 206-543-0397.

7–10. **Conference on Finite Fields, Coding Theory, and Advances in Communication and Computing**, University of Nevada, Las Vegas. (Feb. 1991, p. 143)

7–14. **1991 ASL European Summer Meeting (Logic Coloquium '91) in conjunction with the Ninth International Congress of Logic, Methodology and Philosophy of Science**, Uppsala, Sweden. (Dec. 1990, p. 1456)

8–11. **Joint Mathematics Meetings**, University of Maine, Orono, ME. (including the summer meetings of the AMS, AWM, MAA, and PME)

INFORMATION: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

11–15. **Eleventh Annual Crypto Conference (Crypto '91)**, University of California, Santa Barbara. (Feb. 1991, p. 143)

11–17. **European Young Statisticians Meeting**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 745)

12–16. **Workshop on p-adic Monodromy and the Birch-Swinnerton-Dyer Conjecture**, Boston University, Boston, MA. (Feb. 1991, p. 143)

12–17. **NSF-CBMS Regional Research Conferences in the Mathematical Sciences: Higher Order Asymptotics with Applications to Statistical Inference**, University of North Carolina, NC. (Dec. 1990, p. 1456)

14–16. **Short Conference on Uniform Mathematics and Applications (International Conference on Quasi-Uniformities and Related Structures)**, Bern, Switzerland. (Sep. 1990, p. 937)

18–24. **The Navier-Stokes Equations: The-**

ory and Numerical Methods, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 745)

*18–24. **The Third Conference of the Canadian Number Theory Association**, Queen's University, Kingston, Ontario. (Please note changes from Sep. 1990, p. 938)

PROGRAM: The conference is dedicated to Paulo Ribenboim on his retirement from Queen's. There will be a special session in his honor organized by his research associates and former students.

ORGANIZING COMMITTEE: A. Granville, R. Gupta, E. Kani, H. Kisilevsky, R. Mollin, C. Stewart, N. Yui.

INVITED SPEAKERS: F. Beukers (Utrecht), D. Boyd (UBC), D. Brownawell (Penn State), J. Coates (Cambridge), C. Deninger (Münster), K. Dilcher (Dalhousie), G. Frey (Essen), J.B. Friedlander (Toronto), A. Granville (IAS & Georgia), R. Heath-Brown (Oxford), U. Jannsen (MPI, Bonn), M. Jutila (Turku), H. Montgomery (Michigan), K. Murty (Toronto), R. Murty (McGill), J. Neukirch (Regensburg), N. Nygaard (Chicago), T. Oda (RIMS, Kyoto), J. Oesterle (Paris VI), L. Szpiro (ENS, Paris), F. Thaine (Campinas), J. Vaaler (Texas), M. Waldschmidt (Paris VI), D. Zagier (MPI, Bonn).

INFORMATION: C. Burns, Dept. of Math. and Stats., Queen's Univ., Kingston, Ontario K7L 3N6; email: cnta@qucdn.bitnet.

18–September 4. **Twenty-first Summer Ecole de Calcul des Probabilités**, Saint Flour, France. (Jul./Aug. 1990, p. 745)

19–22. **1991 Joint Statistical Meetings**, Atlanta, GA. (Mar. 1988, p. 466)

19–23. **NSF-CBMS Regional Research Conferences in the Mathematical Sciences: Qualitative and Structured Matrix Theory**, Georgia State University, GA. (Dec. 1990, p. 1456)

19–23. **The Seventh Prague Topological Symposium**, Prague, Czechoslovakia. (Dec. 1990, p. 1456)

*19–24. **NSF/CBMS Regional Conference on Qualitative and Structured Matrix Theory**, Georgia State University, Atlanta, GA.

PRINCIPLE SPEAKER: C.R. Johnson.

INFORMATION: C.A. Eschenbach, Georgia State University, University Plaza, Atlanta, GA 30303-3083.

19–30. **Course in Functional Integration and its Applications**, Trieste, Italy. (Jan. 1991, p. 49)

19–September 6. **College on Singularity Theory**, Trieste, Italy. (Sep. 1990, p. 938)

20–24. **Second Colloquium on Differential Equations**, Plovdiv, Bulgaria. (Feb. 1991, p. 144)

*20–27. **Sixth Workshop on Hadronic Mechanics**, San Marino, Italy.

PURPOSE: To finalize a comprehensive "Review of Hadronic Mechanics and its Applications" which is currently under preparation at the Institute for Basic Research in Palm Harbor, FL by A. Aringazin (USSR), A. Jannussis (Greece), D.F. Lopez (S. America), M. Nishioka (Japan), M. Mijatovic (Yugoslavia).

CONFERENCE TOPICS: Anomalous behavior of the mean life of unstable hadrons with speed, deformation of the extended charge distribution of hadrons under external fields with consequential alteration of the magnetic moment; expected violation of the time reversal symmetry under external strong interactions while recovering the exact symmetry in the known center-of-mass experiments, and similar experiments where the emphasis is in the reproduction of the central conditions for measures under electromagnetic interactions.

INFORMATION: R.M. Santilli, Chairman, Organizing Committee, Sixth Workshop on Hadronic Mechanics, The Institute for Basic Research, P.O. Box 1577, Palm Harbor, FL 34682-1577; 813-934-9593; Fax: 813-934-9275.

*20–30. **Third Pan-African Congress of Mathematicians**, Nairobi, Kenya.

INFORMATION: C. Oyake, Dept. of Math., Kenyatta Univ., Nairobi, Kenya.

21–23. **Thirteenth Boundary Element Method International Conference**, Tulsa, OK. (Nov. 1990, p. 1288)

21–24. **Colloquium on Differential Equations and Applications**, Budapest, Hungary. (Dec. 1990, p. 1457)

21–25. **The International Conference on the Theory of Rings, Algebras, and Modules in Honor of A.I. Shirshov**, Barnaul, U.S.S.R. (Jul./Aug. 1990, p. 745)

*24–30. **Twelfth International Joint Conference on Artificial Intelligence (IJCAI-91)**, Sydney, Australia.

INFORMATION: J. Mylopoulos or R. Reiter, Dept. of Computer Science, Univ. of Toronto, Toronto, Ontario M5S 1A4, Canada.

25–31. **Klassifikation Komplex-Algebraischer Varietäten**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 745)

25–31. **Conference on Classifying Spaces of Compact Lie Groups and Finite Loop Spaces**, Göttingen University. (Nov. 1990, p. 1288)

26–31. **International Conference on Differential Equations: EQUADIFF 91**, Barcelona, Spain. (Feb. 1991, p. 144)

September 1991

*1–5. **Colloquium on Intuitive Geometry**, Balatonaliga, Hungary.

ORGANIZER: Janos Bolyai Mathematical Society.

INFORMATION: C. Szabados, Vice-Secretary General of the JBMS, Janos Bolyai Mathematical Society, Budapest, Anker Koz 1–3. I. 111., H–1061; Tel: 427-741.

1–7. **Topologie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 745)

3–6. **Seventeenth International Conference on Very Large Data Bases (VLDB '91)**, Barcelona, Spain. (Jan. 1991, p. 49)

3–6. **Functional Integration and its Applications**, Trieste, Italy. (Jan. 1991, p. 50)

3–10. **Applied Mathematics in the Aerospace Field**, Erice (Trapani), Sicily. (Jan. 1991, p. 50)

4–6. **Twenty-fifth Annual DOD Cost Analysis Symposium**, Xerox International Center for Training and Management Development, Leesburg, VA. (Feb. 1991, p. 144)

4–10. **IMA Tutorial**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1139)

7–9. **International Workshop on Software for Automatic Control Systems**, Irkutsk, USSR. (Oct. 1990, p. 1139)

8–14. **Niedrigidimensionale Topologie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 745)

8–14. **Knoten und Verschlingungen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 745)

9–13. **Journées Arithmétiques**, Geneva, Switzerland. (Dec. 1990, p. 1457)

9–13. **ICMTA 5 Teaching Mathematics by Applications**, Noordwijkerhout, The Netherlands. (Jan. 1991, p. 50)

9–27. **School on Dynamical Systems**, Trieste, Italy. (Sep. 1990, p. 938)

10–13. **IFAC/IMACS Symposium on Fault Detection, Supervision and Safety for Technical Processes-SAFEPROCESS '91**, Baden-Baden, Federal Republic of Germany. (Apr. 1990, p. 502)

11–13. **IFAC/IFIP/IMACS Symposium on Robot Control (SYROCO '91)**, Vienna, Austria. (Oct. 1990, p. 1140)

11–14. **Fourth SIAM Conference on Applied Linear Algebra**, Univ. of Minnesota, Minneapolis, MN. (Nov. 1990, p. 1288)

13–15. **Representation Theory Conference**, University of Oregon, Eugene, OR. (Nov. 1990, p. 1288)

14–27. **An International Conference on Theoretical Aspects of Computer Software**, Tohoku University, Sendai, Japan. (Feb. 1991, p. 144)

15–20. **DMV-Jahrestagung 1991**, Bielefeld, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

15–21. **Geometrie der Banachräume**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

*16–17. **Seventh International Summer School on Probability Theory and Mathematical Statistics**, Varna-Golden Sands, Bulgaria.

CHAIRMAN: A. Obretenov, Inst. of Math. of the Bulgarian Academy of Sciences.
INVITED SPEAKERS: Ch. Charalambides (Athens), E. Csáki (Budapest), J.-P. Dion (Montréal), C.C. Heyde (Canberra), R. Liptser (Moscow), P. Ney (Madison, WI).
INFORMATION: L. Mutafchiev, P.O. Box 373, 1090 Sofia, Bulgaria; Fax: (359-2) 752078.

16–20. **Summer School on Minimal Models, Lie Groups and Differential Geometry**, Universidad de Santiago de Compostela, Spain. (Feb. 1991, p. 144)

22–28. **Nonlinear and Random Vibrations**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

23–29. **Sixth Symposium on Classical Analysis**, Kazimierz Dolny, Poland. (Apr. 1990, p. 502)

24–27. **International Conference on Theoretical Aspects of Computer Software**, Tohoku Univ., Sendai, Japan. (Sep. 1990, p. 938)

25–27. **Ninth GAMM Conference on Numerical Methods in Fluid Mechanics**, Lausanne, Switzerland. (May/Jun. 1990, p. 613)

29–October 5. **Kombinatorik Geordneter Mengen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

30–October 2. **First International Conference of the Austrian Center for Parallel Computation (ACPC)**, Salzburg, Austria. (Feb. 1991, p. 145)

October 1991

1–4. **SCAN-91 IMACS-GAMM International Symposium on Computer Arithmetic and Scientific Computation**, Universität Oldenburg, Germany. (Feb. 1991, p. 145)

*3–10. **Fifth International Conference on Complex Analysis and Applications '91 with a Symposium on Generalized Functions**, Varna, Bulgaria.

CONFERENCE TOPICS: Analytic functions of one and several complex variables, analytic manifolds and spaces, generalized functions and integral transforms, applications in mathematical physics.
CALL FOR PAPERS: Abstract deadline: March 31, 1991.
INFORMATION: I. Dimovski or V. Hristov, Complex Analysis and Applications '91, Institute of Mathematics, Bulgarian Academy of Sciences, 1090 Sofia, P.O. Box 373, Bulgaria; Telex: 22628 BANMAT BG, Telefax: (0359 2) 75 20 78.

6–12. **Arbeitsgemeinschaft mit Aktuellem Thema (wird in den Mitteilungen der DMV Heft 3/1991 bekanntgegeben)**, Oberwolfach, 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)

7–11. **Workshop on Stochastic and Deterministic Models**, Trieste, Italy. (Sep. 1990, p. 938)

7–11. **IMA-INRIA Workshop on Transfer of Mathematics to Industry in the U.S. and France**, University of Minnesota, Minneapolis, MN. (Dec. 1990, p. 1458)

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)

14–18. **IMA Workshop on Sparse Matrix Computations: Graph Theory Issues and Algorithms**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1140)

16–18. **SIAM Workshop on Micromechanics**, Leesburg, VA. (Nov. 1990, p. 1288)

18–19. **Differential and Delay Equations**, Iowa State University, Ames, Iowa. (Jan. 1991, p. 50)

20–26. **C^*-Algebren**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 50)

21–26. **Third International Workshop–Conference on Evolution Equations, Control Theory, and Biomathematics**, Han-sur-Lesse, Belgium. (Nov. 1990, p. 1288)

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.

PROGRAM: AI*IA was founded in 1988 with the intent of promoting the development of study and research in artificial intelligence and its applications. This congress will focus on high quality scientific and technical results as well as on innovative industrial applications.
CONFERENCE TOPICS: Architectures, languages and environments; knowledge representation and automated reasoning; problem solving and planning; knowledge acquisition and automatic learning; cognitive models; natural language; perception and robotics; industrial applications of artificial intelligence.
CALL FOR PAPERS: Papers (5000 words max) must be in English. Authors must send 4 copies including summary (about 200 words) and key words, and they should point out the scientific topic being treated. Papers must arrive by April 10, 1991. Papers should be sent to: S. Gaglio, CRES, Centro per la Ricerca Elettronica in Sicilia, Viale Regione Siciliana, 49, 90046, MONREALE (Palermo).
INFORMATION: Local Organization: See address above. Scientific Secretariat: E. Ardizzone, F. Sorbello, Dipartimento di Ingegneria Elettrica, Univ. di Palermo, Viale delle Scienze, 90128 Palermo; tel: +39-91-595736/489856/421639; Telefax: +39-91-488452.

November 1991

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)

9–10. **Western Sectional Meeting**, 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)

17–23. **Singularitäten der Kontinuumsmechanik: Numerische und Konstruktive Methoden zu Ihrer Behandlung**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

*18–22. **Supercomputing '91**, Albuquerque, NM. (Please note changes from Jan. 1990, p. 62)

PROGRAM: The conference will bring together supercomputing researchers, design managers, and computational scientists and engineers to report advances and experiences, state needs, suggest future directions, and exchange information. It will include a broad technical program covering current results in a variety of disciplines; an in-depth tutorial program for those needing training in a specific area; and the most comprehensive exhibition

of products pertaining to supercomputing. The technical program will consist of contributed and invited papers, panels, poster sessions, research exhibits, and workshops.
CALL FOR PAPERS: Deadline for Papers: April 1, 1991 to A. Hayes at address below or at ahh@lanl.gov.
INFORMATION: R.L. Elliott (Conference Chair), Computing and Communications Division, MS B260, Los Alamos National Laboratory, Los Alamos, NM 87545; 505-665-4506; Fax: 505-665-4361; email: rle@lanl.gov.

20–26. **C^*-Algebren**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

24–30. **Numerische Methoden der Approximationstheorie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1990, p. 746)

25–26. **Central Section**, North Dakota State University, Fargo, ND.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

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)

2–6. **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)

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)

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)

January 1992

1–11. **Mathematische Optimierung**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

5–8. **Second Caribbean Conference on the Fluid Dynamics**, University of the West Indies, St. Augustine, Trinidad. (Jan. 1991, p. 51)

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)

13–17. **IMA Workshop on Linear Algebra, Markov Chains, and Queuing Models**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)

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)

February 1992

2–8. **Thermodynamische Materialtheorien**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

9–15. **Numerical Methods for Parallel Computing**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

16–22. **Funktiontheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

23–29. **p-Adische Analysis und Anwendungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

24–28. **IEEE Computer Society COMPCON Spring '92**, San Francisco, CA. (Jan. 1990, p. 62)

24–March 1. **IMA Workshop on Iterative Methods for Sparse and Structured Problems**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)

March 1992

1–7. **Klassifizierende Räume und Anwendungen der Steenrod-Algebra**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

8–14. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

15–21. **Regelungstheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

22–28. **Teichmüller-Theorie und Modulraume Riemannscher Flachen**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

27–28. **Central Section**, Southwest Missouri State University, Springfield, MO.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

29–April 4. **Topologische Methoden in der Gruppentheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

30–April 3. **Workshop on Statistical Methods in Molecular Biology**, Mathematical Sciences Research Institute, Berkeley, CA. (Oct. 1990, p. 1141)

The following new announcements will not be repeated until the criteria in the last paragraph in the box at the beginning of this section are met.

August 1992

*3–7. **Sixth Workshop on Lie-Admissible Formulations**, Clearwater, FL.

PURPOSE: To conduct mathematical theoretical and experimental studies on open (non-conservative) classical and quantum mechanical systems via their representation in terms of time evolution laws characterized by Lie-Admissible Algebras.
INFORMATION: G.F. Weiss, Chairman of the Organizing Committee, Sixth Workshop on Lie-Admissible Formulations, The Institute for Basic Research, 495 A-19, no. 1577, Palm Harbor, FL 34682-1577; Tel: 813-934-9593; Fax: 813-934-9275. Participation shall be restricted to mathematicians and physicists either with a record of publication in Lie-Admissible Algebras and their applications or with a preprint in the field that must be submitted jointly with the application for participation.

August 1994

*3–11. **The International Congress of Mathematicans 1994**, Zürich, Switzerland.

INFORMATION: R. Jeltsch, Seminar für Angewandte Mathematik, ETH Zürich, CH-8092 Zürich, Switzerland; Tel: +41 1 256 34 52; email: jeltsch@math.ethz.ch or na.jeltsch@na-net.ornl.gov.

New AMS Publications

New from the AMS

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.

POLYHEDRAL COMBINATORICS
William Cook, and Paul D. Seymour, Editors

(Proceedings of a DIMACS Workshop, 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 include 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.

Contents

1980 *Mathematics Subject Classifications*: 05C38, 05C45, 05C70, 90C10, 90C27
ISBN 0-8218-6591-9, LC 90-49139, ISSN 1052-1798
288 pages (hardcover), March 1991
Individual member $33, List price $55,
Institutional member $44
To order, please specify DIMACS/1N

DISTRIBUTED COMPUTING AND CRYPTOGRAPHY
Joan Feigenbaum and Michael Merritt, Editors

(Proceedings of a DIMACS Workshop, 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.

Contents

1980 *Mathematics Subject Classifications*: 68M10, 68P25, 94A60; 03B45, 03B70, 68M20, 68N99, 68Q15, 68Q60, 68S15
ISBN 0-8218-6590-0, LC 90-49828, ISSN 1052-1798
262 pages (hardcover), March 1991
Individual member $31, List price $51,
Institutional member $41
To order, please specify DIMACS/2N

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 sciences. 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 accessible 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.

Contents

1980 *Mathematics Subject Classifications*: 00A07, 00A25, 01-01, 46-01, 49-01, 49-03, 49A99
ISBN 0-8218-0165-1, LC 90-21246
187 pages (softcover), March 1991
Individual member $18, List price $23
To order, please specify MAXMIN/N

TOPICS IN REPRESENTATION THEORY
A. A. Kirillov, Editor

(Advances in Soviet Mathematics, Volume 2)

Almost every major mathematical theory, from 19th century classical analysis and geometry to the newest abstract constructions of category theory, have recently acquired a "physical flavor." In the case of representation theory, two new areas of mathematical physics—the theory of completely integrable systems and string theory—have had a great influence. In addition, the idea of supersymmetry has become a general mathematical principle that has had important ramifications in representation theory. Together with this wave of new connections and new trends in representation theory, more traditional activity, dealing mostly with the study of classical objects, has also flourished.

The papers in this volume were written by members of the seminar on representation theory at Moscow University, which has been running continuously since 1961. The papers reflect some of the new influences seen in representation theory today. Among the topics included are representation theory of "large" groups, indecomposable representations of the affine unimodular group of the plane, dual objects for certain real reductive Lie groups, and geometrical interpretations of a certain infinite-dimensional Lie algebra.

Contents

1980 *Mathematics Subject Classifications*: 17B10, 17B65, 22E47, 22E65, 22E70; 20C32, 20M30, 58A99
ISBN 0-8218-4101-7, LC 90-26017, ISSN 1051-8037
247 pages (hardcover), March 1991
Individual member $50, List price $83,
Institutional member $66
To order, please specify ADVSOV/2N

MAXIMAL SUBGROUPS OF EXCEPTIONAL ALGEBRAIC GROUPS

Gary M. Seitz

(Memoirs of the AMS, 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.

Contents

Labelled diagrams, restrictions on $L(G)|X$, and root groups; Reduction to the case X simple; $X = A_1, A_2, B_2, G_2, A_3, B_3, C_3, A_4, B_4, C_4, D_4, F_4, E_6, E_7$; X of classical type and rank$(X) \geq 5$; The main theorems.

1980 *Mathematics Subject Classifications*: 20E28, 20G15, 20G14
ISBN 0-8218-2504-6, LC 90-26491, ISSN 0065-9266
197 pages (softcover), March 1991
Individual member $16, List price $26,
Institutional member $21
To order, please specify MEMO/441N

BOUNDEDNESS RESULTS FOR OPERATORS WITH SINGULAR KERNELS ON DISTRIBUTION SPACES

Rodolfo H. Torres

(Memoirs of the AMS, 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 ϕ-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.

Contents

The atomic decomposition of the Triebel-Lizorkin spaces; Generalized Calderón-Zygmund operators; Generalized Calderón-Zygmund operators on Triebel-Lizorkin spaces; Operators with singular kernels of different sizes; Pseudodifferential operators on Triebel-Lizorkin spaces.

1980 *Mathematics Subject Classifications*: 43B20; 46F12, 47G05
ISBN 0-8218-2505-4, LC 90-26446, ISSN 0065-9266
172 pages (softcover), March 1991
Individual member $11, List price $18,
Institutional member $14
To order, please specify MEMO/442N

MAPPING CLASS GROUPS OF LOW GENUS AND THEIR COHOMOLOGY

D. J. Benson and F. R. Cohen

(Memoirs of the AMS, 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.

Contents

Artin's braid group and the homology of certain subgroups of the mapping class group; Specht modules and the cohomology of mapping class groups; The mod 2 *cohomology of the mapping class group for a surface of genus two.*

1980 *Mathematics Subject Classifications*: 57M20, 20J05; 20C20, 20C30, 20F36, 20F38, 55R99, 57T99
ISBN 0-8218-2506-2, LC 90-26421, ISSN 0065-9266
104 pages (softcover), March 1991
Individual member $12, List price $20,
Institutional member $16
To order, please specify MEMO/443N

SOCIÉTÉ MATHÉMATIQUE DE FRANCE, ASTÉRISQUE

The AMS distributes Astérisque only in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF, Ecole Normale Superieure, Tour L, 1 rue Maurice Arnoux, 92120 Montrouge, France, or to OFFILIB, 48 rue Gay-Lussac, 75240 Paris Cedex 05, France. Individual members of either AMS or SMF are entitled to the member price. (ISSN 0303-1179)

ON THE ANDRÉ-QUILLEN COHOMOLOGY OF COMMUTATIVE $\mathbb{F}_2$-ALGEBRAS

Paul G. Goerss

(Astérisque, Number 186)

Quillen and André have explored and made more rigorous a notion of cohomology of commutative algebras (or, more generally, simplicial commutative algebras). They were able to do a number of systematic calculations, particularly in the case of a local ring with residue field of characteristic zero. However, the case of non-zero characteristic remained a problem, despite its central importance for certain applications, such as to homotopy theory. In this book, the author explores the André-Quillen cohomology of supplemented algebras over the field $\mathbb{F}_2$ of two elements and completely determines the structure of this cohomology, including a product and "Steenrod" operations. A necessary part of the program is a complete examination of the homotopy theory of simplicial algebras, which draws upon the work of many authors.

Content

The homotopy theory of simplicial algebras: *Preliminaries on simplicial algebras; Homotopy operations and the structure of homotopy; homotopy operations and Steenrod squares*; **Homology and cohomology**: *Homology, cohomology, cofibrations and the suspension; Products and operations in cohomology*; **Quillen's fundamental spectral sequence**: *Quillen's spectral sequence; The Jacobi identity and its ramifications; Applications of Quillen's spectral sequence; The proof of the Adem relations; Projective extension sequences and a quadratic operation;*

The cohomology of Abelian objects: *Applications of the Hilton-Milnor Theorem; A reverse Adams spectral sequence for computing $H^*_{\mathscr{D}}A$; A Koszul resolution for computing $Ext_{\mathscr{D}}$; Operations in the reverse Adams spectral sequence; The proof of Theorem 13.2.*

1980 *Mathematics Subject Classifications*: 13D03; 18G30, 55U35
ISSN 0303-1179
170 pages (softcover), March 1991
Individual AMS or SMF member $18, List price $25
To order, please specify AST/186N

FINITE GEOMETRIES AND COMBINATORIAL DESIGNS

Earl S. Kramer and Spyros S. Magliveras, Editors

Contemporary Mathematics, Volume 111

More than eighty participants from all over the world attended an AMS Special Session on Finite Geometries and Combinatorial Designs held in Lincoln, Nebraska in the fall of 1987. This volume contains the proceedings of that Special Session, in addition to several invited papers. Employing state-of-the-art combinatorial and geometric methods, the papers show significant advances in this area. Topics range over finite geometry, combinatorial designs, their automorphism groups, and related structures.

Requiring graduate-level background, this book is intended primarily for researchers in finite geometries and combinatorial designs. However, the interested nonspecialist will find that the book provides an excellent overview of current activity in these areas.

1980 *Mathematics Subject Classifications:* 05, 51
ISBN 0-8218-5118-7, LC 90-45302,
ISSN 0065-9266
312 pages (softcover), October 1990
Individual member $32,
List price $53,
Institutional member $42
To order, please specify
CONM/111NA

All prices subject to change. Free shipment by surface; for air delivery, please add $6.50 per title. *Prepayment required.* **Order from** American Mathematical Society, P.O. Box 1571, Annex Station,, Providence, RI 02901-1571, or call toll free 800-321-4AMS (321-4267) in the continental U.S. and Canada to charge with Visa or MasterCard.

COMBINATORIAL GROUP THEORY

Benjamin Fine, Anthony Gaglione and Francis C.Y. Tang, Editors

Contemporary Mathematics, Volume 109

The AMS Special Session on Combinatorial Group Theory—Infinite Groups, held at the University of Maryland in April 1988, was designed to draw together researchers in various areas of infinite group theory, especially combinatorial group theory, to share methods and results. The session reflected the vitality and interests in infinite group theory, with eighteen speakers presenting lectures covering a wide range of group-theoretic topics, from purely logical questions to geometric methods. The heightened interest in classical combinatorial group theory was reflected in the sheer volume of work presented during the session.

This book consists of eighteen papers presented during the session. Comprising a mix of pure research and exposition, the papers should be sufficiently understandable to the nonspecialist to convey a sense of the direction of this field. However, the volume will be of special interest to researchers in infinite group theory and combinatorial group theory, as well as those interested in low-dimensional (especially three-manifold) topology.

1980 *Mathematics Subject Classifications*: 20
ISBN 0-8218-5116-0, LC 90-40475,
ISSN 0271-4132
191 pages (softcover), October 1990
Individual member $22, List price $37,
Institutional member $30
To order, please specify CONM/109NA

All prices subject to change. Free shipment by surface; for air delivery, please add $6.50 per title. *Prepayment required.* **Order from** American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571, or call toll free 800-321-4AMS (321-4267) in the continental U.S. and Canada to charge with Visa or MasterCard.

AMS Reports and Communications

Election Results of 1990

The newly elected Vice President of the Society is Chandler Davis. The newly elected Members-at-Large of the Council are David A. Cox, John M. Franks, Frank Gilfeather, Steven H. Weintraub, and Ruth J. Williams. The newly elected Trustee is M. Susan Montgomery.

All candidates in noncontested elections were elected to their respective offices.

The candidates elected to the Nominating Committee for 1991 are Michael Aschbacher, Jerry Lawrence Kazdan, and Walter David Neumann.

The candidates elected to the Editorial Boards Committee for 1991 are Richard James Milgram and Nolan R. Wallach.

The composition of the Council for 1991 follows.

Council for 1991

President:
Michael Artin
Ex-President:
William Browder
Vice Presidents:
Lenore Blum
Chandler Davis
Dennis P. Sullivan
Treasurer:
Franklin P. Peterson
Associate Treasurer:
Steve Armentrout
Secretary:
Robert M. Fossum
Associate Secretaries*:
Joseph A. Cima
W. Wistar Comfort
Andy Roy Magid
Lance W. Small
Members-at-large:
Jonathan L. Alperin
Sheldon Axler
Joan S. Birman
Fan R. K. Chung
Charles Herbert Clemens
Lawrence J. Corwin
David A. Cox
John M. Franks
Frank Gilfeather
Carl Pomerance
Michael C. Reed
Hugo Rossi
William Thurston
Steven H. Weintraub
Ruth J. Williams
Shing-Tung Yau

*One of these four is a voting member at each meeting.

Representatives of Committees

Bulletin Editorial Committee
Richard S. Palais, Chair
Colloquium Editorial Committee
To Be Named
Committee to Monitor Problems in Communications
Arthur M. Jaffe, Chair
Journal of the American Mathematical Society
To Be Named
Mathematical Reviews Editorial Committee
B. A. Taylor, Chair
Mathematical Surveys Editorial Committee
Victor Guillemin, Chair
Mathematics of Computation Committee
Walter Gautschi, Chair
Proceedings Editorial Committee
William J. Davis, Co-Chair
Representative on American Journal
M. Salah Baouendi
Science Policy Committee
Michael C. Reed, Chair
Transactions and Memoirs Committee
David J. Saltman, Chair

Trustees for 1991

Michael Artin
Steve Armentrout
Frederick W. Gehring
Ronald L. Graham
M. Susan Montgomery
Franklin P. Peterson
John C. Polking
Paul Sally, Jr.

The members of the Society have passed the proposed Amendments to the Bylaws as result of the election of 1990. They are as follows:

Article VII

Election of Officers and Terms of Office

SECTION 1. The term of office shall be one year in the case of the president-elect and the ex-president; two years in the case of the president, the secretary, the associate secretaries, the treasurer, and the associate treasurer; three years in the case of vice presidents and members-at-large of the Council, one vice president and five members-at-large retiring annually; and five years in the case of the trustees. In the case of members of the editorial committees and appointed members of the communications committees, the term of office shall be determined by the Council. The term of office for elected members of the Executive Committee shall be four years, one of the elected members retiring annually. All terms of office shall begin on February 1 and terminate on January 31 with the exception that the officials specified in Articles I, II, III, IV, and V (excepting the president-elect and ex-president) shall continue to serve until their successors have been duly elected or appointed and qualified.

SECTION 4. On or before February 15, the secretary shall send to all members of the Council for a mail vote a ballot containing two names for

each place to be filled on the Executive Committee. The nominees shall be chosen by a committee appointed by the president. Members of the Council may vote for persons not nominated. Any member of the Council who is not an *ex officio* member of the Executive Committee (see Article V, Section 1) shall be eligible for election to the Executive Committee for a term extending beyond the regular term on the Council, that person shall automatically continue as a member of the Council during the remainder of that term on the Executive Committee.

Article VII
Election of Officers and Terms of Office

SECTION 2. The president-elect, the vice presidents, the trustees, and the members-at-large of the Council shall be elected by written ballot. An official ballot shall be sent to each member of the Society by the secretary on or before October 10, and such ballots, if returned to the secretary in envelopes bearing the name of the voter and received within thirty days, shall be counted. Each ballot shall contain one or more names proposed by the Council for each office to be filled, with blank spaces in which the voter may substitute other names. A plurality of all votes cast shall be necessary for election. In case of failure to secure a plurality for any office, the Council shall choose by written ballot among the members having the highest number of votes. The secretary, the associate secretaries, the treasurer, and the associate treasurer shall be appointed by the Council in a manner designated by the Council. Each committee named in Article III, Section 1 or 3, shall be appointed by the Council in a manner designated by the Council. Each such comittee shall elect one of its members as chairman in a manner designated by the Council.

Article IX
Dues and Privileges of Members

SECTION 8. After retirement from active service on account of age or on account of long term disability, any ordinary or contributing member who is not in arrears of dues and with membership extending over at least twenty years may, by giving proper notification to the secretary, have dues remitted. Such a member shall receive *Notices* and may request to receive the *Bulletin* as privileges of membership during each year until membership ends.

Robert M. Fossum
Secretary
Urbana, Illinois

Miscellaneous

Personals

George D. Byrne, of the Exxon Research and Engineering Company in Annandale, NJ, was awarded the 1990 Computing Practice Award given annually by the American Institute of Chemical Engineers (AIChE) "to recognize outstanding contributions in the practice or application of chemical engineering to computing and systems technology." Byrne was cited "for his contributions in numerical methods, especially differential equations, related software, and their applications in chemical engineering." The award was given November 14, 1990 in Chicago.

Ganapati P. Patil, of the Center for Statistical Ecology and Environmental Statistics at The Pennsylvania State University, has been appointed Distinguished Professor at the University. The title recognizes a limited number of outstanding professors throughout the Penn State system. Professor Patil was awarded the title on the basis of his "exceptional record of teaching, research, and service."

Robert A. Rankin, of the University of Glasgow, has been elected to Honorary Membership of the Edinburgh Mathematical Society in recognition of his outstanding services to mathematics in Scotland and his distinguished research in modular forms.

Wojbor A. Woyczynski, has resigned as Chairman of the Department of Mathematics and Statistics at Case Western Reserve University after nine years. He will continue as Professor and Director of the CWRU Center for Stochastic and Chaotic Processes in Science and Technology.

Deaths

James H. Case, of the University of Utah, died on October 23, 1990, at the age of 62. He was a member of the Society for 36 years.

Hans Freudenthal, Professor Emeritus of Utrecht University, died on October 13, 1990, at the age of 85. He was a member of the Society for 41 years. (See News and Announcements, *Notices*, February 1991, p. 113).

John C. Oxtoby, of Bryn Mawr College, died on January 2, 1991, at the age of 80. He was a member of the Society for 55 years.

Kanhaya Lal Singh, of Fayetteville State University, died on November 22, 1990, at the age of 46. He was a member of the Society for 20 years.

New Members of the AMS

ORDINARY MEMBERS

Renee Birgit Adams, La Jolla, CA
Mary Dell Beard, McKinleyville, CA
Sarah Marie Belcastro, Haverford College, PA
Martin Berz, Michigan State Univ, East Lansing
Francisco J Bido, Brooklyn, NY
Carla J Boardman, Chester, VA
Tanya Boboricken, Los Altos Hills, CA
Mary M Briggs, Delmar, NY
Rhodella Brown, Orange City, FL
Jin-yi Cai, Princeton Univ, NJ
Devendra K Chawla, Frankfort, KY
Chung-Ki Cho, Pohang Institute of Science & Technology, Korea
Vladimir Corny, Bratislava, Czechoslovakia
Roy Danchick, Los Angeles, CA
Jerry Donato, Syracuse, NY
James B Eblin, Lake Oswego, OR
Hassan Mostafa El-Owaidy, Cairo, Egypt
Edward P Emerson, Minneapolis, MN
Scott T Emery, Livermore, CA
Choo Shan Eng, Houston, TX
Samuel N Enurah, Baltimore, MD
John D Ferriby, Troy, MI
Robert F Fliess, West Liberty State College, WV
Gary Franklin, Denver, CO
Patrick A Frey, Memphis, TN
Tinghui Fu, Ithaca, NY
Charles A Garwin, Santa Monica, CA
Gaston O Giroux, Univ de Sherbrooke, Quebec, Canada
Roland Glowinski, Univ of Houston-University Park, TX
Lisa Jayne Gray, Ithaca, NY
Dale E Green, Corvallis, OR
Richard M Grossman, Glen Oaks, NY
Shyamal Guha, Texas Southern Univ, Houston, TX
Brendan E Hassett, New Haven, CT
Ahmedou Hauba, Nouakchott, Mauritius
David L Hector, Broomfield, CO
Man-Soo Hong, Arlington, TX
Stephen Humphries, Brigham Young Univ, Provo, UT
Vincent G Hurtig, Morris, MN
Arne Jakobsen, Norwegian Institute of Technology, Trondheim, Norway
Richard W Janson, Janson Industries, Canton, OH
Xingzhi Ji, Univ of Alberta, Edmonton, Canada
Ronald L Kendrick, Manassas, VA
Rodney B Kerby, Silver Spring, MD
Steve Kern, Torrance, CA
Takashi Kimura, Univ of Texas at Austin
Guido Kings, Princeton Univ, NJ
Valentin Y Koloskov, Academy of Sciences of the USSR, Moscow
Constantin S Konstantopoulos, Boston Univ, MA
Amy Lynn Krebsbach, Sheboygan, WI
Elliot Jay Kurzius, Astoria, NY
Jean-Louis Lassez, IBM, Yorktown Heights, NY
Robert W Leasure, Stark Technology College, Canton, OH
Celeste M Leathers, Avon Lake, OH
Han-Chow Lee, Palo Alto, CA
Sarah Lesher, Silver Spring, MO
David W Linder, Montreal, Quebec, Canada
Dean W Linder, Starkville, MS
Kenneth A Lowe, West Valley City, UT
Craig S MacInnes, Kingston, RI
David Marain, Fair Lawn, NJ
Julia E Massey, Livingston Univ, AL
Jack R McCown Jr, Central Oregon Community College, Bend
David Stuart Miller, Laurel, MD
Eric Alexander Moore, Chapel Hill, NC
Paul Mugambi, Makerere Univ, Kampala, Uganda
George R Murphy, Butler, PA
Mwiinga E Muwezwa, Univ of Botswana, Gaborone
John D Nesbit, Milton, Australia
Nguyen Q Nguyen, Santa Ana, CA
Sam Owre, Menlo Park, CA
Ronald T Paloutzian, Selma, CA
Dimpy Pathria, Princeton Univ, NJ
Jean-Marc Patin, Orvault, France
Nolan E Penn, Univ of California, San Diego, La Jolla
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POSITIONS AVAILABLE

CALIFORNIA

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Temporary Postdoctoral Positions

Several temporary positions beginning in Fall 1991 are anticipated for new and recent Ph.D.'s of any age, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. The terms of these appointments may range from one to three years. Applicants for NSF or other postdoctoral fellowships are encouraged to apply for these positions; combined teaching/research appointments may be made for up to three years. Mathematicians whose research interests are close to those of regular department members will be given some preference. Applicants should send a resume, and reprints, preprints, and/or dissertation abstract, and ask three people to send letters of recommendation to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than April 1, 1991. (Applications received for our earlier January 15, 1991 deadline will automatically be considered for this deadline also.) The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA, RIVERSIDE
Department of Mathematics
Riverside, California

Applications are invited for temporary faculty positions beginning in September 1991. These positions are at the Visiting Assistant/Associate Professor levels. Candidates should have received a Ph.D. degree by September 1991. The positions are open to applicants from all research areas within Mathematics. Candidates should have significant accomplishments or high potential in both research and teaching.

Candidates should send their curriculum vitae and list of publications, and at least three letters of recommendation to:

Professor Gerhard Gierz
Chair, Temporary Faculty Search Committee
Department of Mathematics
University of California, Riverside
Riverside, CA 92521-0135

by April 1, 1991. UCR is an Affirmative Action/Equal Opportunity Employer.

DISTRICT OF COLUMBIA

NATIONAL RESEARCH COUNCIL
Mathematical Sciences
Staff Director

The NATIONAL RESEARCH COUNCIL is seeking a Staff Director for its Board on Mathematical Sciences. Responsibilities include directing a professional staff, conducting a diverse set of studies in the mathematical sciences, and implementing those studies in concert with university, governmental, and industrial sectors. Requires Ph.D. or equivalent in a directly relevant field; 7–10 years relevant experience, extensive working familiarity with research in pure and applied mathematics and statistics; experience with administration and/or study project management; and demonstrated management and communications skills.

Please submit a resume and the names of three references to: NRC/CPSMA, NAS 285 (NM-644.001), 2101 Constitution Avenue, N.W., Washington, DC 20418. An Equal Opportunity Employer.

GEORGIA

GEORGIA INSTITUTE OF TECHNOLOGY

The Center for Dynamical Systems and Nonlinear Studies expects to have some long and short-term visiting positions beginning Fall 1991. These positions are in nonlinear differential equations, dynamical systems, computational methods and related areas. In addition to a resume and at least three letters of reference, candidates should send a summary of future research plans to Professor Jack K. Hale, Director, CDSNS, Georgia Institute of Technology, Atlanta, GA 30332–0190. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

ILLINOIS

LAKE FOREST COLLEGE
Department of Mathematics and Computer Science
Lake Forest, Illinois 60045-2399

Applications are invited for a probable opening in Mathematics at the Instructor or Assistant Professor level, starting in the fall of 1991. We seek candidates with a Ph.D., a commitment to excellent teaching in a quality liberal arts environment, and an active interest in mathematical research. The teaching load is three courses per semester.

Applicants should send a Curriculum Vitae and arrange to have three letters of reference and a graduate transcript sent by March 20, 1991 to: Edward W. Packel, Chairperson.

Applications from minorities and women are actively encouraged. AA/EOE.

LOUISIANNA

LOYOLA UNIVERSITY
New Orleans, Louisiana

The Department of Mathematical Sciences at Loyola University invites applications for an anticipated tenure-track position in Mathematics at the Assistant Professor level. The position will begin in August 1991, pending availability of funds. Candidates are expected to have a Ph.D. degree in Mathematics and a strong commitment to teachng at an undergraduate

Liberal Arts institution. Candidates with strong research potential in all areas of pure or applied mathematics are invited to apply. Salary is competitive.

Candidates should send (1) official transcripts of all college work, (2) a curriculum vita, and (3) three letters of recommendation to:

Chair of Search Committee. MS-1
Department of Mathematical Sciences
P. O. Box 104, Loyola University
6363 St. Charles Avenue
New Orleans, Louisiana 70118

Application must be received by March 22, 1991. Loyola University is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

LOYOLA UNIVERSITY
New Orleans, Louisiana

The Department of Mathematical Sciences at Loyola University invites applications for an anticipated tenure-track position in Mathematics at the Assistant or Associate Professor level. The position will begin in August 1991, pending availability of funds. Candidates are expected to have a Ph.D. degree in Mathematics and a strong commitment to teaching at an undergraduate Liberal Arts institution. An established record of scholarly research is necessary for appointment at the rank of Associate Professor. Preference will be given to candidates in analysis or geometry; however, strong candidates in all areas of pure or applied mathematics are invited to apply. Salary is competitive.

Candidates should send (1) official transcripts of college work, (2) a curriculum vita, and (3) three letters of recommendation to:

Dr. Duane Randall, Chair
Department of Mathematical Sciences
MS-2
P.O. Box 104, Loyola University
6363 St. Charles Avenue
New Orleans, Louisiana 70118

Applications must be received by March 22, 1991. Loyola University is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

LOYOLA UNIVERSITY
New Orleans, Louisiana

The Department of Mathematical Sciences at Loyola University invites applications for an anticipated tenure-track position in Mathematics at the Assistant Professor level. The position will begin in August 1991, pending availability of funds. Candidates are expected to have a Ph.D. degree in Mathematics and a strong commitment to teachng at an undergraduate Liberal Arts institution. Candidates with strong research potential in all areas of pure or applied mathematics are invited to apply. Salary is competitive.

Candidates should send (1) official transcripts of all college work, (2) a curriculum vita, and (3) three letters of recommendation to:

Chair of Search Committee, MS-3
Department of Mathematical Sciences
P.O. Box 104, Loyola University
6363 St. Charles Avenue
New Orleans, Louisiana 70118

Applications must be received by March 22, 1991. Loyola University is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

MASSACHUSETTS

AMHERST COLLEGE

Applications are invited for a one-year visiting position in Mathematics, preferrably at the Assistant Professor level, beginning in August 1991.

Amherst College is a private, undergraduate college which emphasizes both research and teaching. We attract bright students, possess a lively faculty, and have an administration committed to a vigorous program in mathematics.

The Department of Mathematics and Computer Science consists of seven mathematicians and three computer scientists. We are located in the Seeley G. Mudd building, which also houses classrooms, seminar rooms, a library for mathematics and computer science, and the academic computer center. Research facilities include computers in most faculty offices and a network of Sun workstations.

Amherst College is part of a five college consortium that also includes the University of Massachusetts and Hampshire, Mount Holyoke and Smith Colleges. There are numerous faculty seminars held at Amherst and the University, and Boston is less than two hours away.

If some anticipated leaves take place and if we receive authorization from the administration, the position may be extended to a second (and possibly third) year given satisfactory performance in the first year.

Applicants should hold a Ph.D. in mathematics. Please submit a vita, three references, and transcripts from both your graduate and undergraduate institutions. All applications received by February 15 are assured of consideration.

Amherst College is an Affirmative Action/Equal Opportunity Employer and encourages applications from minorities and women.

Reply to:
Professor David A. Cox, Chair
Department of Mathematics and
Computer Science
Amherst College
Amherst, MA 01002

or send electronic mail to: dacox@amherst.bitnet or dac@cs.amherst.edu

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MISSISSIPPI

MISSISSIPPI STATE UNIVERSITY
Department of Mathematics and Statistics

Applications are invited for two or more anticipated tenure-track or visiting positions for 1991-92. At least one of the positions will be in statistics and probably at least at the associate professor level. Candidates should possess a doctoral degree, demonstrate a strong potential for research, and have a commitment to effective teaching. All areas are welcomed but preference will be given to the following: for the mathematics position(s), applied mathematics, computational mathematics, particularly computational geometry, and partial differential equations; for the statistics positon(s), multivariate analysis, nonparametric and robust inference, categorical analysis, and linear and non-linear models.

The Department offers graduate programs leading to the Master of Arts degree (M.A.) and the Master of Science degree (M.S.) in both mathematics and statistics and the Doctor of Philosophy degree (Ph.D.) in mathematical sciences. Facilities exist for applicants with interest in interdisciplinary research efforts. Applicants with an interest in the computational aspects of the mathematical sciences may have the opportunity to participate in research efforts with the National Science Foundation Engineering Research Center for Computational Field Simulation at Mississippi State University.

Applicants should send a curriculum vitae and arrange for three letters of recommendation to be sent to: C. Wayne Mastin, Chairman, Search Committee, Department of Mathematics and Statistics, P. O. Drawer MA, Mississippi State, MS 39762. The committee will begin to review applications on March 1, 1991, and continue until positions are filled. Mississippi State University is an equal opportunity/affirmative action employer.

THE UNIVERSITY OF SOUTHERN MISSISSIPPI
Faculty Position in Scientific Computing

The faculty of Scientific Computing at the University of Southern Mississippi invites applications for an anticipated tenure-track faculty position at the Assistant Professor level for the 1991-1992 academic year pending funding. The new Ph.D. degree program in Scientific Computing will be initiated at Stennis Space Center near Bay St. Louis, MS, with implementation on the Hattiesburg Campus the following year. It is an interdisciplinary program with emphasis areas in computational mathematics, computational physics, and computer science.

The successful candidate will have a Ph.D. in computer science, mathematics, or physics. Responsibilities will include teaching at the graduate level, attracting external funds for basic and/or applied research, and supervising research of graduate students. Salary will be commensurate with qualifications and experience. Review of applications will begin April 1.

Send application packet, consisting of a curriculum vitae and a list of three references to: Chair, Scientific Computing Faculty Search Committee, College of Science and Technolgy, The University of Southern Mississippi, Hattiesburg, MS 39406-5165. USM is an EO/AA employer.

NEW YORK

STATE UNIVERSITY OF NEW YORK

State University of New York, Institute of Technology at Utica/Rome. Two Mathematics tenure-track positions will be filled effective September 1, 1991. A Ph.D. in any area of applied mathematics or theoretical physics is required. Duties include teaching three undergraduate courses each semester (12 contact hours/semester) and involvement in scholarly activity. Teaching experience in mathematics and ability to teach both introductory mathematics courses for technical and engineering students and more advanced courses which support the mathematics minor. The advanced courses may include any of the following: linear algebra, calculus III (multivariate calculus), applied statistical analysis, differential equations, series and boundary value problems, discrete mathematics for computer science, complex variables and their application, probability models. The SUNY Institute of Technology at Utica/Rome is an upper division and graduate college located in Central Upstate New York, at the Western gateway to the Adirondack Mountains. Enrollment is 2500. The Institute emphasizes quality teaching and involvement with student activities. Continuing faculty development is given high priority and research activities are encouraged and supported. Rank and salary will be commensurate with qualifications and experience. The Institute of Technology is an Affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply. Send letter of interest, current curriculum vitae, and the names of three references to: Anthony F. Panebianco, Director of Personnel/Affirmative Action, SUNY Institute of Technology at Utica/Rome, Drawer 9107, P.O. Box 3050, Utica, New York 13504-3050. Review of applications will begin March 1, 1991, and continue until positions are filled.

SYRACUSE UNIVERSITY
Department of Mathematics
Box 1, Syracuse, NY 13244–1150

There may possibly be positions available at the junior level beginning Fall 1991. Candidates should have outstanding research ability and evidence of excellence in teaching. Applications are invited in any area of mathematics and in mathematics education and statistics. Send a letter of application and vita with a list of publications, and have three letters of reference sent to: Daniel Waterman, Chair.

Syracuse University is an Equal Opportunity/Affirmative Action Employer.

NORTH CAROLINA

DUKE UNIVERSITY
Department of Computer Science

Applications are invited for a possible tenure-track position in the area of Scientific Computing at the rank of Assistant Professor, beginning September 1991.

The Department has major research efforts in scientific computing with emphasis on numerical linear algebra, the solution of PDEs, and VLSI simulation; artificial intelligence, particularly in the areas of logic programming, natural language interface, and search methodologies; theory and algorithms with emphasis on parallel and randomized algorithms; and computer systems with emphasis on systems performance, communications, and computer architectures.

Applicants should include a curriculum vitae, a list of publications, a few most important publications and a list of references. These should be sent by March 31, 1991 to:

Professor Donald J. Rose, Chairman
Department of Computer Science
Duke University
Durham, NC 27706

Duke University is an affirmative action, equal opportunity employer.

OHIO

CASE WESTERN RESERVE UNIVERSITY
Statistics Positions

Tenure track positions, possibly senior, in Applied Statistics will be available in the Summer of 1991. Outstanding research record or proven research potential and teaching excellence is required. Initial appointments will be in the Department of Mathematics and Statistics. Since the University has made the reestablishment of Statistics a priority for future development it is expected that these positions will eventually be in an independent Statistics Department.

Case Western Reserve University provides a wide scope to interact with researchers in other Schools (Medicine, Engineering, Management, Nursing, Dentistry, Law and the Applied Social Sciences). There is ample opportunity for cooperative ventures with members of the Faculties of Mathematics and Natural Sciences, the Humanities and the Social Sciences. The University also has several established research Centers, including th CWRU Center for Stochastic and Chaotic Processes in Science and Technology, whose efforts woul be enhanced by cooperation with applied statisticians.

Women and minority groups candidates are especially encouraged to apply. CWRU is an affirmative action and an equal opportunity employer. Send vita plus three letters of recommendation to

Dr. C. A. Cullis, Dean
Faculty of Mathematics and Natural Sciences
Crawford Hall,
Case Western University
Cleveland, OH 44106

THE UNIVERSITY OF AKRON
Faculty Positions
Department of Mathematical Sciences

The Department of Mathematical Sciences at The University of Akron invites applications for a number of faculty positions. The department seeks

1. an individual with a Ph.D. in Mathematics. An interest in freshman-sophomore curriculum development and articulation with regional secondary schools is desirable.
2. an individual with a Ph.D. in Statistics, preferably in the area of statistical computing, quality control, or applied probability.

Additional positions in mathematics, applied mathematics, statistics and computer science are anticipated. Starting date September 3, 1991. Each response should indicate to which position the application is directed.

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Please send a curriculum vitae, transcripts, and at least three letters of reference to:

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Head – Department of Mathematical Sciences

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MATHEMATICAL REVIEWS

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Applications and recommendations are invited for a one- or two-year half-time appointment as an Associate Editor of *Mathematical Reviews* (*MR*), to commence during the summer of 1991. Applications will be welcome from persons taking leave from other positions and in particular from tenured faculty members who can take leave to come to *MR* for one or two years.

The *MR* office of the American Mathematical Society is located in Ann Arbor, Michigan, not far from the campus of the University of Michigan. The editors, although employees of the AMS, enjoy many privileges at the University. At present, *MR* employs fifteen mathematical editors, about six consultants and over sixty nonmathematicians. It produces *Mathematical Reviews*, *Current Mathematical Publications*, various indexes, the on-line service MathSci and MathSci Disc. The responsibilities of an Associate Editor fall primarily in the day-to-day operations of selecting articles and books suitable for review, classifying these items, assigning them to reviewers, editing the reviews when they are returned and correcting the galley proof. An individual with considerable breadth in pure or applied mathematics is sought and preference will be given to those applicants with expertise in mathematical physics, statistics, theoretical computer science and/or geometry. The ability to write good English is essential and the ability to read mathematics in major foreign languages is important. (The ability to read mathematical articles in Russian or Chinese is especially desirable.)

Persons interested in combining a sabbatical or other leave with this half-time appointment as an Associate Editor are encouraged to write (or telephone) for further information. The twelve-month salary is negotiable and will be commensurate with the experience the applicant brings to the position.

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Mathematical Reviews
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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 sciences. 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 accessible 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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NEW SERIES

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Theory of Singularities and its Applications
V.I. Arnold, Editor

The Soviet Academy of Sciences has authorized a new book series, co-edited by V.I. Arnold, S.G. Gindikin, and V. Maslov, to be published only in English by the American Mathematical Society. Advances in Soviet Mathematics *will contain collections of top-quality articles focused on an area of mathematical research having a strong research group in the Soviet Union. Each of the two to three volumes per year will have its own editor who is an outstanding mathematician connected with the research school represented by the volume. The appearance of this new series attests to the vitality and productivity of researchers in the Soviet Union and will help to disseminate their results to a wider segment of the international mathematical sciences community.*

The theory of singularities lies at the crossroads between those branches of mathematics which are the most abstract and those which are the most applied. Algebraic and differential geometry and topology, commutative algebra and group theory are as intimately connected to singularity theory as are dynamical systems theory, control theory, differential equations, quantum mechanical and quasi-classical asymptotics, optics, and functional analysis.

This collection of papers incorporates recent results of participants in the editor's ongoing seminar in singularity theory, held in the Mechanics and Mathematics Department of Moscow University for over twenty years. With its broad range of subject matter, this volume will appeal to a wide range of readers in various areas of the mathematical sciences. Among the topics covered are: construction of new knot invariants, stable cohomology of complementary spaces to diffusion diagrams, topological properties of spaces of Legendre maps, application of Weierstrass bifurcation points in projective curve flattenings, classification of singularities of projective surfaces with boundary, nonsmoothness of visible contours of smooth convex hypersurfaces, flag manifolds, hyperbolic partial differential systems, and control theory.

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FIFTY YEARS OF *MATHEMATICAL REVIEWS*
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Mathematical Reviews celebrated its fiftieth anniversary at the Joint Mathematics Meetings in Louisville, Kentucky in January 1990. This historic event was highlighted by a lecture by Saunders Mac Lane, whose broad knowledge, long memory, and caustic wit make this videotaped lecture entertaining and insightful. Starting with the origins of MR, Mac Lane tells a story peppered with many anecdotes. He culled some of the amusingly scathing reviews that have appeared in MR and even discovered a case of what might be a record for getting the largest number of papers out of a single theorem. In addition, he gives a sense for the way MR has expanded and changed over the years. The lecture is a fitting tribute from one great influence in mathematics to another.

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NONWELLFOUNDED SETS AND THEIR APPLICATIONS
Jon Barwise

Nonwellfounded sets were originally a part of set theory but were later banned because they were thought to be implicated in the paradoxes of set theory. (An example of a nonwellfounded set is $a = (1,2,a)$, with the usual definition of an ordered triple.) However, in recent years, they have been finding their way back into set theory as researchers have shown that nonwellfounded sets are far from incoherent and in fact have many useful applications in computer science, artificial intelligence, and cognitive science. This videotaped expository lecture presents a fascinating look at the use and theory of nonwellfounded sets. Illuminating the subject with clarity of exposition and with carefully chosen examples, Barwise first motivates the subject with a discussion of applications, then moves on to the theory. This lecture would be accessible and appealing to anyone with a background in undergraduate mathematics.

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SOME APPLICATIONS OF GROUP REPRESENTATIONS
Nolan Wallach

In this videotaped lecture, Nolan Wallach presents examples of applications of Lie theory that show how the subject has gone beyond its original roots in an unexpected way. Lie initially envisioned his theory as a way of solving differential equations by reducing the number of variables. As Wallach demonstrates, Lie theory is often used today to set certain problems in a larger context by increasing the number of variables. Although the system then becomes larger, it often becomes simpler because one can use the power of abstraction in representation theory and exploit symmetries in the new, larger system. Using examples from differential equations and classical and quantum mechanics that demonstrate this principle, Wallach presents a lucid and engaging lecture. The lecture should be accessible to advanced undergraduates or graduate students with strong backgrounds in analysis.

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