NOTICES
OF THE
AMERICAN MATHEMATICAL SOCIETY

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This calendar lists all meetings approved prior to the date this issue went to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have been assigned. Programs of the meetings will appear in the issues indicated below. First and supplementary announcements of the meetings will have appeared in earlier issues. Abstracts of papers presented at a meeting of the Society are published in the journal Abstracts of papers presented to the American Mathematical Society in the issue corresponding to that of the Notices which contains the program of the meeting, insofar as is possible. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. The abstract deadlines listed below should be carefully reviewed since an abstract deadline may expire before publication of a first announcement. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of special sessions.

Meetings

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* Please refer to page 460 for listing of Special Sessions.
† Preregistration/Housing deadline is June 6.
†† These dates are earlier than previously published.

Conferences

July 7–26, 1991: AMS Summer Research Institute on Algebraic Groups and their Generalizations, Pennsylvania State University, University Park, Pennsylvania.
August 6–7, 1991: AMS Short Course on The Unreasonable Effectiveness of Number Theory, University of Maine, Orono, Maine.

Deadlines

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* 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.
ARTICLES

405 Automatic Theorem Proving Awards Presented
The 1991 Milestone and Current Awards for Automatic Theorem Proving (ATP) were presented at the Society's January meeting in San Francisco. The Milestone Award, for foundational work in ATP, was presented to Woodrow W. Bledsoe, and the Current Award, for ongoing research that shows promise, was presented jointly to Robert S. Boyer and J Strother Moore.

411 1990 Annual AMS-MAA Survey (Second Report)
This report includes an update on the number of and the employment status of the 1989-1990 new doctorates, as well as information on enrollments and on faculty characteristics.

FEATURE COLUMNS

420 Computers and Mathematics  Keith Devlin
This month Paul R. Halmos, of Santa Clara University, writes about some of the positive effects computers can have on mathematics education as well as some of the dangers they pose. Also, R.S. Pinkham reviews Polymath and Jim Northrup reviews Function Finder.

426 Inside the AMS
This month's column includes: reports from the AMS Secretary, Robert M. Fossum, and Treasurer, Franklin P. Peterson; an update of the Strategic Planning Task Force; a description of e-MATH's service for job seekers and employers; and an announcement by Raymond Ayoub, Chair of the AMS Committee on Service to Mathematicians in Developing Countries, of a new National Mathematics Centre in Nigeria.

436 Washington Outlook
Lisa A. Thompson reports on trends in federal support for the mathematical sciences, prospects for future support, and FY 1992 proposed budgets for federal agency mathematical sciences programs.
From the Executive Director . . .

UNDERGRADUATE MATHEMATICS

The mathematics education reform movement is a topic of debate within the mathematical community, as well as in government circles and the popular press. Much of this debate concerns school mathematics, but, for a large segment of our community, reform begins much closer to home: undergraduate mathematics education. A recent report from the National Research Council (NRC) has underlined the importance of addressing the need for change at the undergraduate level, has identified many areas for reform, and has set forth an action plan for government, colleges and universities, and the mathematical community.

In 1988, two NRC boards, the Board on Mathematical Sciences and the Mathematical Sciences Education Board, appointed the Committee on the Mathematical Sciences in the Year 2000, or MS2000. The objective of MS2000 was to review the status of undergraduate mathematical sciences education in the U.S., develop a plan for revitalization of mathematics education at the nation’s colleges and universities, and delineate responsibilities for the implementation of the plan. The reports Everybody Counts - A Report to the Nation on the Future of Mathematics Education (the executive summary appeared in the March 1989 issue of Notices, page 227) and A Challenge of Numbers (the executive summary of this report appeared in the May/June 1990 issue of Notices, page 547) were products of MS2000. Now, there is a new report which concludes the work of the MS2000 Committee. It is titled Moving Beyond Myths: Revitalizing Undergraduate Mathematics. The bulk of this report will appear in the July/August 1991 issue of Notices (see News and Announcements in this issue of Notices for information on ordering copies of the report).

Moving Beyond Myths describes the need to revitalize undergraduate mathematics and demonstrates the challenge this task entails. Many of the problems of mathematics education at all levels are traced to myths about mathematics and the learning of mathematics, such as the idea that success in mathematics depends more on innate ability than on hard work. The report is likely to stir a good deal of debate within the community, for it contains a fairly serious indictment of the undergraduate mathematics education system and of the traditions and habits of mathematical sciences departments in colleges and universities across the nation. Some of the depictions are less than admiring, with provocative titles such as “Wasted Breath”, “Missing Context”, “Casual Teaching”, “Flawed Models”, “Outmoded Values”, and “Invisible Instructors”. Nonetheless, the report goes right to the heart of many of the problems with undergraduate mathematics education and concludes with specific goals and an extensive action plan.

Crystallizing consensus and moving the community toward action is not an easy task. As the report itself states, the implementation of the action plan “will tax the creativity, commitment, adaptability, and energies of mathematical sciences faculty and departments, college-university administrations and trustees, professional societies, and federal and state governments.” Reform in mathematics education must include, if not begin with, a revitalization of undergraduate mathematics and involves our community. The report specifically challenges professional societies in its action plan. The AMS cannot ignore this opportunity to work with others to make a difference.

William Jaco
Change in Current Science
There has been a recent change in an old journal which should be pointed out to mathematicians. The journal is Current Science, a general science journal published in Bangalore, India. It is now similar to Nature and Science in that it publishes review articles, research announcements, book reviews and news of science organizations. There is an emphasis on science in India, but developments elsewhere are covered. It differs in its coverage of mathematics. Three years ago Atle Selberg’s article on Ramanujan first appeared there. The review of winners of the Fields Medals. Not only are these articles much more extensive than the coverage in Science, which changed the Jones polynomial to an equation, they give more background and technical details than the articles in Notices. I found them very helpful and interesting.

The University of Wisconsin main library dropped its subscription to Current Science in 1979, so I do not know when the change mentioned above was made. Our subscription has been restarted, and I hope many of you will be able to start subscriptions in your libraries. This treatment of mathematics should be encouraged. If it is continued successfully for a few years, it may spread to our general science journals.

The editor is a crystallographer, S. Ramaseshan, a long time friend of mathematics. The address is Current Science, P.B. No. 8001, Sadashivana­gar, Bangalore 560 080, India.

Richard Askey
University of Wisconsin-Madison
(Received March 4, 1991)

Call to Combinatorists
The number of conferences in the area of Combinatorics and related topics is rapidly increasing. There are examples of conferences happening even the very same week, or sometimes there are two conferences a month from each other but geographically very close. We think that there is a need to coordinate the schedule of conferences in the area. Our suggestion is following. When you start to organize a conference on Combinatorics or on any related topics please let us know the planned date and place of it, before making the final decision. We shall immediately inform you about conferences planned around your suggested date. In case of any conflict you should negotiate with the other party to solve it. The real coordination could be started only from the year 1992, but it is useful for you at least to know about the (semi-)conflicting conferences. This is why we think you could inform us about all forthcoming conferences. On the other hand, if you are not an organizer but you would like to learn about the conferences, you may inquire about them. Our offer might cause us an infinite amount of work so please try to get this information from your colleagues first.

Please use any of our addresses: G.O.H. Katona, (Secretary General of the Bolyai Janos Mathematical Society) Mathematical Institute, Budapest, P.O. Box 127, 1364, Hungary; Tel: office (36-1)-117-3050, home (36-1)-163-6293. H1164KAT@ELLA.UUCP; or B.S. Stechkin, (Secretary of the Soviet Committee of the Bernoulli Society) Steklov Mathematical Institute, Vavilova 42, 117966, Moscow GSP-1, USSR; Tel: office (7-095)-135-0480, home (7-095)-237-5739, Email: bernoulli@prob.mian.su.

Boris Stechkin
Steklov Mathematical Institute
(Received March 12, 1991)

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

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

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

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

Letters should be mailed to the Editor of Notices, American Mathematical Society, P.O. Box 6248, Providence, RI 02940, or sent by email to notices@math.ams.com, and will be acknowledged on receipt.
The American Mathematical Society is seeking applications and nominations for candidates for the position of Associate Treasurer of the Society.

The Associate Treasurer is an officer of the Society. The Associate Treasurer is appointed by the Council of the Society for a term of two years beginning on 31 January of each odd numbered year.

The primary responsibilities of the Associate Treasurer are to know and understand the budget of the Society, to monitor the financial condition of the Society, and to advise the Board of Trustees concerning the financial consequences of its decisions. The Associate Treasurer works in close cooperation with the Treasurer, and serves as Treasurer when necessary.

The Associate Treasurer is a member of the Board of Trustees, the Council, the Agenda and Budget Committee, and the Investment Committee and serves on several other committees of the Society. As a member of the Council, the Associate Treasurer serves as liaison between the Board of Trustees and the Council and offers advice to the Council on the financial aspects of its deliberations.

There are two other areas of major responsibility: (1) The Associate Treasurer is delegated by the Board of Trustees to monitor staff appointments and promotions and to review staff raises. (2) The Associate Treasurer serves as liaison Trustee for Mathematical Reviews and, in this capacity, monitors the budget of Mathematical Reviews.

While the term of office is two years, it is anticipated that the person filling this office will be reappointed biennially for a number of terms, to ensure continuity.

Applications and nominations can be sent to the chair of the search committee, Ronald L. Graham, or the Secretary of the Society, Robert M. Fossum.

Dr. Ronald L. Graham
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Murray Hill, NJ 07974
rlg@research.att.com

Professor Robert M. Fossum
Department of Mathematics
University of Illinois
1409 West Green St.
Urbana, IL 61801
robert@math.uiuc.edu

Applications or nominations received by 30 September 1991 will be assured full consideration. The newly appointed Associate Treasurer will take office formally on 31 January 1993, but should be appointed by the Council as early in 1992 as possible to permit a smooth transition.

All necessary expenses incurred by the Associate Treasurer in the performance of duties for the Society are reimbursed, including travel and communications.
The 1991 Milestone and Current Awards for Automatic Theorem Proving were presented at the Society’s annual meeting in San Francisco on January 18, 1991. The Milestone Award was presented to Woodrow W. Bledsoe, University of Texas at Austin, and the Current Award was presented jointly to Robert S. Boyer, Computational Logic, Inc., and J. Strother Moore, University of Texas at Austin.

Given periodically for advances in Automatic Theorem Proving (ATP), the Milestone and Current Awards were first presented in 1983. The Milestone Award is for foundational work in ATP and the Current Award is for ongoing research that shows promise. The principal endowment for these prizes was made by the Fredkin Foundation and the funds are administered by Carnegie Mellon University.

The awards are presented on the recommendation of the AMS Committee on Automatic Theorem Proving whose members at the time of this award were David Mumford (chair), Jacob Schwartz, and John L. Selfridge, assisted by a subcommittee consisting of John McCarthy and Gerald Sussman.

The text that follows contains the Committee’s citations for the awards, the recipients’ response to the awards and brief biographical sketches of the recipients.

Milestone Award
Woodrow W. Bledsoe

Citation
Automatic theorem proving has been one of the principal scientific goals of Artificial Intelligence throughout its life. Woodrow W. Bledsoe has been a central figure in this endeavor, inspiring and guiding the field for over twenty years. His broad view of the subject, using resolution and non-resolution techniques, his deep study of theorem proving in analysis and with inequalities and his development of interactive theorem provers—whose goal is a human-machine synergy on a truly cognitive level—mark him out as a major innovator in the field.

Response
I am delighted to receive this Milestone Award and feel that this is a recognition by the American Mathematical Society of the importance of all of the work that has been and is being done in the field of Automated Theorem Proving (ATP). My own research has depended greatly on the pioneering work of others, especially earlier researchers such as Newell and Simon who built the first practical prover, Hao Wang, who received the first Milestone Award, Martin Davis and H. Putnam, and many others including J. Alan Robinson who introduced Resolution, the best known method in our field, and Larry Wos. Earlier mathematicians and logicians, such as Leibniz, Frege, Presburger and Herbrand, laid much of the foundation, and later colleagues, including some of my excellent students, have carried on the work.

I love mathematics and know the thrill of discovering the proof of a theorem. Trying to get computers to do the same thing is a challenge that I cannot resist. Inroads have been made, there is great excitement, I am pleased with what has been done, but automated provers still do not compete with real mathematicians on most theorems. I firmly believe that that situation will change in the coming decades.

My own work (in ATP) has centered on Analysis, especially elementary and intermediate real analysis. Three provers have played a role in our work: STR+VE, SET-VAR, and NON-STAN.

One of the main problems with automating real analysis is in handling the field axioms for the reals (e.g., \( x + y = y + x \)) and axioms for inequalities (e.g., \( x < y \land y < z \rightarrow x < z, x < y \rightarrow \exists z(x < z < y) \)). These tend to explode the search space of provers in a way that is disastrous. STR+VE is a prover, developed by Larry Hines and myself, for handling theorems about general inequalities, which controls that explosion to some extent, allowing it to prove such theorems as, the sum of two continuous functions is continuous (delta-epsilon proof), and more complicated ones. STR+VE is a general purpose prover, it is complete for (can prove any theorem in) first order logic. Larry Hines, Ken Kunen, and Michael Richter collaborated on this important completeness proof. But completeness alone is not enough, power is more important: to finish a proof in reasonable time.

SET-VAR is a prover which attempts proofs in an extension of first order logic which requires the binding of “set variables”. It proves theorems like the Intermediate Value Theorem—using the Least Upper Bound Axiom—where a set variable must be instantiated. It is also believed
Automatic Theorem Proving Awards Presented

to be complete for an extension of first order logic, which includes a number of theorems such as, a continuous function takes on its maximum on a closed interval. It works together with STR+VE.

NON-STAN is limited in scope but is very powerful in its area of expertise. It is based on the concept of Non-Standard Analysis and is easily able to handle the above mentioned theorems as well as many others in intermediate real analysis. It was developed mostly by Michael Ballantyne.

All of these provers have a crucial “Rewrite Rule” component, whereby certain rules (e.g., \( x + 0 \rightarrow x \)) are being continuously applied to simplify the formulas in the proof. Such rewriting methods were also pioneered by Larry Wos, Robert Boyer and J Moore, Donald Knuth, and others, and are widely studied in ATP. We have also worked on Interactive Provers, where the human helps with proof discovery. This may become the most important area of ATP. But even here a strong stand-alone prover is required.

Other methods, so called “people methods”, such as Analogy, using examples and counterexamples, conjecturing, etc., have also absorbed a lot of our time, and we believe that they will play an important role in the future of ATP. Another key is in attracting more first class mathematicians to this field, to augment the excellent researchers who are already there.

Woodrow W. Bledsoe

Biographical Sketch
Woodrow W. Bledsoe was born November 12, 1921 in Oklahoma. He received his bachelor’s degree in mathematics from the University of Utah in 1948 and his Ph.D. in

1953 from the University of California at Berkeley. After holding a position as Lecturer at U.C. Berkeley (1951-1953), he became a research scientist at Sandia Laboratories, Albuquerque, New Mexico, where he became head of the Mathematics Department (1956-1960). During 1960-1966 he worked as a research scientist at Panoramic Research Inc., Palo Alto, California, where he served as president during 1963-1965.

Professor Bledsoe then moved to the University of Texas at Austin in January 1966 as a full professor of mathematics, where he served as acting chairman during 1967-1969, and chairman during 1973-1975. He also assumed a professorship in computer science (as well as mathematics) when that department was formed in 1967. He held an Ashbel Smith Professorship of Mathematics and Computer Science during 1981-1987, and the Peter O’Donnel, Jr. Chair in Computing Systems from 1987 to present. He was on leaves of absences as a visiting professor of computer science at the Massachusetts Institute of Technology during 1970-1971, at Carnegie Mellon University during the spring 1978, and as Vice President of Artificial Intelligence at MCC (the Microelectronics and Computer Technology Corporation) during 1984-1987.

Professor Bledsoe has been a member of the AMS since 1953 and authored papers in various mathematical journals (and in other journals). He chaired the committee for awarding Milestone and Current Prizes in ATP, during 1960-1986, before it was taken over by the AMS. He was president of the American Association of Artificial Intelligence, 1984-1985, and served on the Board of Trustees of the corresponding international organization (IJCAI), 1975-1983 (chairman, 1975-1977). He serves on the editorial board of the International Journal of Artificial Intelligence and The Journal of Automated Reasoning. He has also chaired various special sessions on Automated Theorem Proving at conferences.

During his career, Professor Bledsoe’s research interests have included measure theory, general topology, product topological measure spaces, systems analysis, automated pattern recognition, and automated theorem proving. His current emphasis is on analogy and methods for analysis in automated theorem proving.

Current Award
Robert S. Boyer
and
J Strother Moore

Citation
Computer programs are some of the most complex objects created by technology. Verifying that they meet their specifications is a major technological problem. The work of Robert S. Boyer and J Strother Moore in applying automatic theorem proving to this area and also to verifying mathematical proofs dwarfs that of any other researcher. Both the number and range of the “real” programs and algorithms
they have verified is indeed impressive. Perhaps above all others, their work establishes the field of automated theorem proving to be of substantial applied significance.

Robert S. Boyer

Response

Like chess and checkers, mathematics is a game that can be played by a computer. As Gödel remarked, “The development of mathematics toward greater precision has led, as is well known, to the formalization of large tracts of it, so that one can prove any theorem using nothing but a few mechanical rules.” In chess and checkers, some computers play better than most experts, but this is far from true, today, about computers in mathematics. Only in a very few areas of mathematics, such as in the factorization of large integers, symbolic integration, and a few parts of geometry, are computers as good as expert mathematicians. Why is mathematics seemingly so much harder than chess or checkers to mechanize successfully? One reason is that in mathematical proofs, there is, at any point, an infinite number of moves one can make. (For example, one could choose to instantiate the theorem that addition is commutative with arbitrarily large integers.) The experience that there is an infinite number of legal moves that one could make in a proof is a common experience: think of all the proofs of deep theorems whose crucial step is something like “consider the following set,” where the set in question is not something one would have considered for years.

The Current Prize in Automatic Theorem Proving, which I am so pleased to share with J Moore, my colleague of almost twenty years, has been awarded to us for the construction and application of a computer program that proves theorems in a variant of elementary number theory. (The “variation” is to include enough camouflage in the form of data types such as ordered pairs and strings as to give the theory a computer science feel, akin to that of Pure Lisp, and a practical bent.) For the most part, the prover is constructed in principles of automatic theorem proving not discovered by us but rather by many people to whom we are greatly indebted (e.g., Martin Davis, Hao Wang, A. Newell, H. Simon, J. McCarthy, R. Burstall, J. A. Robinson, L. Wos, D. Loveland, R. Kowalski, W. W. Bledsoe, D. Knuth, L. Hodes, and M. Ballantyne). Not to suggest that it was easy to orchestrate the good ideas we have borrowed from so many brilliant fellows! Perhaps the most original contribution we have made to the science of automatic theorem proving is in our implementation of a method for guessing which induction to try. Because first-order elementary number theory has an infinite number of instances of the induction scheme as axioms, deciding which of these axioms to consider is a nontrivial problem. Very roughly speaking, our “heuristic” for choosing an induction is to try to use the dual of the recursive definitions of the concepts involved in the conjecture we are trying to prove. The details of our prover can be found in our books A Computational Logic and A Computational Logic Handbook (Boyer & Moore, Academic Press, 1979 and 1988).

The successful application of our prover to thousands of theorems has been undertaken by many of our colleagues, to whom we are most grateful. The many expert users of our system merit having jointly received the Current Prize with us; particularly noteworthy are Bill Bevier, Bishop Brock, John Cowles, Ben DiVito, Art Flatau, David Goldschlag, Don Good, C. H. Huang, Chris Lengauer, Warren Hunt, Matt Kaufmann, David Russinoff, N. Shankar, Ann Siebert, Matt Wilding, Bill Young, and Yuan Yu. Pointers to the amazing number of theorems they have induced our prover to check can be found in “A Theorem Prover for a Computational Logic” (Lecture Notes in Computer Science 449, Springer-Verlag, 1990, pp. 1-15.) The success of the prover in checking all those theorems, many of which are nontrivial, e.g., quadratic reciprocity and the Church-Rosser theorem, is primarily due to the persistence of the users of our prover in guiding it towards proofs. What are the principal means that the users use to guide the prover? One means is to state intermediate lemmas. These lemmas act almost like logic programs in guiding the prover to consider certain subgoals. For example, a lemma of the form

\[ p(x) \land q(x) \rightarrow f(x) = g(x), \]

once stated and proved, would be a hint to the prover to attempt to rewrite any term \( f(t) \) later encountered to the term \( g(t) \), provided it is possible first to establish the subgoals \( p(t) \) and \( q(t) \). Another means is to define recursive concepts in such a way that our prover will be tricked into doing the right induction!

Because progress in automatic theorem proving is slowed by the paucity of mathematicians who work in the field, there are two points that I want to make. First, checking, as opposed to discovering, mathematics seems technologically feasible with available computing technology. Not only our prover but those of de Bruijn, Suppes, Bledsoe, Constable, McCune-Lusk-Overbeek-Wos, Gordon-Milner-Morris-Newey-Wadsworth, Farmer-Gutman-Thayer, and others have been used to check a wide subset of elementary mathematics, and there seems hardly any barrier to checking any part of it for which one has the patience. As a rule of thumb, it may be guessed that checking a result by machine (for a skilled user) will take no more than an order of magnitude longer than it would take to write out the proofs (and all antecedent foundations) at the level of detail of an undergraduate textbook. Is not the evidence of the feasibility of mechanically checking proofs also some evidence that the time is ripe for further progress in mechanically discovering proofs, by talented mathematicians? Second, it should perhaps be revealed that, in addition to possible economic benefits in realms such as mechanical program verification, building and using a theorem prover can be as aesthetically satisfying as playing chess or chamber music. We are most grateful to the people who have sponsored our research (Tom Keenan, Bob Grafton, Ralph Wachter, Bill...
Biographical Sketch

Robert S. Boyer was born August 2, 1946 to Fred Y. Boyer and Catherine A. Boyer. Prior to his birth, his mother had been cracking coded messages while his father was battling kamikazes. Prior to college, Boyer attended eleven schools as his father practiced law in naval bases up and down the coasts. Boyer has been married to Anne Olivia Herrington since 1966, and they have three children: Madeleine, Margaret, and Nathaniel.

As a high school student in Kingsville, Texas, Boyer made a presentation to a Texas meeting of the AMS on some theorems about three dimensional matrices and attended the NSF John von Neumann summer mathematics institute at SMU. As an undergraduate at the University of Texas at Austin, Boyer studied mathematics under R. L. Moore and H. S. Wall; logic under Paul Lorenzen and Norman Martin; and philosophy under John Silber and Tom Gould. As a mathematics graduate student at the University of Texas at Austin, Boyer was fortunately introduced to the joy of writing theorem-provers in Lisp by his advisor, W. W. Bledsoe, who was a student of that practicing formalist A. P. Morse. Boyer’s Ph.D. thesis was about locking, one of the many variants of resolution. This thesis was written while at the M.I.T. Artificial Intelligence Lab, during a year that Bledsoe spent a sabbatical there. Boyer next went, in 1971, to do research in the Metamathematics Unit at the University of Edinburgh, a Delphi and Mecca of automated reasoning and formal approaches to Artificial Intelligence. There Boyer began collaborating with Moore on their prover and many other projects, e.g., a text editor; their collaboration has continued at SRI International, the University of Texas at Austin, and Computational Logic, Inc., in Austin. Now they are working on recoding a new version of their prover in its own logic, a subset of applicative Common Lisp. Boyer has also done research at MCC in Austin. Currently, Boyer holds a professorship in computer sciences at the University of Texas at Austin and a courtesy appointment in the mathematics department there. Boyer is a member of the editorial boards of Artificial Intelligence, the Journal of Automated Reasoning, the Journal of Logic and Computation, Springer’s new Lecture Notes in Artificial Intelligence, and Kluwer’s new series on automated reasoning. He was general chairman of the 1984 conference on Lisp and Functional Programming. He is the co-author or editor of fewer than five books and 18 articles. His and Moore’s prover, however, is available without fee by anonymous ftp from Internet site cli.com, and by running the prover on the examples supplied one can generate over twenty megabytes of proofs with English commentary.

J Strother Moore

Response

I am honored to share with Bob Boyer the 1991 Current Award for Automatic Theorem Proving. Our collaboration on this problem is now twenty years old and since the beginning our path has been intertwined with those blazed by two other researchers: Woody Bledsoe and John McCarthy. It was therefore particularly satisfying that Bledsoe won the Milestone Award this year and that McCarthy presented the awards. I would like to thank these two people again and acknowledge our intellectual debt to them. In addition, I would like to acknowledge our debt to those of our students and colleagues who have contributed to our system’s success by using it to prove landmark theorems, namely Bill Bevier, Bishop Brock, John Cowles, Ben DiVito, Art Flatau, David Goldschlag, Don Good, C. H. Huang, Chris Lengauer, Warren Hunt, Matt Kaufmann, David Russinoff, N. Shankar, Ann Siebert, Matt Wilding, Bill Young, and Yuan Yu.

It is my impression, perhaps wrongly so, that work in automatic theorem proving has received relatively little attention from the mathematical community. If this is true, it is a great pity for two reasons. First, great mathematical talent will probably be required to build a machine that exhibits great mathematical talent. Second, automatic theorem proving is a wonderfully pure application of mathematics. Readers of this article presumably understand the allure of trying to build a machine that does formal mathematics. But why would a nonmathematician be interested in such a machine? One justification is that the mechanization of formal reasoning may play a role in the mechanization of informal reasoning and thus in the construction of “smart” machines. But there is a much more direct link between formal reasoning and economic interests and that...
link is explained by the fact that computer programs exist simultaneously in the formal, symbolic world of mathematics and in the world of our everyday life. When regarded as formal objects, programs are just strings of symbols that give step by step descriptions of how to do such symbolic tasks as bisect a line segment, find the greatest common divisor, print the text of this article on a page, or prevent unauthorized access to a database. When regarded as everyday objects, programs are bought and sold just like fountain pens and combination locks.

The sellers of programs—or at least the designers and manufacturers—intend the programs to accomplish certain jobs and the buyers expect those jobs to be performed correctly. Today, the assurance that programs do what they are said to do is achieved—such as it is—largely by testing. This is the same technique used to “debug” other ordinary objects like pens and locks. But programs are generally much more complicated than pens and locks and testing often fails to uncover all the bugs.

But because programs are formal objects, their properties can, in principle, be proved. That is, it is possible to prove formally that a certain construction bisects a line, that a certain algorithm finds the gcd, that a certain program lays out all the text and only the text, etc. The theorem that a given program is “correct”—by which I mean that the program has some formally expressed property believed by the designer to capture his intention—is generally difficult to prove. This difficulty stems not from deep mathematical intricacy but from the presence of unfamiliar formal concepts and myriad cases. It is therefore especially reassuring to have a machine check an alleged proof. This may be expensive. But fixing or even recovering from bugs in software is even more expensive, especially if the software is concerned with national security, finance, health and safety, or consumer goods replicated millions of times. Unfortunately, even though the problems raised by most of today’s software are not mathematically deep, they are beyond the abilities of unassisted machines.

Our twenty years of research have produced a formal mathematical logic, a mechanical theorem prover (or, as some say, a proof checker) for that logic, and hundreds of examples that indicate both the strengths and weaknesses of the system in specifying and proving properties of programs. The logic is first order and quantifier free. It syntactically resembles McCarthy’s Pure Lisp. The axioms characterize primitive functions such as if-then-else and equality. Two definitional principles permit the consistent extension of the logic. The first principle may be used to introduce new classes of inductively constructed objects such as the integers and binary trees. The second principle may be used to introduce total, recursively defined functions on such objects. The rules of inference include those for propositional calculus with equality, instantiation, and mathematical induction. The theorem prover is a computer program of about 1 million characters, written in the Common Lisp programming language. The details of the logic and theorem prover may be found in our books A Computational Logic and A Computational Logic Handbook (Academic Press, 1979 and 1988). To find out how to obtain a copy of the program electronically without fee contact the authors at Computational Logic, Inc., 1717 West 6th Street, Suite 290, Austin, TX 78703, or send an electronic message to boyer@cli.com.

The theorem prover’s behavior on any given problem is determined by the database of previously proved theorems available to it. The informed user may therefore lead the system to the proof of difficult theorems by presenting it with a cleverly designed sequence of preparatory lemmas. Indeed, one can virtually feed it a proof encoded as a sequence of theorems and it is in this sense that our program can be called a “proof checker” rather than an automatic theorem prover. In any case, the user is crucial to the system’s success on interesting problems because it is the user’s responsibility to decompose the problem into manageable steps. But the user need not be trusted since the logical validity of all formulas is established by the system. That is, a “bad” user can lead the system into an impenetrable forest of uninteresting theorems, but cannot cause the system to announce that a non-theorem is valid.

In the hands of a “good” user, the system can be led to the proofs of deep theorems. Some of the theorems whose proofs have been checked by our system include (in number theory) Fermat’s “little” theorem, Wilson’s theorem, and Gauss’ law of quadratic reciprocity; (in metamathematics) the recursive unsolvability of the halting problem, the tautology theorem, the Church-Rosser theorem of lambda-calculus, and Gödel’s incompleteness theorem; (in computer science) the correctness of various sorting and searching algorithms, operating systems, compilers, linkers, and hardware designs. An annotated bibliography of the major achievements of our system and its users may be found in A Computational Logic Handbook.

I am simultaneously proud and a little embarrassed by this list. The pride comes from the knowledge that these proofs are deep; even after the user has structured the problem, the system must bridge relatively large logical gaps by itself. The embarrassment comes from the knowledge that this is twenty years of work and it is still a daunting task to undertake the proof of the next hard theorem. Perhaps you can show us how it should be done.

Biographical Sketch

J Strother Moore, born on September 11, 1947, grew up in Dickinson, Texas. At the age of 16 he attended a National Science Foundation summer institute at the University of Oklahoma, where he learned computer programming. After graduating from Dickinson High School in 1966, he entered the Massachusetts Institute of Technology. While his major was pure mathematics, he was employed as a programmer throughout his undergraduate education, working for the M.I.T. Laser Research Group (numerical solutions to differential equations), TRW (debugging the Apollo onboard software), IBM (systems analysis tools), and State Street Bank and Trust (mutual funds accounting). He credits his
employment as much as his formal education for shaping his career.

Upon graduating from M.I.T. in 1970, he entered graduate school at the University of Edinburgh, Scotland. While his initial dissertation topic was the mechanized understanding of children’s stories, he programmed professionally for the Metamathematics Unit, writing resolution theorem provers under the direction of Bob Kowalski. In 1971, he began his collaboration with Robert S. Boyer, who joined the Unit as a postdoc. Eventually Moore changed his dissertation topic to mechanized theorem proving. His adviser was Bernard Meltzer. He graduated in 1973, having co-authored with Boyer the idea of structure sharing in resolution theorem proving (an idea intimately connected with the efficient execution of logic programs) and the so-called “Edinburgh” version of their logic and automatic theorem prover. The most impressive result claimed by that theorem prover was the theorem establishing that a simple sort program produced ordered output.

Moore then spent three years at Xerox Palo Alto Research Center where he worked on text processing and the precise specification of the language Interlisp. During this period, Boyer and Moore collaborated on the invention of the fast string searching algorithm that bears their names and continued work on their lisp theorem prover. The most impressive theorem proved during this period was the correctness of a ripple-carry binary addition algorithm.

In 1976, Moore joined Boyer in the Computer Science Laboratory of SRI International. With funding from NSF and the Office of Naval Research, Boyer and Moore devoted full-time to their automatic theorem prover. In 1978, their system proved the existence and uniqueness of prime factorizations, as well as the correctness of several programs including their fast string searching algorithm. In 1979 they published their first book, *A Computational Logic*, describing the logic and theorem prover.

Moore became an associate professor in the Department of Computer Sciences at the University of Texas at Austin in 1981. He obtained the rank of professor in 1984 and held the Gottesman Family Centennial Professorship of Computer Science. Six students have received doctorates under his and Boyer’s joint direction and their students are responsible for many of the most impressive achievements of the Boyer-Moore automatic theorem prover, including the proof of Gauss’ law of quadratic reciprocity, Gödel’s incompleteness theorem, and the correctness of a compiler, a simple operating system, and a microprocessor.

In 1983, Moore and four others founded Computational Logic, Inc. (CLI), with the long-term view of developing a corporate research environment to support program verification and automatic theorem proving. In 1987, Moore took leave without pay from the University of Texas at Austin, to work full-time at CLI and, in 1989, he resigned his position to stay there.

Moore is married to Miren Carranza. They have four children: Lisa, Nicholas, Jonathan, and Natalie.

Moore has received a number of honors and awards. For one month in 1980 he held the International Chair in Computer Science created by IBM Belgium and delivered a course on his work at the University of Liege. In 1983, Boyer and Moore were awarded the McCarthy Prize for their work in automatic theorem proving. With Boyer, Moore has co-authored two books and co-edited a third.
This is the second report of the 1990 Survey. A first report appeared in the November 1990 Notices, pages 1217-1250. It included a report on the 1989-1990 new doctorates, starting salaries, faculty salaries, and a list of names and thesis titles of the 1989-1990 doctorates. A supplementary list of 1989-1990 doctorates appears in this issue of Notices. The 1990 Annual AMS-MAA Survey represents the thirty-fourth in an annual series begun in 1957 by the Society. The 1990 Survey was under the direction of the AMS-MAA Data Committee whose members are: Edward A. Connors, Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Charlotte Lin, Don C. Loftsgaarden, David J. Lutzer, James W. Maxwell (ex officio), Donald E. McClure (chair), and Donald C. Rung. Comments or suggestions regarding the Annual Survey may be directed to members of the AMS-MAA Data Committee.

For these reports, departments are divided into groups according to the highest degree offered in the mathematical sciences:

**Groups I and II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.1

**Group I** is composed of 39 departments with scores in the 3.0-5.0 range.

**Group II** is composed of 43 departments with scores in the 2.0-2.9 range.

**Group III** contains the remaining U.S. departments reporting a doctoral program.

**Group IV** contains U.S. departments (or programs) of statistics, biostatistics, and biometrics reporting a doctoral program.

**Group V** contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

**Group Va** is applied mathematics/applied science; **Group Vb** is operations research and management science.

**Group VI** contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

**Group M** contains U.S. departments granting a master's degree as the highest graduate degree.

**Group B** contains U.S. departments granting a baccalaureate degree only.

1These findings were published in An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences, edited by Lyle E. Jones, Gardner Lindsey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of Notices, pages 257-267, and an analysis of the above classifications was given in the June 1983 Notices, pages 392-393. For a listing of departments in Groups I and II see the April 1988 Notices, pages 532-533.

### Highlights

- The final (spring) count of new doctorates shows a total of 950 doctorates in the mathematical sciences awarded by U.S. institutions in the period July 1, 1989 through June 30, 1990. This is the largest number since 1975-1976 and is 24% higher than the 1984-1985 final count.

- The final count shows 410 U.S. citizens among the 947 doctoral recipients whose citizenship status is known. This is the second highest total number of U.S. citizens in the past six years, but the percentage (43%) is a historical low for the seventeen years in which citizenship status has been followed in the Annual Survey.

- A total of 537 non-U.S. citizens were awarded doctorates in 1989-1990. This is the largest number ever reported and represents an increase of 148% over the number of non-citizen new doctorates ten years earlier.

- The percentage of U.S. citizens among all graduate students, including master's degree candidates and special students, in U.S. doctorate-granting mathematics departments is 56%, substantially higher than the percentage they represent among new doctorates.

- In the final count there were 90 women (22%) among the 410 U.S. citizen new doctorates. Among non-U.S. citizens, women represent 15% of the new doctorates. These percentages are substantially lower than the ones for earlier stages of the mathematics education pipeline. Among all U.S. citizen graduate students in U.S. mathematical sciences departments, women constitute 36% of the total. At the undergraduate level, 43% of junior/senior mathematical sciences majors are women.

- Out of the 943 new doctorates (from U.S. or Canadian institutions) whose employment status is known, 60% are employed in academic positions in the U.S., 16% are employed in nonacademic positions in the U.S., and 20% are employed outside the U.S. Only 2% are reported as not yet employed, and the remainder are not seeking employment.
I. Introduction
The Annual AMS-MAA Survey collects information each year about departments, faculties and students in the mathematical sciences in the United States and Canada. This article reports results from two parts of the 1990 Annual AMS-MAA Survey. First, we update information about new doctorates reported earlier in the November 1990 issue of Notices (see pages 1217–1221). Second, we present summaries of results about characteristics of faculties and of instructional programs at the undergraduate and graduate levels.

The Second Report is patterned after previous years’ reports in the interest of continuity and to make year-to-year comparisons possible. Some new types of information are reported, however, and the AMS-MAA Data Committee continues to welcome suggestions from the mathematics community concerning other types of information or reporting about the mathematics scene which members of the profession would find to be of interest.

In the 1990 Annual Survey, new information was requested from departments about faculty hiring and about different categories of faculty positions. Traditionally, the Annual Survey has done a detailed analysis of the employment status of new doctorates broken down by the field of their thesis. In the 1990 survey we added questions about the demand side of the employment market, in particular about the availability of openings in the academic job market. At the time that these questions were added to the survey, considerable attention was being given in the scientific press to projected shortages of trained scientists during the next decade. The new information collected in this area is intended to provide a baseline for comparison of changing demand in the future. It will also provide some basis for understanding recent perturbations of the academic job market.

New questions were also added to the survey in 1990 to enable a finer breakdown in the analysis of nontenured faculty ranks.

A more comprehensive and penetrating reporting of information about faculty populations and instructional programs in mathematics and the mathematical sciences will be contained in the forthcoming report on the 1990 Survey of Undergraduate Programs in the Mathematical Sciences and Computer Science, conducted by the Conference Board on Mathematical Sciences (CBMS).

II. Update on the 1989–1990 New Doctorates
Information about new doctorates awarded between July 1, 1989 and June 30, 1990 was collected from doctorate-granting departments in late spring 1990 and from a follow-up census of individual degree recipients. The First Report of the 1990 Annual Survey (November 1990 issue of Notices, pages 1217–1230) presents the survey results obtained about new doctorates up to the time of that report. Here we update the earlier figures on the basis of more complete returns.

Table 1: New Doctorates, Fall and Spring Counts

<table>
<thead>
<tr>
<th></th>
<th>85–86 Fall</th>
<th>86–87 Fall</th>
<th>87–88 Fall</th>
<th>88–89 Fall</th>
<th>89–90 Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>756 782</td>
<td>779 808</td>
<td>804 828</td>
<td>905 919</td>
<td>933 950</td>
</tr>
<tr>
<td>Canada</td>
<td>45 45</td>
<td>66 66</td>
<td>52 55</td>
<td>53 62</td>
<td>58 59</td>
</tr>
<tr>
<td>Total</td>
<td>801 827</td>
<td>845 874</td>
<td>856 883</td>
<td>958 981</td>
<td>991 1009</td>
</tr>
</tbody>
</table>

The spring count of new doctorates (Table 1) shows a total of 950 doctorates in mathematical sciences awarded by U.S. institutions and 59 awarded by Canadian institutions. The final count for U.S. institutions is a 3% increase from the previous year and is the highest number reported since 1975–1976. Citizenship status is known for 947 of the new doctorates awarded by U.S. institutions. The total of 410 U.S. citizens is marginally lower than last year’s spring count of 419, but still is the second highest figure since 1983–1984. The percentage of U.S. citizens (43%) is an all-time low.

The number of non-U.S. citizen new doctorates has risen steadily since 1978–1979. The final spring count shows 537 non-U.S. citizens, representing an increase of 148% from the count in 1979–1980. In the same ten-year period the number of U.S. citizen new doctorates has decreased by more than 30%.

Among the U.S. citizens, the final tally shows 90 women and 320 men. The percentage of women (22%) among the U.S. citizens is substantially higher than the percentage (15%) among non-U.S. citizens.

Employment data for new doctorates, broken down by the field of their thesis research, are updated in Tables 2A and 2B (see next page). The employment matrices report the status of the 991 new doctorates included in the fall count; employment status is known for 943. Overall, the majority (60%) of new doctorates assumed academic positions in the U.S. The percentage assuming academic positions, regardless of country, is 77%. The proportions assuming academic vs. nonacademic positions vary greatly with the field of the thesis. For example, in probability and statistics, which includes over 200 doctoral recipients from statistics graduate programs, 47% of those whose employment status is known took academic positions in the U.S.

The updated matrix shows 19 new doctorates (2%) still seeking employment. This figure does not include non-U.S. citizens who are known to have returned to their country of origin and who may be still seeking employment outside the U.S. At the same time a year ago, 3% of the 1988–1989 new doctorates were reported as still seeking employment.

Finally, we note that the names of the 1989–1990 new doctorates and their thesis titles were published in Notices (November 1990 and a supplemental list in this issue).
### Table 2A: Employment Status of 1989–1990 New Doctorates in the Mathematical Sciences

<table>
<thead>
<tr>
<th>Type of Employer</th>
<th>Algebra or Number Theory</th>
<th>Real or Complex Analysis</th>
<th>Geometry or Topology</th>
<th>Logic</th>
<th>Probability or Statistics</th>
<th>Applied Mathematics</th>
<th>Discrete Math or Combinatorics</th>
<th>Numerical Analysis</th>
<th>Linear or Nonlinear Optimization</th>
<th>Other</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>19</td>
<td>28</td>
<td>39</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
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<td></td>
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<tr>
<td>Group II</td>
<td>13</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
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<td>Group III</td>
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<td>3</td>
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<td>2</td>
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<td>Group IV</td>
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<td>Group V</td>
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<td></td>
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<td>Masters</td>
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<td>3</td>
<td>22</td>
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<td>Bachelors</td>
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<td>12</td>
<td>6</td>
<td>17</td>
<td>21</td>
<td>10</td>
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<td>Other Academic Departments</td>
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<td>37</td>
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<td>2</td>
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<td>5</td>
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<td>Research Institutes</td>
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<td>41</td>
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<td>Canada, Nonacademic</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Foreign, Academic</td>
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<td>18</td>
<td>5</td>
<td>3</td>
<td>2</td>
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<tr>
<td>Foreign, Nonacademic</td>
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<td>2</td>
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<td></td>
<td>2</td>
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<tr>
<td>Total</td>
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<td>117</td>
<td>25</td>
<td>282</td>
<td>171</td>
<td>57</td>
<td>35</td>
<td>26</td>
<td></td>
<td>991</td>
</tr>
</tbody>
</table>

*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".

### Table 2B: Employment Status of 1989–1990 New Doctorates in the Mathematical Sciences Females Only

<table>
<thead>
<tr>
<th>Type of Employer</th>
<th>Algebra or Number Theory</th>
<th>Real or Complex Analysis</th>
<th>Geometry or Topology</th>
<th>Logic</th>
<th>Probability or Statistics</th>
<th>Applied Mathematics</th>
<th>Discrete Math or Combinatorics</th>
<th>Numerical Analysis</th>
<th>Linear or Nonlinear Optimization</th>
<th>Other</th>
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<td></td>
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<td>Canada, Academic</td>
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<td></td>
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<td></td>
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<td></td>
<td>8</td>
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<tr>
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<td></td>
<td>3</td>
</tr>
<tr>
<td>Foreign, Academic</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td></td>
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<td></td>
<td></td>
<td>15</td>
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<tr>
<td>Foreign, Nonacademic</td>
<td></td>
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<td>Not seeking employment</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<td>Not yet employed</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<td></td>
<td></td>
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<td>4</td>
</tr>
<tr>
<td>Unknown (U.S.)</td>
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<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Unknown (non-U.S.)*</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>12</td>
<td>21</td>
<td>4</td>
<td>62</td>
<td>34</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td></td>
<td>183</td>
</tr>
</tbody>
</table>

*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".
III. Faculty Characteristics

Information about faculty members and instructional programs was collected from mathematical sciences departments in the fall 1990 Departmental Profile Survey. The First Report contained information collected earlier about faculty salaries.

Table 3A shows attrition due to deaths and retirements of faculty in mathematical sciences. For Groups I, II and III combined, the rate is the same as last year. The attrition rates for faculty from Group B and Group VI are curiously higher than the others. The demographic profile of faculty in the Second Report of the 1989 Annual Survey (July/August 1990 issue of Notices, pages 659–662) showed that 15% of Group B faculty and 22% of Group VI faculty are age 55 or older compared to 19% for all groups combined.

Table 3B reports the new information on numbers of full-time faculty positions which departments attempted to fill with doctorates during 1989–1990. These data must be interpreted cautiously since the response rate is less than 100%. The response rate varies by group, and any attempt to project totals from the raw data may be affected by selection biases. Among doctoral new hires, women constitute 15% of the total in Groups I, II and III combined and 21% in Groups M and B combined.

Tables 3C and 3D (see next page) report percentages of women among different types of full-time faculty. This year's survey collected more detailed information about nontenured ranks in order to be able to analyze the subpopulation of full-time faculty members whose positions are not tenure-eligible. Such positions include, for example, postdoctoral fellows, research positions, and some instructorships and lectureships. In Groups I, II and III combined, the non tenure-eligible positions account for 7% of the doctoral faculty and 9.5% of all full-time faculty. In Groups M and B combined, the non tenure-eligible faculty members account for 4% of the doctoral faculty and 14% of all full-time faculty.

Table 3C reports the percentages of women by group and tenure status for faculty who have a doctorate. Table 3D reports the corresponding survey results for all full-time faculty. In the latter analysis, which includes the non-doctoral faculty, the percentage of women among non tenure-eligible faculty is substantially higher than the corresponding percentages either among doctoral faculty or among tenure-eligible ranks.

Tables 3E and 3F (see next page) report changes in sizes of nontenured and tenured faculty populations by group and by sex. Overall, the sizes of the tenured and nontenured populations increased, with the subpopulations of women showing substantially greater increases than the subpopulations of men.

---

Table 3A. Faculty Attrition*

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>I+II+III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of full-time faculty</td>
<td>1.1</td>
<td>1.3</td>
<td>1.8</td>
<td>1.4</td>
<td>1.4</td>
<td>0.5</td>
<td>1.8</td>
<td>2.4</td>
<td>2.7</td>
</tr>
</tbody>
</table>

*Percentage of full-time faculty who were in the department in fall 1989 but were reported to have retired or died by fall 1990.

Table 3B. Faculty Recruitment

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>I+II+III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of open positions*</td>
<td>169</td>
<td>87</td>
<td>195</td>
<td>451</td>
<td>89</td>
<td>21</td>
<td>281</td>
<td>316</td>
<td>50</td>
</tr>
<tr>
<td>Doctoral hires, male</td>
<td>125</td>
<td>62</td>
<td>131</td>
<td>318</td>
<td>53</td>
<td>15</td>
<td>166</td>
<td>176</td>
<td>42</td>
</tr>
<tr>
<td>Doctoral hires, female</td>
<td>19</td>
<td>12</td>
<td>26</td>
<td>57</td>
<td>15</td>
<td>3</td>
<td>49</td>
<td>44</td>
<td>4</td>
</tr>
<tr>
<td>Nondottoralt hires, male</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>29</td>
<td>57</td>
<td>0</td>
</tr>
<tr>
<td>Nondottoralt hires, female</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>28</td>
<td>47</td>
<td>0</td>
</tr>
<tr>
<td>Number of unfilled positions</td>
<td>24</td>
<td>17</td>
<td>32</td>
<td>73</td>
<td>18</td>
<td>2</td>
<td>46</td>
<td>42</td>
<td>4</td>
</tr>
<tr>
<td>Response rate by group**</td>
<td>85%</td>
<td>86%</td>
<td>84%</td>
<td>85%</td>
<td>74%</td>
<td>33%</td>
<td>59%</td>
<td>49%</td>
<td>63%</td>
</tr>
</tbody>
</table>

**The proportion of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to the recruitment data only.
### Table 3C. Percentage of Women among Doctoral Full-time Faculty, Fall 1990

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>I+II+III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of all doctoral faculty</td>
<td>6.0</td>
<td>6.5</td>
<td>8.8</td>
<td>7.1</td>
<td>13.3</td>
<td>7.9</td>
<td>13.8</td>
<td>17.2</td>
<td>6.3</td>
</tr>
<tr>
<td>% of tenured doctoral faculty</td>
<td>4.5</td>
<td>5.1</td>
<td>5.7</td>
<td>5.1</td>
<td>6.3</td>
<td>7.7</td>
<td>10.4</td>
<td>13.3</td>
<td>3.7</td>
</tr>
<tr>
<td>% of untenured, tenure-eligible doctoral faculty</td>
<td>10.2</td>
<td>11.4</td>
<td>17.0</td>
<td>14.0</td>
<td>29.5</td>
<td>6.7</td>
<td>20.9</td>
<td>24.3</td>
<td>19.1</td>
</tr>
<tr>
<td>% of non tenure-eligible doctoral faculty</td>
<td>11.6</td>
<td>14.6</td>
<td>13.0</td>
<td>12.3</td>
<td>24.4</td>
<td>13.3</td>
<td>27.7</td>
<td>26.2</td>
<td>13.8</td>
</tr>
</tbody>
</table>

### Table 3D. Percentage of Women among All Full-time Faculty, Fall 1990

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>I+II+III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of all full-time faculty</td>
<td>6.6</td>
<td>9.3</td>
<td>13.3</td>
<td>9.8</td>
<td>14.1</td>
<td>7.7</td>
<td>21.6</td>
<td>24.6</td>
<td>6.4</td>
</tr>
<tr>
<td>% of non tenure-eligible faculty</td>
<td>15.5</td>
<td>50.0</td>
<td>48.0</td>
<td>33.7</td>
<td>27.1</td>
<td>11.8</td>
<td>55.7</td>
<td>44.7</td>
<td>14.0</td>
</tr>
</tbody>
</table>

### Table 3E. Faculty Size

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>I+II+III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>2.6</td>
<td>8.6</td>
<td>2.2</td>
<td>3.9</td>
<td>1.1</td>
<td>5.8</td>
<td>0.4</td>
<td>6.2</td>
<td>7.8</td>
</tr>
<tr>
<td>Female</td>
<td>33.3</td>
<td>-15.0</td>
<td>17.4</td>
<td>12.0</td>
<td>25.4</td>
<td>0.0</td>
<td>9.2</td>
<td>9.6</td>
<td>-12.5</td>
</tr>
<tr>
<td>Total</td>
<td>5.3</td>
<td>5.1</td>
<td>4.4</td>
<td>4.9</td>
<td>6.9</td>
<td>5.3</td>
<td>2.1</td>
<td>7.0</td>
<td>3.5</td>
</tr>
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</table>

### Table 3F. Faculty Size

<table>
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<tr>
<th>GROUPS</th>
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<th>III</th>
<th>I+II+III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>-0.1</td>
<td>0.8</td>
<td>0.9</td>
<td>0.5</td>
<td>3.2</td>
<td>4.8</td>
<td>0.1</td>
<td>2.2</td>
<td>7.5</td>
</tr>
<tr>
<td>Female</td>
<td>5.0</td>
<td>13.2</td>
<td>3.0</td>
<td>6.7</td>
<td>3.0</td>
<td>37.5</td>
<td>6.0</td>
<td>6.7</td>
<td>17.6</td>
</tr>
<tr>
<td>Total</td>
<td>0.1</td>
<td>1.4</td>
<td>1.0</td>
<td>0.8</td>
<td>3.2</td>
<td>6.8</td>
<td>0.7</td>
<td>2.8</td>
<td>7.8</td>
</tr>
</tbody>
</table>
IV. Undergraduate Enrollment Profile and Majors
Data on undergraduate enrollments and majors are summarized in Tables 4A through 4E. The year-to-year percentage changes given in Tables 4A and 4D are based on responses obtained on the 1990 Departmental Profile Survey form alone and are not affected by differential response rates from one year to the next.

Survey results about class sizes were last reported three years ago, for the 1987 Annual Survey. There are no striking changes from 1987 to the present results shown in Table 4C.

Every five years, the CBMS Survey has collected and analyzed more detailed information about enrollment patterns, curricular trends, and other information pertaining to mathematics instructional programs. We alert readers to a report which is now in preparation for the 1990 CBMS Survey.

Table 4A. Percentage Change in Undergraduate Enrollments, Fall 1989 to Fall 1990

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>% change</td>
<td>-0.1</td>
<td>-3.9</td>
<td>0.1</td>
<td>1.7</td>
<td>-1.5</td>
<td>0.3</td>
<td>1.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Response rate by group*</td>
<td>90%</td>
<td>84%</td>
<td>79%</td>
<td>66%</td>
<td>28%</td>
<td>55%</td>
<td>46%</td>
<td>70%</td>
</tr>
</tbody>
</table>

*The proportion of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to Tables 4A through 4C on undergraduate enrollments.

Table 4B. Distribution of Undergraduate Enrollments, Fall 1990

<table>
<thead>
<tr>
<th>COURSES</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV+III</th>
<th>M</th>
<th>B</th>
<th>M+B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remedial mathematics*, %</td>
<td>10.0</td>
<td>6.4</td>
<td>12.2</td>
<td>10.0</td>
<td>16.2</td>
<td>17.2</td>
<td>16.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Remedial math + pre-calculus, %</td>
<td>24.8</td>
<td>26.8</td>
<td>38.6</td>
<td>31.4</td>
<td>32.6</td>
<td>32.3</td>
<td>32.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Remedial math + pre-calculus + calculus, %</td>
<td>57.9</td>
<td>59.0</td>
<td>60.7</td>
<td>59.4</td>
<td>47.1</td>
<td>46.9</td>
<td>47.0</td>
<td>34.0</td>
</tr>
</tbody>
</table>

*Arithmetic, high school algebra, geometry.

Table 4C. Average Class Size, Fall 1990

<table>
<thead>
<tr>
<th>COURSES</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remedial mathematics*</td>
<td>32</td>
<td>34</td>
<td>41</td>
<td>19</td>
<td>35</td>
<td>28</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>Traditional pre-calculus</td>
<td>32</td>
<td>39</td>
<td>43</td>
<td>37</td>
<td>29</td>
<td>99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-year calculus</td>
<td>35</td>
<td>44</td>
<td>38</td>
<td>31</td>
<td>25</td>
<td>69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undergraduate statistics</td>
<td>37</td>
<td>44</td>
<td>36</td>
<td>44</td>
<td>50</td>
<td>33</td>
<td>27</td>
<td>42</td>
</tr>
<tr>
<td>Undergraduate computer science</td>
<td>30</td>
<td>25</td>
<td>19</td>
<td>35</td>
<td>42</td>
<td>23</td>
<td>18</td>
<td>33</td>
</tr>
<tr>
<td>Other undergraduate mathematics, majors</td>
<td>29</td>
<td>31</td>
<td>26</td>
<td>22</td>
<td>16</td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other undergraduate mathematics, nonmajors</td>
<td>36</td>
<td>34</td>
<td>39</td>
<td>34</td>
<td>27</td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduate courses</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>15</td>
<td>17</td>
<td>11</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>All courses</td>
<td>30</td>
<td>34</td>
<td>33</td>
<td>32</td>
<td>27</td>
<td>29</td>
<td>23</td>
<td>42</td>
</tr>
</tbody>
</table>

*Arithmetic, high school algebra, geometry.

Table 4D. Percentage Change in Junior/Senior Majors, Fall 1989 to Fall 1990

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>% change</td>
<td>5.6</td>
<td>-5.9</td>
<td>-3.9</td>
<td>10.5</td>
<td>-7.7</td>
<td>2.3</td>
<td>3.9</td>
<td>4.1</td>
</tr>
</tbody>
</table>
Table 4E. Percentage of Women among Junior/Senior Majors, Fall 1990

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>B</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of departmental majors</td>
<td>37.9</td>
<td>40.8</td>
<td>42.3</td>
<td>42.1</td>
<td>30.3</td>
<td>45.5</td>
<td>44.1</td>
<td>30.4</td>
</tr>
</tbody>
</table>

V. Graduate Student Profile

Survey results about characteristics of graduate students are summarized in Tables 5A through 5C.

In comparison with last year's Second Report on the 1989 Annual Survey, we note that Groups I and IV, which report substantial increases in the number of first-year graduate students in fall 1990, are the same groups reporting substantial decreases in fall 1989 (Table 5A). At the same time, the groups (II and III) that reported substantial increases in fall 1989 are the same ones showing moderate declines in numbers of first-year students in fall 1990.

Except for Group I, the percentage of women among U.S. citizen graduate students is substantially higher than the overall percentage of women among U.S. citizen new doctorates (Table 5B).

A similar dichotomy stands out in the summary of citizenship status for full-time graduate students (Table 5C). The percentage of U.S. citizens among full-time graduate students is substantially higher in Groups I, II, III and IV than their percentage among new doctorates.

Table 5A. Percentage Change in Number of Graduate Students, Fall 1989 to Fall 1990

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-year students</td>
<td>8.1</td>
<td>-0.8</td>
<td>-5.4</td>
<td>14.5</td>
<td>-13.7</td>
<td>4.3</td>
<td>-10.8</td>
</tr>
<tr>
<td>All years</td>
<td>4.9</td>
<td>5.4</td>
<td>4.0</td>
<td>1.5</td>
<td>-3.3</td>
<td>15.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Response rate by group*</td>
<td>87%</td>
<td>72%</td>
<td>67%</td>
<td>59%</td>
<td>28%</td>
<td>47%</td>
<td>60%</td>
</tr>
</tbody>
</table>

* The proportion of usable forms varies for different sections of the Departmental Profile Survey. The response rates reported here apply to Tables 5A through 5C on graduate student enrollments.

Table 5B. Percentage of U.S. Citizen Women among U.S. Citizen Graduate Students, Fall 1990

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of first-year students</td>
<td>26.9</td>
<td>35.3</td>
<td>40.1</td>
<td>41.5</td>
<td>36.1</td>
<td>48.6</td>
</tr>
<tr>
<td>% of all years</td>
<td>23.0</td>
<td>34.0</td>
<td>37.3</td>
<td>40.4</td>
<td>26.2</td>
<td>45.4</td>
</tr>
</tbody>
</table>

Table 5C. Percentage of U.S. Citizen Graduate Students, Fall 1990

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of first-year students</td>
<td>55.4</td>
<td>63.4</td>
<td>62.0</td>
<td>51.2</td>
<td>48.4</td>
<td>74.7</td>
</tr>
<tr>
<td>% of all years</td>
<td>52.4</td>
<td>56.4</td>
<td>57.9</td>
<td>46.5</td>
<td>44.3</td>
<td>73.9</td>
</tr>
</tbody>
</table>
Acknowledgment

The Annual AMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical scene vital to the entire mathematical community. Yearly, collegiate departments in the United States, and the doctorate-granting departments in Canada, are provided the opportunity to respond. The quantity and quality of the responses directly determine the quality of the information in these reports. Without the dedicated cooperation of the secretarial and administrative support staff in the mathematical science departments we would not be able to conduct a survey, nor be confident in our analysis of its results. We are, unfortunately, unable to thank personally all the departmental assistants for their cooperation, but it is nonetheless appreciated. However, we are able to thank the administrative support staff of the AMS, especially Marcia Almeida, Monica Foulkes, and James W. Maxwell, whose efforts are acknowledged and appreciated.

Bibliography


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Doctoral Degrees Conferred 1989–1990

Supplementary List

The following list supplements the list of thesis titles published in the November 1990 issue of Notices. Each entry contains the name of the recipient and the thesis title. The number in parentheses following the name of the university is the number of degrees granted by the department.

**CALIFORNIA**

University of Southern California (5)

Mathematics

Bauer, Maximilian, Example of pseudo-Anosov homeomorphisms.
Jaecker, Tauno, Stochastic flow with a singular vortex.
Morris, Pircilla Jean, On a class of homogeneous stochastic flows.
Neubauer, Michael G., On solvable monodromy groups of fixed genus.
Spieler, Gisela, Parameter estimation by system theoretic methods.

**COLORADO**

University of Denver (1)

Mathematics and Computer Science

Marranes-Marbeau, Jocelyne Helene, Analysis of a discrete quantum probability model.

**KANSAS**

Kansas State University (1)

Statistics

Crabb, Jeffrey, A SAS program to correct the analysis of unbalanced two-way split-plot designs.

**MINNESOTA**

University of Minnesota, Minneapolis (4)

Statistics

Adams, John, Evaluating regression strategies.
Bian, Guorui, Bayesian statistical analysis with independent bivariate priors for the normal location and scale parameters.
Kang, Chang Wook, Generalization of the diagnostic methods of recursive residuals.
Wong, Weng Kee, Heteroscedastic optimal design.

**MONTANA**

Montana State University (2)

Mathematical Sciences

Doyle, Randall Ross, Extensions to the development of the sine-Galerkin method for parabolic problems.
Lewis, David Lamar, A fully Galerkin method for parabolic problems.

**NEW YORK**

Polytechnic University (4)

Mathematics

Bershatsky, Eugene, The development of confidence bounds for a sales forecast.
Chau, Jack-Kang, Normal lattices and measures.
Hertzlinger, Joseph, Normality and similar properties in lattices.
Schutz, Robert W., On regular lattice measures.

**CANADA**

University of Calgary (1)

Mathematics and Statistics

Ye, Qiang, Symmetric matrix pencils.

Errata

The thesis title for Mark R. Purtill (Mathematics, Massachusetts Institute of Technology) was incorrect in the November 1990 Notices. The correct title is “André permutations, lexicographic shellability, and the cd-index of a convex polytope.”

The name of David Halpern (Mathematics, University of Arizona) was spelled incorrectly in the November 1990 Notices.
Computers and Mathematics

This month's column

Are computers harmful to mathematics? Steve Speer writes to say he thinks they might be. Steve is a beginning mathematics graduate student at the University of Arizona. He is probably typical of most math graduate students these days in using electronic mail regularly; maybe less typical in almost never using word processors, though he acknowledges that he will probably be forced to start using \TeX some day soon. He can see too the possibilities of using various graphics packages and computer algebra systems to help develop intuitions about problems in geometry, dynamical systems, and so forth. His concern is that there is a real danger of overuse and addiction, a situation he compares with the havoc wrought in our society by drugs. As products of modern science, drugs have great value, but if not carefully controlled they can cause enormous damage. So too with computers, says Steve, who argues that the danger is particularly acute when it comes to small children.

In claiming that blind overuse or extreme addiction to computers can be harmful to the development of the future mathematician, Steve is surely right. As R. W. Hamming wrote in a book published in 1973, "The purpose of computing is insight, not numbers," a favorite quotation of mine that also appears in one of this month's software reviews. The "intelligent" use of computers in mathematics is as a tool to help our thought processes, not to replace them. For the present day generation of mathematicians, this is clearly the way we regard the sleek new machines that now grace our offices; we developed our mathematical skills long before computers were widely available. But the oft-lamented scenario of the high school math student who reaches for the calculator in order to evaluate the square root of 81 (or even of \(-81\)) should be enough to sound the warning bell as far as future generations are concerned.

If you want to see some of the positive effects computers can have on mathematics education, take a look at the new book Visualization in Teaching and Learning Mathematics, edited by Walter Zimmerman and Steve Cunningham, and published by the Mathematical Association of America. This excellent collection of articles provides a wealth of ideas for the intelligent use of computers in the mathematics classroom. It also indicates some of the dangers. So too does this month's feature article, written by Paul Halmos, who at one time early in his career was an assistant to John von Neumann, one of the pioneers who started the whole computer age.

Following Halmos' article there are two software reviews. R. S. Pinkham reviews Polymath and Jim Northrup looks at Function Finder. Editor's address: Professor Keith Devlin Department of Mathematics Colby College Waterville, Maine 04901 Correspondence by electronic mail is preferred: email address kjdevlin@colby.edu

Is Computer Teaching Harmful?

P. R. Halmos*

Is computer teaching really harmful? I used to be sure it was, but when I sat down to write this note I asked the opinion of a few friends, and some of the answers I got shook my beliefs. What follows is the result: (1) how to use computers to teach abstract concepts; (2) how numerical calculations can help teaching; and (3) how a computer can check predictive thinking. After these plusses, I go on to a minus: (4) computerized teaching of abstract concepts at the wrong time can be dangerous. The conclusion, my conclusion, is that (5) while the very existence of computer programs can improve the quality of our teaching, at the same time they create a strong possibility of replacing good teaching by bad, and, therefore, they must be used with wisdom—or not at all.

Good Programs

Let's begin by looking at some of the powerful and impressive arguments in favor of bringing the computer to the classroom.

Keith Devlin [4] talks about DE-Graph. It is, he says, a program "designed to provide graphical representation of differential equations, together with routines for their numerical solution." You type in \(y' = \sin(xy)\), for instance, and, bingo!, a vector field appears on the screen (a lot of small arrows) along with a family of particular solutions. He describes the experience of an instructor introducing DE-Graph to a class by beginning to explain how it was used. "Within five minutes at the most, no one in the room was paying any attention to what he was saying... . Everyone was too engrossed in investigating various of the dozen or so menu-available sample differential equations

*Paul Halmos has three degrees from the University of Illinois. Soon after getting the last one he became, for a couple of years, assistant to John von Neumann. Since then he has taught at many universities, including Miami, Montevideo, Hawaii, Edinburgh, and Western Australia. He has been on the faculty of Santa Clara University since 1985. His mathematical interests include ergodic theory, algebraic logic, and operators on Hilbert space.
supplied with the program... Interest-driven, explorative learning from the first moment”, says Devlin, and “... great” he concludes.

Jane Day [3] writes: “... $\sin{x}$ is a weird looking expression, and the fact that it has a limit as $x \to 0$ is even weirder to freshmen. A computer graphing program can illustrate this very nicely. ... Graphing in 3-D is really tough for most students now, because solid geometry is hardly taught in high school any more. So a graphing package for that, and one for functions given in polar coordinates can be helpful.”

Sheldon Axler [1] tells about a program that solves the Dirichlet problem for polynomials for the sphere in $\mathbb{R}^n$, “... Suppose you want to find a harmonic function on $\mathbb{R}^2$ that agrees with the polynomial $x^3y^4z^5$ on the unit sphere $x^2 + y^2 + z^2 = 1$. The program will tell you the solution, which is a polynomial in $\{x, y, z\}$ of degree 12.”

Good Calculations

What do you want your students to learn in calculus? Is it that an integral is a sum of very many very small numbers, and a differential is the difference between the values of a function at two points that are very near to each other? Even in the dark ages of rote calculus (fifty years ago?, last year?), most mathematicians would have given the second answer, but would spend most of their time in the class room on the first.

Courant’s book [2] was one of the first in which (definite) integration was defined before differentiation, and the teaching community received the idea with both praise and opprobrium. The vulgate approach was (still is?) first to define derivatives, then to define anti-derivatives, and then, partly via an undefined concept of area and partly via some hastily described limits of sums, to define definite integration.

With this approach the fundamental theorem of the calculus is neither surprising nor exciting and it becomes easy to forget. Instead of understanding and remembering that it is neither surprising nor exciting and that as far as $\sin{x}$ is concerned, the computer will continue to think that the harmonic series converges. Worse yet: even if you had a computer with infinite precision, and started calculating the partial sums of the harmonic series at the rate of one term per second, it comes to only twenty-eight thousand years, and even at the

only some of the time, and a systematic discussion of all the so-called “elementary” functions appears to be out of reach. Courant apologizes for the complication, but, we are to infer, that’s life.

The reason for teaching students that integrals are sums is to prepare them for an understanding of the fundamental theorem, as well as for an understanding of the kinds of non-elementary integrals that arise daily in both theory and practice. How to make students remember that integrals are sums is a problem that the use of electronic computers can go far toward solving. The computer can evaluate the sums that arise, and it does so as a brusque oracle, without confusing and distracting us with special tricks that have nothing to do with calculus. After “integrating” a few (a few dozen?, a few hundred?) functions by summation, a student is likely to remember that integration is summation, and might even express a wish for a systematic method that yields the answers without computation. When a student arrives at that point, with or without nudging, the time has come to take a hard look at “definite” integrals with variable upper limits. The study of such integrals is motivation—added motivation—for introducing derivatives. Slopes and speeds are important, of course, but the extra reason for looking for “anti-integrals”, a reason that has actually arisen in class and has therefore an immediate background for the student, might be found more convincing by some.

The second good use of computers that I want to advocate has to do with infinite series. That’s a tough subject for many students, and concrete examples that can be computed at the board are not easy to come by. The standard examples are $\sum \frac{1}{n^2}$, $\sum \frac{1}{n!}$, and $\sum \frac{1}{n^2}$, and their obvious relatives, but numerical calculations soon become difficult even with them. An obedient computer that can add up enough terms to make convergence seem plausible might give experimental information of value. It could perhaps even calculate the waiting time necessary to achieve accuracy within a prescribed $\epsilon$, and thus provide the experience that might make the subsequent discussion of the theory more plausible than it usually appears.

There is a catch, however, the catch produced by round-off error: its effect is the startling theorem that as far as computers are concerned a series converges if and only if its terms tend to 0. That’s right, isn’t it? If the machine works with, say, 20 digit accuracy, then as soon as the absolute values of the terms of a series get below $10^{-20}$ times the partial sum already accumulated, adding one more term becomes the same as adding zero. With a convergent series, the computer is likely to make guessing the sum, or in any event guessing its order of magnitude, easier than blind fumbling makes it, but no matter how long you experiment, the computer will continue to think that the harmonic series converges. Worse yet: even if you had a computer with infinite precision, and started calculating the partial sums of the harmonic series at the rate of one term per second, it will take you something over 28 million years to reach the sum 35. At the rate of a thousand terms per second, that comes to only twenty-eight thousand years, and even at the
improbable rate of a million terms per second, it would take twenty-eight years. What conclusion is the calculation of those partial sums likely to suggest to a student: convergence or divergence?

**Programs as Checks**

A third way of using a computer in teaching is as a check on the results of thinking. Trivial example: if you used integration by parts to evaluate $\int \arctan x \, dx$, then a computer (or Peirce’s famous “Short table. . .” [5]) can tell you that you did or didn’t get it right. It’s obviously helpful to know that you did not—more work must be done. And it is generally admitted that it is helpful to know that you did get it right—a bit of praise, a friendly “well done”, is a big psychological push toward the next success.

There are many better examples that illustrate the same point. Thus, for instance, one of the most important things to learn about differential equations is how to describe the solution before (or even instead of) actually finding it. What are its qualitative aspects? Is it periodic? Does it tend to $\infty$? *DE-Graph* will do that for you, and more. You give it your differential equation, and a few seconds later you can see that your prediction was right (or was not). Similar comments apply, obviously, to 3-D graphing (what does a saddle point, such as the one of $z = xy$, look like?).

Speaking of the harmonic functions program, Sheldon Axler says: “Some nice theory goes into the algorithms that make the program work, and it’s enjoyable to show the class that the theorems we have proved have concrete applications.”

**Answers too Soon**

I would now like to go on to argue that the aspects of computer assistance that its advocates offer as the best are likely in fact to present us with the most serious educational problems. Yes, it is true that an omniscient computer that can tell you the answer that’s guaranteed to be right, so that you may compare your answer with it, is a great teaching tool—but it is a dangerous tool. The danger is that it is possible to use the computer to exhibit the answer without insisting on thinking first, and that is bad teaching. A computer derived answer is an oracular one—we ask “how much?” or “what shape?”, and we get an answer. That’s good. We do not, however, get an insight—and that’s bad. No, no, no, no—please don’t start to object and to say that insights frequently (always?) come from accumulations of painfully learned hard facts. Of course they do. But, to coin a proverb, “no pain, no gain”. If I am told early on that the derivatives of

\[ 1, x, x^2, x^3, x^4, \text{and } x^5 \]

are

\[ 0, 1, 2x, 3x^2, 4x^3, \text{and } 5x^4, \]

then, of course, I get “insight” into the derivative of $x^n$ for many other values of $n$—but is that really insight? I think genuine insight can be acquired only by going through the difference quotient business for $n = 2$, and then $n = 3$, and then perhaps taking a backward look at $n = 1$, and not by merely receiving an oracular statement of several facts.

Adding Riemann sums with the aid of a computer has mnemonic value by repeatedly emphasizing that integration is addition; it doesn’t pretend to provide insight. The same sort of comment applies to adding partial sums of infinite series; it shows concretely what it means for a sequence of terms to get near to something. Using a computer to check the predicted properties of the solutions of a differential equation has psychological value at the very least. But using a computer to omit prediction and, instead, to make it tell us what the pictures of the solutions look like is just like using a computer to differentiate $x^n$; that has very little value, if any. One of the most important aspects of learning mathematics, of coming to understand it, is the joyful frustration of not knowing the answer; robbing a student of the struggles that lead to the answer, and of the blissful understanding that victory brings, is bad teaching.

The interest-driven, explorative learning praised by Keith Devlin is what every good teacher tries to produce, sure, as early as possible, sure, and the first moment is not too early—but what were those *DE-Graph* learners that he tells about learning? Answer: pictures—not methods of finding pictures. They had fun making the pictures come up and change, and that is, of course, another reason why they stopped listening to the explanation. I am all in favor of fun, and learning with fun is better (and more efficient) than the same learning without it, but to have fun with $X$ when you set out to learn about $Y$ is not learning about $Y$.

Bad teaching of the kind just mentioned—answers first, methods later (if ever?)—was not invented by computers; it could perfectly well have existed long before. Any calculus teacher can tell students to write $\frac{n}{x^{n-1}}$ on every sheet of paper on which $x^n$ appears, and to do so long before difference quotients are on the horizon. Judging from many students who have arrived in my classes after having been exposed to calculus in high school, I suspect that many calculus teachers do just that. Tables of integrals (Peirce’s and others) have existed and have been popular for a long time, and during all that time teachers could have “taught” integration simply by putting one into each student’s hands. And even if a teacher didn’t do that, students could have been doing it to themselves—looking things up is sometimes regarded as less painful than thinking about them. I don’t really believe, however, that that kind of bad teaching has been widespread—books are awkward to search in, and to look something up in a table is not always a totally trivial task. Computers nowadays are something else again. They are easily accessible to students, their aficionados advertise them as a big step toward the future, and they are fun, fun, fun to search. You push buttons, and things happen instantaneously and spectacularly, and if that’s not what you wanted to know, you can make it go away and push another button. The reason cats and little children like to play with ping pong balls is that a tiny effort instantaneously produces a large result—very satisfying.
Teach Mathematics, not Programs
What is worrisome about computer-assisted teaching is the emphasis. Some enthusiasts seem tempted to teach, at best, how to use a computer to do something, and, at worst, how to use one particular program to do something, rather than teach what the something is. That’s bad teaching, and perhaps I am not saying anything more profound than that bad teachers will do a bad job and good teachers will do a good job, with the computer or without. My worries about DE-Graph and the Dirichlet problem program are caused by the kind of bad teaching that the use of such programs (their use at the wrong time) can lead to. The process is like devoting most of the time in the education of would-be automotive engineers to teaching them how to drive, or like educating would-be cryptographers by teaching them how to run a cryptography machine. Necessary, probably yes; sufficient, certainly no. I am inclined to go to the other extreme and to oppose the teaching of computer use in mathematics courses altogether. To use an analogy: pseudo-education such as that is likely to produce people who sometimes have occasion to push the button labelled “cos” on a hand-held calculator without having any idea what cosine means and without being able to predict that the result of pushing it for \(60^\circ\) will be \(1/2\). Such people exist, but they are not what the product of mathematics courses is intended to be. We want to produce, among others, people who will be able to design the computers of tomorrow, not just run the ones of today.

What conclusion can be drawn from these observations? One possibility is to prohibit the use of computers as a source of answers in the class room—but, of course, that’s silly. It’s silly because it is unrealistic. Even if no teacher used computers that way, they would still be available to students, and, unlike tables of integrals, they would be easily available and fun to use. We cannot legislate computer teaching out of existence. Computers are here to stay, both in and out of the class room, and we have to learn to live with them. Question: how? Answer: by changing the direction of teaching so as to emphasize non-computerized ideas and methods. In calculus courses let us teach hard calculus; let us teach ideas, let us teach the sources of the mechanical ways of approaching problems; and let us turn out students who, when their time comes, will be able to solve problems that so far we are too ignorant even to state.

Am I saying that computers have in fact done a tremendous amount of good—that they are forcing us to do what we should have been doing all along? Maybe. Am I, however, saying that computers should not replace any part of our teaching? Yes.

References

Reviews of Mathematical Software

Polymath
Reviewed by R. S. Pinkham*

Polymath provides an interactive calculator-like environment which combines scientific and engineering plotting, a Forth-like programming language, an editor, and a comprehensive documentation system. As best as I can tell, it was designed and developed by Greg Lobser. It may be obtained from Lobster Softwear, Contract Station #6, P. O. Box 7055, Littleton, Colorado 80123, phone: (303)973-1028.

Anyone who has used Forth, especially in one of its minimal implementations, has probably been amazed by its small size, the speed, and ease of use, but hankered for floating point, better documentation facilities, the ability to make really first class plots, and possibly a good within-environment editor. This system has it all.

I ran the Polymath system under DOS 3.3, and found no mention of it running on a Mac platform.

To help the reader evaluate my assessment of this system, I provide some background. I am neither hacker, computer, nor computer scientist, but I have used computers and computing attitudes as tools of mathematical enlightenment since the 1950’s. I am an ardent believer in the maxim “The purpose of computing is insight, not numbers.” [Hamming, 1973] Since 1982 my school, Stevens Institute of Technology, has had mandatory purchase of computers by freshman, and I have used such machines to enhance both undergraduate and graduate instruction.

So it was that I undertook to review this software as a possible contender for CC3 [Holden, 1989] and/or APL in graduate numerical analysis classes or even as a system to be used in undergraduate calculus and computational linear algebra.

Polymath is more difficult to learn than CC3 but less so than APL. It offers more plotting options than CC3 when making 2-d graphs but provides no 3-d facilities such as found in CC3. CC3 is recursive; Polymath is not.

I found the written documentation annoying. Much of what one needs to know is there, but until I had sufficiently immersed myself in the program to be able to intuit the author’s intent, I was often puzzled or at best annoyed. Or consider the on-line “Guide”. If you select “G” to find out about logical control, at the top of the display you see “Explain H” and “H” is about the block editor. If you hit

*R.(Roger) S. Pinkham teaches mathematics at Stevens Institute of Technology in Hoboken, New Jersey.
“Enter” you will find yourself in a discussion of the block editor. Now this all makes sense once you figure out what is going on, but the first time through it is frustrating.

There are very handy and ingenious syntax devices of which I was here-to-fore unaware. A statement like

\[
\text{If( } \text{dup} \gt= 0 \text{ ) sqrt endif,}
\]

which “reads right,” would result in an error on all RPN (reverse Polish notation) systems with which I am familiar. But in Polymath this translates into the more usual

\[
dup 0 \gt= \text{if sqrt endif.}
\]

This is because:

1. Words may be composed with up to 15 characters. These characters may be entirely alphanumeric or entirely special characters, but not both.

2. A word followed immediately by a parenthesis is executed after the contents of the parenthesis.

3. If a word composed of special characters is followed immediately by a word composed of alphanumeric characters, then the effect is the same as if the alphanumeric word had been enclosed by parenthesis.

I find this delightful.

Now there is at least one horrendous bug and a few major annoyances that must be addressed before I can recommend the system. The double asterisk denotes exponentiation. Thus 2 3 ** or 2**3 (using the aforementioned convention) returns 8, as it should. 0 3 ** returns 1, which it should not! But worse is –2 3 **, i.e. (–2)³, which results in –17.25.

Error returns and error recovery are in some cases annoying rather than amusing or helpful, and in some instances non-existent. Working in radians, the system will give a handsome graph of \( x \times \cos(x) \) on the interval 0.01 to 10. When asked to do the same thing for 0 to 10, one gets not only a goofy plot, but upon returning from the plot one finds the error message “You have attempted the impossible! The following problem was detected: Division by zero.” Worse yet! You’re wedged and have to do a warm reboot.

Some errors, particularly in file handling, are so severe as to necessitate a cold reboot, and all is lost.

Mistype cow for cos and you get the error message, ‘I haven’t the foggiest idea what “cow” means.’ I believe the anthropomorphism is unwise, but in any case the humor, if any, pales after the fourth or fifth time.

In short, I believe Polymath has the potential to be a first class piece of software, but it needs cleaning up before being sent out into the world.

References

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**Function Finder**

**Reviewed by James Northrup***

*Function Finder* is a game-like program designed to demonstrate the relationship between the coefficients of the equation of a line and the table of \((x, y)\) values which the equation generates. The most likely setting for its use would be a high school algebra course, or a college pre-calculus course. While the basic concept and several of the design features are quite good, the implementation could go further towards tapping the potential of the basic concept.

The program internally generates the equation of a line, and presents the student with a table of \((x, y)\) values on that line. From this data, the student is expected to determine the coefficients of the equation, and to enter those into a dialog box. The program increases the difficulty of this task as the students successfully computes coefficients. At the early levels of the game, the student is able to choose the \(x\) coordinates, and the lines have nice integer coefficients. At higher levels, the \(x\) coordinates are chosen for the student, and the coefficients of the equation might be fractions involving halves and fourths. Eventually, the sequence of successes is rewarded with a congratulatory message at the end of the game. A failure at any point in the game presents the student with the option of trying again, or returning to an easier level (see figure on next page). Students can save a partially-played game to a file and return to it at a later time.

My chief complaint with the program is that it does not involve graphical representations of lines in any way. For example, an incorrect guess at the coefficients causes the program to display a second table of \((x, y)\) coordinates, this table corresponding to the students mistaken guess. It would have been much more illustrative to show the student the graph of the guessed equation, and contrast that to the graph of the correct equation. From a table of numbers, it is not at all clear whether just the slope was computed incorrectly, or the \(y\)-intercept, or both. A graph would have made the nature of the students mistake obvious, and would have suggested the correct course of action. I found the tabular explanation of the error frustrating rather than helpful.

On the other hand, the program does include quite a number of nice features. The program does an outstanding job of anticipating the types of mistakes a user might make while playing the game, and in such cases provides clear directions for correcting the mistake. The user interface itself is simple and clear, and there is an on-line help facility. One interesting feature is the survey conducted at the end of each level; upon completing a level, the student is asked some questions about the methodology used for computing the coefficients. These can be saved to a file and printed out later. Unfortunately, the program insists that these questions

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Computers and Mathematics

be asked; their is no way to turn this feature off.

There are a few small bugs in the program. The on-line documentation contains some spelling errors. If you attempt to open a previously saved game, and then select the cancel button in the file requestor, you will get two IO error message dialog boxes. One interface design flaw is that the coefficients of an incorrect guess are deleted from the dialog box before you have a chance to ponder the source of your error. I am surprised to see that these errors persist at least through version 2.3 of the program, the version I had available to me.

The concept of Function Finder is a good one. I would, however, extend it in two ways. First of all, it would be better to include a greater variety of functions, rather than just lines. Secondly, the description of the function sought could be presented graphically as well as in tabular form. If a graph of the function were included, the game could certainly be extended to higher degree polynomials and trigonometric functions as well. I expect that even logarithms, exponentials, and roots could be included, for more advanced students. Given that Function Finder does not include such functions, one could create the same effect by creating template documents in a more general purpose symbolic/graphical package such as Mathematica, or a general purpose numerical/graphical package such as MathCad.

Function Finder runs on any Macintosh with at least 512K of memory and the enhanced ROM. It will not run under Multifinder or Switcher. It was developed by Dr. Jere Confrey of Cornell University and is available from Kinkos Academic Courseware Exchange.

An example of Function Finder.
Report of the Secretary
Robert M. Fossum

Strategic Planning
The last year of the last decade and the second year of the Society’s second century may be remembered as that year in which the mission and goals of the Society were evaluated within the context of modern mathematics and the current mathematical milieu. The process of examining them and perhaps altering them was put into place. Nineteen hundred ninety was a year in which the Society’s Long Range Planning Committee (LRPC)* was “to go into high gear” and devise a five-year plan of action for the Society. But as Hugo Rossi, current chair of the LRPC, wrote:

“. . . The LRPC recognized that there are “forces” affecting the mathematical community with which the Society was not dealing effectively. To plan a course of action to do so required stepping back and taking as objective a look as possible at the Society and its membership to better understand its role and capabilities. The LRPC felt it was presumptuous for its six members to speak for the Society and excessive work for them to find the voice of the membership without assistance.”

This recognition came after the LRPC had struggled with its assignment for most of 1990. The Committee felt that professional help was in order and it recommended to the Council’s Executive Committee (EC) and the Society’s Board of Trustees (BT) that the Society engage Facilitators from the firm KPMG-Peat-Marwick to bring professional guidance into the long range planning process and that a task force expanding the LRPC be appointed to work with these Facilitators toward, as Rossi writes:

“. . . discovering and then concisely articulating the ambitions and needs of the mathematical community which the Society represents, and to formulate a set of goals and strategies to achieve those goals, based on that information.”

The EC BT agreed and the Strategic Planning Task Force (SPTF) was formed in late 1990.* (An update of the SPTF’s activities is in an article following the Treasurer’s report in this section.) Its real work began early in 1991 and it hopes to report to the EC BT in May 1991.

A problem identified by the LRPC and members of the EC BT early in the long range planning process was the mission statement of the Society as found in the 1923 Certificate of Incorporation of the AMS:

“The particular business and objects of the Society are the furtherance of the interests of mathematical scholarship and research.”

Many felt that this statement does not serve to guide the organization in its role definition and decision-making. The Mission Statement should define the AMS and distinguish it from other mathematical membership organizations. From the Mission Statement is derived the
• Mandates: those functions and purposes the AMS is required to provide;
• Aspirations: idealized conceptions of what the AMS hopes to be;
• Constituents: the institutions and individuals the AMS is committed to serving; and
• Values: the principles and standards the AMS strives to maintain and impart.

This examination of the Mission Statement is only the beginning of the assignment for the Task Force. Again Rossi writes:

“. . . the SPTF is concerned with eternal truths like mission statements, but it is even more concerned with goals for the next five years derived from those eternal truths, goals which are attainable, and strategies to attain them.”

*The members of the SPTF are: President Michael Artin, Salah Baouendi, Lenore Blum, Ex-President William Browder, Robert M. Fossum, Ramesh Gangolli, Chair of the Board Frederick Gehring, Ronald L. Graham, Executive Director William H. Jaco, Donald L. Kreider, Jill P. Mesirov, Treasurer Franklin Peterson, Hugo Rossi (chair), Richard A. Tapia, and William P. Thurston.
A major effort has been made to obtain the guidance and sentiments of the members of the Society and the leadership. The role of the Facilitators has been to focus the attention of the Task Force and to help it in gathering this guidance.

As this is being written, the SPTF is preparing its final report that it hopes to have ready by mid May 1991. Certainly the results of this and other deliberations of the Task Force will be reported in the Notices as they become known. Of course implementation of any recommendations would have to be considered by the various governing bodies of the Society.

While strategic planning was at the forefront on the minds of some of the officers and staff of the Society, other more mundane activities were also taking place.

Meetings
The Annual Meeting of the Society in 1990 was held in Louisville, Kentucky in January. The Colloquium Lectures were delivered by Shlomo Sternberg and the Gibbs Lecture was given by George B. Dantzig. There were four AMS-MAA Invited Addresses, six Invited Addresses, eighteen Special Sessions and many sessions for contributed papers.

The 1990 Summer Meeting of the Society was held in Columbus, Ohio on the campus of Ohio State University in August. This meeting celebrated the Seventy-Fifth Anniversary of the founding of the Mathematical Association of America (MAA). That portion of the scientific program devoted to Society activities was reduced in deference to MAA activities. There was a joint AMS-MAA Invited Address delivered by the former President of the Society, Saunders Mac Lane, and there were two Progress in Mathematics Lectures, one by Michael G. Crandall and one by John W. Morgan. There were six Special Sessions and the usual complement of sessions for contributed papers.

Since the International Congress on Mathematical Education (ICME) will take place in mid August 1992 in Quebec City, Canada, the AMS and MAA investigated the possibility of meeting just before or just after the Congress in Quebec City. Unfortunately, the logistics did not work out. Furthermore, it became clear that any special scientific program on mathematical education planned by the two organizations would probably duplicate parts of the ICME program. Hence the AMS-MAA Joint Meetings Committee decided not to hold a Summer Joint Meeting in 1992. The MAA will hold meetings of some of its committees and Board of Governors just before the ICME. Meetings of the Council of the AMS and other committees will be arranged.

The AMS and MAA have agreed to meet jointly with the Canadian Mathematical Society in August 1993 at the University of British Columbia in Vancouver, British Columbia. The three organizations are planning an exciting scientific program.

The International Congress of Mathematicians met in Kyoto, Japan, in August 1990.

Prizes and Awards
A feature of Annual and Summer Meetings is the awarding of prizes. At the Annual Meeting in Louisville in January 1990, the 1990 Frank Nelson Cole Prize in Algebra was awarded to Shigefumi Mori of Nagoya University for his work on the classification of algebraic varieties. This prize and its sibling, the Frank Nelson Cole Prize in Number Theory were founded in memory of Frank Nelson Cole on the occasion of his retirement as secretary of the Society after twenty-five years of service as editor-in-chief of the Bulletin. It is awarded every five years for a notable research memoir in algebra that has appeared in the past five years written by a member of the Society or published in a recognized North American journal. It should be noted that Mori received the Fields Medal for this work at the International Congress of Mathematicians in August of 1990.

The Leroy P. Steele Prizes for 1990 were awarded at the Summer Meeting of the Society held in Columbus, Ohio. The 1990 Steele Prize for Expository Writing went to R. D. Richtmyer for his book Difference Methods for Initial Value Problems published by Interscience in 1957. The 1990 Steele Prize for a Fundamental Paper went to Bertram Kostant for his paper “On the Existence and Irreducibility of Certain Series of Representations”, Lie Groups and Their Representations (I. M. Gelfand, editor), J. Wiley, 1975. The 1990 Steele Career Prize was awarded to Raoul Bott for his incisive contributions to characteristic classes, K-theory, index theory, and many other tools of modern mathematics. The Leroy P. Steele Prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein, and are endowed by a bequest from Leroy P. Steele.

The 1990 Norbert Wiener Prize in Applied Mathematics was awarded at the Joint Mathematics Meeting in Columbus, Ohio. The 1990 prize was awarded jointly to Michael Aizenman, for his contribution of original and non-perturbative mathematical methods in statistical mechanics, and Jerrold E. Marsden, for his contributions to the study of differential equations in mechanics. This award is made jointly by the AMS and the Society for Industrial and Applied Mathematics (SIAM).

A new award established by the Society was presented at the Annual Meeting in January. The 1990 American Mathematical Society Award for Distinguished Public Service was presented to Kenneth M. Hoffman for his leadership in establishing channels of communication between the mathematical community and makers of public policy as well as the general public. This Award is to be presented every two years to a research mathematician who has made a distinguished contribution to the mathematics profession through public service during the preceding five years.

AMS Centennial Fellowships
AMS Centennial Fellowships were awarded in 1990 to Michael Anderson of the State University of New York at Stony Brook, to Carolyn S. Gordon of Washington University in St. Louis, and to Stephen A. Mitchell of the
University of Washington. These fellowships are intended to provide enhanced research opportunities to mathematicians who are several years past the Ph.D., who have a strong research record, but who have not had extensive postdoctoral research support in the past. They are awarded to individuals who have received a Ph.D. from seven to twelve years prior to winning the award. The stipend in 1990 was $36,000 and for 1991 was $38,000. Funds for these awards are contributed by the members of the Society. The Society contributes to the program from its general fund.

Ruth Lyttle Satter Prize
The Council established a new prize to honor the memory of Ruth Lyttle Satter. It is to be awarded to a woman mathematician every other year for an outstanding contribution to research in mathematics during the past five years. This prize is endowed by a gift from Joan S. Birman. (The first Ruth Lyttle Satter Prize was awarded to Dusa McDuff at the Annual Meeting in San Francisco in January 1991.)

Sectional Meetings
There were seven sectional meetings of the Society in 1990 at which twenty-nine Invited Addresses were delivered and fifty-eight Special Sessions were held. Attendance at these sectional meetings is improving. The Society continues to display its books and journals at these sectional meetings. In addition, registration by credit card is now available at most sectional meetings.

Two of these sectional meetings, the one held in Fayetteville, Arkansas in March 1990, and the one held in Albuquerque, New Mexico in April 1990, were held in cooperation with the Society for Industrial and Applied Mathematics. Several of the invited speakers and special sessions were arranged in cooperation with the cognizant SIAM program committee.

Members should take note of a special meeting to be held in June/July 1992, at Robinson College, Cambridge, England jointly with the London Mathematical Society (LMS). The AMS-LMS Program Committee has arranged for a very attractive scientific program. And the local hosts have promised an equally attractive social program. Invited speakers who have already accepted invitations to hold an invited address are Nigel Hitchin, Benedict Gross, Lawrence Evans, and John Ball. Further details will be available as they are known.

Other Conferences
The Society sponsored its annual AMS Summer Research Institute. In 1990 the topic was Differential Geometry, organized by Robert Bryant, Eugenio Calabi, S. Y. Cheng, H. Blaine Lawson, H. Wu, Robert E. Greene (co-chair), and S. T. Yau (co-chair). The Institute was held at the University of California, Los Angeles in July 1990.

The Society sponsored, jointly with the Society for Industrial and Applied Mathematics, the twenty-first AMS-SIAM Summer Seminar in Applied Mathematics. The topic was Vortex dynamics and vortex methods. The seminar was held at the University of Washington during the period June 18-29, 1990.

The Joint Summer Research Conferences in the Mathematical Sciences were held at the University of Massachusetts from June 7 to July 4, 1990. These were sponsored by the AMS, SIAM, and the Institute for Mathematical Statistics (IMS). Topics in 1990 were: Probability models and statistical analysis for ranking data, Inverse scattering on the line, Deformation theory of algebras and quantization with applications to physics, Strategies for sequential search and selection in real time, Schottky problems, and Logic, fields, and subanalytic sets.

Bylaws
The Council in 1990 recommended several changes in the bylaws of the Society that were adopted by the membership in the 1990 Election. These changes were printed in the March 1991 issue of Notices. In general they related to terms of office of several of the officers and the method by which some of the officers and members of the editorial boards are appointed.

Science Policy
The Committee on Science Policy (CSP) has been active during 1990. Early in 1990 it recommended that the Council establish a Committee on Education. The Society has been considering many items related to mathematics education. Each time the Society would react in an ad hoc fashion. So it was felt that a standing committee was necessary in order to consider Society responses to these educational items. The August 1990 Council approved the recommendation and the Society now has a Committee on Education.

Related to this is the recommendation by the CSP that areas of cooperation between AMS and MAA be encouraged. The November 1990 ECBT seconded this recommendation by authorizing the President to appoint an ad hoc committee of the Society to be ready to engage in cooperative efforts with MAA. Then early in 1991, the Presidents of MAA and the AMS have agreed to establish a joint ad hoc committee, the AMS-MAA Committee on Cooperation, to study this further.

Education
As mentioned above, the Council has established a Committee on Education. The first chair of this committee is Ramesh Gangolli. It met for the first time in Tampa, FL in March 1991. Its activities will be reported periodically.

JPBM
The Joint Policy Board for Mathematics (JPBM) is a cooperative venture sponsored by the Society, the MAA, and SIAM. One of its major activities has been to direct its Office of Governmental and Public Affairs (OGPA) in Washington, DC. Since July 1, 1990 OGPA had been operating with Edward Connors as its Director.
Each of the three participating organizations have three representatives on JPBM and the chair of JPBM rotated among the organizations’ presidents. In 1990, JPBM decided that it needed a tenth member to act as permanent chair and Hugo Rossi was appointed.

A vital issue facing JPBM is the role it will play in establishing and enunciating policy and the amount of activity it will support in Washington. For example, the Strategic Planning Task Force and other governing bodies of the Society will consider whether the Society should have its own “presence” in Washington. If it decides to do so, then parts of OGPA activities may become superfluous.

Committees
As part of the long range planning process, a study of the committee structure has commenced. A list of charges for all committees of the Society, including the joint committees, is being assembled. A good portion of this work was finished in mid 1990. As of the end of 1990 there were 173 committees listed in the 1991 Professional Directory (which represents the status at the end of 1990). In the middle of 1990 there were 431 members of Society committees. These represented 139 institutions from 38 of the 50 states, 5 different institutions in Canada, and a handful of institutions from outside North America.

Economics
The economic situation had its effects on the Society budget, as will be reported by the Treasurer. Steve Armentrout announced that he will serve only one more term as Associate Treasurer, so a search has been initiated to identify a new Associate Treasurer.

Conclusion
This is only a brief summary of the activities of the Society during 1990. The strategic planning effort will result in a rethinking of what the Society is doing and where it is headed. As a result, it will probably be interesting in 1992 to compare the Secretary’s report for 1991 with this one for 1990.

Report of the Treasurer (1990)
Franklin P. Peterson

I. Introduction
From a financial perspective, 1990 was a disappointing year for the Society. Although 1990 was budgeted to produce an excess of revenues over expenses (surplus) in an amount greater than was achieved in 1989, I must report a deficit of $13,000. There are several reasons for this, the most significant of which I will explain here.

A significant portion of the Society’s surplus is attributable to investment income. Income from long-term investments was $266,000 lower in 1990 than in 1989, and $218,000 lower than the 1990 budget. Although these sorts of fluctuations in income cannot be avoided, it is some comfort to note that the return on the Society’s investments was higher than the return in equity investments in general during 1990.

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From an operational point of view, the Society’s book publication program fell short of expectations. Several steps were taken in 1990 to improve the book publishing program in the future. These include reorganizing the publication and production activities of the Society (one-time costs associated with these changes and recorded expenses in 1990 were approximately $170,000). These changes should allow for more efficient production and the acquisition of more manuscripts in the future. The increased acquisitions will be seen first in the area of Russian translations. During 1991, the society’s marketing resources will be strengthened. This should provide for more efficient distribution of AMS titles to more markets.

Management of the Society has been grappling with the problem of space in the Society’s headquarters building. It had been estimated that expansion of the building (either at the current site or elsewhere) would have been necessary in 1991. The future direction of the Society, including where its headquarters should be located, was under discussion during 1990. Rather than commit to a costly physical expansion prior to the outcome of these discussions, it was decided to seek a temporary space solution during 1990. The Society was able to lease space in a building only a short walk from the headquarters building. The rental of this space added $65,000 of unbudgeted expense in 1990.

Finally, the State of Rhode Island vigorously enforced its escheatable property laws. Under these laws, the state has the right to confiscate property which has remained “unclaimed” for more than five years. An example of the sort of property involved is a check sent to a vendor, but which is not cashed by the vendor. The state audited the books of the AMS going back to 1978, and as a result the AMS was required to record additional expenses of approximately $105,000.

Were it not for these various unusual matters, the Society’s bottom line would have been a more respectable positive number.

In spite of the deficit for 1990, the Society’s balance sheet remains healthy. As of December 1990, there was no long-term or short-term bank debt, and unrestricted fund balances amounted to 41% of total assets, the same percentage as in the prior year.

II. Summary Financial Statements
The Treasurer this year again presents to the membership summary financial statements of the Society. A copy of the Society’s audited financial statements, as submitted to the Trustees and the Council, will be sent from the Providence Office to any member who requests it from the Treasurer. The Treasurer will be happy to answer any questions members may wish to put to him concerning the financial affairs of the Society.
## SUMMARY STATEMENT OF ACTIVITY
For the Years Ended December 31, 1990 and 1989
(Thousands of Dollars)

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>1989</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journals</td>
<td>$9,780</td>
<td>$9,360</td>
</tr>
<tr>
<td>Books</td>
<td>1,636</td>
<td>1,682</td>
</tr>
<tr>
<td>Dues</td>
<td>1,532</td>
<td>1,411</td>
</tr>
<tr>
<td>Membership Activities</td>
<td>237</td>
<td>270</td>
</tr>
<tr>
<td>Meetings</td>
<td>533</td>
<td>423</td>
</tr>
<tr>
<td>Grants and Contracts</td>
<td>1,263</td>
<td>953</td>
</tr>
<tr>
<td>Investment Income</td>
<td>725</td>
<td>987</td>
</tr>
<tr>
<td>Other</td>
<td>891</td>
<td>658</td>
</tr>
<tr>
<td>Total revenue</td>
<td>$16,597</td>
<td>$15,744</td>
</tr>
</tbody>
</table>

| Expense                |           |           |
| Journals               | $8,533    | $8,113    |
| Books                  | 1,426     | 1,723     |
| Marketing              | 594       | 418       |
| Membership Records     | 391       | 370       |
| Membership Activities  | 508       | 304       |
| Meetings               | 712       | 628       |
| Grants and Contracts   | 1,342     | 1,139     |
| Software Development   | 873       | 548       |
| MR Database            |           |           |
| Projects               | 679       | 662       |
| Other                  | 1,552     | 946       |
| Total expense          | $16,610   | $14,851   |

| Excess (Deficiency) of Revenues over Expenses | ($13) | $893 |

## SUMMARY BALANCE SHEET
December 31, 1990
(Thousands of Dollars)

<table>
<thead>
<tr>
<th>Assets</th>
<th>1990</th>
<th>1989</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash and temporary investments</td>
<td>$3,315</td>
<td>$4,397</td>
</tr>
<tr>
<td>Other short-term investments</td>
<td>833</td>
<td>306</td>
</tr>
<tr>
<td>Receivables-members and others (less allowance doubtful accounts)</td>
<td>1,325</td>
<td>972</td>
</tr>
<tr>
<td>Deferred prepublication costs</td>
<td>977</td>
<td>845</td>
</tr>
<tr>
<td>Inventory of completed books and back volumes of journals</td>
<td>1,234</td>
<td>1,231</td>
</tr>
<tr>
<td>Prepaid expenses and deposits</td>
<td>1,014</td>
<td>875</td>
</tr>
<tr>
<td>Property and equipment (less accumulated depreciation)</td>
<td>5,176</td>
<td>5,284</td>
</tr>
<tr>
<td>Total operating assets</td>
<td>13,874</td>
<td>13,910</td>
</tr>
<tr>
<td>Long-term investments (unrestricted)</td>
<td>6,755</td>
<td>6,289</td>
</tr>
<tr>
<td>Total operating assets and unrestricted investments</td>
<td>20,629</td>
<td>20,199</td>
</tr>
<tr>
<td>Long-term investments (restricted)</td>
<td>2,280</td>
<td>2,164</td>
</tr>
<tr>
<td>Total assets</td>
<td>$22,909</td>
<td>$22,363</td>
</tr>
</tbody>
</table>

### Liabilities and fund balances

| Accounts payable                  | $954   | $1,085 |
| Subscriptions, dues, and other revenues received in advance | 8,600 | 8,520 |
| Other miscellaneous liabilities   | 1,713  | 1,212  |
| Total liabilities                 | 11,267 | 10,817 |
| Unrestricted fund balances:       |        |        |
| Operating fund balance            | 2,607  | 3,093  |
| Unrestricted invested fund balances: |       |        |
| Future operations                 | 6,594  | 6,114  |
| Friends of Mathematics            | 124    | 124    |
| Other                             | 37     | 51     |
| Total unrestricted invested funds | 6,755  | 6,289  |
| Total unrestricted fund balances  | 9,362  | 9,382  |
| Restricted fund balances:         |        |        |
| Endowment funds:                  |        |        |
| The Endowment Fund                | 100    | 100    |
| Robert Henderson                  | 548    | 548    |
| Joseph Fels Ritt                  | 23     | 23     |
| Prize funds                       | 183    | 169    |
| Waldemar J. Tritzinsky            | 189    | 189    |
| C. V. Newsom Fund                 | 100    |        |
| Centennial Research Fellowship    | 3      | 1      |
| Pooled Income Fund                | 5      | 5      |
| Eliakim Hastings                  | 3      | 3      |
| Undistributed net gains on investment transactions | 1,098 | 1,126 |
| Total restricted invested funds    | 2,280  | 2,164  |
| Total liabilities and fund balances | $22,909| $22,363|

### III. Operations

I now turn to a more detailed discussion of the Society's 1990 operations.

**Journals.** Journals provide the largest fraction of the Society's revenues and expenses. In the past, journals have operated at a net loss (the net loss on *MR* was greater than the combined net income of the other journals). Since 1985, journals (in the aggregate) have operated in the black and provided a very significant portion of the Society's surplus (the excess of revenues over expenses in the summary financial statements above). It can be expected that the amount of surplus generated by journals will decrease over the next few years. This is a result of pressure from subscribers to keep prices low, and increases in costs which are largely outside of the control of the Society (postage will increase 20% in 1991, to cite an example). Alternative cost saving opportunities and alternative sources of support are being sought to compensate for the higher expenses.
Books. Included in this category are not only books (monographs or collections of articles) but review volumes and indexes to journals. Books, exclusive of the latter, continue to be financially sound, and selling prices of AMS books compare favorably with other mathematical books.

Review volumes and indexes have been very costly to produce, resulting in high prices. In 1988, indexes and review volumes together produced a small surplus. However, in 1989 and 1990 it became apparent that review volumes were no longer being purchased at the rate at which they once were. In spite of the fact that the prices of the review volumes have been kept artificially low, they have not sold well. As a result, it was necessary in both 1990 and 1989 to “write down” the Society’s inventory of these books to an amount more likely to be recovered from future sales. The effect of this accounting adjustment was an increase of expenses charged against review volumes and indexes amounting to approximately $98,000 and $121,500 respectively, including overhead and other indirect costs.

Dues, Membership Activities, and Membership Records. The Society has about 485 institutional members and 26,800 individual members. Of the latter, about 10,400 pay no dues because they are student nominees, emeritus members, or reviewers without convertible currency. Individual member dues are two-tiered to provide some relief to lower paid members. Increases in dues for individual members are set annually by a cost-of-living index.

Costs which can be considered to be partially covered by dues include the cost of maintaining membership records, the deficits of Abstracts, Bulletin, EIMS, Notices and the Professional Directory, deficits from meetings, including the Employment Register, deficits from MathSci, and the AMS support of the Joint Policy Board on Mathematics.

Meetings. Meetings has operated at an overall deficit, as a service to the mathematics community. The 1990 deficit was somewhat less than the 1989 deficit. In future years, the deficits should be even smaller, as a result of increases in registration fees.

Grants and Contracts. The amount of money available from the federal government has declined substantially over the years. Currently, support is mainly for travel and subsistence for participants in research conferences, institutes, and seminars, plus the Society’s cost in preparing and running these conferences. The money received from government agencies is reimbursement only, with no profit to the AMS. The Society also has contracts to perform services for other organizations, and this helps to recover some fixed costs.

Software Development Projects. The primary project included in this group is the development of a system for the management of order fulfillment, customer and membership databases, and related functions. The costs involved include personnel costs, computer usage charges and other indirect costs. This is intended to benefit all of the publications and membership related activities of the Society.

MR Database Development. This is another software development project. It is a rewrite of the MR database, which is used for the management of the information used in the preparation of Mathematical Reviews and related publications. Its cost also includes personnel costs, computer usage charges and other indirect costs.

Other Revenues and Expenses. The principal components of other revenues and expenses are MathSci (by far the single largest item), \TeX related products, and the AMS support of the Joint Policy Board on Mathematics.

IV. Assets and Liabilities

So far, this report has dealt with sources of revenue and applications of expense. Another aspect of the Society’s finances is what it owns and owes, or its assets and liabilities, which are reported above in the Summary Balance Sheet. The Society maintains its accounts in fund groups. The operating funds include membership and publications activities; the invested funds include both endowment funds (gifts and bequests whose principal is required to be invested in perpetuity and whose income must be used for the purpose stated by the donor) and quasi-endowment funds (those funds set aside by the Board of Trustees for designated purposes). Most of the quasi-endowment funds have been designated for future operations.

The Society’s fiscal year coincides with the period covered by subscriptions and dues. Since dues and subscriptions are generally received in advance, the Society reports a large balance of cash and temporary investments on its fiscal year-end, December 31. This amounted to about $4,148,000 in 1990 and $4,703,000 in 1989. The recorded liability for the revenues received in advance was about $8,600,000 and $8,520,000 on the same dates. The difference can be thought of as having been invested in the Society’s other assets. Effectively, the Society borrows from its subscribers to finance current operations. This is a common practice in the publishing industry and allows the Society to maintain a very low amount of bank debt, which was zero throughout 1990 and 1989.

The Society’s property and equipment include land, buildings and improvements, and office furniture, equipment and software. The Society also owns a small amount of transportation equipment. The land, buildings, and improvements include the Society’s headquarters building in Providence and the Mathematical Reviews offices in Ann Arbor. The largest part of the Society’s office equipment is its investment in computer facilities.
Update on Strategic Planning

AMS Strategic Planning Task Force members:
- Michael Artin, Massachusetts Institute of Technology
- Salah Baouendi, University of California at San Diego
- Lenore Blum, International Computer Science Institute
- William Browder, Princeton University
- Robert M. Fossum, University of Illinois, Urbana-Champaign
- Ramesh Gangolli, University of Washington
- Frederick W. Gehring, University of Michigan, Ann Arbor
- Ronald L. Graham, AT&T Bell Laboratories
- William H. Jaco, AMS
- Donald L. Kreider, Dartmouth College
- Jill P. Mesirov, Thinking Machines
- Franklin P. Peterson, Massachusetts Institute of Technology
- Hugo Rossi, University of Utah (Chair)
- Richard A. Tapia, Rice University
- William P. Thurston, Princeton University

April, 1991—The Society’s strategic planning process, begun late last year, is moving into its final stages, including a reevaluation of the Society’s mission statement and the formulation of a multi-year strategic plan. By the time this issue of Notices reaches its readers, the planning process will have been completed and the strategic plan will have been presented to the Executive Committee and Board of Trustees during their meeting in May of this year. Once the strategic plan is approved, the next step is developing an operating plan and designing evaluation mechanisms.

Two previous issues of Notices carried articles about the strategic planning process (“Strategic Planning for the Society,” January 1991, page 17, and “Future Directions,” March 1991, page 178). Since those articles appeared, a great deal of work has been done. The Strategic Planning Task Force has met three times for extensive discussions on issues underlying the planning process. A consulting firm has completed a resource audit of the Society and has provided assistance to structure the Task Force’s deliberations. In addition, the AMS was awarded a $25,000 grant from the Sloan Foundation to support the strategic planning process. This grant is in addition to the $25,000 awarded earlier this year by the Exxon Education Foundation.

First Steps

The Task Force met during the Joint Mathematics Meetings in San Francisco in January 1991. Part of the purpose of this half-day meeting was to orient the Task Force members to the systematic set of activities to be carried out as part of the strategic planning process. One of these activities is a reevaluation of the Society’s mission statement. A mission statement for an organization should incorporate a number of components: mandates, those functions the organization is required to provide; aspirations, idealized conceptions of what the organization hopes to be; constituents, the individuals and institutions the organization serves; and values, the principles and standards the organization strives to maintain and impart. The Task Force is reexamining the Society’s mission statement in light of these ideas.

The distinction between the mission and goals is an important one. The mission is captured in a broad, overarching statement that defines the Society’s reason for existence and that will guide the Society in its planning for decades to come. Goals are met by specific actions taken in pursuit of the mission during the lifetime of the strategic plan, which is typically three to five years.

Another crucial part of the strategic planning process is the resource audit, an intensive analysis not only of the operational health of the Society, but also of how well the Society is serving its constituencies and is adapting to change. During the San Francisco Meetings, key members of the mathematical community were interviewed in order to get their perspective on the Society’s goals and activities. In-depth questionnaires were sent to another 120 members and representatives of other constituencies, and a shorter survey form was sent to 1200 randomly-selected members. Also interviewed were key staff at the AMS headquarters in Providence and at the Mathematical Reviews office in Ann Arbor.

The interviews and survey provide a snapshot of how the Society is perceived within the membership. For example, most agreed that the publications and meetings were two of the Society’s most important activities. However, in other areas—such as mathematics education or public policy—there was either disagreement over the role of the AMS or confusion over whether the AMS ought to be involved. The information gathered in the resource audit was developed into a set of eight “strategic issues” the Society must address.

March Meeting

In a meeting held on March 9, 1991 at the AMS headquarters in Providence, the Task Force continued to build consensus on a mission statement for the Society and discussed the findings of the resource audit. The strategic issues defined during the audit helped to focus the discussion:

- The Mission of the AMS. Many AMS voluntary leaders, general members, and staff believe the Society's mission statement needs to be reexamined. The current mission statement does not serve to guide the organization in its role definition and decision-making. The AMS mission statement reads: “The particular business and objects of the Society are the furtherance of the interests of mathematical scholarship and research” (Certificate of Incorporation of AMS, 1923).

The Task Force agreed that the Society’s mission statement must be reformulated. They felt the mandates should be centered on mathematical knowledge: creating and studying it, teaching it, conveying it to other sciences, and promoting its appreciation among the general public. In addition, they felt that the Society’s mission must also address the health of the profession, including increasing the participation of traditionally underrepresented groups.
The discussion also produced a list of values, such as open and exploratory scientific inquiry, quality and excellence in research and teaching, interactions with colleagues, and applications of mathematics. In addition, the Task Force examined the various constituencies the Society serves. Since the time of that meeting, the Task Force has built on these ideas to generate successive drafts of a mission statement, in an attempt to come to a consensus on a final version.

- **AMS Publications, Meetings, and Membership.** There is widespread agreement that publications, meetings, and membership are the three most important and visible AMS programs. These programs are considered to be central to the Society's mission. There is general consensus that publications, meetings, and membership should continue to be core AMS programs in the future. There are, however, strategic—as well as operational—issues that need to be addressed regarding the future of these programs and their relationship to other current and potential AMS programs.

The Task Force wondered how aggressive the AMS publications program should be, in light of the Society's status as a non-profit organization. In addition, they felt the Society must position itself to respond to changing patterns in publishing and library acquisitions, as well as the development of new publishing technologies. On the subject of meetings, the Task Force noted that AMS meetings are formulated on the basis of scientific objectives and often run deficits. Can the Society achieve a better balance between scientific objectives and fiscal constraints? The Task Force felt that some AMS member services were not well known to the membership. In addition, they discussed the paradoxical situation of a membership that feels left out of governance but does not respond to calls for volunteers. They concluded that the Society needs to develop new ways of encouraging member participation in its activities.

- **Other AMS Programs and Services.** Beyond meetings, publications, and membership programs, there is no shared vision regarding which additional AMS programs should be offered and how these programs—both individually and collectively—might address the many challenges facing mathematics and the mathematics profession.

The Task Force focused on the question of the Society’s role in public policy. The most important mechanisms in this area have been the AMS presidency, the AMS Science Policy Committee, and the Joint Policy Board for Mathematics. Most members believe the Society should be involved in public policy, but there is disagreement over exactly what form the involvement should take.

- **External Challenges Facing the AMS and the Mathematics Community.** The major external challenges facing the AMS and the mathematics community over at least the next decade are widely recognized and acknowledged by the AMS voluntary leadership and others in the mathematical community. The appropriate role for the AMS in responding to these issues is subject to debate. The major external issues, not in priority order, include: 1) Mathematics education curricular reform at all levels; 2) The renewal of the profession by ensuring sufficient and qualified enrollments in mathematics at the collegiate and graduate levels; 3) National public policy development in support of the sciences generally and mathematics specifically; and 4) The lack of a positive image of mathematics and mathematicians in the broader social context.

How mathematics fits into the national agenda is not well articulated, the Task Force felt, nor has the mathematical sciences community satisfactorily explained the role of individual scientific inquiry in that agenda. Once these questions are answered, the role of the mathematical researcher in educational issues should become clearer. The newly-formed AMS Committee on Education will provide direction to the Society in these matters.

- **Vitality of the Mathematics Profession.** Maintaining the vitality of the mathematics profession is a major external challenge facing the AMS. Many interviewees and members of the Strategic Planning Task Force believe that the Society needs to elevate this issue and play a lead role in its many aspects.

There is widespread agreement that the vitality of the mathematics profession is inextricably linked to mathematics education at all levels, as well as to the public image of mathematics and national science and education policies. The Task Force noted the importance of “pipeline” issues, of improving the participation of underrepresented groups, and of attracting more American students to graduate programs in mathematics. They also felt that the AMS should do more to recognize and support programs that are addressing these problems and should provide leadership in renewing the profession.

- **Fragmentation of the Mathematics Community.** Fragmentation of the mathematics community generally complicates the definition of the AMS’s role in the resolution of issues confronting the profession. Additionally, the image of the AMS in the broader mathematics community is a barrier to productive working relationships.

The Task Force felt that the mathematical community is fragmented by distinctions such as “researcher” versus “educator,” or “pure” versus “applied” mathematician. Noting that such labels often lead to artificial controversies and create barriers to collaboration, the Task Force sought to remove such barriers by emphasizing the ways in which different aspects of the profession overlap and depend upon each other. In addition, they noted that the Society is often perceived as elitist. By confronting and eliminating this perception, the AMS can help to move the entire mathematical community in more positive and cooperative directions.

- **Membership, Voluntary Leadership, and Governance.** The AMS does not effectively and efficiently use its available voluntary leadership nor does it have in place an effective strategy to extend opportunities to the broader membership to become voluntary leaders and enhance their participation in and commitment to the AMS.

The way Society leadership is selected and the role of the various governing bodies need to be clarified, in order to encourage participation in Society affairs by a broader
segment of the membership. The Task Force recognizes the importance of finding ways to enlarge and broaden the pool from which the Society’s leadership comes. In addition, they noted that if the AMS committee structure were streamlined and clarified, the Council could more effectively delegate unresolved issues.

- **Internal Management of the AMS.** The internal management of AMS operations does not effectively and efficiently utilize resources available.

  The Task Force concluded that, while the AMS has a very dedicated staff, the various divisions of the Providence office need to be better integrated internally and more closely connected to Society leadership. One of the Task Force’s key roles is to articulate the goals and directions of the Society so that they can be readily translated by management into well-coordinated action and so that the effectiveness of these actions can be assessed.

  The meeting concluded with a look at the strengths of the AMS: membership, prestige, dedication of the staff, sound financial basis, quality of publications, international scope, and so on. The Task Force noted that the strategic planning process presented excellent opportunities for the Society to affect change in a number of important areas, including public awareness, mathematics education reform, and recruitment into the profession from non-traditional talent pools.

  During the AMS Sectional Meeting at the University of South Florida in March 1991, the Committee on Science Policy, the Committee on Education, and the Council received progress reports on the strategic planning process. The two committees passed resolutions containing recommendations for the Task Force as it proceeds with its work. The resolutions of both committees asked the Task Force to recommend a draft of the mission statement and flesh out the details of the strategic plan. The final document will be presented to the Executive Committee and Board of Trustees during its meeting in Washington, DC in May 1991.

  **Allyn Jackson**
  Staff Writer

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**e-MATH**

A new version of the e-MATH system was installed on March 31. New features include a command-driven Combined Membership List (CML) name look-up; a newly updated on-line CML database which features changes to member information submitted since November; and an option that submits suggestions or problems concerning e-MATH directly to e-MATH Support.

**Services**

The following services are currently provided by e-MATH:

- A searchable, on-line CML database.
- An option that allows users to report changes to information in the CML and regular updates of the on-line database.
- A professional register for employment and postdoctoral opportunities permitting users to submit resumes or browse available positions (see next page).
- An option that allows employers to register employment or postdoctoral positions in the AMS’s Employment Information in the Mathematical Sciences in conjunction with e-MATH (see next page).
- A repository for AMS-supported TeX software that is available via anonymous FTP.
- An option that allows users to list or request the Mathematical Reviews Classification Scheme.
- An option that allows users to request copies of mathematical publications through the AMS’s document delivery service (MathDoc).

**Command-driven e-MATH Service**

e-MATH now offers a command-driven name look-up for CML searches. This service is designed to provide VM/CMS and MVS sites that support telnet capability with some access to e-MATH services, as well as to provide an accelerated look-up option. To use the service, type:

```
telnet e-math.ams.com 2050
```

(Note: the Internet address 130.44.1.100 may be used instead of the host name e-math.ams.com.) At the prompt:

```
Enter Name (blank line to quit):

Last:First
```

Note that there are no spaces around the `:`. The search wildcard `*` may be used in the name string.

If your host operating system supports an alias function, the telnet command can be assigned a name (e.g., cml, lookup, get) to minimize what you need to remember and to minimize keystrokes.
Accessing e-MATH

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

- A connection to an INTERNET host.
- VT100 connectivity in communications software and host operating system.
- Terminal tabs set at every eight columns.

Help screens are available for each e-MATH application. For additional assistance, electronic mail can be sent to support@e-math.ams.com.

Employment Information in the Mathematical Sciences on e-MATH

e-MATH now offers convenient electronic access to the AMS’s Employment Information in the Mathematical Sciences (EIMS) for both job seekers and employers. Employment information is found under the Professional Opportunities option on the e-MATH main menu. There is a provision for postdoctoral as well as regular positions.

For job applicants, e-MATH offers:

- electronic access to positions listed in the current EIMS publication. Positions can be browsed online, or the entire list can be e-mailed.
- electronic posting of brief resumes that facilitate initial contact (but do not replace formal application procedures). Brief resumes are forwarded electronically to contact people listed for positions provided an e-mail address for contact is listed.

For employers, e-MATH offers:

- immediate visibility for position postings, especially useful for late-approval positions.
- immediate access to a nationally-based applicant pool, especially useful when a position must be filled quickly or on short notice.
- electronic means for submitting postings to EIMS for publication.

To access e-MATH:

telnet e-math.ams.com or telnet 130.44.1.100. Login and password are e-math.

New Mathematics Centre in Nigeria

The “National Mathematics Centre” has been established in Abuja, the newly built capital of Nigeria. The director is Professor James Ezeilo who is hoping to host short term visitors. Meanwhile, he has asked the AMS for help in soliciting donations of journals and monographs for the library of the Centre.

Donations should be of a caliber appropriate to a mathematics center. In order to avoid excessive duplication, individuals interested in donating books and journals should send a list of their materials to the undersigned at

Department of Mathematics
Pennsylvania State University
University Park, PA 16802.

He will coordinate the donations and inform donors which books and journals are appropriate. At that time, he will provide further information regarding where to send the materials in the United States and how to obtain a receipt for the donation, which qualifies as a charitable contribution.

Dr. Barbara Ricks, of Books for the World, has kindly agreed to pay for the shipping of the materials from the U.S. to the Centre.

Raymond Ayoub, Chair
AMS Committee on Service to Mathematicians in Developing Countries
This month's column is written by Lisa A. Thompson, who is the Assistant for Governmental Affairs of the Joint Policy Board for Mathematics (JPBM).

Mathematical Sciences in the FY 1992 Budget
Trends in Federal Support for the Mathematical Sciences

Federal support for the mathematical sciences expanded significantly during the early and mid-1980's, and included the establishment of new mathematics programs at the Defense Advanced Research Projects Agency and the National Security Agency. Starting in about FY 1988, however, government-wide spending on mathematics reached something of a plateau, with little or no real annual growth since.

The burgeoning federal budget deficit and Gramm-Rudman-Hollings deficit caps are largely responsible for these lean years. Despite presidential proposals for healthy increases, spending plans for basic research typically suffer at the hands of the congressional budget process. Furthermore, basic research in support of defense, which accounts for more than one-third of federal support for mathematics, is declining in real terms, although Congress eased the decline in FY 1991, in part with earmarks. Budgets for the mathematical sciences are strongly correlated to the overall basic research budgets.

In the context of recommendations made by the National Research Council's Board on Mathematical Sciences, progress toward bringing federal support for mathematics into balance with support for other scientific disciplines of comparable size, while significant, falls short of demonstrated need. The rise in funding of the early and mid-1980's did contribute to much-needed growth in graduate research assistantships and postdoctoral fellowships.

On the brighter side, several multiagency research initiatives of national interest will provide new opportunities for the mathematical sciences. The High Performance Computing and Communications program is designed to extend U.S. leadership in all advanced areas of computing and networking and includes as a component expanding basic research and human resources in this field. The mathematics programs at the National Science Foundation (NSF) and Department of Energy are involved in this initiative. The Division of Mathematical Sciences at NSF has also begun a program to foster collaboration between mathematicians and geoscientists, as part of a government-wide focus on global change research. It is possible that for the immediate future such national initiatives in support of specific goals will be the only significant source of new funds for basic research in the traditional scientific disciplines.

Prospects for Future Support for Mathematics

In FY 1991, funding for the mathematical sciences will grow by a few percent above inflation. Spending by the Department of Defense (DOD), and especially the Universities Research Initiative (URI), accounts for all of this real growth.

The proposed FY 1992 budget for mathematics, and for basic research in general, follows the pattern of recent years (see table next page). Spending on civilian science, including the mathematical sciences programs at the National Science Foundation and the Department of Energy (DOE), is proposed to rise considerably over FY 1991 levels, while real reductions are planned for defense basic research, including the five DOD mathematics programs.

However, basic research at NSF and DOE, and thus their mathematical sciences programs, are highly susceptible to congressional budget cuts, especially during FY 1992 as real resources available for domestic discretionary spending shrink. Combined with the flat budgets planned for the DOD mathematics programs, prospects for federal support for mathematics indicate continued stagnation, although if Congress adds funds to DOD basic research accounts, as happened last year, some of the money could be channelled toward the mathematical sciences.

FY 1992 Proposals for Agency Mathematical Sciences Programs

The table shown on the next page gives budget figures for the mathematical sciences programs described on the next page, including estimates of FY 1991 spending and of proposed spending in FY 1992. The accuracy of these figures varies by agency, and the FY 1992 proposals are subject
to the congressional budget process to varying degrees. All figures shown in the chart and cited below are in terms of current dollars.

Each funding agency provides support for a variety of activities including individual and group awards, institutes, equipment, and special programs for women and minorities. Thus, the figures given are not for spending on mathematics research per se, but are funds spent or estimated to be spent by the federal mathematics programs on the various elements of the mathematical sciences enterprise.

<table>
<thead>
<tr>
<th>FEDERAL SUPPORT FOR THE MATHEMATICAL SCIENCES</th>
<th>FY 1989-1992, in millions, current dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>FY 89</td>
</tr>
<tr>
<td>Current budget percent change</td>
<td></td>
</tr>
<tr>
<td>National Science Foundation</td>
<td></td>
</tr>
<tr>
<td>DMS</td>
<td>66.02</td>
</tr>
<tr>
<td>Other</td>
<td>8.00</td>
</tr>
<tr>
<td>TOTAL, NSF</td>
<td>74.02</td>
</tr>
<tr>
<td>Department of Defense</td>
<td></td>
</tr>
<tr>
<td>AFOSR</td>
<td>16.45</td>
</tr>
<tr>
<td>ARO</td>
<td>11.50</td>
</tr>
<tr>
<td>ONR</td>
<td>12.02</td>
</tr>
<tr>
<td>DARPA</td>
<td>12.00</td>
</tr>
<tr>
<td>NSA</td>
<td>2.86</td>
</tr>
<tr>
<td>TOTAL, DOD</td>
<td>54.83</td>
</tr>
<tr>
<td>Department of Energy</td>
<td></td>
</tr>
<tr>
<td>University Support</td>
<td>5.70</td>
</tr>
<tr>
<td>National Laboratories</td>
<td>6.50</td>
</tr>
<tr>
<td>TOTAL, DOE</td>
<td>12.20</td>
</tr>
<tr>
<td>Other Agencies</td>
<td>1.00</td>
</tr>
<tr>
<td>TOTAL, Non-NSF</td>
<td>68.03</td>
</tr>
<tr>
<td>TOTAL, All Agencies</td>
<td>142.05</td>
</tr>
</tbody>
</table>

**National Science Foundation (NSF)**

The NSF Division of Mathematical Sciences (DMS) provides almost half of all federal support for the mathematical sciences, funding a spectrum of activities in mathematics research and infrastructure, human resource development, and the diffusion of mathematics into science and technology. Specifically, DMS supports individual investigators, research institutes, postdoctoral fellowships, research conferences, and undergraduate programs.

The mathematical sciences programs will grow by only 4.2 percent in FY 1991, due to the cuts Congress made in the proposed overall NSF research budget. DMS plans to spend $79.52 million in FY 1992, $7.5 million or 10.4 percent above the current plan for FY 1991. Much of the increment will be used to fund activities in support of a number of national initiatives, including increasing the number of new investigators as called for by the Board on Mathematical Sciences; the High Performance Computing and Communications program; and education and human resource development. DMS’s role in this last initiative includes funding graduate and undergraduate research as well as undergraduate curriculum development.

**Air Force Office of Scientific Research (AFOSR)**

Funding for mathematical sciences research in support of the Air Force mission is provided by the Mathematical and Information Sciences Directorate of AFOSR. Of an estimated $23 million to be spent by the directorate in FY 1992, approximately $17 million is planned for mathematical sciences, including Universities Research Initiative programs and roughly $1 million for Air Force laboratory research. This proposed funding level is the same as that for FY 1991.

**Army Research Office (ARO)**

The mathematical sciences program of the Army Research Office also expects a level budget for FY 1992. It will fund a number of new centers, including one or two in nonlinear analysis, stochastic analysis, and symbolic methods. The Universities Research Initiative will provide approximately $1.7 million for a center for foundations of intelligent systems. Funding for the Army High Performance Computing Research Center will continue.

**Office of Naval Research (ONR)**

The Mathematical Sciences Division of the Office of Naval Research funds mathematics research in support of the naval mission, with designated programs in the areas of applied analysis, discrete mathematics, numerical analysis, operations research, probability and statistics, and signal analysis. It maintains a core program and also funds accelerated research initiatives (ARI’s) as needed.

In FY 1991 the mathematics division plans to spend just over $8 million on the core programs and approximately $4.8 million on ARI’s. It also expects to spend roughly $1 million in Universities Research Initiative money. The FY 1992 budget calls for $9.3 million in core program funding, a 13.6 percent increase over FY 1991, and no growth in ARI funding, for a total of just over $14 million. The division does not expect to receive URI funding in FY 1992.
Defense Advanced Research Projects Agency (DARPA)
The Applied and Computational Mathematics program at DARPA is undertaken to support the agency's advanced technology development mission. DARPA funds mathematics research in four areas: modeling and simulation; algorithmic development; digital signal processing; and intelligent control. It should be noted that in this environment some of the research supported transcends the traditional boundary dividing the disciplines of mathematics on the one hand and computer science and engineering on the other.

The budget for FY 1992 calls for a more than 13 percent increase in the core program, to $12.57 million, and for a decrease in URI funding, to roughly $2.5 million.

National Security Agency (NSA)
The NSA Mathematical Sciences Program experienced its first substantial budget decrease since its inception in 1981. In FY 1990, the program expended a total of $3.4 million on grants in number theory, algebra, discrete mathematics, probability, statistics, and cryptology. The current spending plan for FY 1991 is $3.1 million, a decrease of 9 percent from the FY 1990 level.

Because so many new grants were funded with new money in FY 1990, the support for new grants in FY 1991 will be limited to about two-thirds of the FY 1990 funding level for new grants. Planned FY 1992 spending, $3 million, is slightly less than FY 1991 spending, but includes support for a larger number of new grants.

The Mathematical Sciences Program will begin 1992 with a new program, which will award grants in four categories: the Young Investigators Grant, the Standard Grant, the Senior Investigators Grant, and the Conferences and Special Situations Grant.

Department of Energy (DOE)
The Applied Mathematical Sciences program in the DOE Office of Energy Research is devoted to understanding models arising in DOE research and development programs and at providing supercomputing resources to DOE's researchers.

Growth in DOE's mathematical sciences program was halted in FY 1991 due to congressional action on the overall Office of Energy Research budget. The FY 1992 budget proposal calls for an 11.4 percent increase over the FY 1991 level. Much of this funding would be part of the High Performance Computing Initiative.

In addition, the Office of Energy Research scientific computing branch is proposing to spend $4 million in FY 1992 to facilitate the emergence of computational science, an applications driven discipline drawing from traditional scientific and engineering applications disciplines, computational mathematics, and computer science. The objective is to create a critical mass of computational scientists that can begin to tackle some of the fundamental problems in science and engineering using the advanced computing environments developed by the HPCC program.

Other Federal Agencies
Several agencies, including the National Aeronautics and Space Administration, the National Institutes of Health, and the National Institute of Standards and Technology support mathematical sciences programs, largely as an intramural activity. A rough estimate of $1 million for these programs can be made.

In recent years, there has been intense work in linear and nonlinear programming, much of it centered on understanding and extending the ideas underlying N. Karmarkar's interior-point linear programming algorithm, which was presented in 1984. This interdisciplinary research was the subject of an AMS Summer Research Conference on Mathematical Developments Arising from Linear Programming, held at Bowdoin College in the summer of 1988, which brought together researchers in mathematics, computer science, and operations research. This volume contains the proceedings from the conference.

Among the topics covered in this book are: completely integrable dynamical systems arising in optimization problems, Riemannian geometry and interior-point linear programming methods, concepts of approximate solution of linear programs, average case analysis of the simplex method, and recent results in convex polytopes. Some of the papers extend interior-point methods to quadratic programming, the linear complementarity problem, convex programming, multi-criteria optimization, and integer programming. Other papers study the continuous trajectories underlying interior-point methods. This book will be an excellent resource for those interested in the latest developments arising from Karman's linear programming algorithm and in path-following methods for solving differential equations.
News and Announcements

Lothar Collatz
1910–1990

Lothar Collatz, longtime director of the Institute of Applied Mathematics, the Mathematical Seminar, and the Computing Center of the University of Hamburg, died on September 26, 1990. He was born on July 6, 1910 in Arnsberg, Westfalia and studied mathematics and physics at the Universities of Greifswald, Munich, Göttingen, and Berlin. He earned his Ph.D. from the University of Berlin in 1935 and his Habilitation from the Technische Hochschule Karlsruhe in 1937.

Collatz made important contributions to differential equations, eigenvalue problems, approximation, and optimization, as well as to the numerical solution of problems in these areas. He had more than fifty Ph.D. students, and almost thirty students received their Habilitation under his direction.

Collatz’ many honors include election to a number of honorary societies in the sciences and honorary doctorates from universities all over the world. He received an honorary medal from the Bulgarian Academy of Sciences in 1985.

AMS Centennial Fellowships Awarded

The Society has awarded two Centennial Fellowships for 1991-1992. The recipients are Daniel Bump of Stanford University and Kari Vilonen of Brandeis University.

Daniel Bump

Daniel Bump received his Ph.D. in 1982 from the University of Chicago under Professor Walter Baily. He taught at the University of Texas at Austin and the University of Rochester before joining the faculty at Stanford University in 1986. He has also visited at the Institute for Advanced Study in Princeton, the Institute for Advanced Study at the Hebrew University of Jerusalem, and Sonderforschungsbereich 170 in Göttingen. In 1989 he became Associate Professor at Stanford. He intends to use the AMS Centennial Fellowship to teach half-time at Stanford for two years so as to concentrate on research.

His work has been in the area of automorphic forms. His particular interests are metaplectic forms and novel uses of the Rankin-Selberg method. He is fortunate to have had as collaborators Solomon Friedberg, David Ginzburg, Dorian Goldfeld, Jeffrey Hoffstein and Eugene K.-S. Ng. He is also pleased to acknowledge the influence of the work of Piatetski-Shapiro and Rallis on the Rankin-Selberg method and of Kazhdan and Patterson on metaplectic forms.

Kari Vilonen

Kari Vilonen received his Ph.D. in 1983 from Brown University under the direction of R. MacPherson. He was a Moore instructor at Massachusetts Institute of Technology from 1983 to 1986 spending the 1984-1985 academic year at the Mathematical Sciences Research Institute at Berkeley. From 1986 to 1989 he was a Benjamin Pierce assistant professor at Harvard University. He is currently an assistant professor at Brandeis University.

Professor Vilonen’s research interests include topology and representation theory.

Information about the competition for the 1992-1993 AMS Centennial
Guggenheim Fellowships Awarded

The John Simon Guggenheim Memorial Foundation has announced awards to 143 artists, scholars, and scientists in its sixty-seventh annual competition. The awards, gleaned from 3092 applications, were made on the basis of unusually distinguished past achievement and exceptional promise for future accomplishment. A total of $3,790,000 will be awarded this year.

There were seven mathematical scientists among the awardees this year. Their names, affiliations, and areas of research are: RICHARD M. DUDLEY, Massachusetts Institute of Technology, empirical processes and nonlinear functionals; BJORN ENQUIST, University of California at Los Angeles, numerical methods for nonlinear partial differential equations; HARUZO HIDA, University of California at Los Angeles, studies in number theory; ARTHUR JAFFE, Harvard University, quantum fields and geometry in infinite dimensions; DEXTER C. KOZEN, Cornell University, completeness of the propositional μ-calculus; ANDREW CHI-CHIH YAO, Princeton University, Boolean circuits and communication complexity; DAVID D. YAO, Columbia University, the algebraic structure of discrete event systems.

Douglas Arnold Receives Sacchi Landriani Prize

Douglas Arnold of Pennsylvania State University has been awarded the first International Giovanni Sacchi Landriani Prize of 10 million Italian Lire. The prize recognizes important original contributions in the field of numerical methods for partial differential equations. Administered by the Instituto Lombardo, Accademia di Scienze e Lettere in Milan, the prize was presented at a ceremony celebrating the inauguration of the 188th year of the Academy. The ceremony took place on February 28, 1991 in the Napoleonic Salon of the Brera Palace in Milan.

Arnold’s major research interests are numerical analysis, partial differential equations, mechanics, and the interplay among these fields. The major goal of this work is to use rigorous mathematical analysis to contribute significantly to the improvement and understanding of the algorithms actually used to solve mechanical problems. In recent years, his principal effort has focused on plate models. His other areas of research are mixed finite element methods, boundary element methods, and the modeling of mechanical constraints.

Arnold received his Ph.D. from the University of Chicago in 1979. He went to the University of Maryland as an assistant professor and attained the rank of professor in 1989. Since then, he has been a professor at Pennsylvania State University. He is author or co-author of about thirty publications in numerical analysis and partial differential equations. He is editor of the SIAM Journal of Numerical Analysis and is on the Editorial Advisory Board for Computational Mechanics.

The prize honors the memory of Giovanni Sacchi Landriani, a researcher at the University of Pavia who made important contributions in the areas of numerical methods for the Navier-Stokes equations, spectral methods, and domain decomposition methods. Sacchi Landriani died in 1989 at the age of thirty-one.

Colliot-Thélène Wins Fermat Prize

Jean-Louis Colliot-Thélène, director of research at the Centre National de Recherche Scientifique (CNRS), has received the 1991 Fermat Prize for Research in Mathematics. Colliot-Thélène received the award for “his work on the arithmetic of rational varieties, research conducted for the most part jointly with J.-J. Sansuc.”

Colliot-Thélène completed his thèse de doctorat d'Etat ès-sciences in 1978, with a jury consisting of M. Artin, C. Houzel, A. Néron (director), M. Raynaud, J.-P. Serre, and P. Swinnerton-Dyer. He has been with CNRS since 1970 and became director of research in 1984. He has held visiting positions at Cambridge University (1982), the University of California at Berkeley (1990), and Harvard University (1991). He received the Albert Châtelet Medal in 1980, was awarded the Prix de l’Académie des Sciences (Charles-Louis de Saules de Frecyinet) in 1985, and presented a 45-minute invited address at the International Congress of Mathematicians in Berkeley in 1986.

Noam Elkies Wins NAS Prize

Noam Elkies of Harvard University has received the National Academy of Sciences Award for Initiatives in Research. The $15,000 prize recognizes Elkies’ “distinguished research on number theory, particularly his proof that every elliptic curve over the rational numbers has an infinite number of primes of supersingular reduction and his construction of dense sphere packings in Euclidean space using Mordell-Weil lattices.”

The prize, established in 1980 by AT&T Bell Laboratories in honor of William O. Baker, is awarded annually in various fields to recognize innovative young scientists and to encourage research likely to lead toward new capabilities for human benefit. The field for 1991 was mathematics.

Kemeny Receives Robinson Award

JOHN G. KEMENY, professor of mathematics and president emeritus of Dartmouth College, received EDUCOM’s first annual Louis Robinson Award. The award, which includes $25,000 in cash and $25,000 in IBM equipment and software, was created to stimulate and recognize advances in using information technology to improve teaching and learning.

The citation for Kemeny commends him “for a lifetime of innovative achievement and leadership in putting the computer at the service of teachers and students in higher education.” Kemeny developed distributed timesharing computing at Dartmouth in the early 1960s and developed the programming language BASIC. He served as chair of the U.S. National Committee on Mathematics Instruction (1958-1960) and received the Priestley Award (1976) and the Education Award of the American Mathematical Society.

The Louis Robinson Award is funded by IBM and is administered by EDUCOM, a non-profit consortium of colleges, universities, and other institutions dedicated to promoting the use of computing and communications technology in higher education. The award honors the late Louis Robinson, who served as IBM’s director of university relations and advocated computer technology applications to education.

Ivars Peterson
Wins Communications Award

Ivars Peterson will receive the Joint Policy Board for Mathematics (JPBM) Communications Award on July 10, 1991 in Washington, DC, during a ceremony held in conjunction with the Second International Conference on Industrial and Applied Mathematics. The $1000 award recognizes Peterson’s exceptional skill in communicating mathematics to the general public over the last decade.

Peterson is the mathematics and physics editor of Science News. His 1988 book, The Mathematical Tourist: Snapshots of Modern Mathematics, has sold over 70,000 copies and will soon be available in several foreign languages. His latest book, Islands of Truth: A Mathematical Mystery Cruise, was published last year. Peterson has bachelor’s degrees in physics, chemistry, and education from the University of Toronto. He taught high school mathematics and science for eight years and during that period produced a monthly newsletter, “Photon: Physics for Fun.”

The two previous recipients of the JPBM Communications Award are James Gleick, author of Chaos: Making a New Science, and the playwright Hugh Whitemore, author of Breaking the Code.

Elections to the Academy of Engineering

The National Academy of Engineering has announced the election of seventy-seven new members and seven foreign associates. Among those elected who may be of interest to Notices readers are: Roger W. Brockett, Harvard University; Rudolf E. Kalman, University of Florida, Gainesville; David J. Kuck, Center for Computer Research Development, University of Illinois at Urbana-Champaign; Leslie Lamport, Digital Equipment Corporation; John L. Lumley, Cornell University; Thomas L. Magnanti, Massachusetts Institute of Technology; James L. Massey, Swiss Federal Technical University, Zurich; Earll M. Murman, Massachusetts Institute of Technology; W. Harmon Ray, University of Wisconsin. Helmut E. Sobieczky, German Aerospace Research Establishment, Goettingen, was elected a foreign associate.

Awards for Undergraduate Papers

Five undergraduates have won AMS awards recognizing excellent student papers. Each AMS Award for an Outstanding Pi Mu Epsilon Student Paper Presentation commends a paper presented at the 1990 summer meeting of Pi Mu Epsilon, held during the Joint Mathematics Meetings in Columbus, Ohio in August 1990. This is the second year that the AMS has provided funds for awards for student presentations.

The winning students are: Anna Fiehler, Miami University; Francis Fung, Kansas State University; Lisa Hansen, Western Michigan University; Richard Kinkela, Youngstown State University; and Chikako Mese, University of Dayton.

Winners in the Mathematical Contest in Modeling

Six student teams have received awards for their outstanding solutions in the Mathematical Contest in Modeling (MCM), which gives students the opportunity to challenge their skill in solving real-world modeling problems. The winning solutions were chosen from a total of 260 entries, including a number from foreign countries such as the People’s Republic of China and Mexico.

Each three-student team had a three-day weekend to produce an analysis of one of two modeling problems, using only inanimate resources. The first problem concerned a city water tank. The level of the tank changes throughout the day, and a pump automatically goes on when the water drops below a certain level. Given data on the water level at various times and on when the pump goes on, the problem is to determine the flow out of the tank and the amount of water used in one day. The second problem concerned minimal spanning trees for a communications network. Given rectangular coordinates for nine stations on a communications network, the problem is to design a minimum-cost spanning tree for the network, using only rectilinear lines, and to generalize the problem.

For the water tank problem, the solutions of three student teams were judged Outstanding. The students, their advisors, and institutions are: Scott Briercheck, Bernard McCoy, Wayne Pavalko, Advisor: J. R. Case, Hiram College, Ohio; Lieke Daley, Dirk Helgemo, John Kenny, Advisor: R. J. Praga, Ripon College, Wisconsin; Anna T. Baumgartner, Anupama M. N. Rao, Eiluned A. Roberts, Advisor: R. A. Hollister, University of Alaska, Fairbanks.

For the Steiner trees problem, the solutions of three teams were judged Outstanding. The students, their advisors, and institutions are: Timothy McGrath, Monica Menzies, Christopher Smith, Advisor: P. D. Straffin, Beloit College, Wisconsin; Patrick J. Melody, Hall L. Moore, Mary M. Wood, Advisors: J. August and F. Portier, Mount St. Mary’s College, Maryland; Zvi Margaliot, Alex Pruess, Patrick Surry, Advisor: H. Rasmussen, University of Western Ontario.

Two of the sponsors of the MCM, the Society for Industrial and Applied Mathematics and the Operations Research Society of America, each choose a team from those judged outstanding and provide expenses for the teams to attend the societies’ meetings. Those interested in more information on the next MCM can contact the director of the MCM, Ben Fusaro, Department of Mathematics, Salisbury State University, Salisbury, MD 21801.
Top Westinghouse Prize for Mathematics Project

ASHLEY M. REITER, a senior at the North Carolina School of Science and Mathematics in Durham, captured the top prize in the Westinghouse Science Talent Search with a mathematics project on fractal geometry. The Science Talent Search (STS), begun in 1942, is administered by Science Service, a non-profit organization. One of the most prestigious science competitions in the nation, the STS drew over 1500 entries competing for a total of $205,000 in scholarship funds.

As an intern at the San Diego Supercomputer Center, Reiter developed her own programming and numerical methods to carry out computer simulations to determine the dimension of fractals generated by Pascal’s triangle. She will receive a $40,000 scholarship and plans to continue her studies in mathematics at Rice University.

Two others among the top ten prizewinners submitted projects in mathematics. The fourth-place winner of a $15,000 scholarship is DEAN CHUNG, a student at Mountain Lakes High School in New Jersey. He selected a project in combinatorial geometry in which he investigated “graceful” and “non-graceful” geometric configurations. The ninth-place winner, JIM WAY CHEUNG, a student at the Bronx High School of Science in New York, received a $10,000 scholarship for a project on continued fractions over the Eisenstein integers.

The winners were selected by a panel of eight scientists following interviews designed to evaluate the students’ scientific creativity and potential. The awards banquet, attended by 1200 people, featured President Bush as a speaker. Of the 2000 finalists in the STS since its inception, five have won Nobel Prizes and two—David Mumford of Harvard University and Paul J. Cohen of Stanford University—have won Fields Medals. Many have been elected to the National Academy of Sciences and the National Academy of Engineering.

“Futures” Television Series Wins Award

The television series “Futures,” featuring mathematics teacher Jaime Escalante, was selected as one of the winners of the 1990 Peabody Awards for outstanding television and radio programs. Produced by the Public Broadcasting Service and aimed at children, “Futures” highlights the importance of mathematics in daily life in an exciting and motivational format.

The series uses guest celebrities, famous athletes, and leaders from mathematics and science to communicate the message that preparation for life in the twenty-first century includes mastery of mathematics. “Futures” is funded by the U.S. Department of Energy, ARCO, IBM Corporation, and the Carnegie Corporation of New York. Twenty-six Peabody Awards were chosen from a total of 702 entries.

Downturn in Academic Job Market

The period of steady improvement in the academic job market which characterized the decade of the eighties appears to have come to an end. Anecdotal reports abound of the difficulties being currently experienced by those seeking jobs within the academic job market, especially new Ph.D.s. A panel discussion on the current academic job market at the San Francisco Joint Mathematics Meeting held in January, sponsored by the AMS-MAA Committee on Employment and Educational Policy, generally confirmed the already growing concern for those seeking employment during the current recruitment season. The April issue of Notices (pages 296-297) contains an article by panel member D. J. Lewis which grew out of his presentation at this panel. In spite of the current downturn in employment opportunities, no doubt exacerbated by the current economic recession in the U.S., the long-term outlook for employment opportunities within the mathematical sciences is considered positive.

The AMS is undertaking steps to gain further insight into the nature of the problem and to lead efforts by the mathematical sciences community to address the problem. The AMS-MAA Data Committee has undertaken a quick survey of leading doctorate-producing mathematics departments in an effort to gain a more complete picture of the employment outlook for new doctorates currently seeking employment. Another step already taken by the AMS is the implementation within the Society’s bulletin board—e-MATH—of an electronic employment register listing open positions and short resumes of those seeking employment. The Society’s long-standing publication on available positions, Employment Information in the Mathematical Sciences (EIMS), is currently being linked with the e-MATH listing of open positions. (For more information on this electronic employment service see page 435 of this issue.)

Upcoming issues of Notices will contain reports on the progress of efforts by the AMS to address aspects of the current employment problem.

MS2000 Releases Report

The Committee on the Mathematical Sciences in the Year 2000 of the National Research Council has released a major report, Moving Beyond Myths: Revitalizing Undergraduate Mathematics. The report presents an action plan to address such issues as improving undergraduate mathematics education, developing the mathematical potential of underrepresented groups, involving mathematicians in school mathematics, and broadening the rewards structure.
in the mathematical community to include teaching and scholarship as well as research.

The full report, which will appear in the July/August issue of Notices, may be ordered from National Academy Press, 2101 Constitution Avenue, NW, Washington, DC 20418: telephone 1-800-624-6242 or 202-334-3313. The cost of the report is $7.95 (prepaid) plus shipping.

Reports Released on Professional Teaching Standards
In March 1991, the National Council of Teachers of Mathematics (NCTM), the Mathematical Association of America (MAA), and the Mathematical Sciences Education Board (MSEB) released coordinated reports focusing on professional standards for teachers of mathematics. The reports make recommendations for the education, training, and evaluation of present and prospective teachers of school mathematics.

The NCTM report, Professional Standards for Teaching Mathematics, is a companion to an earlier NCTM document, Curriculum and Evaluation Standards for School Mathematics, which appeared two years ago. The curriculum standards recommended sweeping changes in what is taught in mathematics classrooms, while the new report demonstrates how those changes can be implemented by teachers and college faculty.

The NCTM report presents fifty-five vignettes depicting outstanding mathematics teaching and sets forth twenty-four standards outlining the support, training, and evaluation required to ensure good teaching. The report urges teachers to emphasize group learning, the development of mathematical reasoning instead of memorization of formulas, the use of conjecturing and problem-solving, and the connection of mathematics to applications. The report also recommends substantive changes in teacher evaluation, proposing long-term, cyclical assessments that measure the quality of the learning environment. Teachers are to be an integral part of the assessment system.

A Call for Change: Recommendations for the Mathematical Preparation of Teachers of Mathematics, from the MAA, presents recommendations for college mathematics and for teachers education. The basic tenet of the report is that the college classroom should be an environment in which future teachers experience and internalize effective instructional models. The report presents standards for mathematics teachers at all levels, as well as standards for teachers of various grade levels.

Counting on You: Actions Supporting Mathematics Teaching Standards, prepared by the MSEB, is aimed at a broad base of constituencies having an interest in improving mathematics education. Counting on You explains the need for reform in mathematics education and stresses that teacher professionalism is the key to success in mathematics education reform.

Copies of the NCTM report are available for $25 each, with discounts for multiple copies. For more information, contact: National Council of Teachers of Mathematics, 1906 Association Drive, Reston, VA 22091; telephone 800-235-7566 or 703-620-9840.

Copies of the MAA report are $7 each from: Mathematical Association of America, 1529 Eighteenth Street, NW, Washington, DC 20036; telephone 202-387-5200. The MSEB report is $2.95, with discounts for multiple quantities. Contact: Mathematical Sciences Education Board, TPROF, 818 Connecticut Avenue, NW, Suite 500, Washington, DC 20006; telephone 202-334-3294.

News from the Mathematical Sciences Institute
Cornell University
Under the terms of a new agreement with the U.S. Army Research Office, the Mathematical Sciences Institute (MSI) at Cornell University is being restructured to include three Centers of Excellence. These will include the MSI Center for Symbolic Methods in Algorithmic Mathematics under the direction of M. Sweedler of Cornell University, the MSI Center for Stochastic Analysis under the direction of R. Durrett of Cornell University, and the MSI/Stony Brook Center for the Mathematics of Nonlinear Systems under the direction of J. Glimm of SUNY, Stony Brook. In addition, MSI, in a joint effort with ORA, will undertake a major new effort in Hybrid Systems funded by DARPA. A. Nerode of Cornell continues at MSI as Institute Director.

The MSI Center for Symbolic Methods in Algorithmic Mathematics will develop subjects, methods, algorithms, models, software, and science and engineering applications for symbolic computation and algorithmic mathematics. O. Moreno of EPSCoR, University of Puerto Rico will coordinate minority research programs. Joint programs with the Claremont College Mathematics Clinics program, under the direction of S. Busenberg, are being planned. The Center Advisory Panel includes J. Davenport (Univ. of Bath), J. Marsden (U.C. Berkeley), A.M. Odlyzko (Bell Labs. and AT&T), D.S. Scott (Carnegie-Mellon Univ.), and S. Winograd (IBM Research).

The MSI Center for Stochastic Analysis will develop and apply ideas of probability to a wide variety of fields: chemistry, physics (statistical mechanics, field theory, quantum mechanics), biology (ecology, genetics), economics, finance, computer and communication networks, and to mathematics itself. The Center Advisory Panel will include D. Aldous (U.C. Berkeley), T.G. Kurtz (Univ. of Wisconsin), and D. Stroock (M.I.T.).

The MSI/Stony Brook Center for the Mathematics of Non-linear Systems will conduct research on nonlinear differential equations used to describe complex nonlinear systems and materials. The principal institutional participants are Cornell University and SUNY Stony Brook. Other participants are Los Alamos National Laboratories, the University of Rochester, and Syracuse University. Minority research participants are from the EPSCoR program of the University of Puerto Rico, CUNY at New York, and the New Jersey Institute of Technology. There are also outreach programs for government and industry, and cooperative research projects with Army laboratory scientists.

An Institute-wide advisory committee will consist of one member from the advisory panel of each Center and
News from the Mathematical Sciences Research Institute

Berkeley, California

Three special events will be sponsored by the Mathematical Sciences Research Institute (MSRI) during May and June:

**May 6 – 8, 1991.** As part of the special half-year program on Strings in Mathematics and Physics, there will be a Workshop on Mirror Symmetry organized by P. Candelas and S.-T. Yau. The existence of “mirror pairs” of Calabi-Yau manifolds is one of the striking discoveries arising out of string theory and appearing quite mysterious from the point of view of classical algebraic geometry. The string-theoretic approach yields very specific information, such as the number of rational curves of each degree on certain algebraic varieties. For example, for degree 3, on the quintic threefold, the number comes out to 317, 206, 375. The workshop will explore these and related results coming from mirror symmetry.

**May 11 – 12, 1991.** MSRI is sponsoring a meeting in honor of Tosio Kato, held in 60 Evans Hall on the U.C. Berkeley campus. Invited speakers include S. Agmon, H. Brezis, C. Foias, P. Lax, R. Phillips, G. Ponce, I. Sigal, B. Simon, and W. Strauss.


In July, MSRI will hold its second special program for graduate students from sponsoring institutions. The topic this year will be “4-Manifolds”, with lectures by R. Kirby of U.C. Berkeley and R. Stern of U.C. Irvine. The program will run from July 8 to July 19, 1991.

A number of workshops have been scheduled for the academic year 1991-1992 in conjunction with the two year-long programs: “Statistics”, and “Lie Groups and Ergodic Theory with Applications to Number Theory and Geometry”. They are:


The Statistics program will be divided into three subprograms. The first two will run from September 3, 1991 through January 1992. They are “Empirical processes and applications” and “Semiparametric models and survival analysis”. The third, “Resampling and other computer intensive methods” will run from February through June 1992.

The period July 6 – August 14, 1992 will be devoted to a summer program in Mathematical Biology.

For preliminary information on the 1992-1993 programs please consult the advertisements elsewhere in this issue.

Staff Changes at the National Academy

Kenneth M. Hoffman, formerly executive director of the Mathematical Sciences Education Board (MSEB) of the National Research Council (NRC), has assumed the newly-created position of NRC Associate Executive Officer for Education. Ray C. Shiflett, who served as the MSEB’s associate executive director since September 1990, has been named executive director of the MSEB.

In his new position, Hoffman will oversee the NRC Coordinating Council for Education. Currently, there are many programs and activities addressing education and human resource issues throughout the NRC. To provide a focus for these programs, the NRC
has created the 13-member Council to advise the NRC on mathematics and science education, facilitate cooperation and interaction among the various NRC educational activities, and develop an overarching mission, strategy, and infrastructure for NRC educational activities and policies.

Before becoming Executive Director of MSEB in September 1989, Hoffman served as the Director of Governmental and Public Affairs for the Joint Policy Board for Mathematics. He is on the faculty at the Massachusetts Institute of Technology, where he served as head of the mathematics department from 1971 to 1979.

In taking the position of Executive Director of MSEB, Shiflett will oversee a wide array of programs to promote excellence in education in the mathematical sciences. The 40-member Board includes classroom teachers, mathematics supervisors and administrators, members of school boards and parent organizations, college and university mathematicians, and representatives from business and industry. The purpose of the Board is to provide a continuing national assessment capability for mathematics education. Shiflett is professor of mathematics at California State Polytechnic University in Pomona, where he served as dean of the College of Science from 1984 to 1990. His work in developing programs that increase the graduation rates of underrepresented minority students has received national recognition.

Staff Changes at NSA
In July 1991, Charles Osgood, a mathematician with the National Security Agency (NSA), will succeed Marvin Wunderlich as manager of NSA’s Mathematical Sciences Program, which awards research grants in the mathematical sciences.

Richard Shaker, former mathematics adviser to the chief scientist of NSA, has been named chief of mathematics research. Shaker’s successor is George Alberts.

Errata
National Science Foundation
A list of the staff of the Division of Mathematical Sciences of the National Science Foundation appeared in the September 1990 and the March 1991 issue of Notices, pages 883 and 199, respectively. The correct spelling of the name of the program director for Geometric Analysis is Robert Molzon. His electronic mail address is rmolzon@nsf.gov (Internet) or rmolzon@nsf (Bitnet).

National Medals of Science
In the article on the National Medals of Science in the April 1991 issue of Notices, the name of the author of the commentary on Patrick Suppes’ research in the use of interactive programs for instruction was given incorrectly. That portion of the article was written by Woodrow W. Bledsoe of the University of Texas at Austin.

The Notices staff regrets these errors.
Dear Colleague:

Funding Information for the Mathematical Sciences

Changes in Curriculum Development Program Deadlines
The deadline for proposals to the Calculus Curriculum Development program of the National Science Foundation will be moved from the usual early February date. Although the deadline had not been finalized at the time of this writing, it could be as early as October 4, 1991 for awards to be made in fiscal year 1992. The new program announcement is expected to be available in early summer.

A second program for Curriculum and Course Development in Engineering, Mathematics, and the Sciences supports activities to improve introductory-level courses, such as precalculus, discrete mathematics, geometry, and statistics, as well as general courses for non-majors. This program does not support courses in the calculus sequence, including linear algebra and differential equations. The deadline for this program is also being changed and will likely be sometime in mid-September 1991.

For more information on either program, contact William Haver, Division of Undergraduate Science, Engineering, and Mathematics Education, Room 639, National Science Foundation, 1800 G Street NW, Washington, DC 20550; telephone 202-357-7051; electronic mail whaver@nsf.gov (Internet) or whaver@nsf (Bitnet).

Open Letter on Collaborative Research
Promoting collaboration among the biological, computational, and mathematical sciences represents a special challenge for the National Science Foundation (NSF). Striking advances in biology, computer science, and mathematics are creating opportunities for important collaborative work. Biological fields such as molecular biology, neuroscience, and ecosystems offer challenging computational and analytical problems. Meanwhile, revolutionary developments in analytical methods, computation theory, and computer hardware are widely thought to have important application to these problems. However, establishing and supporting an environment for effective interdisciplinary research requires the cooperative action of the research community and the research programs at NSF. This letter is intended to enlist your participation in a broadly based research effort in mathematical and computational aspects of modern biological problems.

It is interesting that present collaboration between biological scientists, on the one hand, and mathematical and computer scientists, on the other hand, continues a long tradition of biological influence on the basic models and methods of computing and mathematics. For example, many of the models of computation studied by computational theorists over the past forty years are explicitly motivated by biological systems. Entire subdisciplines, such as artificial intelligence and neural network processing have developed in part from the desire to provide a computational explication of overtly biological phenomena. In the more distant past, the work of Darwin and Mendel transformed biology and dramatically broadened the horizon for biological research, generating new problems that attracted the attention of mathematicians and statisticians. In particular, the mathematical efforts of Galton, Pearson, and Fisher to resolve biological questions helped form the field of modern statistics.

Today, widespread technical and popular discussions are calling attention to such intriguing problems as the following: (1) unraveling the meaning of the billions of nucleotides that make up the human genome using analytical and algorithmic methods, (2) visualizing how the folding and knotting of DNA affects its function, (3) representing in a scientific database biological diversity by millions of elements with changing and sometimes ill-defined components, (4) modeling the complete human nervous system with its \(10^{15}\) connections representing nonlinear relationships among \(10^{12}\) components. In nearly all major biological subdisciplines, the underlying processes of interest are now thought to be "information rich" and in need of study by computational and quantitative tools and methods.

Following the recommendations of several NSF sponsored workshops at this interface, it is our intention, over the next several years, to increase NSF support for interdisciplinary research in computational and mathematical aspects of the biological sciences. We are specifically interested in new research that makes significant contributions to biological, computational, and mathematical research.

We believe that the best ideas for research within a field of science originate from the investigators themselves.
Therefore, the examples mentioned in this letter are given only to illustrate, not to limit, the scope of this interdisciplinary support.

For the coming year, proposals addressing computational and mathematical problems in biology should be directed to the “regular” research programs, i.e., in mathematics, computer science, or biology. (A description of all NSF programs can be found in the publication Guide to Programs: Fiscal Year 1991, NSF 90-25.) In most cases, advance discussions with NSF program officers will help investigators determine the best programs for their work. Interdisciplinary teams are especially encouraged to apply. Only one proposal for any project need be submitted. We are committed to cooperation in the review and possible funding of interdisciplinary proposals.

We are particularly concerned with promoting infrastructure in the scientific community to facilitate the work of biological, computational, and mathematical scientists in work at interdisciplinary interfaces. The development of shared vocabularies, research goals and methods, conferences and journals, and value systems are, in our view, an essential part of any such collaboration. Accordingly, we have a special interest in fiscal year 1991 in supporting activities that lead to improved infrastructure. These activities might include highly directed “summer schools”, workshops or symposia that seek to increase the joint awareness of scientists in the basic problems and research modes of the others’ disciplines. By the same token, proposals whose aim is to make it easier and more desirable for young scientists to undertake such interdisciplinary research, are of interest.

We believe this is an exciting venture that will further biology while leading to advances in mathematics and computer science that will prove to be of as great and lasting significance as the works of Galton, Pearson, and Fisher in mathematics or von Neumann, Wiener, and McCulloch and Pitts in computer science. We encourage you to participate by contacting NSF program officers for further information and discussions of your ideas, for interdisciplinary (team) research proposals as well as for infrastructural support.

Sincerely,

Richard A. DeMillo
Director, Division of Computer and Computation Research
202-357-9747

Yi-Tzuo Chien
Director, Division of Information Robotics and Intelligent Systems
202-357-9572

Judith S. Sunley
Director, Division of Mathematical Sciences
202-357-9669

John Wooley
Director, Division of Instrumentation and Resources
202-357-9880

CRYPTOLOGY AND COMPUTATIONAL NUMBER THEORY
Carl Pomerance, Editor
Proceedings of Symposia in Applied Mathematics, Volume 42

In the past dozen or so years, cryptology and computational number theory have become increasingly intertwined. Because the primary cryptologic application of number theory is the apparent intractability of certain computations, these two fields could part in the future and again go their separate ways. But for now, their union is continuing to bring ferment and rapid change in both subjects.

This book contains the proceedings of an AMS Short Course in Cryptology and Computational Number Theory, held in August 1989 during the Joint Mathematics Meetings in Boulder, Colorado. These eight papers by six of the top experts in the field will provide readers with a thorough introduction to some of the principle advances in cryptology and computational number theory over the past fifteen years. In addition to an extensive introductory article, the book contains articles on primality testing, discrete logarithms, integer factoring, knapsack cryptosystems, pseudo-random number generators, the theoretical underpinnings of cryptology, and other number theory-based cryptosystems. Requiring only background in elementary number theory, this book is aimed at non-experts, including graduate students and advanced undergraduates in mathematics and computer science.

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.

1980 Mathematics Subject Classification: 11, 94
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Individual member $34, List price $57,
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1991 AMS Elections

Council Nominations

President-Elect
One president-elect will be elected by the Society in a contested election in the fall of 1991. The candidate elected will serve for one year as president-elect, two years as president, and one year as ex-president. The term of office will begin February 1, 1992. The Council has nominated two candidates for the position, namely:

Ronald L. Graham  Stephen Smale

Vice President, Members-at-Large, Trustee
One vice-president, five members-at-large of the Council, and one trustee will be elected by the Society in a contested election in the fall of 1991.

The vice-president will serve for a term of three years effective February 1, 1992. The Council has nominated three candidates for the position, namely:

Avner Friedman  Robert Osserman
Linda Keen

The five members-at-large will serve for a term of three years. The Council nominated nine candidates, namely:

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

The trustee will serve for a term of five years. The Council nominated two candidates, namely:

Maria M. Klawe  Charles C. Sims

President's Candidates

Nominating Committee for 1991 and 1992
Three members of the Nominating Committee are to be elected in the fall of 1991. Continuing members are: Michael Aschbacher, Jerry L. Kazdan, Barbara Lee Keyfitz, Ray Kunze, Walter David Neumann, Robert F. Williams. One candidate has been nominated by petition, namely:

Carol S. Wood

President Michael Artin will name five additional candidates so that there are six candidates for the three positions.

Editorial Boards Committee
Two members of the Editorial Boards Committee are to be elected in the fall of 1991. Continuing members are: Linda Keen, Richard James Milgram, Barry Simon, Nolan R. Wallach. President Michael Artin will name four candidates for the other two places.

Robert M. Fossum
Secretary
Urbana, Illinois
The eight-hundred-and-sixty-sixth meeting of the American Mathematical Society will be held at Portland State University (PSU), Portland, Oregon on Friday, June 14, and Saturday, June 15, 1991. All special sessions and sessions for contributed papers will be held in Neuberger Hall, and invited addresses will be given in Room 190 of the School of Business Administration (Professional Schools Building).

Invited Addresses
By invitation of the Western Section Program Committee, there will be three invited fifty-minute 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 five special sessions of selected 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 Latilais, Portland State University.

**Cycles and poles of L-functions**, Dinakar Ramakrishnan, and Jonathan David Rogawski, University of California, Los Angeles.

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

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

Contributed Papers
There will also be a session for contributed ten-minute papers. Late papers will not be accommodated.

Registration
The meeting registration desk will be located in the third floor Atrium of Neuberger 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 Orono Mathfest announcement in the April issue of *Notices.*

Accommodations
A block of rooms is being held in the Portland Student Services dormitory in Montgomery Hall on the PSU campus. 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 toll free at 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.

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 Portland, Oregon
 Portland State University
 June 14–15

Program
A - Neuberger Hall
B - Professional Schools Bldg. (School of Business Administration)
Meetings

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 $65

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 Neuberger 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 PSU 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. Neuberger 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. Neuberger 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.

DRIVING INSTRUCTIONS: 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 Highway 26 from the west, take I-405 one-half mile south from the interchange with Highway 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.
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 June 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.

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Friday, June 14

**Special Session on Fourier Analysis, I**

9:00 a.m.—10:50 a.m. Room 358, Neuberger Hall

9:00 a.m. Hamel bases and partitions of compact connected Abelian groups into sets of full outermeasure.

Gerald L. Itzkowitz, Queens College, City University of New York (866-42-01)

9:30 a.m. Embedding of the Fourier Stieltjes algebra into the dual of certain C*·algebra.

Anthony To-Ming Lau, University of Alberta (866-43-03)

10:00 a.m. Bilinear operators on $L^p(G)$ of locally compact groups.

Colin C. Graham*, Lakehead University, and Anthony T. M. Lau, University of Alberta (866-43-17)

10:30 a.m. On convolution operators which are not expressible as convolution by bounded measures.

E. E. Granirer, University of British Columbia (866-42-08)

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**Special Session on Inverse Problems and Applications, I**

9:00 a.m.—10:55 a.m. Room 350, Neuberger Hall

9:00 a.m. Some determined inverse problems.

James Ralston* and Gregory Eskin, University of California, Los Angeles (866-35-35)

9:30 a.m. Boundary conditions and impedance imaging.

Margaret Cheney, Rensselaer Polytechnic Institute (866-35-28)

10:00 a.m. Limited data tomography and micro-local analysis.

Eric Todd Quinto, Tufts University (866-35-36)

10:30 a.m. Inverse scattering for the Schrodinger equation in a magnetic field.

Ziqi Sun, Wichita State University (866-35-26)

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**Special Session on Combinatorial Group Theory and Low Dimensional Topology, I**

9:30 a.m.—10:50 a.m. Room 343, Neuberger Hall

9:30 a.m. Reconstruction of manifolds from their spines.

Dale Rolfsen* and David Gillman, University of British Columbia (866-57-58)

10:00 a.m. Fixed subgroups of free group automorphisms.

Xingguo Zhang, Michigan State University (866-20-47)

10:30 a.m. Groups satisfying the restricted Gromov property.

Benjamin Fine*, Fairfield University, and Gerhard Rosenberger, University of Dortmund, Federal Republic of Germany (866-20-53)

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**Special Session on Cycles and Poles of L-Functions, I**

9:30 a.m.—10:50 a.m. Room 346, Neuberger Hall

9:30 a.m. Cycles on certain arithmetic quotients of the two-ball.

Jonathan D. Rogawski, University of California, Los Angeles (866-14-62)

10:00 a.m. Symmetric square $L$-functions on $GL(n)$.

Daniel Bump, Stanford University (866-11-64)

10:30 a.m. A globalization of the Merkurjev-Suslin theorem and cycles on arithmetic schemes.

Yevsey Nisnevich, Johns Hopkins University, Baltimore (866-14-54)

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**Invited Address**

11:00 a.m.—11:50 a.m. Room 190, School of Business Administration

The Tate conjectures: Introduction and examples.

Dinakar Ramakrishnan, California Institute of Technology (866-14-37)
### Program of the Sessions

#### Invited Address

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker(s)</th>
<th>Institution</th>
<th>Phone Number</th>
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<tbody>
<tr>
<td>2:00 p.m. – 2:50 p.m.</td>
<td>Room 190, School of Business Administration</td>
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<tr>
<td>(16)</td>
<td><em>Inverse boundary value problems and applications.</em></td>
<td>Gunther A. Uhlmann, University of Washington</td>
<td>(866-35-49)</td>
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#### Special Session on Meromorphic Differential Equations, I

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<th>Time</th>
<th>Speaker(s)</th>
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<tr>
<td>3:00 p.m. – 5:20 p.m.</td>
<td><em>A differential analogue of Kummer theory.</em></td>
<td>Daniel Bertrand, Universite de Paris VI, France</td>
<td>(866-14-25)</td>
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<td>3:50 p.m.</td>
<td><em>Moduli of Fuchsian linear differential equations with fixed Galois groups.</em></td>
<td>Michael F. Singer, North Carolina State University</td>
<td>(866-12-21)</td>
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<td>4:40 p.m.</td>
<td><em>Multisummability of formal solutions.</em> Preliminary report.*</td>
<td>Yasutaka Sibuya, University of Minnesota, Minneapolis</td>
<td>(866-34-23)</td>
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#### Special Session on Combinatorial Group Theory and Low Dimensional Topology, II

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<th>Time</th>
<th>Speaker(s)</th>
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<th>Phone Number</th>
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<tr>
<td>3:00 p.m. – 5:20 p.m.</td>
<td><em>Distinguishing presentations of metacyclic fundamental groups of 3-manifolds.</em></td>
<td>Kensington Hall, University, Madison</td>
<td>(866-57-55)</td>
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<td>3:30 p.m.</td>
<td><em>Degree one maps between 3-manifolds.</em></td>
<td>Yongwu Rong, Michigan State University</td>
<td>(866-57-15)</td>
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<tr>
<td>4:00 p.m.</td>
<td><em>An embedding for the second homotopy group of a subcomplex of a finite contractible two-complex.</em></td>
<td>William A. Bogley, Oregon State University</td>
<td>(866-20-52)</td>
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<tr>
<td>4:30 p.m.</td>
<td><em>Discussion</em></td>
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<td>5:00 p.m.</td>
<td><em>Groups and topographs.</em></td>
<td>S. Kalajdzievski, University of Manitoba</td>
<td>(866-20-45)</td>
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#### Special Session on Cycles and Poles of L-Functions, II

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<tr>
<td>3:00 p.m. – 5:20 p.m.</td>
<td><em>Cycle classes of infinite order and zeroes of L-series on triple products of elliptic curves.</em></td>
<td>Joe F. Butcher, Reed College</td>
<td>(866-14-61)</td>
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<td>3:30 p.m.</td>
<td><em>Some correspondences between modular threefolds.</em></td>
<td>Neils O. Nygaard, University of Chicago</td>
<td>(866-14-59)</td>
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<td>4:00 p.m.</td>
<td><em>Abelian varieties associated with K3 surfaces.</em></td>
<td>Kapil H. Paranjape, University of Chicago</td>
<td>(866-14-63)</td>
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<td>4:30 p.m.</td>
<td><em>Discussion</em></td>
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#### Special Session on Fourier Analysis, II

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<tr>
<td>3:05 p.m. – 5:50 p.m.</td>
<td><em>On the cycle map for codimension two cycles on varieties over finitely generated fields.</em></td>
<td>Wayne M. Raskind, University of Arizona</td>
<td>(866-14-60)</td>
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#### Special Session on Inverse Problems and Applications, II

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<tr>
<td>3:00 p.m. – 5:25 p.m.</td>
<td><em>Trying to beat Heisenberg.</em></td>
<td>Rick Lavine, University of Rochester</td>
<td>(866-35-33)</td>
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<td>3:30 p.m.</td>
<td><em>Microlocal analysis of restricted X-ray transforms.</em></td>
<td>Allan Greenleaf* and Gunther Uhlmann, University of Washington</td>
<td>(866-44-60)</td>
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<td>4:00 p.m.</td>
<td><em>Boundary data for Schrödinger operators.</em></td>
<td>William Rundell, Texas A &amp; M University, College Station</td>
<td>(866-34-06)</td>
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<td>4:30 p.m.</td>
<td><em>Undetermined coefficient problems for second order equations.</em></td>
<td>Allan Fryant, Jamestown College</td>
<td>(866-12-21)</td>
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<td>5:00 p.m.</td>
<td><em>Local tomography.</em></td>
<td>Adel Faridani, Oregon State University</td>
<td>(866-35-34)</td>
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#### General Session

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<tr>
<td>3:00 p.m. – 5:10 p.m.</td>
<td><em>Essential vertices in maximum matchings.</em></td>
<td>James E. Simpson, University of Kentucky</td>
<td>(866-05-51)</td>
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<td>3:20 p.m.</td>
<td><em>Constructing the spherical harmonics.</em></td>
<td>Allan Fryant, Jamestown College</td>
<td>(866-31-10)</td>
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<td>3:40 p.m.</td>
<td><em>Inverse spectral theory for some singular Sturm-Liouville problems.</em></td>
<td>Robert Carlson, University of Colorado, Colorado Springs</td>
<td>(866-34-41)</td>
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<td>4:00 p.m.</td>
<td><em>Dirichlet operator and equivalence of subspaces.</em></td>
<td>Karim Seddighi, Shiraz University, Iran</td>
<td>(866-47-14)</td>
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<td>4:20 p.m.</td>
<td><em>An extension of norm inequalities for integral operators on cones when 0 &lt; p &lt; 1.</em></td>
<td>V. Sidat*, California State University, Dominguez Hills, and K. Zhou, California State University, Sacramento</td>
<td>(866-47-48)</td>
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<td>4:40 p.m.</td>
<td><em>Generalized coupling model of global electrocortical activity.</em></td>
<td>Syed Arif Kamal* and Khursheed A. Siddiqui, University of Karachi, Pakistan</td>
<td>(866-92-16)</td>
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<td>5:00 p.m.</td>
<td><em>The maximal ideal space of L^p.</em></td>
<td>M. Rajagopalan*, Tennessee State University, and Peter Greim, The Citadel</td>
<td>(866-46-66)</td>
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### Friday, June 14 (cont’d)

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<tr>
<th>Time</th>
<th>Session</th>
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<tr>
<td>4:00 p.m.</td>
<td>Differentiation of Zygmund functions. Preliminary report.</td>
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<td>David Ullrich, Oklahoma State University, Stillwater (866-42-04) (Sponsored by Alan V. Noell)</td>
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<tr>
<td>4:30 p.m.</td>
<td>Entropy norms and lacunary Fourier series. Preliminary report.</td>
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<td>W. Christopher Lang, Mississippi State University (866-42-11)</td>
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<td>5:00 p.m.</td>
<td>Convolution measure algebras that are not hypergroups.</td>
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<td>William C. Connett and Alan L. Schwartz*, University of Missouri, St. Louis (866-42-12)</td>
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<td>5:30 p.m.</td>
<td>Classification of self-dual divisible LCA groups.</td>
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<td>Sheng L. Wu, University of Oregon (866-43-13)</td>
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### Saturday, June 15

#### Special Session on Fourier Analysis, III

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<th>Time</th>
<th>Session</th>
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<tr>
<td>8:30 a.m.–10:50 a.m.</td>
<td>Littwood-Paley sets. Kathry E. Harde*, University of Waterloo, and Ivo Klemes, McGill University (866-42-09)</td>
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<td>9:00 a.m.</td>
<td>Littwood-Paley theory on solenoids. Preliminary report.</td>
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<td>Nakhil H. Asmar* and Stephen Montgomery-Smith, University of Missouri, Columbia (866-43-18)</td>
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<tr>
<td>9:30 a.m.</td>
<td>The $L^p$-conjecture for hypergroups. Preliminary report.</td>
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<td>Richard Vrem, Humboldt State University (866-43-05)</td>
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<td>10:00 a.m.</td>
<td>Generalized maximal functions of Martingales.</td>
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<td>Andrew G. Bennett* and Berns S. W. Schroeder, Kansas State University (866-60-19)</td>
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<td>10:30 a.m.</td>
<td>The set of closed subgroups of a topological group.</td>
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<td>Tom Hollingsed, University of Oregon (866-22-22)</td>
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#### Special Session on Combinatorial Group Theory and Low Dimensional Topology, III

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<th>Time</th>
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<tr>
<td>9:00 a.m.–10:50 a.m.</td>
<td>Fixed point free actions on homology 3-spheres.</td>
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<td>Erhard Luft and Dennis Sjerve*, University of British Columbia (866-57-57)</td>
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<td>9:30 a.m.</td>
<td>Non-homotopy equivalent 2-complexes with isomorphic $\pi_1$ and $\pi_2$. Preliminary report.</td>
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<td>Nancy Waller* and M. Paul Latiolais, Portland State University (866-57-56)</td>
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<td>10:00 a.m.</td>
<td>$R$-trees and partial rotations. Preliminary report.</td>
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<td>Frank S. Rimlinger, Fairfield University (866-20-02)</td>
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<tr>
<td>10:30 a.m.</td>
<td>3-Manifolds whose universal covers are 1-connected at $\infty$, and group-theoretic ideas. Preliminary report.</td>
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<td>John R. Stallings, University of California, Berkeley (866-20-44)</td>
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### Special Session on Inverse Problems and Applications, III

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<tr>
<td>9:00 a.m.–10:55 a.m.</td>
<td>Constructing two-dimensional potentials from nodal line patterns.</td>
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<td>Joyce R. McLaughlin*, Rensselaer Polytechnic Institute, and Ole H. Hald, University of California, Berkeley (866-35-27)</td>
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<td>9:30 a.m.</td>
<td>Inverse hyperbolic problems with local boundary measurements.</td>
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<td>Victor Isakov, Wichita State University (866-35-32)</td>
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<tr>
<td>10:00 a.m.</td>
<td>Identification of the elasticity tensor by boundary measurements.</td>
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<td>Gen Nakamura, Josui University, Japan (866-35-65) (Sponsored by Gunther A. Uhlmann)</td>
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<tr>
<td>10:30 a.m.</td>
<td>Parallel algorithms for an inverse Sturm-Liouville problem. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>Michael Pilant* and William Rundell, Texas A&amp;M University, College Station (866-34-07)</td>
</tr>
</tbody>
</table>

### Invited Address

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td>11:00 a.m.–11:50 a.m.</td>
<td>Recent progress in meromorphic differential equations.</td>
</tr>
<tr>
<td></td>
<td>V. S. Varadarajan, University of California, Los Angeles (866-34-42)</td>
</tr>
</tbody>
</table>

### Special Session on Meromorphic Differential Equations, II

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td>2:00 p.m.–4:30 p.m.</td>
<td>Calculating Stokes’ multipliers for some meromorphic differential equations. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>D. A. Lutz*, San Diego State University, and R. Schaecke, University of Essen, Germany (866-34-40)</td>
</tr>
<tr>
<td>2:50 p.m.</td>
<td>Logarithmic decay and overconvergence of the unit root and associated zeta functions. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>Bernard Dwork, Princeton University, and Steven Sperber*, University of Minnesota, Minneapolis (866-14-43)</td>
</tr>
<tr>
<td>3:40 p.m.</td>
<td>Fuchsian moduli on a curve. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>K. Iwasaki, University of Tokyo, Japan (866-34-24) (Sponsored by Donald G. Babbitt)</td>
</tr>
</tbody>
</table>

### Special Session on Inverse Problems and Applications, IV

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td>2:00 p.m.–4:25 p.m.</td>
<td>Problems in impedance imaging.</td>
</tr>
<tr>
<td></td>
<td>David Isaacson, Rensselaer Polytechnic Institute (866-35-29)</td>
</tr>
<tr>
<td>2:30 p.m.</td>
<td>Spectrally determined singularities in a potential.</td>
</tr>
<tr>
<td></td>
<td>Constantine J. Callias, Case Western Reserve University (866-35-46)</td>
</tr>
</tbody>
</table>
### Program of the Sessions

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker(s)</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:00 p.m.</td>
<td>X-ray reconstruction in $\mathbb{R}^3$.</td>
<td>David Finch, Oregon State University (866-35-31)</td>
<td></td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Numerical recovery of certain discontinuous</td>
<td>Kurt Bryan, NASA Langley Research Center, Virginia</td>
<td></td>
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<tr>
<td></td>
<td>conductivities.</td>
<td>(866-35-39)</td>
<td></td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>The recovery of potentials from finite spectral data.</td>
<td>Bruce Lowe*, Michael Pilant and William Rundell, Texas A&amp;M University, College Station (866-34-38)</td>
<td></td>
</tr>
</tbody>
</table>

*Lance W. Small*
Associate Secretary
La Jolla, California

### Presenters of Papers

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

- AMS Invited Lecturer
- AMS Special Session Speaker

- Asmar, N. H., 46
- Bennett, A. G., 48
- Bertrand, D., 17
- Beyl, F. R., 20
- Bogley, W. A., 22
- Bryan, K., 65
- Buhler, J. P., 24
- Bump, D., 13
- Callias, C. J., 63
- Carlson, R., 35
- Cheney, M., 6
- Faridani, A., 32
- Finch, D., 64
- Fine, B., 11
- Fryant, A., 34
- Graham, C. C., 3
- Granirer, E. E., 4
- Greenleaf, A., 29
- Grunbaum, F. A., 28
- Hare, K. E., 45
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- Isakov, V., 55
- Itzkowitz, G. L., 1
- Iwasaki, K., 61
- Kalajdzievski, S., 23
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- Lang, W. C., 42
- Lau, A. T., 2
- Lavine, R., 30
- Lowe, B., 66
- Lutz, D. A., 59
- Lyons, R., 40
- McLaughlin, J. R., 54
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- Nisnevich, Y., 14
- Nygaard, N. O., 25
- Paranjape, K. H., 26
- Pilant, M., 57
- Quinto, E. T., 7
- Rajagopalan, M., 39
- Ralston, J., 5
- Ramakrishnan, D., 15
- Raskind, W. M., 27
- Rimlinger, F. S., 52
- Rogawski, J. D., 12
- Rolfsen, D., 9
- Rong, Y., 21
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- Schwartz, A. L., 43
- Seddighi, K., 36
- Siadat, V., 37
- Sibuya, Y., 19
- Simpson, J. E., 33
- Singer, M. F., 18
- Sjerve, D., 50
- Sperber, S., 60
- Stallings, J. R., 53
- Sun, Z., 8
- Uhlmann, G. A., 16
- Ullrich, D., 41
- Varadarajan, V. S., 58
- Vrem, R., 47
- Waller, N., 51
- Wu, S. L., 44
- Zhang, X., 10
Supplement to Announcement in April Notices

Please refer to the Preliminary Announcement for this meeting which appears on pages 319–349 of the April 1991 issue of Notices. The Important Deadlines from the preliminary announcement are reproduced below for convenience. The forms for Preregistration/Housing, MAA Minicourses, and the Summer List of Applicants are located at the back of this issue.

Other AMS-MAA Sessions
AMS-MAA Invited Address: The title of the AMS-MAA Invited Address by Fan R. K. Chung is Laplacians of graphs and hypergraphs.

The title of the AMS-MAA Invited Address by Louis Nirenberg has been changed to On the maximum principle.

MS 2000 Report—Issues and Needed Actions: This panel discussion will now be cosponsored by the MAA Science Policy Committee and the AMS Committee on Science Policy.

Other AMS Sessions
The AMS Committee on Science Policy panel discussion has been moved to Thursday, August 8, 2:00 p.m. to 3:00 p.m. The title is Report of the Strategic Planning Task Force: Its potential for the coming decade. The moderator is Hugo Rossi, University of Utah.

IMPORTANT DEADLINES

<table>
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<tr>
<th>IMPORTANT DEADLINES</th>
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<tr>
<td>AMS Abstracts</td>
<td>May 1</td>
</tr>
<tr>
<td>For Consideration for Special Sessions</td>
<td>May 1</td>
</tr>
<tr>
<td>Of Contributed Papers</td>
<td>May 22</td>
</tr>
<tr>
<td>MAA Abstracts</td>
<td>May 8</td>
</tr>
<tr>
<td>Of Contributed Papers</td>
<td>June 6</td>
</tr>
<tr>
<td>Summer List of Applicants</td>
<td>June 6</td>
</tr>
<tr>
<td>ORDINARY Preregistration and Housing</td>
<td>June 6</td>
</tr>
<tr>
<td>MAA Minicourse Preregistration</td>
<td>June 6</td>
</tr>
<tr>
<td>Motions for AMS Business Meeting</td>
<td>July 8</td>
</tr>
<tr>
<td>Hotel Changes and Cancellations</td>
<td>July 9</td>
</tr>
<tr>
<td>with Service Bureau</td>
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<tr>
<td>Cancellations for all Banquets and Tours (50% refund)</td>
<td>July 9</td>
</tr>
<tr>
<td>FINAL Preregistration (no housing)</td>
<td>July 11</td>
</tr>
<tr>
<td>Residence Hall Package Changes and</td>
<td></td>
</tr>
<tr>
<td>Cancellations with Service Bureau (90% refund)</td>
<td>July 26</td>
</tr>
<tr>
<td>Preregistration Cancellations (50% refund)</td>
<td>August 2</td>
</tr>
</tbody>
</table>

Other AMS Events of Interest
Representatives from various Society departments and divisions will be available daily in the AMS Information Booth for informal discussions with interested participants. A schedule indicating when these staff members will be present in the booth will appear in the program for the meeting. All participants are encouraged to meet with the staff to share ideas, to discuss issues of concern, and to talk about what the Society can do in the future to assist them in achieving their goals as professional mathematicians. Comments and suggestions on any phase of the Society’s operation are welcome. Come join us in working toward a better future for mathematics and all mathematicians!

MAA-Mu Alpha Theta Lecture
The title of the MAA-Mu Alpha Theta Lecture on Thursday at 1:40 p.m. is Calculus in an age of technology.

MAA Minicourses
Minicourse #10 on Mathematical computer graphics on the HP-28C&S and HP-48SX: A means to arouse students’ interest in mathematics organized by Yves Nievergelt, Eastern Washington University has been canceled.

Other MAA Sessions
Topics for the panelists for the Committee on Computers in Mathematics Education and the CUPM Subcommittee on Symbolic Computer Systems panel discussion on Uses of computers in NSF calculus projects are William H. Barker, Bowdoin College, Mathematica in calculus reform; Joan R. Hundhausen, Colorado School of Mines, Calculus, physics, and technology—mutually supportive; David O. Lomen, University of Arizona, Tucson, The role of technology in calculus; and Dennis M. Schneider, Knox College, Using Mathematica to teach calculus.

Speakers for the SUMMA Intervention Workshop on Friday, August 9, include Bonnie Berken, St. Norberts College, and Paul J. Sally, Jr., University of Chicago.

Activities of Other Organizations
The Association for Women in Mathematics’ panel discussion will now be cosponsored by MAA and is titled Careers
Meetings

that count: Opportunities in the mathematical sciences. The moderator will be Jenny Baglivo, Boston College.

The AWM Membership Meeting will now be held at 4:00 p.m. on Thursday immediately following the AWM panel.

The MAA-Pi Mu Epsilon Reception has been moved to Friday, August 9, from 5:45 p.m. to 6:45 p.m.

A high-level public official will give the Science Policy Address sponsored by the Joint Policy Board for Mathematics and the Office of Governmental and Public Affairs to be held from 6:30 p.m. to 7:30 p.m. on Friday. A reception will follow from 7:30 p.m. to 8:30 p.m.

Social Events

The Marsh Island Band that will play at the lobster cookout is a contradance band that plays traditional music of New England, French Canada, Appalachia, and the British Isles, on instruments which include fiddle, autoharp, penny whistle, guitar, banjo, piano, and hammered dulcimer.

Registration

The Orono Mathfest preregistration fee for Student/Unemployed/Emeritus is $25 as listed on the Preregistration/Housing Form. It was incorrectly listed as $26 in the text of the first announcement.

American Mathematical Society Short Course Series

Introductory Survey Lectures on

The Unreasonable Effectiveness of Number Theory

Orono, Maine, August 6-7, 1991

The following synopsis and reading list supplements those presented in the first announcement of the Short Course to be held at the University of Maine, Orono; see the April 1991 issue of Notices, pages 347-349 for program and registration information. Speakers/topics are: MANFRED R. SCHROEDER, University of Göttingen, The Unreasonable Effectiveness of Number Theory in Physics, Communication, and Music; GEORGE E. ANDREWS, Pennsylvania State University, Number Theory and Statistical Mechanics; JEFFREY C. LAGARIAS, AT&T Bell Laboratories, Number Theory and Dynamical Systems; GEORGE MARSGAGLIA, Florida State University, The Mathematics of Random Number Generators; VERA S. PLESS, University of Illinois at Chicago, Cyclotomy and Cyclic Codes; and M. DOUGLAS McILROY, AT&T Bell Laboratories, Number Theory in Computer Graphics.

These codes have properties analogous to properties of quadratic residue codes. The idempotents of binary duadic codes can be constructed from unions of certain cyclotomic cosets.

Self-dual codes are combinatorially interesting and include many of the best algebraic codes. We now have number theoretic conditions on the length \( n \) when extended cyclic self-dual codes can exist.

A main problem in combinatorics is the determination of which \( n \) can be the order of a projective plane. We show how the existence of a cyclic projective plane is related to the existence of certain of the codes discussed above. Based on this connection we show that some determined \( n \) cannot be the order of a cyclic projective plane.

The basic concepts for codes, cyclic codes and projective planes will be given. Many examples will be provided.

The Joint Mathematics Meetings in Baltimore will be held January 8–11 (Wednesday–Saturday), 1992. The first full announcement of the meetings will appear in the October 1991 issues of Notices and Focus. This preliminary announcement is made to encourage member participation and to provide lead time for submission of abstracts for consideration for presentation 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 Addresses 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 September 11, 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 October 2, 1991. A charge of $16 is imposed for retyping abstracts that are not in camera-ready form. Late papers will not be accepted.

MAA Contributed Papers
Contributed papers are being accepted on several topics in collegiate mathematics for presentation in contributed paper sessions at the meeting. The topics, organizers, and their affiliations are:

- Environmental mathematics, Ben A. Fusaro, Salisbury State University. Papers are invited that treat topics that are suitable for a liberal arts mathematics course or for a modeling course, preferably at the sophomore-junior level.
- Research in undergraduate education, Ed Dubinsky, Purdue University. Presentations are invited that describe research on the learning and teaching of any aspect of undergraduate mathematics. Descriptions of courses taught must be in the context of investigations into such questions as to how mathematics is learned, methods of teaching, effectiveness of the approach, and similar issues.
- Mathematics placement testing programs: Their organization, administration and problems, Rose Hamm, College of Charleston, and John G. Harvey, University of Wisconsin, Madison. Papers on various aspects of placement testing programs are welcome. Of special interest are the test(s) used and the other data used (e.g., aptitude scores, high school GPA's), as well as the problems that arise and the ways of solving them.
- The “seven-into-four” problem, David Carlson, San Diego State University, and Ann Watkins, California State University, Northridge. This session was organized by the Committee on Calculus Reform and the First Two Years (CRAFTY). Papers are invited which present innovative ways of solving the seven-into-four problem. Seven courses (Calculus I, II, and III, Differential Equations, Discrete Mathematics, Linear Algebra, and Probability/Statistics) have been recommended for the first four semesters of college mathematics. Is it possible to squeeze them all in? What are some good partial solutions to the problem?
- Innovations in mathematics courses for business, Wade Ellis, Jr., West Valley College, and Barbara A. Jur, Macomb Community College. This session is organized by the CUPM Subcommittee on Service Courses, which focuses on service courses for business students. Contributed papers may address issues of specialized business subject matter, innovative instructional techniques, the relationship of business oriented courses to the mathematics curriculum, or other related topics.
- Actuarial mathematics, James W. Daniel, University of Texas, Austin. Contributions should address educational (or research) issues in actuarial mathematics, including
such topics as curricula, teaching methods, program organization, textbooks, software, professional exams, and research.

- A toolbox for liberal arts mathematics courses, John Emert and Kay Meeks, Ball State University. Liberal arts mathematics courses generally include as goals the changing of students' perception of mathematics and the illumination of relationships between mathematics and other disciplines. The purpose of this session is to share innovative, yet practical and transferable, ideas and techniques which can aid in the development and realization of these common goals. Topics for discussion may include: creative classroom techniques and assignments; fresh, unusual topics for inclusion in courses; and specific ways to encourage students' discovery of the usefulness of mathematics in their own fields of study.

- Mathematics for the health sciences, Henry C. Foehl, Philadelphia College of Pharmacy and Science. Papers contributed for this session should describe the content of courses or sequences of courses that constitute part or all of the mathematics requirements for degree programs in the health or health related sciences. Of particular interest are criteria for selecting the appropriate content for such courses and methods for integrating the content into the curricula of various degree programs, especially where the courses also serve as the mathematics component of a core curriculum.

- Using spreadsheets to teach mathematics, Robert S. Smith, Miami University. The spreadsheet is a powerful and versatile—yet easy to use—software tool that has become increasingly popular in the teaching of the mathematical sciences. It is ideal for implementing algorithms which rely upon iterative procedures or recurrence relations, and is a natural tool for solving many types of applied problems. This session invites papers which illustrate the spreadsheet as a problem solving, data analysis, or graphing tool. Papers are also invited which demonstrate how the spreadsheet can be used to prove theorems, discover patterns and results, or illustrate mathematical concepts. Papers which describe courseware that is developed around the spreadsheet are strongly encouraged.

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes. Individuals wishing to submit papers for any of these sessions should note the following NEW PROCEDURES: The name(s) and address(es) of the author(s) and a one-page summary of the paper should be sent directly to the organizer of the session by September 11. Proposals should NOT be sent to the MAA Washington office. The organizer will acknowledge receipt of the proposal; if the proposal is accepted, the organizer will send the contributor an abstract form. The abstract form must be sent to the AMS in Providence prior to October 2. In an effort to save time, if the contributor has access to the new MAA abstract form, the original can be sent to the AMS and a copy of it to the organizer along with the one-page summary. (If the paper is not accepted, the abstract will be omitted from the program.) The abstract will be photographically reproduced from the copy supplied by the author on the MAA abstract form, which is similar to the abstract forms used for contributed papers by the AMS. They will be published in an abstract journal, copies of which are available in the registration area during the meetings. The MAA abstract form may be requested from the AMS or the MAA.

Rooms where sessions of contributed papers will be held are equipped with an overhead projector and screen. Blackboards are not available. Persons having other equipment needs should contact the MAA Associate Secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403-1222; electronic mail: ross@math.uoregon.edu) as soon as possible, but in any case prior to November 9. Upon request, the following will be made available: one additional overhead projector/screen, 35mm carousel slide projector, or 1/2" or 3/4" VHS video cassette recorder with one color monitor.

**Electronic Submission of AMS and MAA Abstracts**

This service is available to those who use the \TeX\ type-setting 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, \AMSTeX, or the \LaTeX\ package. Only abstracts should be sent to abs-submit@math.ams.com. Questions regarding an abstract should be addressed to abs-misc@math.ams.com. Questions regarding meetings should be addressed to meet@math.ams.com.
Invited Addresses and Special Sessions

Invited Addresses at AMS Meetings
The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings, the list of speakers is incomplete.

Orono, ME, August 1991
Please refer to the first announcement of this meeting in the April Notices.

Philadelphia, PA, October 1991
Michael T. Anderson Marjorie Senechel
Abbas Bahri Panagiotis E. Souganidis

Fargo, ND, October 1991
Ian D. Macdonald Henry C. Wente
Harald Upmeier Sylvia M. Wiegand

Santa Barbara, CA, November 1991
Daryl Cooper Stanley J. Osher
Richard S. Elman

Baltimore, MD, January 1992
Ya M. Eliashberg William Browder
Michael E. Fisher (Retiring Presidential Address)

Bethlehem, PA, April 1992
Jean-Luc Brylinski Edward Y. Miller
Ingrid Daubechies Douglas C. Ravenel

Cambridge, England, June 1992
(Joint meeting with the London Mathematical Society)
John M. Ball Nigel J. Hitchin
Lawrence Craig Evans Edward Witten
Benedict H. Gross

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.

August 1991 Meeting in Orono, Maine
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: Expired
Please refer to the first announcement of this meeting in the April Notices and also the updated information that appears elsewhere in this issue.

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
Abbas Bahri, Nonlinear partial differential equations
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
Invited Addresses and Special Sessions

Halil Mete Soner and Panagiotis E. Souganidis, Phase transitions and/or front propagation
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 Gomez, 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. U以人为本, 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
Daryl Cooper and Darren Long, Low dimensional topology and negatively curved groups
Anant P. Godbole, Applied probability
Kenneth R. Goodearl and Birge K. Zimmerman-Huisgen, Ring theory
William B. Jacob, Quadratic forms

January 1992 Meeting in Baltimore, Maryland
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: September 11, 1991
Bette Anne Case, Preparing the college mathematics teachers of the future
John Dillon, Design and codes
Peter L. Duren and Boris Korenblum, Bergman spaces
Florence D. Fasanelli, Victor J. Katz and David E. Rowe, History of mathematics
Naomi Fisher, Harvey B. Keynes and Philip D. Wagreich, Mathematics and education reform
B. A. Fusaro, Environmental mathematics
Frank Goss hams, Invariant theory
Paul D. Humke, Classical real analysis
Zhong Li and C.-C. Yang, Iteration and factorization of entire and meromorphic functions
Peter A. McCoy, Function theoretic methods in partial differential equations
M. Zuhair Nashed, Interaction of harmonic analysis, signal processing and computational mathematics
Jonathan M. Rosenberg, Index theory
Seenith Sivasundaram, Stability and control
W. Stephen Wilson, Algebraic topology

March 1992 Meeting in Tuscaloosa, Alabama
Southeast Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: June 13, 1991
Deadline for consideration: December 12, 1991
Jon M. Corson, Martyn Russell Dixon, Martin J. Evans and Frank Roehl, Infinite groups and group rings

March 1992 Meeting in Springfield, Missouri
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 26, 1991
Deadline for consideration: December 12, 1991
Boris M. Schein, Semigroups

April 1992 Meeting in Bethlehem, Pennsylvania
Eastern Section
Associate Secretary: W. Wistar Comfort
Deadline for organizers: July 11, 1991
Deadline for consideration: January 2, 1992
Edward F. Assmus, Jr. and Jennifer D. Key, Finite geometry

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: February 7, 1992

October 1992 Meeting in Dayton, Ohio
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: January 30, 1992
Deadline for consideration: July 13, 1992

January 1993 Meeting in San Antonio, Texas
Associate Secretary: W. Wistar Comfort
Deadline for organizers: April 13, 1992
Deadline for consideration: September 17, 1992

May 1993 Meeting in DeKalb, Illinois
Associate Secretary: Andy R. Magid
Deadline for organizers: August 21, 1992
Deadline for consideration: To be announced

August 1993 Meeting in Vancouver, British Columbia, Canada
Associate Secretary: Lance W. Small
Deadline for organizers: November 11, 1992
Deadline for consideration: To be announced

October 1993 Meeting in Galveston, Texas
Associate Secretary: Andy R. Magid
Deadline for organizers: January 22, 1993
Deadline for consideration: To be announced

January 1994 Meeting in Cincinnati, Ohio
Associate Secretary: Joseph A. Cima
Deadline for organizers: April 5, 1993
Deadline for consideration: To be announced
Invited Addresses and Special Sessions

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 individuals are selected to give Invited Addresses. The number of Special Sessions at a Summer or Annual Meeting is limited. The algorithm that determines the number of Special Sessions allowed at a given meeting, while simple, is not repeated here, but can be found in “Rules for Special Sessions” on page 614 in the April 1988 issue of Notices.

Each person selected to give an Invited Address is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the PCNM or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an ex-officio member of the committee and whose address may be found below). These proposals must be in the hands of the PCNM at least nine months prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Proposals that are sent to the Providence office of the Society, to Notices, or directed to anyone other than the Associate Secretary will have to be forwarded and may not be received in time to be considered for acceptance.

It should be noted that Special Sessions must be announced in Notices in such a timely fashion that any member of the Society who so wishes may submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration. This deadline is usually three weeks before the deadline for abstracts for the meeting in question.

Special Sessions are very effective at Sectional Meetings and can usually be accommodated. The processing of proposals for Special Sessions for Sectional Meetings is handled in essentially the same manner as for Annual and Summer Meetings by the Section Program Committee. Again, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline after which members can no longer send abstracts for consideration for presentation in that Special Session.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. These proceedings appear in the book series Contemporary Mathematics.

More precise details concerning proposals for and organizing of Special Sessions may be found in the “Rules for Special Sessions” or may be obtained from any Associate Secretary.

Proposals for Special Sessions to the Associate Secretaries

The programs of Sectional Meetings are arranged by the Associate Secretary for the section in question:

Western Section
Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
Electronic mail: g.small@math.ams.com
(Telephone 619—534—3590)

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
Invited Addresses and Special Sessions

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, AAMS-\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.

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**QUANTUM LINEAR GROUPS**

Brian J. Parshall and Jian-pan Wang  •  Memoirs of the AMS, Volume 439

This volume begins with a general discussion of the theory of quantum groups. The authors view the theory as a natural extension of the theory of affine group schemes. They establish a number of foundational results, including the theory of induced representations and spectral sequences for quantum group cohomology. They then apply these results to give a detailed study of the quantum general linear group and its representation theory. Some of the central topics included are a development of quantum determinants, Frobenius kernels and their representation theory, high weight theory, and the generalization of various important theorems concerning the cohomology of vector bundles on the flag manifold. Finally, the authors use the theory to give a treatment of $q$-Schur algebras, proving, for example, that $q$-Schur algebras are quasi-hereditary.

1980 Mathematics Subject Classifications: 20, 14
ISBN 0-8218-2501-1, LC 90-19310,
ISSN 0065-9266
168 pages (softcover), January 1991
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The twenty-fifth annual Symposium on Some Mathematical Questions in Biology on Theoretical approaches for predicting spatial effects in ecological systems will be held during the Annual Meeting of the Ecological Society of America, August 4–8, 1991 in the San Antonio Convention Center in San Antonio, Texas. The symposium is sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics (SIAM), and the Society for Mathematical Biology (SMB).

The AMS-SIAM-SMB Committee on Mathematics in the Life Sciences serves as the Organizing Committee for the symposium. The committee at the time this topic was selected consisted of Jack D. Cowan, James W. Curran, Marcus B. Feldman, Eric S. Lander, Marc Mangel, and James D. Murray. Robert H. Gardner serves as organizer.

The theme of the symposium is Theoretical approaches for predicting spatial effects in ecological systems. There will be one afternoon session including six 30-minute lectures.

The names and affiliations of the speakers and titles are as follows (* denotes presenter):

- **Debra P. Coffin**, William K. Lauenroth, and Ingrid C. Burke, Colorado State University, Spatial dynamics in recovery of shortgrass steppe ecosystems;
- **Virginia H. Dale**, Frank Southworth, Robert V. O’Neill, and Robert Frohn, Oak Ridge National Laboratory, Simulating spatial patterns and socio-economic and ecologic effects of land use change in Rondonia, Brazil;
- **Bruce T. Milne**, University of New Mexico, Albuquerque, Renormalization relations for spatial models;
- **Stephen W. Pacala**, University of Connecticut, Storrs, Neighborhood population dynamics models;
- **Wilfred F. Wolff**, University of Tennessee, Knoxville, A spatial individual-oriented model for a wading bird nesting colony.

Proceedings of the symposium will be published by the AMS in the series Lectures on Mathematics in the Life Sciences.

Information about registration and housing can be found in the March issue of Bulletin of the Ecological Society of America or by contacting the Mathematical Biology Symposium Conference Coordinator, AMS, Post Office Box 6887, Providence, RI 02940, by telephone 401-455-4146, by electronic mail BAV@MATH.AMS.COM, or by FAX 401-455-4004.

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**EXTRAPLOATION THEORY WITH APPLICATIONS**

Bjorn Jawerth and Mario Milman • Memoirs of the AMS, Number 440

In the last few decades, interpolation theory has become an established field with many interesting applications to classical and modern analysis. In this book, the authors develop a general theory of extrapolation spaces, which is a complement to the familiar theory of interpolation spaces. Their results allow an extension of the classical extrapolation theorem of Yano to scales of Banach spaces. They give applications to classical and modern analysis, including extreme forms of Sobolev imbedding theorems, rearrangement inequalities for classical operators, and Nash-Moser implicit function theorems.

1980 Mathematics Subject Classifications: 46; 42
ISBN 0-8218-2502-X, LC 90-23642,
ISSN 0065-9266
82 pages (softcover), January 1991
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Call For Topics
For 1993 Conferences

Suggestions are invited from mathematicians, either singly or in groups, for topics for the various conferences that will be organized by the Society in 1993. The deadlines for receipt of these suggestions are given below, as well as some relevant information about each of the conferences. An application form to be used when submitting suggested topic(s) for any of these conferences (except the Short Course Series) may be obtained by writing to the Meetings Department, American Mathematical Society, P.O. Box 6887, Providence, RI 02940; telephoning 401-455-4146; or sending electronic mail to MEET@MATH.AMS.COM.

Individuals willing to serve as organizers should be aware that the professional meetings staff in the Society’s Providence office will provide full support and assistance before, during, and after each of these conferences thereby relieving the organizers of most of the administrative detail. Organizers should also note that for all conferences, except Summer Research Conferences, it is required that the proceedings be published by the AMS and that proceedings of Summer Research Conferences are frequently published. An A member of the Organizing Committee must be willing to serve as editor of the proceedings.

All suggestions must include (1) the names and affiliations of proposed members and the chairman of the Organizing Committee; (2) a one- to two-page description addressing the focus of the topic, including the importance and timeliness of the topic, and estimated attendance; (3) a list of the recent conferences in the same or closely related areas; (4) a tentative list of names and affiliations of the proposed principal speakers; and (5) a list of likely candidates who would be invited to participate and their current affiliations. Individuals submitting conference suggestions are requested to recommend sites or geographic areas which would assist the Meetings Department in their selection of an appropriate site.

1993 AMS Summer Institute
Summer Institutes are intended to provide an understandable presentation of the state of the art in an active field of research in pure mathematics and usually extend over a three-week period. Dates for a Summer Institute must not overlap those of the Society’s summer meeting, which is scheduled for August 15-19. There should be a period of at least two weeks between them. Proceedings are published by the AMS as volumes in the series Proceedings of Symposia in Pure Mathematics.

Current and recent topics:
1988—Operator theory/Operator algebras and applications, organized by William B. Arveson of the University of California, Berkeley, and Ronald G. Douglas of the State University of New York at Stony Brook.
1989—Several complex variables and complex geometry, organized by Steven G. Krantz of Washington University.
1990—Differential geometry, organized by Robert E. Greene of the University of California, Los Angeles, and Shing-Tung Yau of Harvard University.

Deadline For Suggestions: September 1, 1991

1993 AMS-SIAM-SMB Symposium
Some Mathematical Questions in Biology
This one-day symposium, sponsored jointly by the AMS, the Society for Industrial and Applied Mathematics (SIAM), and the Society for Mathematical Biology (SMB), is usually held in conjunction with the annual meeting of a biological society closely associated with the topic. Papers from the symposia are published by the AMS as volumes in the series Lectures on Mathematics in the Life Sciences.

Current and recent topics:
1988—Dynamics of excitable media, organized by Hans G. Othmer of the University of Utah.
1989—Sex allocation and sex change: Experiments and models, organized by Marc Mangel of the University of California, Davis.
1990—Neural Networks, organized by Jack D. Cowan of the University of Chicago.
1992—Proposal not yet selected.

Deadline For Suggestions: September 1, 1991

1993 AMS-SIAM Summer Seminar
The goal of the Summer Seminar, sponsored jointly by the AMS and the Society for Industrial and Applied Mathematics (SIAM), is to provide an environment and program in applied mathematics in which experts can exchange the latest ideas and newcomers can learn about the field. Proceedings are published by the AMS as volumes in the series Lectures in Applied Mathematics.
Call for Topics

1993 AMS-IMS-SIAM Joint Summer Research Conferences in the Mathematical Sciences

These conferences, jointly sponsored by the AMS, the Institute for Mathematical Statistics (IMS), and the Society for Industrial and Applied Mathematics (SIAM), emulate the scientific structure of those held at Oberwolfach and represent diverse areas of mathematical activity, with emphasis on areas currently especially active. Careful attention is paid to subjects in which there is important interdisciplinary activity at present. A one-week or two-week conference may be proposed. Topics for the tenth series of one-week conferences, being held in 1991, are: Stochastic modeling and statistical inference for selected problems in biology; Graph minors; Theory and applications of multivariate time series analysis; Stochastic inequalities; Biofluiddynamics; Motives; Mathematical aspects of classical field theory; and Systems of coupled oscillators.

Deadline For Suggestions: September 1, 1991

NOETHER-LEFSCHETZ THEORY AND THE PICARD GROUP OF PROJECTIVE SURFACES

Angelo Felice Lopez • Memoirs of the AMS, Number 438

This book deals with the study of curves lying on general members of families of smooth projective surfaces over the complex numbers. The guiding philosophy is that the set of curves on such surfaces is as small as it can possibly be; more precisely, this means that the group of classes of Cartier divisors (or, equivalently, the group of line bundles called the Picard group) of a general surface has the lowest possible rank given by the geometry of the family.

The focus of the book is Noether-Lefschetz theory, the study of the locus of smooth surfaces in $\mathbb{P}^3$ whose Picard group is not $\mathbb{Z}$. The first part of the book presents a brief survey of basic concepts and results, together with some natural questions arising in the theory. In the second part, a deformation-theoretic technique introduced by Griffiths and Harris is used to determine the Picard group of a general surface in $\mathbb{P}^1$ containing a fixed curve. This idea is generalized in the third part to families of surfaces in higher projective spaces, namely complete intersection surfaces in $\mathbb{P}^n$.

1980 Mathematics Subject Classifications: 14
ISBN 0-8218-2500-3, LC 90-19299, ISSN 0065-9266
112 pages (softcover), January 1991
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May 1991


INVITED SPEAKERS: J. Kaput (Southeastern Mass. Univ.) - Mathematics and technology-Multiple visions of multiple futures; C. Laborde (Grenoble) - Approches theoriques et methodologiques des recherches francaises en didactique des mathematiques.

INFORMATION: L. Jansson, Secretary-Treasurer CMESG, Faculty of Education, Univ. of Manitoba, Winnipeg, Manitoba R3T 2N2.

*24–25. Minisymposium on Nonlinear Diffusion Equations and their Equilibrium States, University of Minnesota, Minneapolis, MN.


INFORMATION: Institute for Mathematics and its Applications, Univ. of Minnesota, 514 Vincent Hall, 206 Church St. S.E., Minneapolis, MN 55455-0436; tel: 612-624-6066; Fax: 612-624-7370; ima_staff%csfsa.umn.edu@cs.umn.edu or ima_staff@ima.umn.edu.


30–31. Special Session on Polymer Configurations: Nonlinear and Nonlocal Diffusion

Problems, University of Minnesota, Minneapolis, MN. (Nov. 1990, p. 1286)

June 1991


INFORMATION: J. Parente, Statistics Center, 272 Caldwell Hall, Cornell Univ., Ithaca, NY 14853; 607-255-8066; cse@cornell.bitnet.


5–15. A Normal Form for the


* 10–12. Seventh Annual Symposium on Computational Geometry, North Conway, NH.

INFORMATION: S. Drysdale, Math. and Comp. Sci. Dept., Dartmouth College, Hanover, NH 03755; 603-646-2101.


ORGANIZERS: R. Grossman (Univ. of Illinois at Chicago), A. Nerode (Mathematical Sciences Institute, Cornell)

INFORMATION: R. Grossman, Univ. of Illinois at Chicago, Mail Code 249, Chicago, IL 60680; 312-413-2164; grossman@uiuc.edu or A. Nerode, MSI, Cornell Univ., 409 College Ave., Ithaca, NY 14850; 607-255-8005; anil@msun7.msi.cornell.edu.


FEATURED SPEAKER: M. Diener (U. Paris 7).

INFORMATION: Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.


* 13–15. Eighth Annual Workshop in Geometric Topology, University of Wisconsin-Milwaukee, WI.

SPONSORS: National Science Foundation and the University of Wisconsin-Milwaukee.


PRINCIPLE SPEAKER: A. Casson, Univ. of California, Berkeley.

INFORMATION: R. Ancel or C. Guibault, Dept. of Math., Univ. of Wisconsin-Milwaukee, Milwaukee WI 53201; 414-229-5269 (Ancel) or 414-229-4568 (Guelbault); email: aancel.cs4.csd.uwm.edu or craigg.cs4.csd.uwm.edu.


14–15. Western Section, Portland State University, Portland, Oregon.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


* 17–21. Géométrie Algébrique et théorie des codes (AGCT-3), Centre International de Rencontres Mathématiques.


INFORMATION: Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.


INFORMATION: R. Spigler, Dipartimento di Metodi e Modelli Matematici per le Scienze Applicate, Univ. of Padova, via Belzoni 7, 35131 Padova, Italy; Tel: 0039-49-83-19-14; Fax: 0039-49-83-19-95.


* 20–23. Fourth Boston Workshop for Mathematics Faculty, Wellesley College, Wellesley, MA.


20–27. NP-Completeness: The First 20 Years, Erice (Trapani), Sicily. (Jan. 1991, p. 47)
Meetings and Conferences


*28. A Conference to Honor Garrett Birkhoff on his 80th Birthday**, Harvard University, Cambridge, MA.

**PROGRAM:** This conference will be held concurrently with the 3rd IMACS International Symposium on Computational Acoustics. The one day program of presentations will have special emphasis on Birkhoff’s many contributions, and those of his past students, to those aspects of computational mathematics that are of importance in the numerical solution of partial differential equations.

**INFORMATION:** M.G. Cormier, Harvard Univ., Pierce Hall, 29 Oxford St., Cambridge, MA 02138; email: robinson@pacific.harvard.edu.


30–July 3. **Chaos and Catastrophes, Dynamical Systems Institute, Boston University, Boston, MA.** (Feb. 1991, p. 142)


**July 1991**


**INFORMATION:** R. Herman, rherman@cmms.umd.edu; fax: 301-405-9377; or B. Tanbay, tanbay@rboun.bitnet@cunyvm.cuny.edu; fax: 90-1-1513168.


**FEATURED SPEAKER:** A. Chenciner (U. Paris VII).

**INFORMATION:** Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.


2–5. **European Control Conference, Grenoble, France.** (Jul./Aug. 1990, p. 744)


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)


8–12. **Thirty-Fifth Annual Conference of the Australian Mathematical Society, Melbourne, Australia.** (Oct. 1990, p. 1139)


8–14. **ICOR ’91 International Conference**

MAY/JUNE 1991, VOLUME 38, NUMBER 5
8–26. 1991 Summer Research Institute on Algebraic Groups and their Generalizations, Pennsylvania State University, University Park, PA.

Informations: 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)


* 15–19. Semiconductors, Minneapolis, MN.

Informations: W. Miller, Jr., Institute for Mathematics and its Applications, Univ. of Minnesota, 514 Vincent Hall, 206 Church St. SE, Minneapolis, MN 55455.


Featured Speaker: D. Sotteau (U. Paris XI).

15–August 9. IMA Summer Program in Semiconductors, University of Minnesota, Minneapolis, MN. (Dec. 1990, p. 1456)

Organizer: N.L. White, Univ. of Florida. Informations: N. L. White, Dept. of Math., Univ. of Florida, Gainesville, FL 32611; 904-392-0281; white@math.ufl.edu.


21–25. Renormalization and Rigidity, Dynamical Systems Institute, Boston University, Boston, MA. (Feb. 1991, p. 143)
28–August 2. Conference on Symbolic Dynamics and its Applications, Yale University, New Haven, CT. (Nov. 1990, p. 1287)
29–August 9. SMS-NATO ASI: Universal Algebra and Orders, Université de Montréal, Montréal, Canada. (Dec. 1990, p. 1456)

August 1991

Informations: B. Verducci, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

* 1–2. Workshop on Non-Stationary Stochastic Process and Their Applications, Hampton University, Hampton, Virginia.

Purpose: To bring together the mathematicians and engineers working and applying non-stationary stochastic processes in one place to share their findings. There will be four invited one hour speakers as well as a chance of half hour talks by the interested participants. This workshop, organized jointly by Hampton Univ. and NASA Langley Research Center is going to be supported by a NASA grant. Reasonable housing and meals will be available through the Hampton Univ. dormitories.


* 4–24. SIMS Tutorial: Mathematical Sciences in Genomic Analysis, Stanford University, Stanford, CA.

Program: The Societal Institute of the Mathematical Sciences (SIMS) will conduct a three week tutorial on the Mathematical Sciences in Genomic Analysis. Those instructing the tutorial will demonstrate how mathematical and computational methods can be used effectively in genomic analysis—particularly in connection with the Human Genome Project. This tutorial is intended for advanced undergraduates, graduate students, and postdoctorals in the biological and mathematical sciences who have a keen interest in the application of quantitative methodologies to genomic analysis and who have had some experience in the application of quantitative methodologies to one or more scientific fields. Funds are available to qualified applicants for travel and living costs for the tutorial.

Tutorial Topics: Fragment assembly, informatics, pattern analysis of molecular sequences, DNA and protein structure predictions.

Invited Speakers: C.J. Benham, Mount Sinai School of Medicine; D. Botstein,
Meetings and Conferences


INFORMATION: SIMS, 97 Parish Road South, New Canaan, CT 06840; 203-966-1008; Fax: 203-972-6069.


INFORMATION: G.E. Lasker, Symposium Chairman, School of Computer Science, Univ. of Windsor, Windsor, Ontario N9B 3P4, Canada.


PROGRAM: The purpose of this meeting is to promote the collaboration of Finnish and Soviet specialists and young scientists. The scientific program will consist of a few main lectures and a session for contributed papers/posters.

INVITED SPEAKERS: M. Jacobsen (Copenhagen) and B. Øksendal (Oslo).

INFORMATION: A.-M. Dahlstrom, Secretary of the Mathematics department, tel: 358-21-654372; email: (earn/bitnet) adahlstrom@fina; (decnet) abovax:adahlstrom; (internet) adahlstrom@abo.fi.

6-7. AMS Short Course on the Unreasonable Effectiveness of Number Theory, University of Maine, Orono, ME.

INFORMATION: M. Foulkes, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


7-14. 1991 ASL European Summer Meeting (Logic Colloquium ’91) in conjunction with the Ninth International Congress of Logic, Methodology and Philosophy of Science, Uppsala, Sweden. (Dec. 1990, p. 1456)

8-10. 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)


12-16. Workshop on p-adic Monodromy and the Birch-Swinnerton-Dyer Conjecture, Boston University, Boston, MA. (Feb. 1991, p. 143)


PROGRAM: The purpose of this meeting is to promote the collaboration of Finnish and Soviet specialists and young scientists. The scientific program will consist of a few main lectures and a session for contributed papers/posters.

INVITED SPEAKERS: M. Jacobsen (Copenhagen) and B. Øksendal (Oslo).

INFORMATION: A.-M. Dahlstrom, Secretary of the Mathematics department, tel: 358-21-654372; email: (earn/bitnet) adahlstrom@fina; (decnet) abovax:adahlstrom; (internet) adahlstrom@abo.fi.

14-16. Short Conference on Uniform Mathematics and Applications (International Conference on Quasi-Uniformities and Related Structures), Bern, Switzerland. (Sep. 1990, p. 937)


18-30. Molecular Evolution, Marine Biological Laboratory, Woods Hole, MA.

PROGRAM: A series of lectures and discussions exploring multiple approaches to molecular evolution, and a computer laboratory for phylogenetic and sequence analysis. This two week program is designed for established investigators, post-doctoral fellows, and advance graduate students. Scientists with a strong interest in molecular evolution including organismic biologists, molecular biologists, and ecologists are encouraged to apply. In addition, mathematicians, statisticians and computer scientists with some background in molecular biology and with an interest in molecular evolution are encouraged to apply. Since a major goal of this program is to provide a forum for exchange of information between organismic and molecular biologists, students will be asked to actively participate in evening discussion sessions.

CONFERENCE TOPICS: The theoretical basis for comparative sequence analysis of proteins and nucleic acids; the analysis of genomic sequence data and identification of homologous sequences; the applicability of macromolecular sequences to phylogenetic analyses and contemporary approaches to molecular systematics; the impact of molecular phylogeny data on understanding the ecology and evolutionary history of liming systems; the use of model systems for the study of microevolution; the evolution of chromosomes and genomes; current views on the evolution of mutation rates, introns, transposable elements, repeated DNA sequences, and multi-gene families.

INFORMATION: F. Dwane, Admissions Coordinator, Marine Biological Laboratory, Woods Hole, MA 02543; 508-548-3705 ext. 216.


19-23. NSF-CBMS Regional Research Conference in the Mathematical Sciences: Qualitative and Structured Matrix Theory, Georgia State University, GA. (Dec. 1990, p. 1456)


19-24. NSF-CBMS Regional Conference on Qualitative and Structured Matrix Theory, Georgia State University, Atlanta, GA. (Mar. 1991, p. 242)


19-September 6. College on Singularity Theory, Trieste, Italy. (Sep. 1990, p. 938)

* 20-25. The II International Conference on Algebra in Honor of A.I. Shirshov (1921–
Meetings and Conferences

1981), Altai University, Barnaul, USSR. (Please note changes from Jul./Aug. 1990, p. 745)

PROGRAM: The main sections of the conference will be 1). Group theory, 2). Ring theory, 3). Model theory and algebraic systems, 4). Algebraic methods in geometry, analysis and theoretical physics, 5). Applied and computer algebra. Talks of 60, 45, and 30 minutes are planned.


INFORMATION: USSR, 630090, Novosibirsk, Institute of Mathematics, S.A. Syskin; Tel: (3832) 351568, 354462; Telex: 133146 TEVUS; Fax: (3832) 352653.


FEATURED SPEAKER: J.-M. Deshouillers (U. Bordeaux I).

INFORMATION: Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.

3–6. Seventeenth International Conference on Very Large Data Bases (VLDB ‘91), Barcelona, Spain. (Jan. 1991, p. 49)


4–10. IMA Tutorial, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1139)


PROGRAM: To bring together invited foreign specialists and Romanian geometers and topologists.

CONFERENCE TOPICS: Lagrangian and Hamiltonian geometries, partial differential equations on manifolds, submanifolds, convexity and extremal problems, Morse theory, dynamical systems, fiberings, foliations, Gauge theory, applications of geometry and topology to sciences, teaching and the nature of geometry and topology, etc.

CALL FOR PAPERS: Two copies of titles, authors, all author's addresses, summaries and full papers should be submitted by May 15, 1991.


FEATURED SPEAKER: P. Liardet (U. Aix-Marseille I).

INFORMATION: Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.

9–27. School on Dynamical Systems, Trieste, Italy. (Sep. 1990, p. 938)


PROGRAM: The conference is arranged as a Seminar-Workshop and will be devoted to provide an exhaustive and updated overview of parallel numerical methods for the solution of Ordinary Differential Equations.

ORGANIZERS: A. Bellen (Univ. of Trieste), M. Zennaro (Univ. of L’Aquila).

INVITED SPEAKERS: K. Burrage (Auckland, New Zealand), I. Galligani (Univ. Bologna, Italy), C.W. Gear (NEC Princeton, NJ), Z. Jackiewicz (Arizona State Univ., AZ), P.J. van der Houwen (CWI Amsterdam, Netherlands), O. Nevanlinna (Univ. Helsinki), S.P. Norsett (NTH Trondheim), D. Trigiante (Univ. Bari, Italy), M. Zennaro (Univ. L’Aquila, Italy).

INFORMATION: The registration fee is $90 to be paid on arrival. Contact: A. Bellen, Dip. di Scienze Matematiche, Universita’ I-34100 Trieste, Italy; email: na.bellen@na-net.orl.gov or bellen@univ.trieste.it.

11–14. Fourth SIAM Conference on Applied Linear Algebra, Univ. of Minnesota, Minneapolis, MN. (Nov. 1990, p. 1288)


* 16–18. IFAC/IFIP/IMACS Symposium on Robot Control (SYROCO ‘91), Vienna, Austria. (Please note date change from Oct. 1990, p. 1140)

16–20. Summer School on Minimal Models, Lie Groups and Differential Geometry, Universidad de Santiago de Compostela,
Spain. (Feb. 1991, p. 144)


**Featured Speakers:** J.-P. Francoise (U. Paris 6), R. Roussarie (U. de Dijon).
**Information:** Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.


**23. One Day Function Theory Meeting, University of Lancaster, Lancaster, England.**

**Sponsor:** London Mathematical Society.
**Information:** D. Kershaw, email: maa013@central1.lancaster.ac.uk; Fax: (+44 524) 841710.


**Information:** Y. May, Conference Officer, The Institute of Mathematics and its Applications, 16 Nelson St., Southend-on-Sea, Essex SS1 1EF, England.

*23–27. Cryptothéorie, Centre International de Rencontres Mathématiques.

**Featured Speaker:** J. Stern (ENS, Paris).

**Information:** Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.


**Program:** This is the inaugural conference of the Center for Nonlinear Analysis of Carnegie Mellon Univ. and Hampton Univ. Limited financial support is available for other participants.

**Information:** CNA Conference, Dept. of Math., Carnegie Mellon Univ., Pittsburgh, PA 15213-3890; Fax: (412) 268-6380; email: shreve@galley.ece.cmu.edu.


**Invited Speakers:** M. Artin (MIT), R. Dipper (Univ. of Oklahoma), M. Kapranov (Cornell), B. Parshall (Univ. of Virginia), N. Reshetikhin (Harvard Univ.), L. Scott (Univ. of Virginia), S. Paul Smith (Univ. of Washington), J.T. Stafford (Univ. of Michigan), J. Stasheff (Univ. of North Carolina).

**Information:** To the organizers: E. Kirkman, Dept. of Math., Wake Forest Univ., Winston-Salem, NC 27109; 919-759-5351; kirkman@mathcsc.wfu.edu; or J. Kuzmanovich, Wake Forest Univ., 919-759-5300; kuz@mathcsc.wfu.edu.


30–October 2. First International Conference of the Austrian Center for Parallel Computation (ACPC), Salzburg, Austria. (Feb. 1991, p. 145)

*30–October 4. Journées de Probabilités, Centre International de Rencontres Mathématiques.

**Featured Speakers:** J. Azéma, M. Yor (U. Paris 6).

**Information:** Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.

October 1991


7–11. Workshop on Stochastic and Deterministic Models, Trieste, Italy. (Sep. 1990, p. 938)

7–11. IMACS-INRIA Workshop on Transfer of Mathematics to Industry in the U.S. and France, University of Minnesota, Minneapolis, MN. (Dec. 1990, p. 1458)


**Information:** W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


*14–16. Mathématique et Informatique, Centre International de Rencontres Mathématiques.

**Featured Speakers:** J.M. Boe (U. de Montpellier).

**Information:** Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.

14–18. IMACS 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)

*16–18. IFAC/IMACS/IFIP Workshop on Cultural Aspects of Automation, Krems, Austria.

**Program:** Scope: Promotion and understanding interplay between technological development, social conditions and effects, and cultural change. To develop and transfer views and methodologies that include cultural aspects to control engineers and interdisciplinary groups dealing with constructions and systems designs.

**Information:** P. Kopacek, O.P.W.Z., A-1014 Wien, Rockgasse 6, Austria.


*21–25. Analyse Algébrique des Perturbations Singulières, Centre International de Rencontres Mathématiques.

**Featured Speaker:** L. Boutet de Monvel (U. Paris 6).

**Information:** Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.

21–26. Third International Workshop—Conference on Evolution Equations, Control Theory, and Biomathematics, Han-sur-
Meetings and Conferences

Lesse, Belgium. (Nov. 1990, p. 1288)
25–26. Central Section, North Dakota State University, Fargo, ND.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940. Please note correct date of meeting from previous Notices listings.


November 1991

*1–3. Partial Differential Equations and Mechanics, Southern Illinois University, Carbondale, IL.

PURPOSE: This meeting is the annual meeting of the Society for Natural Philosophy. The SNP nourishes specific research aimed at the unity of the mathematical and physical sciences. It seeks to recognize and promote work of high quality. It operates through the organization of selective meetings on topics of common interest to small groups of mathematicians, physicists, chemists, and engineers.


INVITED SPEAKERS: C. Amick (Chicago), S. Antman (Maryland), J. Bona (Penn State), I. Fonseca (Carnegie Mellon), R. Gariepy (Kentucky), D. Phillips (Purdue), M. Renardy (Virginia Tech.), M. Slemrod (Wisconsin), W. Ziemer (Indiana).

CALL FOR PAPERS: A limited number of papers involving the use of PDE's in a mechanics problem will be selected. Abstract deadline: September 15, 1991.

INFORMATION: SIUC, Dept. of Math., Carbondale, IL 62901-4408; 618-453-5302; email: ge0641@siucvmb.bitnet.

*3–6. ORSA/TIMS Joint National Meeting, Anaheim, CA.

PROGRAM: The theme of the Joint National Meeting of the Operations Research Society of America (OSRA) and The Institute of Management Science (TIMS) “Toward Global Excellence: Technology, Quality and Service,” is designed to stimulate presentation of cutting edge research on topics which enable organizations to achieve competitive advantage and global excellence.

INFORMATION: ORSA/TIMS Anaheim, c/o ORSA Business Office, 1314 Guilford Ave., Baltimore, MD 21202.


FEATURED SPEAKER: Ph. Picard (U. de Lyon I).

INFORMATION: Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.


INVITED SPEAKERS: J.D. Berg, Univ. of Illinois; R. Foote, Wabash College; S.G. Harris, St. Louis Univ.; G.R. Jensen, Washington Univ.; J. Kaminker, Indiana Univ.-Purdue Univ. Indianapolis.


9–10. Western Section, University of California, Santa Barbara.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

11–15. IMA Workshop on Combinatorial and Graph-Theoretic Problems in Linear Algebra, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1140)


18–22. Workshop on Discrete Groups, Number Theory and Ergodic Theory, Mathematical Sciences Research Institute (MSRI), Berkeley, CA.

PROGRAM: This is the first workshop planned as part of MSRI's 1991-1992 program on Lie Groups and Ergodic Theory.

ORGANIZING COMMITTEE: M. Burger, M. Ratner, and P. Sarnak (Chair).

INFORMATION: I. Kaplansky, Director, Mathematical Sciences Research Institute, 1000 Centennial Dr., Berkeley, CA 94720.


FEATURED SPEAKER: L. Niglio (U. d’Avignon).

INFORMATION: Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.


PROGRAM: The conference will cover recent developments of representation theories of real and p-adic Lie groups, Lie algebras and quantum groups, harmonic analysis on homogeneous spaces, their applications and related topics.

ORGANIZING COMMITTEE: M. Hashizume (Okayama), K. Kumahara (Tottori), H. Midorikawa (Tokyo), M. Wakayama (Tottori).

INFORMATION: M. Wakayama, Dept. of Math., Tottori Univ., Tottori 680, Japan; Fax: Japan 857(28)6343; email: dp54677@jpukdpc.bitnet.

December 1991

Fourth International Conference on Numerical Combustion, St. Petersburg, FL. (Feb. 1991, p. 146)


*2–4. Fourth International Conference on Numerical Combustion, St. Petersburg, FL.

ORGANIZER: J.D. Buckmaster, Univ. of Illinois, Urbana.


INFORMATION: SIAM Conference Department, 3600 University City Science Center, Philadelphia, PA 19104-2688; 215-382-9800; Fax: 215-386-7999; email: siamcnsf@wharton.upenn.edu.

*2–4. Titre à Préciser, Centre International de Rencontres Mathématiques.

FEATURED SPEAKER: A. Galligo (U. de Nice).

INFORMATION: Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.

2–6. Workshop on Statistical Methods in Imaging, Mathematical Sciences Research
Meetings and Conferences

Institute, Berkeley, CA. (Oct. 1990, p. 1140)

2–9. SIAM Conference on Combustion, St. Petersburg, FL. (Nov. 1990, p. 1289)


FEATURED SPEAKER: E. Bayer (U. de Besancon).

INFORMATION: Société Mathématique de France, Centre International de Rencontres Mathématiques, Case 916, Luminy, 13288 Marseille Cedex 9.


PROGRAM: The objective of the SSA-IMACS conference is to provide for the exchange of information and ideas between those concerned with modelling and simulation and, in particular, between methodologists and practitioners.


INFORMATION: D.G. Mayer, Biometry Branch, Old Dept. of Plant Industries, GPO Box 46, Brisbane, Queensland 4001, Australia; tel: (07) 239-3618; Fax: (07) 239-3199.


1992


IMACS International Conference on Computational Physics, University of Colorado, Boulder, CO. (Oct. 1990, p. 1141)


CONFERENCE TOPICS: Methodologies, expert systems, software tools, applications.

INFORMATION: I. Troch, Technische Univ. Wien, Wiedner Hauptstrasse 6-10, A-1040 Wien, Austria.


INFORMATION: J.R. Rice, Dept. of Computer Science, Purdue Univ., West Lafayette, IN 47907; or R. Vichnevetsky, Dept. of Computer Science, Rutgers Univ., New Brunswick, NJ 08903.

January 1992


8–11. Joint Mathematics Meetings, Baltimore, MD. (Including the annual meetings of the AMS, AWM, MAA and NAM)

INFORMATION: H. Daly, AMS, PO. Box 6248, Providence, RI 02940.


13–17. IMA Workshop on Linear Algebra, Markov Chains, and Queueing Models, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)

*15–17. Workshop on Stochastics and Analysis, Universität Zürich, Zürich, Switzerland.

ORGANIZERS: H. Amann, P. Hess, E. Bolthausen, M. Nagasawa (Uni Zürich); J.D. Deuschel, A.S. Sznitman (ETH Zürich).


INFORMATION: Workshop Secretary, Institut für Angewandte Mathematik, Universität Zürich, Rämistrasse 74, CH-8001, Zürich, Switzerland; Fax: (+441) 262 08 40.


February 1992


*10–11. Workshop on Amenable Ergodic Theory, Mathematical Sciences Research Institute (MSRI), Berkeley, CA.

PROGRAM: This is the second of three workshops planned as part of MSRI's 1991-1992 program on Lie Groups and Ergodic Theory.

ORGANIZING COMMITTEE: H. Furstenberg (Chairman), D. Ornstein, B. Weiss.

INFORMATION: I. Kaplansky, Director, Mathematical Sciences Institute, Berkeley, CA 94720.


*24–March 1. IMA Workshop on Iterative Methods for Sparse and Structured Problems, University of Minnesota, Minneapolis, MN. (Please note addition to Oct. 1990, p. 1141)

SPONSORS: Co-sponsored with the Minnesota Supercomputer Institute.

March 1992


13–14. Southeastern Section, University of Alabama, Tuscaloosa, AL.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

April 1992


11–12. Eastern Section, Lehigh University, Bethlehem, PA.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


PROGRAM: This is one of the three workshops planned as part of MSRI’s 1991-1992 program on Lie Groups and Ergodic Theory.

ORGANIZING COMMITTEE: A. Katok, R. Spatzier, R. Zimmer (Chair).

INFORMATION: I. Kaplansky, Director, Mathematical Sciences Research Institute, 1000 Centennial Dr., Berkeley, CA 94720.


May 1992


June 1992


*1–5. Seventh International Conference on Graph Theory, Combinatorics, Algorithms, and Applications, Western Michigan University, Kalamazoo, MI.


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.

1–5. IMA Workshop on Linear Algebra for Control Theory, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)


*8–11. Sixth SIAM Conference on Discrete Mathematics, University of British Columbia, Vancouver, Canada.


INFORMATION: SIAM Conference Department, 3600 University City Science Center, Philadelphia, PA 19104-2688; 215-382-9800; Fax: 215-386-7999; email: siamconfs@wharton.upenn.edu.


14–20. Fifth International Symposium on Statistical Decision Theory and Related Topics, Purdue University, West Lafayette, IN. (Sep. 1990, p. 938)


INFORMATION: H. Daly, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.


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.

July 1992


PROGRAM: This is the first Congress of the European Mathematical Society (EMS). There will be forty-one conferences on pure and applied mathematics and fifteen round tables on the general theme “Mathematics and Society”.

INFORMATION: ECM, College de France, 3 rue d’Ulm, F-75005, Paris, France.


CALL FOR PAPERS: Papers on all branches of mathematics and science related to the Fibonacci numbers and generalized Fibonacci numbers as well as papers related to recurrences and their generalizations are welcome. Abstracts are to be submitted by March 15, 1992, while manuscripts
Meetings and Conferences

are due by May 1, 1992. Abstracts and manuscripts should be sent in duplicate following the guidelines for submission of articles found on the inside front cover of any recent issue of The Fibonacci Quarterly.

INFORMATION: S. Tzafestas, Intelligent Robotics and Control Unit Computer Science Division, National Technical Univ. of Athens, Zografou 15773, Athens, Greece; Fax: 30-1-7757504; or T. Takamori, Dept. of Instrumentation Engineering, Faculty of Engineering, Kobe Univ., Rokkodai 1-1, Nada, Kobe 657, Japan; tel: (078) 881-1212; Fax: (078) 861-8099.

September 1992


INFORMATION: W. Chuan-Yuan, Chinese Association for System Simulation, 37 Xue Yuan Rd., Beijing 100083, China.

October 1992


INFORMATION: FID’92 Organizing Committee, ICYT, Joaquin Costa, 22., 28002 Madrid, Spain; Tel: 34-1-563-54 82; Fax: 34-1-564 26 44; Telex 22628 CIDMD-E; email: bib-icyt@bib.csic.es.

August 1992

* 26–28. IMACS RM2S ’92 Kobe, Kobe University, Kobi, Japan.

PROGRAM: The aim of RM2S’92 is to provide a forum for the presentation and discussion of the recent advance of Robotics, Mechatronics and Manufacturing Systems.

INFORMATION: G.E. Bergum, Dept. of Computer Science, South Dakota State University, P.O. Box 2201, Brookings, SD 57007-0194.


Program: The RGD Symposia serve as the principle forum for reporting recent advances in kinetic theory, transport processes and nonequilibrium phenomena with applications to numerous overlapping disciplines of interest to physicists, chemists, engineers and mathematicians.

CONFERENCE TOPICS: Kinetic theory methods and transport theory; mathematical methods including discrete velocity models; numerical methods including Monte Carlo simulations and cellular automata; gas surface phenomena and beams; clusters and aerosols; RGD aspects of condensation and evaporation; RGD gas dynamics and jets including vacuum technology, vehicle aerodynamics and external flows; relaxation processes, reaction rates and gas dynamical shocks; RGD in space engineering with microgravity; plasma processing of materials and electron transport; RGD in ionized gases and plasmas; RGD in space science; experimental aspects and instrumentation in RGD; collision dynamics in RGD.


INFORMATION: B. Shizgal, RGD18, Dept. of Chemistry, Univ. of British Columbia, Vancouver, BC Canada V6T 1Y6; 604-822-3997 or 604-822-3266; Fax: 604-822-2847; email: rgd18@ubcmtsg.bitnet.

November 1992


INFORMATION: K.K. Azad, Secretary, Allahabad Mathematical Society, 10, C.S.P. Singh Marg, Allahabad-211001, India.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

December 1992

* 7–11. IMACS Symposium on Scientific Computing and Mathematical Modelling, Bangalore, India.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

January 1993


PROGRAM: The major theme of this conference is the ubiquitousness of the differential equation in Applied Mathematics and will focus in part on both modelling and computational aspects in this respect.

CONFERENCE TOPICS: Numerical methods for the solution of initial value and boundary value problems with or without algebraic constraints; delay differential equations; Volterra integral equations; applications to time-dependent partial differential equations and practical algorithms.

INFORMATION: J. Butcher, Dept. of Math. and Stats., Univ. of Auckland, Auckland, New Zealand.

May 1993

* 20–23. International Conference on Approximation Probability and Related Fields, University of California, Santa Barbara, CA.

ORGANIZERS: G.A. Anastassiou (Memphis State Univ.), S.T. Rachev (Univ. of California, Santa Barbara).


21–22. Central Section, Northern Illinois University, DeKalb, IL.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

October 1993

22–23. Central Section, Texas A&M University, College Station, TX.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.
THE THEORY OF SUBNORMAL OPERATORS
John B. Conway
(Mathematical Surveys and Monographs, Volume 36)

"In a certain sense, subnormal operators were introduced too soon because the theory of function algebras and rational approximation was also in its infancy and could not be properly used to examine this class of operators. The progress in the theory of subnormal operators that has come about during the last several years grew out of applying the results of rational approximation."—from the Preface

This book is the successor to the author's 1981 book on the same subject. In addition to reflecting the great strides in the development of subnormal operator theory since the first book, the present work is oriented toward rational functions rather than polynomials. Although the book is a research monograph, it has many of the traits of a textbook, including exercises.

The book requires background in function theory and functional analysis, but is otherwise fairly self-contained. The first few chapters cover the basics about subnormal operator theory and present a study of analytic functions on the unit disk. Other topics included are: some results on hyponormal operators, an exposition of rational approximation interspersed with applications to operator theory, a study of weak-star rational approximation, a set of results that can be termed structure theorems for subnormal operators, and a proof that analytic bounded point evaluations exist.

BIOGRAPHY

John B. Conway was born on September 22, 1939 in New Orleans, L.A. He received his Ph.D. from Louisiana State University in 1965, having written his thesis under the direction of Heron S. Collins. From 1965 until 1990 he was on the faculty of Indiana University, where he had sixteen doctoral students. During this time he had extended visits at the University of California at Berkeley, the Free University of Amsterdam, and the University of Grenoble. In the fall of 1990 he became the head of the Mathematics Department at the University of Tennessee, his present position.

Professor Conway's research interests began with his thesis on topological vector spaces of functions and measures and has evolved to the theory of operators on Hilbert space. His particular avocation is what might be called "function theoretic operator theory," which is a serious mix of operators and analytic functions. The present Survey is a good example of this mix.

In addition to more than 50 research papers, Professor Conway has written graduate textbooks in complex analysis and functional analysis.

Contents
Preliminaries; Subnormal operators: The elementary theory; Function theory on the unit circle; Hyponormal operators; Uniform rational approximation; Weak-star rational approximation; Some structure theory for subnormal operators; Bounded point evaluations.

1980 Mathematics Subject Classification: 47B20
ISBN 0-8218-1536-9, LC 90-26659, ISSN 0076-5376
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LITTLEWOOD-PALEY THEORY AND THE STUDY OF FUNCTION SPACES
Michael Frazier, Björn Jawerth, and Guido Weiss
(CBMS Regional Conference Series, Number 79
Supported by the National Science Foundation)

Littlewood-Paley theory was developed to study function spaces in harmonic analysis and partial differential equations. Recently, it has contributed to the development of the $\phi$-transform and wavelet decompositions. Based on lectures presented at the NSF-CBMS Regional Research Conference on Harmonic Analysis and Function Spaces, held at Auburn University in July 1989, this book is aimed at mathematicians, as well as mathematically literate scientists and engineers interested in harmonic analysis or wavelets. The authors provide not only a general understanding of the area of harmonic analysis relating to Littlewood-Paley theory and atomic and wavelet

Use the order form in the back of this issue or call 800-321-4AMS (800-321-4267) in the U.S. and Canada to use VISA or MasterCard.
decompositions, but also some motivation and background helpful in understanding the recent theory of wavelets. The book begins with some simple examples which provide an overview of the classical Littlewood-Paley theory. The \( \phi \)-transform, wavelet, and smooth atomic expansions are presented as natural extensions of the classical theory. Finally, applications to harmonic analysis (Calderón-Zygmund operators), signal processing (compression), and mathematical physics (potential theory) are discussed.

Contents

Calderón’s formula and a decomposition of \( L^1(\mathbb{R}^n) \); Decomposition of Lipschitz spaces; Minimality of \( \Omega^{1/2} \); Littlewood-Paley theory; The Besov and Triebel--Lizorkin spaces; The \( \varphi \)-transform; Wavelets; Calderón--Zygmund operators; Potential theory and a result of Muckenhoupt--Wheeden; Further applications.

1980 Mathematics Subject Classifications: 42B25, 42C15
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STORIES ABOUT MAXIMA AND MINIMA

V. M. Tikhomirov (translated by Abe Shenitzer)
(Mathematical World, Volume 1)

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

Ancient maximum and minimum problems
1. Why do we solve maximum and minimum problems?
2. The oldest problem—Dido’s problem
3. Maxima and minima in nature (optics)
4. Maxima and minima in geometry
5. Maxima and minima in algebra and in analysis
6. Kepler’s problem
7. The brachistochrone
8. Newton’s aerodynamical problem

Methods of solution of extremal problems
9. What is a function?
10. What is an extremal problem?
11. Extrema of functions of one variable
12. Extrema of functions of many variables. Lagrange’s principle
13. More problem solving
14. What happened later in the theory of extremal problems
15. The fifteenth story, or rather, a discussion

1980 Mathematics Subject Classifications: 00, 01, 46, 49
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MATHEMATICS OF RANDOM MEDIA

Werner E. Kohler and Benjamin S. White, Editors
(Lectures in Applied Mathematics, Volume 27)

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

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

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

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

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

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

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

Contents


1980 Mathematics Subject Classifications: 60H10, 60J60, 60K35, 82A42, 82A43, 35R60, 60H25, 60JXX, 82A70
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COMPUTER-AIDED VERIFICATION ’90
E. M. Clarke and R. P. Kurshan, Editors
(Proceedings of a DIMACS Workshop, Volume 3)

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

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

Contents

E. M. Clarke, Jr., Temporal logic model checking: Two techniques for avoiding the state explosion problem; H. Eveking, Automatic verification of extensions of hardware descriptions; D. K. Probst and H. F. Li, Using partial-order semantics to avoid the state explosion problem in asynchronous systems; A. Valmari, A stubborn attack on state explosion; G. Berthelot, C. Johnen, and L. Petrucci, PAPETRI: Environment for the analysis of PETRI nets; S. Graf and B. Steffen, Compositional minimization of finite state systems; O. Couderd, J. C. Madre, and C. Berthet, Verifying temporal properties of sequential machines without building their state diagrams; A. Bouajjani, J-C. Fernandez, and N. Halbwachs, Minimal model generation; J. R. Burch, Verifying liveness properties by verifying safety properties; M. Barbeau and G. V. Bochmann, Extension of the Karp and Miller procedure to LOTOS specifications; R. E. Bryant and C.-J. H. Seger, Formal verification of digital circuits using symbolic ternary system models; M. B. Josephs and J. T. Udding, An algebra for delay-insensitive circuits; H. Wong-Toi and D. L. Dill, Synthesizing processes and schedulers from temporal specifications; P. Loewenstein and D. L. Dill, Verification of multiprocessor cache protocol using simulation relations and higher-order logic; C. Courcoubetis, M. Vardi, P. Wolper, and M. Yannakakis, Memory efficient algorithms for the verification of temporal


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APPLIED GEOMETRY AND DISCRETE MATHEMATICS: THE VICTOR KLEE FESTSCHRIFT
Peter Gritzmann and Bernd Sturmfels, Editors
(Proceedings of a DIMACS Workshop, Volume 4)

This volume, published jointly with the Association for Computing Machinery, comprises a collection of research articles celebrating the occasion of Victor Klee's sixty-fifth birthday in September 1990. During his long career, Klee has made contributions to a wide variety of areas, such as discrete and computational geometry, convexity, combinatorics, graph theory, functional analysis, mathematical programming and optimization, and theoretical computer science. In addition, Klee made important contributions to mathematics education, mathematical methods in economics and the decision sciences, applications of discrete mathematics in the biological and social sciences, and the transfer of knowledge from applied mathematics to industry. In honor of Klee's achievement, this volume presents more than forty papers on topics related to Klee's research. While the majority of the papers are research articles, a number of survey articles are also included. Mirroring the breadth of Klee's mathematical contributions, this book shows how different branches of mathematics interact. It is a fitting tribute to one of the foremost leaders in discrete mathematics.

Contents


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RELIABILITY OF COMPUTER AND COMMUNICATION NETWORKS
Fred Roberts, Frank Hwang, and Clyde Monma, Editors
(Proceedings of a DIMACS Workshop, Volume 5)

Reliability problems arise with increasing frequency as our modern systems of telecommunications, information transmission, transportation, and distribution become more and more complex. In December 1989 at DIMACS at Rutgers University, a Workshop on Reliability of Computer and Communication Networks was held to examine the discrete mathematical methods relevant to these problems. There were nearly ninety participants, including theoretical mathematicians, computer scientists, and electrical engineers from academia and industry, as well as network practitioners, engineers, and reliability planners from leading companies involved in the use of computer and communications networks. This volume, published jointly with the Association for Computing Machinery, contains the proceedings from this Workshop.

The aim of the Workshop was to identify the latest trends and important open problems, as well as to survey potential practical applications. The Workshop explored questions of computation of reliability of existing systems and of creating new designs to insure high reliability, in addition to the closely related notion of survivability. Redundancy, single stage and multistage networks, interconnected networks, and fault tolerance were also covered. The Workshop emphasized practical applications, with many invited speakers from a variety of companies which are dealing with practical network reliability problems. The success of the Workshop in fostering many new interactions among researchers and practitioners is reflected in the proceedings, which provide an exciting look at some of the major advances at the forefront of this important field of research.

Contents


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STATISTICAL MULTIPLE INTEGRATION
Nancy Flournoy and Robert K. Tsutakawa, Editors
(Contemporary Mathematics, Volume 115)

High dimensional integration arises naturally in two major subfields of statistics: multivariate and Bayesian statistics. Indeed, the most common measures of central tendency, variation, and loss are defined by integrals over the sample space, the parameter space, or both. Recent advances in computational power have stimulated significant new advances in both Bayesian and classical multivariate statistics. In many statistical problems, however, multiple integration can be the major obstacle to solutions.

This volume contains the proceedings of an AMS-IMS-SIAM Joint Summer Research Conference on Statistical Multiple Integration, held in June 1989 at Humboldt State University in Arcata, California. The conference represents an attempt to bring together mathematicians, statisticians, and computational scientists to focus on the many important problems in statistical multiple integration. The papers document the state of the art in this area with respect to problems in statistics, potential advances blocked by problems with multiple integration, and current work directed at expanding the capability to integrate over high dimensional surfaces.

Contents

N. Flournoy, Preface; K. Berger, Introduction; D. K. Kahaner, A survey of existing multidimensional quadrature routines; A. Genz, Subregion adaptive algorithms for multiple integrals; E. de Doncker and J. A. Kapenga, Parallel systems and adaptive integration; M. Mascagni, High-dimensional numerical integration and massively parallel computing; R. K. Tsutakawa, Multiple integration in Bayesian psychometrics; R. E. Kass, L. Tierney, and J. B. Kadane, Laplace's method in Bayesian analysis; R. L. Wolpert, Monte Carlo integration in Bayesian statistical analysis; J. Geweke, Generic, algorithmic approaches to Monte Carlo integration in Bayesian inference; M. Evans, Adaptive importance sampling and chaining; P. Müller, Monte Carlo integration in general dynamic models; M.-S. Oh, Monte Carlo integration via importance sampling; Dimensionality effect and an adaptive algorithm; V. Luzar and I. Olkin, Comparison of simulation methods in the estimation of the ordered characteristic roots of a random covariance matrix; J. F. Monahan and R. F. Liddle, A stationary stochastic approximation method; Y. L. Tong, Inequalities and bounds for a class of multiple probability integrals, with applications; V. K. Kaishev, A Gaussian cubature formula for the computation of generalized B-splines and its application to serial correlation; J. P. Hardwick, Computational problems associated with minimizing the risk in a simple clinical trial; J. H. Albert, Discussion on papers by Geweke, Wolpert, Evans, Oh, and Kass, Tierney, and Kadane; R. Sharmugam, Comments on computational conveniences discussed in articles by Evans, Geweke, Müller, and Kass-Tierney-Kadane; I. Olkin, A discussion of papers by Genz, Tsutakawa, and Tong; N. Flournoy, A discussion of papers by Luzar and Olkin, Kaishev, and Monahan and Liddle.

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ALGEBRAIC GEOMETRY: SUNDANCE 1988
Brian Harbourne and Robert Speiser, Editors
(Contemporary Mathematics, Volume 116)

This volume contains the proceedings of the NSF-CBMS Regional Conference on Algebraic Geometry, held in Sundance, Utah in July 1988. The conference focused on algebraic curves and related varieties. Some of the papers collected here represent lectures delivered at the conference, some report on research done during the conference, while others describe related work carried out elsewhere.

Contents
S. Diaz and R. Donagi, Hirzebruch surfaces with nontrivial divisors; L. Ein, Normal sheaves of linear systems on curves; D. Gieseker, K. Hulek, and E. Trubowitz, An overview of the geometry of algebraic Fermi curves; B. Harbourne, Automorphisms of cuspidal K3-like surfaces; S. Katz, Small resolutions of Gorenstein threefold singularities; S. L. Kleiman, Multiple tangents of smooth plane curves (after Kaji); S. L. Kleiman and Robert Speiser, Enumerative geometry of nonsingular plane cubics; R. Miranda, The Gaussian map for certain planar graph curves; Z. Ran, Absence of the Veronese from smooth threefolds in $\mathbb{P}^5$; R. Speiser, Limits of conormal schemes.

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CONTINUUM THEORY AND DYNAMICAL SYSTEMS
Morton Brown, Editor
(Contemporary Mathematics, Volume 117)

This volume contains the proceedings of the AMS-IMS-SIAM Joint Summer Research Conference on Relationships between Continuum Theory and the Theory of Dynamical Systems, held at Humboldt State University in Arcata, California in June 1989. The conference reflected recent interactions between dynamical systems and continuum theory, illustrating the increasing confluence of these two areas, this volume contains introductory papers accessible to mathematicians and graduate students in any area of mathematics, as well as papers aimed more at specialists. Most of the papers are concerned with the dynamics of surface homeomorphisms or of continua that occur as attractors for surface homeomorphisms.

Contents
J. M. Aarts and L. G. Oversteegen, Whitney's regular families of curves revisited; S. Baldwin, Sets of periodic points of functions on trees; M. Barge and R. M. Gillette, Indecomposability and dynamics of invariant plane separating continua; B. L. Brechner, M. D. Guay, and J. C. Mayer, Rotational dynamics on cofounders; M. Brown, Fundamental regions of planar homeomorphisms; K. M. Brucks, B. Diamond, M. V. Otero-Espinar, and C. Tresser, Dense orbits of critical points for the tent map; J. Franks and J. Llibre, Periods of surface homeomorphisms; C. L. Hagopian, Fixed-point problems in continuum theory; J. Kennedy, A Technique for constructing examples; W. Lewis, Continuum theory and dynamics problems; W. Lewis, The pseudo-arcs; S. Li, Dynamical properties of the shift map on the inverse limit space; A. Norton, Minimal sets, wandering domains, and rigidity in the 2-torus; J. T. Rogers, Jr., Rotations of simply-connected regions and circle-like continua; R. M. Schori, Chaos: An introduction to some topological aspects; R. F. Williams, How big is the intersection of two thick Cantor sets?; M. Barge and M. Brown, Problems in dynamics on continua.

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PROBABILITY THEORY AND ITS APPLICATIONS IN CHINA
Yan Shi-Jian, Yang Chung-Chun, and Wang Jia-Gang, Editors
(Contemporary Mathematics, Volume 118)

Probability theory has always been an active field of research in China, but, until recently, almost all of this research was written in Chinese. This book contains surveys by some of China’s leading probabilists, with a fairly complete coverage of theoretical probability and selective coverage of applied topics. The purpose of the book is to provide an account of the most significant results in probability obtained in China in the past few decades and to promote communication between probabilists in China and those in other countries. This collection will be of interest to graduate students and researchers in mathematics and probability theory, as well as to researchers in such areas as physics, engineering, biochemistry, and information science.

Among the topics covered here are: stochastic analysis, stochastic differential equations, Dirichlet forms, Brownian motion and diffusion, potential theory, geometry of manifolds, semi-martingales, jump Markov processes, interacting particle systems, entropy production of Markov processes, renewal sequences and $p$-functions, multi-parameter stochastic processes, stationary random fields, limit theorems, strong approximations, large deviations, stochastic control systems, and probability problems in information theory.

Contents
Han-Fu Chen and Lei Guo, Stochastic control systems; Mu-Fa Chen and Shi-Jian Yan, Jump processes and particle systems; Pei-De Chen, Multi-parameter stochastic processes; Tse-Pei Chiang, Stationary random field: prediction theory, Markov model, limit theorems; Sheng-Wu He and Jia-Gang Wang, Some results of semimartingales and jump processes; Zhen-Ting Hou, $Q$-matrix problem; Di-He Hu, Lu-Qin Lu, and Fu-Qing Gao, Summary of recent research accomplishments in Markov processes and Markov fields at Wuhan University; Guo-Ding Hu, Zhao-Zhi Zhang, and Shi-Yi Shen, The study and developments of probability problems in information theory in China; Zhi-Yuan Huang, Some recent development of stochastic calculus in China; Zhi-Shun Liang and Zhi-Rui Huang, Renewal sequences, $p$-functions, their extensions and the related topics; Ming Liao, Brownian motions and geometry of manifolds; Zheng-Yan Lin, Chung-Rong Lu, and Qi-Man Shao, Contribution to the limit theorems; Zhi-Ming Ma, Some new results concerning Dirichlet forms, Feynman-Kac semigroups and Schrödinger equations; Min-Ping Qian, Guang-Lu Gong, and Min Qian, The reversibility and the entropy production of Markov processes; Rong Situ, Theory and applications of stochastic differential equations in China; Zhi-Quan Wu, Xiang-Chen Wang, Xiao-Yun Yang, and De-Li Li, Some recent results on the strong LLN and LIL in Banach spaces; Jia-An Yan, A review of studies in probability theory and stochastic analysis; Wei-An Zheng, On symmetric diffusion processes.
VISION GEOMETRY
Robert A. Meltzer, Azriel Rosenfeld, and Prabir Bhattacharya, Editors
(Contemporary Mathematics, Volume 119)

Since its genesis more than thirty-five years ago, the field of computer vision has been known by various names, including pattern recognition, image analysis, and image understanding. The central problem of computer vision is obtaining descriptive information by computer analysis of images of a scene. Together with the related fields of image processing and computer graphics, it has become an established discipline at the interface between computer science and electrical engineering.

This volume contains fourteen papers presented at the AMS Special Session on Geometry Related to Computer Vision, held in Hoboken, New Jersey in October 1989. This book makes the results presented at the Special Session, which previously had been available only in the computer science literature, more widely available within the mathematical sciences community.

Geometry plays a major role in computer vision, since scene descriptions always involve geometrical properties of, and relations among, the objects or surfaces in the scene. The papers in this book provide a good sampling of geometric problems connected with computer vision. They deal with digital lines and curves, polygons, shape decompositions, digital connectedness and surfaces, digital metrics, and generalizations to higher-dimensional and graph-structured "spaces." Aimed at computer scientists specializing in image processing, computer vision, and pattern recognition—as well as mathematicians interested in applications to computer science—this book will provide readers with a view of how geometry is currently being applied to problems in computer vision.

Contents
A. M. Bruckstein, Self-similarity properties of digitized straight lines;

STRING PATH INTEGRAL REALIZATION OF VERTEX OPERATOR ALGEBRAS
Haruo Tsukada
(Memoirs of the AMS, Number 444)

Affine Kac-Moody algebras are natural generalizations of finite-dimensional simple Lie algebras, and they have many important applications, such as the Rogers-Ramanujan identities and soliton equations. The aim of this book is to establish relations between vertex operator algebras in mathematics and the string path integrals of physics. The author realizes representation spaces of vertex operator algebras as spaces of functionals on functions on a circle. Integral kernels of products of vertex operators are interpreted as string path integrals over cylinders. Their traces are interpreted as string path integrals over elliptic curves. The book provides readers with background in vertex operator algebras and in the basic techniques of string path integrals.

Contents
Vertex operator algebras: Fock spaces; Vertex operators; Representations; Geometric realization of vertex operator algebras: Functional realization of Fock spaces; Function spaces of Riemann surfaces; Geometric realization of vertex operators; Analytic realization of vertex operator algebras: Zeta-regularization; Zeta-regularized determinants on cylinders and elliptic curves; String path integrals over cylinders and elliptic curves.

ATOMIC BOOLEAN SUBSPACE LATTICES AND APPLICATIONS TO THE THEORY OF BASES
S. Argyros, M. Lambrou, and W. E. Longstaff
(Memoirs of the AMS, Number 445)

This book provides a bridge between the theory of bases of Banach spaces and the study of certain types (reflexive, non-self-adjoint) of operator algebras, offering a viewpoint common to both areas. The authors give a characterization of those families of subspaces of a Banach space that arise as those of atoms of an atomic Boolean subspace lattice (ABSL). They obtain new examples of ABSLs, including some with one-dimensional atoms. The latter are shown to arise precisely from strong M-bases of the underlying space. The authors also discuss, for any given ABSL, the question of the strong-operator density of the sub-algebra of finite-rank operators in the algebra of all operators leaving every atom invariant; some affirmative results are presented. On a separable Hilbert space, the given
ABSL satisfies this density property if and only if a certain extremely non-commutative "factor" of it does. In addition, several other areas of investigation in the theory of ABSLs are considered, including "selection" from atoms, "slicing" of atoms, and the double commutant property. The authors also provide many examples.

Contents
Quasi-direct sums; Strong rank one density property; Meshed products; Strong M-bases; Selecting and slicing; The double commutant.

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A SUFFICIENT CRITERION FOR A CONE TO BE AREA-MINIMIZING
Gary R. Lawlor
(Memoirs of the AMS, Number 446)

This book presents a systematic algorithm for proving that certain cones are area-minimizing. The problem of determining what shapes of singularities can occur has stimulated much research since the 1960s, when it was discovered that area-minimizing surfaces can have essential singularities. One landmark was the work of Reese Harvey and Blaine Lawson on calibrations, which helped to motivate Frank Morgan's correct conjecture in 1981 concerning which pairs of planes are area-minimizing. This conjecture was a catalyst for a wave of fruitful ideas, including the method presented in this book.

The algorithm the author describes consists of examining a first order ordinary differential equation based on the curvature and dimension of the cone and ensuring that certain line segments normal to the cone do not intersect. The method is novel in the wide variety of cones to which it can be systematically applied. Many new examples are provided, including the completion of the classification of minimizing cones over products of two or more spheres (in a few cases, such as products of spheres, the criterion is necessary and sufficient). Though the book is written primarily for those in geometric measure theory and differential geometry, much of it is accessible to mathematicians in other areas, as well as to graduate students and advanced undergraduates interested in area-minimizing surfaces.

Contents
A minimization test for cones; Calibrations; The differential equation; Cones for which the criterion is necessary as well as sufficient; Examples of area-minimizing cones; Some perturbation results; Open questions.

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NO NINE NEIGHBORLY TETRAHEDRA EXIST
Joseph Zaks
(Memoirs of the AMS, Number 447)

This book is devoted to a proof of the following problem of F. Bagemihl (1956): What is the maximum number of tetrahedra in three-space such that every two of them meet in a two-dimensional set? Such families are called neighborly. Bagemihl presented an example of eight neighborly tetrahedra and showed that a neighborly family of tetrahedra contains at most seventeen members. This upper bound was reduced to nine in 1965. The question of whether or not there can be nine neighborly tetrahedra has been repeatedly mentioned in the literature since 1956.

This book also treats the problem of the number of combinatorially different examples of eight neighborly tetrahedra. The author concludes by reproducing a proof that there can be at most fourteen tetrahedra in three-space such that every two tetrahedra are separated by a plane containing a facet of each of them. The book allows readers to follow the solution of this long-standing open problem by using various tools, including a few extensive computer searches.

Contents
The Baston matrix; the 24 solutions; Cases #4, 5, 7, 8, 11, 14, 15, 19 and #24; Types of tetrahedra; The use of the Baston matrices; Computer search for case #2; Computer search for case #3; Computer search for case #6, 9 and #10; Computer search for case #12, 16, 17 and #18; Computer search for case #20, 21, 22 and #23; end of the proof; On eight neighborly tetrahedra; At most fourteen nearly-neighborly tetrahedra.

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IDEALS OF IDENTITIES OF ASSOCIATIVE ALGEBRAS
Aleskandr Robertovich Kemer
(Translations of Mathematical Monographs, Volume 87)

This book concerns the study of the structure of identities of PI-algebras over a field of characteristic zero. In the first chapter, the author brings out the connection between varieties of algebras and finitely-generated superalgebras. The second chapter examines graded identities of finitely-generated PI-superalgebras. One of the results proved concerns the decomposition of T-ideals, which is very useful for the study of specific varieties. In the fifth section of Chapter Two, the author solves Specht's problem, which asks whether every associative algebra over a field of characteristic zero has a finite basis of identities. The book closes with an application of methods and results established earlier: the author finds asymptotic bases of identities of algebras with unity satisfying all of the identities of the full algebra of matrices of order two.

Contents
Varieties and Superalgebras: Technical statements, utilizing the theory of representations of the symmetric group; Grassmann hulls of superalgebras; Semiprime varieties. Generalization of the Dubnov-Ivanov-Magata-Higman theorem; Identities of Finitely-Generated Algebras: Numerical characteristic of T-ideals; A theorem on the
FEW NOMIALS
A. G. Khovanskii
(Translations of Mathematical Monographs, Volume 88)

The ideology of the theory of fewnomials is the following: real varieties defined by "simple," not cumbersome, systems of equations should have a "simple" topology. One of the results of the theory is a real transcendental analogue of the Bezout theorem: for a large class of systems of $k$ transcendental equations in $k$ real variables, the number of roots is finite and can be explicitly estimated from above via the "complexity" of the system. A more general result is the construction of a category of real transcendental manifolds that resemble algebraic varieties in their properties. These results give new information on level sets of elementary functions and even on algebraic equations.

The topology of geometric objects given via algebraic equations (real-algebraic curves, surfaces, singularities, etc.) quickly becomes more complicated as the degree of the equations increases. It turns out that the complexity of the topology depends not on the degree of the equations but only on the number of monomials appearing in them. This book provides a number of theorems estimating the complexity of the topology of geometric objects via the cumbersomeness of the defining equations. In addition, the author presents a version of the theory of fewnomials based on the model of a dynamical system in the plane. Pfaff equations and Pfaff manifolds are also studied.

Contents
An Analogue of the Bezout Theorem for a System of Real Elementary Equations; Two Simple Versions of the Theory of Fewnomials; Analogues of the Theorems of Rolle and Bezout for Separating Solutions of Pfaff Equations; Pfaff Manifolds; Real-Analytic Varieties with Finiteness Properties and Complex Abelian Integrals.

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ALGEBRA AS A MEANS OF UNDERSTANDING MATHEMATICS
Saunders Mac Lane

What is the real nature of algebra? How does algebra help us to gain insight into other areas of mathematics? Saunders MacLane probes these and other questions in this insightful videotaped lecture. With almost sixty years of distinguished mathematical research to his credit, MacLane has a commanding perspective on algebra and how it connects to other branches of mathematics. Algebra is, on the one hand, a field of research which today is split into many different subfields. On the other hand, algebra is an instrument for the deeper understanding of the meaning of various mathematical results. As an example, MacLane discusses the concept of automorphism, which, in the hands of Noether and Artin, furthered the understanding of Galois theory. In another instance, he illustrates how homology groups clarify connectivity in topology. In a lecture that ranges from categories to braids, from tensor products to spectral sequences, MacLane shows how algebra forms a common thread uniting them all. The lecture would be accessible to those at the level of an advanced undergraduate.

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COMPUTING OPTIMAL GEOMETRIES
Jean E. Taylor

Over the last decade, computer graphics have had a profound impact in industry, science, engineering, and medicine. However, it is only in the past few years that computers have achieved sufficient power to bring visualization techniques to bear in a serious way on mathematical problems. This videotape testifies to the influence of computing and computer graphics in mathematical research. The material on the videotape was originally presented in a Special Session on Computing Optimal Geometries, held during the Joint Mathematics Meetings in San Francisco in January 1991. Comprising fourteen separate programs—ranging from computation of minimal surfaces to calculation of growth of dendrites, from a model of the beating heart to demonstrations of surface-evolver programs—this videotape reveals how the power of computer graphics is leading to new ways of mathematical thinking. With its many striking and colorful images, it would be an excellent addition to courses at the undergraduate or graduate level. The videotape is accompanied by extended abstracts of papers presented during the Special Session.

Contents
F. Almgren, Computing soap films and crystals; R. F. Almgren, Computation of evolving phase interfaces with Gibbs-Thompson effect; K. Brakke, The opaque cube problem video; M. Callahan, P. Concus and R. Finn, Energy minimizing capillary surfaces for exotic containers; C. Collins, M. Luskin and J. Riordan, Computational images of crystalline microstructure; D. A. Hoffman, Computing minimal surfaces with and without conformal representations; R. Kobayashi, Modelling and simulations of crystal growth; G. Lawlor, Proving area-minimization by slicing; G. Lawlor and F. Morgan, Minimizing cones and networks: immiscible fluids, norms, and calibrations; N. L. Max, The muscle simulation video; D. Mumford, Variational principles arising from Bayesian image understanding; S. Osher, Computing the motion of curves & surfaces via the Hamilton-Jacobi level set approach; H. R. Parks, Numerical approximation of area-minimizing hypersurfaces; J. T. Pitts, New existence theorems for minimal hypersurfaces; H. G. Rebaghi and C. S. Peskin, Reconstruction of the left ventricular (LV) wall from computed tomography (CT) scans of the beating heart; J. A. Sethian, Computing the motion of curves and surfaces via evolving level sets; J. M. Sullivan, Crystalline approximation: Computing minimum surfaces via maximum flows; J. E. Taylor, Motion by crystalline curvature; J. Tegart, Three-dimensional fluid interfaces in a cylindrical container.
Λ-TREES AND THEIR APPLICATIONS
John W. Morgan

In the past few years, various types of trees have been
the subject of a great deal of research, in part due to their
connections with other mathematical objects, such as hyperbolic
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moves on to discuss various aspects and generalizations of
trees. Striking a balance between the technical aspects and
the intuitive power of simple pictures, this clear and well-paced
lecture would be accessible to advanced undergraduates or
graduate students. The videotape is accompanied by lecture
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Andrew J. Majda
The interaction of nonlinear analysis and modern applied mathematics
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Grigori Margulis
Dynamical and ergodic properties of subgroup actions on homogeneous
spaces with applications to number theory
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Richard B. Melrose
Pseudodifferential operators, corners and singular limits
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Birational classification of algebraic threefolds
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Yakov G. Sinai
Hyperbolic billiards
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Karen K. Uhlenbeck
Applications of non-linear analysis in topology
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Code VIDUHLENBECK/N

Alexandre N. Varchenko
Multidimensional hypergeometric functions and their appearance in
conformal field theory, algebraic Λ'-theory, algebraic geometry, etc.
Price $49
Code VIDVARCHENKO/N

Special Address
Edward Witten
Gauge theories and the Jones polynomial
Price $49
Code VIDWITTEN/2N
SURVEYS IN DIFFERENTIAL GEOMETRY
C. C. Hsiung and S. T. Yau, Editors

This volume contains papers presented at a conference organized by the editors of the Journal of Differential Geometry and held in April 1990 at Harvard University. Such conferences are to be held once every three years to survey the field of differential geometry and related subjects. This first conference featured speakers representing algebraic geometry and mathematical physics, among other areas. The speakers are prominent specialists in their respective areas who are able to present broad overviews of recent trends and make predictions and suggestions for future research.

Contents
R. Bott, Stable bundles revisited; G. D'Amra & M. Gromov, Lectures on transformation groups: Geometry and dynamics; J. Kollár, Flips, flops, minimal models, etc.; R. M. Schoen, A report on some recent progress on nonlinear problems in geometry; E. Witten, Two-dimensional gravity and intersection theory on moduli space.

1980 Mathematics Subject Classification: 14, 13, 55, 57, 58, 20, 28, 11, 81
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SÉMINAIRE BOURBAKI
(Astérisque, Number 189–190)

As the précédents volumes de ce Séminaire, celui-ci contient des exposés de synthèse sur des sujets d'actualité: quatre sur la Géométrie algébrique ou arithmétique, trois sur la Topologie et la Théorie des noeuds, trois de Théorie des nombres, un de Physique mathématique, un sur les Équations aux dérivées partielles, un de Théorie des groupes, un de Topologie symplectique et un de Géométrie euclidienne.

On y fait, entre autres, le point sur les invariants de Jones-Witten, l'arithmétique des courbes elliptiques, les formes cubiques rationnelles, les groupes hyperboliques, la cohomologie p-adique et les généralisations de la conjecture de Mordell.

Contents

Michael Atiyah, The Jones-Witten invariants of knots; P. Cartier, Groupes de tresses; B. Perrin-Riou, Travaux de Kolyvagin et rubin; B. Teissier, Algèbre commutative effective; J.-P. Thomenot, La convergence presque sure des moyennes ergodiques; J.-M. Deshouillers, Formes cubiques rationnelles; C. Gérard, Complétude asymptotique des systèmes à n corps; E. Ghys, Les groupes hyperboliques; C. Peters, Algèbre Formel courbes; J. Sjöstrand, Asymptotic des résonnances pour des obstacles; D. Bennequin, Topologie symplectique, convexité holomorphe; L. Illusie, Cohomologie de de Rham et cohomologie étale p-adique; J. Oesterlé, Empelements de sphières; C. Ravenel, The nilpotence and periodicity theorems; L. Szpiro, Equations polynomiales sur une variété abélienne.

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THÉORIE DE L'HOMOTOPIE
H. R. Miller, J.-M. Lemaire and L. Schwartz, Editors
(Astérisque, Number 191)

This volume contains papers presented at the International Conference on Homotopy Theory, held in Marseille-Luminy in July 1988. The two main topics of discussion during the conference form a theme running through most of the papers in this collection. The first is the study of the homotopy type of functions spaces, particularly when the domain is the classifying space of a finite or Lie group. Among the various methods used in this area, unstable Adams spectral sequences and unstable models over the Steenrod algebra were emphasized. Cosimplicial methods of Bousfield-Kan as well as Lannes’ T functor play a crucial role.

The second topic is the use and construction of algebraic models of homotopy types, which have proven especially fruitful in rational homotopy theory, and also with more general coefficient rings, such as arbitrary fields or suitable subrings of the rationals.

Contents

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Ax² + bxy + cy² = n, by John H. Conway, 1991 *Mathematics Subject Classification*: 11. ISBN 0-8218-8027-6, 1990, List price $49.95, Institutional member $39.95, Individual member $29.95, Code VIDCONWAY/NA


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The Transition to Chaos: The Orbit Diagram and the Mandelbrot Set, by Robert L. Devaney, 1991 Mathematics Subject Classification: 58. 1990, List price $54.95, Institutional member $44.95, Individual member $34.95, Code VIDDEV/NA

Combination book and videotape offers. Chaos and Fractals: The mathematics behind the computer graphics, edited by Robert L. Devaney and Linda Keen (1989, 208 pp., ISBN 0-8218-0137-6, hardcover, Code PSAPM/39NA) may be purchased in combination with the following videotapes:


Natural Minimal Surfaces via Theory and Computation, by David Hoffman, 1991 Mathematics Subject Classification: 53. 1990, List price $54.95, Institutional member $44.95, Individual member $34.95, Code VIDHOFMANN/NA

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Recent Appointments

Committee members’ terms of office on standing committees expire on January 31 following the year given in parentheses following their names, unless otherwise specified.

Wen-Ching Li (1993) was appointed to the Committee on Membership by past-chair of the Board of Trustees, Ronald L. Graham. Continuing members of the committee are M. Salah Baouendi (1993), Carol-Ann Blackwood, consultant, Susan Friedlander (1992), Frederick W. Gehring (1992), chair, and Hugo Rossi (1991).


Roger Horn (MAA), Raymond L. Johnson (AMS), Gerald Porter (MAA), and Nancy K. Stanton (AMS) have been appointed by Presidents Deborah T. Haimo (MAA) and Michael Artin (AMS) to the AMS-MAA Joint Program Committee for the Baltimore Meeting. Professor Stanton has been appointed chair.

The March Meeting in South Bend

The 864th meeting of the Society was held in South Bend, Indiana at Indiana University at South Bend on March 15 and 16, 1991. There were 212 registrants, including 187 members of the Society.

Invited Addresses. By invitation of the Central Section Program Committee there were four invited addresses. The speakers, their affiliations, and their titles were as follows: 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, Simplicial complexes associated to finite groups and their representations; and Deane Yang, Columbia University, Questions relating Riemannian geometry and the topology of 3-manifolds. The speakers were introduced by Peter Malcolmson, C. D. Aliprantis, Jonathan Alperin, and William Dwyer, respectively.

Special Sessions. By invitation of the same committee, there were eight Special Sessions of selected 20-minute papers. The topics, the names and affiliations of the organizers, and the speakers were as follows:

Mathematical economics and dynamical systems, C. D. Aliprantis, Indiana University-Purdue University Indianapolis, and Carl Simon, University of Michigan. Speakers were R. Savit, C. Simon, A. McLennan, K. Mount, M. Wooders, M. Khan, R. Boylan, R. Becker, L. Tesfatsion, D. Haunsperger, C. Foias, W. Shafier, L. Jones, O. Burkhistaw, N. Yanellis, S. Williams, and M. Hero.


Model theory, Steven Buechler, University of Notre Dame. Speakers were P. Seitz, K. Holland, P. Rothmaler, A. Borovik, B. Hart, J. Huston, A. Baudisch, D. Saracino, and Y. Peterzil.


Noncommutative ring theory, Gail Letzter, Peter Malcolmson, and Frank Okoh, Wayne State University. Speakers were D. Haile, E. Behr, A. Rosenberg, J. Kerr, J. Rosen, I. Musson, A. Bell, E. Kirkman, M. May, J. Bergen, J. Osterburg, D. Quinn, L. Makar-Limanov, and G. Peters.


Probability and prediction theory, Mohsen Pourahmadi, Northern Illinois University. Speakers were R. Bradley, D. Chambers, T. Sun, B. Rajput, C. Foias, A. Makagon, M. Pourahmadi, P. Masani, E. Slud, R. Bhattacharya, C. Houdre, J. Yukich, S. Csorgo, N. Etemadi, R. Taylor, A. Adler, M. Meer-
Contributed Papers. There were two sessions of contributed ten-minute papers. The session on Geometry, Analysis, and Probability was chaired by Lee Keener of Indiana University at South Bend; seven papers were presented. The session on Foundations, Combinatorics, and Algebra was chaired by William Frascella of Indiana University at South Bend; eight papers were presented.

Committee. Lynn Williams of Indiana University at South Bend supervised local arrangements. He was assisted by Carolyn Fermoye of the Office of Continuing Education of the University.

Andy R. Magid
Associate Secretary
Norman, Oklahoma

Miscellaneous

Personals

George Adomian, the David C. Barrow Professor of Applied Mathematics and Director of the Center for Applied Mathematics at the University of Georgia, has left the University to devote full time to research and consulting.

Sigurdur Helgason, of the Massachusetts Institute of Technology, has received the Major Knight Cross of the Icelandic Falcon from the President of Iceland in recognition of his mathematical research.

Deaths

Kermit H. Carlson, of Valparaiso, Indiana, died on October 13, 1990, at the age of 76. He was a member of the Society for 42 years.

Lothar O. Collatz, Professor Emeritus of the University of Hamburg, died on September 26, 1990, at the age of 80. He was a member of the Society for 22 years. (See the News and Announcements section of this issue of Notices.

Dario Graffi, a Professor Emeritus from Bologna, Italy, died on December 28, 1990, at the age of 85. He was a member of the Society for 39 years.

Gerald B. Haggerty, Professor Emeritus of the University of Rhode Island, died on March 14, 1991, at the age of 85. He was a member of the Society for 45 years.

Ernest Hawkins, of Annapolis, Maryland, died on September 16, 1990, at the age of 88. He was a member of the Society for 61 years.

Lee Horace McFarlan, Professor Emeritus of the University of Washington, died on September 3, 1990, at the age of 94. He was a member of the Society for 65 years.
Visiting Mathematicians

The list of visiting mathematicians includes both foreign mathematicians visiting in the United States and Canada, and Americans visiting abroad. Note that there are two separate lists.

### American Mathematicians Visiting Abroad

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<th>Period of Visit</th>
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<td>Nankai University, People’s Republic of China</td>
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### Visiting Foreign Mathematicians

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<th>Name and Home Country</th>
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<td>Name and Home Country</td>
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RICHARD K. GUY, EDITOR

PROCEEDINGS OF SYMPOSIA IN APPLIED MATHEMATICS
Volume 43

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

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

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

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Interested parties should request a full job description. Applications should include a letter of interest and a current curriculum vitae. Applicants should arrange for three letters of reference to be sent to the address below. The closing date for applications is June 15, 1991. The deadline may be extended if no suitable candidate is found.

Applications should be sent to:
Dr. J. W. Brewer, Chairman
Department of Mathematics
Florida Atlantic University
Boca Raton, FL 33431

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Department of Mathematics

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**RICE UNIVERSITY**

Postdoctoral Research Appointment

The Computational Mathematics Laboratory is seeking applicants for a postdoctoral research appointment to commence in August 1991. The appointee will interact with a research program centering on partial differential equations, numerical analysis, applied mathematics, and wavelet analysis. The candidate should have demonstrated proficiency in at least three, possibly all four of these areas, and should have some programming experience. The research will involve assisting senior investigators to investigate specific problems in this circle of problems, in particular, helping to code mathematical experiments. Rice University is an Equal Opportunity/Affirmative Action Employer and strongly encourages applications from women and minority groups. Please send resumes to:

Director, Computational Mathematics Laboratory, Department of Mathematics, Rice University, P.O. Box 1892, Houston, TX 77251-1892.

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**CANADA**

**UNIVERSITÉ LAVAL**

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Le Département de mathématiques et de statistique sollicite des candidatures pour un poste de professeur en mathématiques appliquées débutant le 1er janvier 1992.

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- avoir déjà acquis une bonne activité de recherche,
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Le poste est subject au ministère de l'Éducation du Québec.

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Division of Mathematical Sciences

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Dr. Henry J. Taijeron, Chair
Computer Science Search Committee
c/o Personnel Services Division
UOG Station, Mangilao, Guam 96923

The selection process will begin April 15, 1991, and continue until the position is filled. EEO/AAE.

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3. Vector bundles and applications, Donaldson theory
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5. Hodge theory, perverse sheaves and D-modules
6. Higher dimensional varieties, classification theory
7. Singularity theory

The program committee consists of: E. Arbarello, A. Beauville, A. Beilinson, H. Clemens (co-chairman), J. Harris, W. Fulton, J. Kollár (co-chairman), S. Mori and J. Steenbrink.

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2. Symbolic representations of smooth dynamical systems
3. Connections with data storage and transmission, number theory, discrete mathematics, and ergodic theory

The program committee consists of R. Adler (chairman), J. Franks, D. Lind and S. Williams.

**TRANSCENDENCE AND DIOPHANTINE PROBLEMS** (a half-year program in the spring). Topics will include:

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The program committee consists of A. Baker (co-chairman), W.D. Brownawell, W.M. Schmidt (co-chairman), P. Vojta.

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**RESEARCH PROFESSORSHIPS**

These awards are intended for midcareer mathematicians; the applicant's Ph.D. should be 1986 or earlier. Please see the separate announcement of these awards in this issue of the Notices. There is an earlier deadline for applications: October 1, 1991. Candidates may apply for both a Senior Membership and a Research Professorship (but only one award will be made per candidate).

**SENIOR MEMBERSHIPS**

Applications are invited for part or all of 1992-93. Letters of recommendation are encouraged but not required. It is generally expected that members at this level will come with partial or full support from other sources. The deadline for applications is November 30, 1991.

**FURTHER REMARKS**

Each application should include an up-to-date vita, a bibliography, and a statement of research plans.

The Institute does not use formal application forms. However, an information sheet giving additional suggestions to prospective applicants is available upon request. Write to: Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley CA 94720. Women and minority candidates are especially encouraged to apply.

Candidates are asked to make sure that their application materials and letters of reference arrive by the deadline (October 1, 1991 for Research Professorships and November 30, 1991 for the others). Late applications cannot be assured a complete consideration. Awards will be announced by early December, 1991 for Research Professorships and by mid-February, 1992 for the others.

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Introduction to Classical Mathematics I
From the Quadratic Reciprocity Law to the Uniformization Theorem

by Helmut Koch, Karl-Weierstrass-Institut fur Mathematik, Berlin

This volume provides an illuminating overview of the classical mathematics of the 19th and first half of the 20th centuries. The methods and results discussed are the real classics of mathematics. The book follows the historical development of mathematics, beginning with Gauss's Disquisitiones Arithmeticae and ending with Weyl's Idee der Riemannschen Fläche. The major topics presented include: Gauss's work on number theory and differential geometry, Dirichlet's work on harmonic analysis and prime numbers and their distribution, Riemann's work on function theory, Dedekind's theory of ideals, and the work of Poincaré on combinatorial topology. This volume will be of interest to researchers and historians interested in the classical development of mathematics.

**CONTENTS**
- Congruences
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- Division of the circle (cyclotomy)
- Theory of surfaces
- Harmonic analysis
- Prime numbers in arithmetic progressions
- Theory of algebraic equations
- The beginnings of complex function theory
- Entire functions
- Riemann surfaces
- Meromorphic differentials on closed Riemann surfaces
- The theorems of Abel and Jacobi
- Elliptic functions
- Riemannian geometry
- On the number of primes less than a given magnitude
- The origins of algebraic number theory
- Field theory
- Dedekind's theory of ideals
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- The Dedekind zeta function
- Quadratic forms and quadratic fields
- The different and the discriminant
- Theory of algebraic functions of one variable
- The geometry of numbers
- Normal extensions of algebraic number fields
- Function fields
- Entire functions with growth of finite order
- Proof of the prime number theorem
- Combinatorial topology
- The idea of a Riemann surface
- Uniformisation

Appendix 1. Rings
Appendix 2. Set theoretic topology
Appendix 3. Green's theorem
Appendix 4. Euclidean vector and point spaces
Appendix 5. Projective spaces
Bibliography
Name Index
General index
The Mathematical Sciences Research Institute (MSRI), announces the availability of Research Professorships for the academic year 1992-93. These awards are intended for midcareer mathematicians; the applicant’s Ph.D. should be 1986 or earlier. An award for a full academic year will be limited to a ceiling of $30,000 and normally will not exceed half the applicant’s salary. Appointments can be made for a portion of the year; the $30,000 ceiling and half salary limit would then be prorated. It is anticipated that between six and ten awards will be made. In addition to the basic stipend, there will be an award for round trip travel to MSRI.

In 1992-93 MSRI will feature three programs: Algebraic Geometry for the entire year, Symbolic Dynamics for the first half, and Transcendence and Diophantine Problems in the second half. Please consult the general MSRI announcement for 1992-93 elsewhere in this issue of the Notices. Research Professorships are directed to applicants in all fields of the mathematical sciences. There are also Senior Memberships, which normally offer smaller awards. An applicant can apply for both (but only one award will be made per applicant). Women and minority candidates are especially encouraged to apply.

MSRI does not use formal application forms. An application should include a vita, a bibliography, a plan of research, and a statement concerning financial requirements. Two letters of reference are required. Candidates are asked to make sure that their application materials and the two letters arrive by October 1, 1991. Late applications cannot be assured a complete consideration. Awards will be announced in early December, 1991.

Send applications to the Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley CA 94720.

The Institute is committed to the principles of Equal Opportunity and Affirmative Action.
The Societal Institute of the Mathematical Sciences (SIMS) will conduct a three week Tutorial on the Mathematical Sciences in Genomic Analysis. The Tutorial will demonstrate how mathematical and computational methods are used in genomic analysis - particularly in connection with the Human Genome Project. Tutorial topics will include fragment assembly, informatics, pattern analysis of molecular sequences, DNA and protein structure predictions. Background lectures will prepare Tutorial participants for the later presentations of senior Tutorial Faculty.

This Tutorial is intended for advanced undergraduates, graduate students, and postdoctorals in the biological and mathematical sciences. It will be held August 4-24, 1991 at Stanford University, and again in the summer of 1992 at an East Coast location.

Serving on the Faculty of the Tutorial is an outstanding group of scientists who will present many of the exciting interdisciplinary research activities central to genomic analysis: Craig J. Benham, (Mount Sinai School of Medicine, Co-chair for this Tutorial); David Botstein, (Stanford University); Elbert Branscomb, (Lawrence Livermore National Laboratory); Fred Cohen, (University of California, San Francisco); Charles Delisi, (Boston University); Ronald Davis, (Stanford University); Alan Lapedes, (Los Alamos National Laboratory); Thomas Marr, (Cold Spring Harbor Laboratory); Gene Myers, (University of Arizona); Tamar Schlick, (New York University); Temple Smith, (Harvard Medical School).

Application forms are available from SIMS, 97 Parish Road South, New Canaan, CT 06840. Phone: 203-966-1008. FAX: 203-972-6069. Requests for financial assistance should be made when making application.

The SIMS Tutorial is supported by a grant to SIMS from the National Center for Human Genome Research, National Institutes of Health, Public Health Service, Department of Health and Human Services.

LIE ALGEBRAS AND RELATED TOPICS
Georgia Benkart and J. Marshall Osborn, Editors
Contemporary Mathematics, Volume 110

The 1984 classification of the finite-dimensional restricted simple Lie algebras over an algebraically closed field of characteristic $p > 7$ provided the impetus for a Special Year of Lie Algebras, held at the University of Wisconsin, Madison, during 1987-88. Work done during the Special Year and afterward put researchers much closer toward a solution of the long-standing problem of determining the finite-dimensional simple Lie algebras over an algebraically closed field of characteristic $p > 7$.

This volume contains the proceedings of a conference on Lie algebras and related topics, held in May 1988 to mark the end of the Special Year. The conference featured lectures on Lie algebras of prime characteristic, algebraic groups, combinatorics and representation theory, and Kac-Moody and Virasoro algebras. Many facets of recent research on Lie theory are reflected in the papers presented here, testifying to the richness and diversity of this topic.

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S.B. Stechkin, Editor  
Proceedings of the Steklov Institute, Volume 189

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**Japan:** Maruzen Co. Ltd., P.O. Box 5050, Tokyo International 100-31, Japan. Tel. Tokyo 272-7211, Telex J26516

**India:** Allied Publishers Pvt. Ltd., 15, J. N. Herdia Marg., Ballard Estate, Bombay 400038, India

Please send information about  
☐ AMS individual membership  
☐ AMS institutional membership  
☐ AMS corporate membership  
☐ AMS institutional associate
Change of Address

Members of the Society who move or who change positions are urged to notify the Providence Office as soon as possible.

Journal mailing lists must be printed four to six weeks before the issue date. Therefore, in order to avoid disruption of service, members are requested to provide the required notice well in advance.

Besides mailing addresses for members, the Society’s records contain information about members’ positions and their employers (for publication in the Combined Membership List). In addition, the AMS maintains records of members’ honors, awards, and information on Society service. Information of the latter kind appears regularly in Notices.

When changing their addresses, members are urged to cooperate by supplying the information requested below. The Society’s records are of value only to the extent that they are current and accurate.

If your address has changed or will change within the next two or three months, please fill out this form, supply any other information appropriate for the AMS records, and mail to the address given below.

Name: ___________________________________________ Customer code: ___________________________________________
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NEW mailing address: ______________________________________________________
New position: ____________________________________________________________

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Location of employer: _____________________________________________________
City State/Province Country Zip Code
Telephone number(s): ______________________________________________________
Electronic address(es): ____________________________________________________
Recent honors and awards: ________________________________________________
Recent personal items for publication in Notices: ______________________________

Mail completed form to:
Customer Services, AMS, P.O. Box 6248, Providence, RI 02940
or send the above information by email to:amsmem@math.ams.com or cust-serv@math.ams.com.
Mathematical Impressions

Anatoliĭ T. Fomenko

“I think of my drawings as if they were photographs of a strange but real world, and the nature of this world, one of infinite objects and processes, is not well known. Clearly there is a connection between the mathematical world and the real world.... This is the relationship I see between my drawings and mathematics.”—Anatoliĭ Fomenko, in the Introduction

Anatoliĭ Fomenko is a Soviet mathematician with a talent for expressing abstract mathematical concepts through artwork. Some of his works echo those of M.C. Escher in their meticulous rendering of shapes and patterns, while other pieces seem to be more visceral expressions of mathematical ideas. Stimulating to the imagination and to the eye, his rich and evocative work can be interpreted and appreciated in various ways—mathematical, aesthetic, or emotional.

This book contains 84 reproductions of works by Fomenko (23 of them in color). In the accompanying captions, Fomenko explains the mathematical motivations behind the illustrations as well as the emotional, historical, or mythical subtexts they evoke. The illustrations carry the viewer through a mathematical world consisting not of equations and dry logic, but of intuition and inspiration.

Since the mid-1970s, Fomenko has created more than 280 illustrations. Not only have his images filled pages of his own numerous books on geometry, but they have also been chosen to illustrate books on other subjects, such as statistics, probability, and number theory. In addition, his works have found their way into the Soviet scientific and popular press and have been displayed in more than 100 exhibits in the Soviet Union, Holland, India, and much of Eastern Europe.

Fomenko describes his images as “deep reflections about the essence of being and about the place of modern man—in particular, the learned man—in the stormy and unpredictable world surrounding him.” His illustrations are the product of a sensitive, aesthetically attuned mind diving deep below the surface of modern mathematics and emerging with great stories to tell.

1980 Mathematics Subject Classification: 00
ISBN 0-8218-0162-7, LC 90-47514
194 pages (hardcover), December 1990;
Individual member $36, List price $45.
To order, please specify MATIMP/NA

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.
In a contemporary course in mathematical analysis, the concept of series arises as a natural generalization of the concept of a sum over finitely many elements, and the simplest properties of finite sums carry over to infinite series. Standing as an exception among these properties is the commutative law, for the sum of a series can change as a result of a rearrangement of its terms. This raises two central questions: for which series is the commutative law valid, and just how can a series change upon rearrangement of its terms? Both questions have been answered for all finite-dimensional spaces, but the study of rearrangements of a series in an infinite-dimensional space continues to this day.

In recent years, a close connection has been discovered between the theory of series and the so-called finite properties of Banach spaces, making it possible to create a unified theory from the numerous separate results. This book is the first attempt at such a unified exposition.

This book would be an ideal textbook for advanced courses, for it requires background only at the level of standard courses in mathematical analysis and linear algebra and some familiarity with elementary concepts and results in the theory of Banach spaces. The authors present the more advanced results with full proofs, and they have included a large number of exercises of varying difficulty. A separate section in the last chapter is devoted to a detailed survey of open questions. The book should prove useful and interesting both to beginning mathematicians and to specialists in functional analysis.

1980 Mathematics Subject Classifications: 46
ISBN 0-8218-4546-2; LC 91-6522; ISSN 0065-9282
122 pages (hardcover). April 1991

Individual member $43,
List price $72, Institutional member $58
To order please specify MMONO/86NA

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Summer List of Applicants

1. This form CANNOT be submitted by electronic mail.
2. Please type. See instructions on facing page. Do not type beyond the box.
4. Return form to: MMSB, P.O. Box 6887, Providence, RI 02940.

<table>
<thead>
<tr>
<th><strong>APPLICANT:</strong> Name</th>
<th>Mailing address (include zip code)</th>
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(A) Specialties:
(B) Career objectives and accomplishments

**ACADEMIC:** ☐ Research, ☐ Teaching

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

Near-term career goals:

Significant achievements or projects, including role:

Honors and offices:

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

Selected titles of papers, reports, books, patents:

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<tr>
<th><strong>Degree</strong></th>
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<th><strong>Institution</strong></th>
<th><strong>No. of abstracts, internal reports</strong></th>
<th><strong>No. of papers accepted</strong></th>
<th><strong>No. of books and patents</strong></th>
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**EMPLOYMENT HISTORY:**

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**DESired POSITION:**

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**References (Name and Institution):**

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

☐ I plan to attend the Summer Meeting

**SUMMARY STRIP**

<table>
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<tr>
<th><strong>Family Name</strong></th>
<th><strong>First Name</strong></th>
<th><strong>Mailing Address</strong></th>
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<th><strong>Institution</strong></th>
<th><strong>Most recent employer</strong></th>
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MAA Minicourse Preregistration Form, Orono, Maine
August 8-10, 1991

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

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

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

(Please print) Surname First Middle

Street address City State Zip

Deadline for MAA Minicourse preregistration: June 6, 1991 (After this date, potential participants are encouraged to call the MAA headquarters at 800-331-1622.)
Deadline for cancellation in order to receive a 50% refund: August 2, 1991
Each participant must fill out a separate Minicourse Preregistration form.
Enrollment is limited to two Minicourses, subject to availability.
Please complete the following and send both form and payment to Linda Heineman at the above address:

I would like to attend ☐ 1 Minicourse ☐ 2 Minicourses
Please enroll me in MAA Minicourse(s): #____________ and #__________
In order of preference, my alternatives are: #____________ and #__________

PAYMENT
Check enclosed: $ ______________
Credit card type: ☐ MasterCard ☐ Visa
Credit card # ___________________________ Expiration date: ___________________________

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

Minicourse Number and Name Organised by Fee
1. Julia Sets and the Mandelbrot Set Robert L. Devaney $36
2. Integrating Calculus and Physics for Freshmen Joan R. Hundhausen & F. Richard Yeatts $36
3. Making Mathematics More Concrete Agnes Azzolino $36
4. Teaching Mathematical Modeling Frank Giordano & Maurice Weir $36
5. Conceptualizing, Organizing, and Seeking Funding for Teacher Education Projects Joan Ferrini-Mundy & Carole Lacampagne $36
6. Symmetry Analysis of Repeated Patterns Donald Crowe $36
7. Great Theorems from Mathematical Analysis: 1689-1881 William Dunham $36
8. Knot Theory for Undergraduates Stefano Gialamas $36
9. Unifying Themes for Discrete Mathematics Ralph Grimaldi $36

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

☐ I would like to preregister for the free Student Workshop organized by the MAA Committee on Student Chapters.
Preregistration/Housing Form, Orono, Maine
August 8-10, 1991

Must Be Received in Providence No Later Than June 6, 1991

Please complete this form and return it with your payment to
Mathematics Meetings Service Bureau
P.O. Box 6887, Providence, Rhode Island 02940 - Telephone: (401) 455-4143-Telex: 797192

DEADLINES:
- Preregistration/Residence Hall Reservations: June 6, 1991
- Final Preregistration (no housing): July 11, 1991
- 90% Refund on Residence Hall Package: July 26, 1991 (no refunds after this date)
- 50% Refund on Tours/Banquets/Cookout: July 9, 1991 (no refunds after this date)
- 50% Refund Preregistration Cancellation: August 2, 1991 (no refunds after this date)

REGISTRATION FEES

<table>
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<tr>
<th>Preregistration by mail by</th>
<th>At Meeting</th>
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<th>MATHFEST</th>
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<tr>
<td>Member of AMS, CMS, MAA, PME</td>
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<tr>
<td>Nonmember</td>
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<td>* Student, Unemployed, or Emeritus</td>
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<th>AMS SHORT COURSE</th>
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<td>Member/Nonmember</td>
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<tr>
<td>* Student, Unemployed, Emeritus</td>
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* See section on "How to Preregister" in the Notices or Focus for definition of "student", "unemployed", or "emeritus" status.

PREREГISTRATION SECTION: Please check the function(s) for which you are preregistering:
- Mathfest [ ]
- AMS Short Course (August 6-7) [ ] (A separate form for MAA Minicourses appears in this issue)

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

2) (Mailing address) (E-mail address) I do not wish my badge and program to be mailed; however, the mailing address for my acknowledgement is given above. [ ]

3) Badge information: Affiliation: Member/Nonmember: [ ] Member Banquet: __ tkt(s)@ $20 each = $ __ (staying on campus) tkt(s)@ $14 each = $ __

4) I am a student at: [ ]

5) Emeritus member [ ] Unemployed [ ]

6) Member of AMS [ ] CMS [ ] MAA [ ] PME [ ] Nonmember [ ] Member of other organizations: AWM [ ] NAM [ ]

7) Mathfest fee $ __

8) AMS Short Course fee $ __

9) Residence Hall payment $ __

10) Opening Banquet: __ tkt(s)@ $15 each = $ __ (staying on campus) tkt(s)@ $9 each = $ __

11) MAA 25-Yr Member Banquet: __ tkt(s)@ $20 each = $ __ (staying on campus) tkt(s)@ $14 each = $ __

12) PME Banquet: __ tkt(s)@ $8 each = $ __ (staying on campus) tkt(s)@ $2 each = $ __

13) Lobster Cookout:
- __ Lobster tkt(s)@ $23 each = $ __ (staying on campus) tkt(s)@ $17 each = $ __
- __ Steak tkt(s)@ $23 each = $ __ (staying on campus) tkt(s)@ $17 each = $ __
- __ Vegetarian tkt(s)@ $23 each = $ __ (staying on campus) tkt(s)@ $17 each = $ __
- __ Child (10 & under) tkt(s)@ $8 each = $ __ (staying on campus) tkt(s)@ $3 each = $ __

14) Tours:
- __ Bangor tkt(s)@ $26 each = $ __ (staying on campus) tkt(s)@ $21 each = $ __
- __ Leonard's Mills tkt(s)@ $15 each = $ __ (staying on campus) tkt(s)@ $10 each = $ __
- __ Moose Watch tkt(s)@ $36 each = $ __
- __ Whale Watch tkt(s)@ $46 each = $ __
- __ White Water Rafting tkt(s)@ $89 each = $ __

15) TOTAL AMOUNT ENCLOSED FOR 7 through 14 $ ____________

NOTE: May be paid by check payable to AMS (Canadian checks must be marked "U.S. Funds") or VISA or MasterCard credit cards.

Credit card type: ____________ Card number: ____________ Expiration date: ____________

If this is your credit card, please print your name as it appears on the credit card on the line below as well as sign your name.

If this is not your credit card, please print card holder's name as it appears on the credit card on the line below, and have the card holder sign:

(Printed name) ____________ (Signature) ____________

Please complete the appropriate sections on the reverse.

For office use only:

Codes: Options: Hotel: Dorm: Room type: 

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<tr>
<th>Dates:</th>
<th>Hotel Deposit</th>
<th>Room/Board Pmt</th>
<th>Total Amt. Paid:</th>
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</thead>
</table>

Special Remarks:

$ ____________ room/board paid; $ ____________ room/board due
HOUSING SECTION:

☐ Please check here if you will not be staying in one of the hotels, motels, or residence halls being offered through the Service Bureau.

☐ Please check here if you will be staying in one of the hotels/motels being offered through the Service Bureau.

UNIVERSITY HOUSING SECTION:

NOTE: Full prepayment for room and board is required. Please make checks payable to AMS. Canadian checks must be marked "In U.S. Funds"; VISA and MasterCard credit cards will also be accepted. Acknowledgements of your residence hall reservations will be sent to address indicated on reverse. The University will assign ALL rooms. Purchase of room and board package is mandatory, and the price of meals is included in the rates below. Please see items #10–14 for purchasing tickets with special prices for participants residing on campus.

Please circle applicable rates listed below for each day and enter totals in column at far right. Please notice per person rates vs. family package rates.

<table>
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<tr>
<th>Adults* (per person)</th>
<th>Youths* (per person)</th>
<th>1 Adult + 1 Adult + 2 Adults+ 2 Adults+ Enter total rate per day</th>
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<td>11–18 yrs. 11–18 yrs. in rollaway in rollaway</td>
<td>10 yrs. &amp; younger 10 yrs. &amp; younger</td>
<td>$41.00 single $37.00 double $33.00 single $31.00 double $63.00 $60.00 $91.00 $89.00</td>
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There is no room and board charge for infants in arms.

*There can be a maximum of two adults in a room. There can be a maximum of three people in a room if one of them is a youth.

Special housing requests, handicapped needs, etc.:

I will arrive on (date) __________ at __________ a.m./p.m., and depart on (date) __________ at __________ a.m./p.m.

Please list other room occupants, indicating ages of children. Please check here if one of the occupants is your spouse ☐

<table>
<thead>
<tr>
<th>FULL NAME</th>
<th>ARRIVAL DATE</th>
<th>DEPARTURE DATE</th>
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</table>

☐ I am not staying in the residence halls but plan to purchase meals in the Wells Commons Dining Hall.

☐ My child/children will attend the Children's Reception on Wednesday, August 7. Ages: ______________________________

☐ My child/children will attend the Art Class on Friday, August 9. Ages: ______________________________
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- global analysis
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- the calculus of variations on manifolds
- topology of manifolds
- mathematical physics

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