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Calendar of AMS Meetings and Conferences

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

Meetings

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

* Please refer to page 1327 for listing of Special Sessions.

Conferences

January 6–7, 1992: AMS Short Course on New scientific applications of geometry and topology, Baltimore, Maryland.

March 5–8, 1992: Joint Workshop on Changing the culture: education and the research community, Oakland/Berkeley, California.

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

July 6–24, 1992: AMS Summer Research Institute on Quadratic forms and division algebras: connections with algebraic K-theory and algebraic geometry, University of California, Santa Barbara.

July 26–August 1, 1992: AMS-SIAM Summer Seminar in Applied Mathematics, Exploiting symmetry in applied and numerical analysis, Colorado State University, Fort Collins, Colorado.

Deadlines

	February Issue	March Issue	April Issue	May/June Issue
Classified Ads*	January 9, 1992	January 30, 1992	February 26, 1992	May 5, 1992
News Items	December 31, 1991	January 21, 1992	February 20, 1992	April 20, 1992
Meeting Announcements**	January 6, 1992	January 23, 1992	February 24, 1992	April 23, 1992

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

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

NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY

ARTICLES

FEATURE COLUMNS

DEPARTMENTS

NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY

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

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From the Executive Director . . .

FEDERAL RESEARCH FUNDING

There is more good science in the nation than the federal research funding system can afford to support. Even if a lot more money were poured into the system, there would always be more opportunities for good research, more researchers competing, and more institutions seeking to expand than the system can fund. This is, in brief, the conclusion of a recent report, "Federally Funded Research: Decisions for a Decade" from the Office of Technology Assessment (OTA), which is an analysis arm of the U. S. Congress. The report addresses in depth four challenges facing the research system: priority-setting must be a major component in making funding decisions; trends in research expenditures must be understood; the future research workforce must be adequately prepared; and appropriate data must be available to assist in ongoing research decision making.

Each of these areas presents challenges to science and engineering in general, and to the mathematical sciences in particular. Furthermore, the report has been well received by both Congress and many of the federal agencies, and numerous responses are under way.

Mathematicians approach priority-setting within mathematics very cautiously. Although the report is concerned with priority-setting within disciplines, it generally views priority-setting on a larger scale. Science competes with federal programs in housing, education, health, defense, and drug law enforcement, to name only a few. This competition for funds places tremendous pressures on science and intensifies the competition at the next level—competition within science itself for research funding. This raises the question of whether priority-setting is feasible in considering the disparate proposals for support of large projects or support of basic science, for support of biomedicine or support of mathematics. Of course, priorities are constantly set in making these decisions. The real questions are, can some rationality be incorporated into the process, and will the scientific community contribute to solving this critical situation?

The staff of the House Committee on Science, Space, and Technology recently approached the Society for assistance in a pilot project to examine ways of making systematic, rational decisions in authorizing research funding for several agencies and projects. The Society agreed to help and, working with the Joint Policy Board for Mathematics and other professional mathematics organizations, is preparing a pilot assessment of mathematics, adhering to a format of questions presented by the committee staff. This task is progressing well, and, if the results merit it, they will be shared with the mathematics community for comment and input. The Commission on Physical Sciences, Mathematics, and Applications at the National Research Council is also undertaking selective assessments of several areas, including mathematics.

Currently, priority-setting in federal science funding is getting the most attention of the challenges identified in the report; however, the findings related to the other challenges are most interesting.

Trends in federal research expenditures indicate that the fastest growing is indirect cost, followed by salaries. The growth in salaries is linked to growth in the size of the research workforce supported by the federal funding system.

The conclusions of the OTA study are not very optimistic about predicted demands for science and engineering Ph.D.s. It runs directly into the paradox of encouraging the participation in science and engineering of presently underrepresented groups, keeping them in the pipeline, regardless of employment opportunities. The report does recognize that a major problem with Ph.D.s in science and engineering is that they are traditionally prepared for positions in academia, therefore facing a less fluid market. This is expected as a major component of the current problem in the mathematics Ph.D. job market; the majority of mathematics Ph.D.s are trained for academic positions with nearly 80% of new mathematics Ph.D.s historically being employed in academia.

The discussions and actions evolving from the OTA report will have an impact on federal funding for research, and, in particular, on funding for the mathematical sciences. By participating in these discussions, the Society is making an effort to insure that the voice of mathematics is heard in the policy making arena and that the mathematical sciences community is kept informed of these developments.

William Jaco

Letters to the Editor

Editorial Committee Policy

The purpose of this letter is to request that the Editorial Committee change its policy regarding letters to the Editor of *Notices* that involve a third party named in the letter.

I will illustrate with a real case. Lenore Blum and I recently submitted an Open Letter that raised the issue of the writings of I. R. Shafarevich on the role of Jews in Russian history. In accordance with your current policy (my understanding of this policy is based on correspondence with the Secretary), you sent a copy of our letter to Shafarevich and solicited his comments. I understand that the decision not to publish our letter was made after that, in the absence of any timely response from Shafarevich. In order to encourage a freer atmosphere and more letters to the Editor, it would be better to first make a decision whether or not a letter is to be published. Only if you decide to publish a letter, should you proceed to solicit comments from third parties.

Irwin Kra
SUNY at Stony Brook
(Received August 16, 1991)

Editor's Note: The *Notices* Editorial Committee (NEC) understands Kra's main concern to be that if a third party is queried about a letter and the letter is subsequently rejected, the third party might interpret the rejection as reflecting a position of the NEC or even of the AMS. However, just as published letters do not typically reflect positions of the NEC or the AMS, neither does the decision not to publish a letter reflect a position of the NEC or the AMS. Indeed, one may agree (respectively, disagree) with the content of a letter, but oppose (respectively, support) publication.

The NEC affirms its general policy of contacting third parties for additional information prior to a decision on the publication of a letter being taken. This is done to promote timeliness and to ensure that the NEC and then the community are as well-informed as possible. However, the NEC has considered Kra's request and has modified its procedures to give the Letter's Editor discretion in this matter to take into account special circumstances if such arise.

Indirect-Cost Rates on NSF Grants

In these days of shrinking NSF support for individual investigators—at least those who are neither young nor women nor minorities—it seems to me that the Division of Mathematical Sciences (DMS) and the mathematical community can no longer afford not to take a hard look at the issue of indirect-cost rates on National Science Foundation (NSF) grants. It should be plain to anyone that rates in the 40% range (or higher) are in no way reflective of the actual indirect cost of *mathematical* research to an institution, even if such rates can be justified (as presumably they have been) as an overall average of the various sciences supported by NSF. Thus we mathematicians and other theoretical scientists with our modest material needs are in effect subsidizing 'expensive' experimental science. It is a subsidy we can no longer afford, if we ever could.

The time has come, I think, for NSF to develop and institute *subject-specific* indirect-cost rates. As a specific figure for Mathematics, it seems to me that a flat rate of 10% is reasonable and realistic, perhaps excluding computational areas; in fact, a similar rate has already been used by NSF in its program of Faculty Awards for Women Scientists and Engineers. If something like this were instituted (assuming a fixed DMS budget), it would immediately create a large and much-needed windfall for Mathematics.

Ziv Ran
University of California, Riverside
(Received August 21, 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.

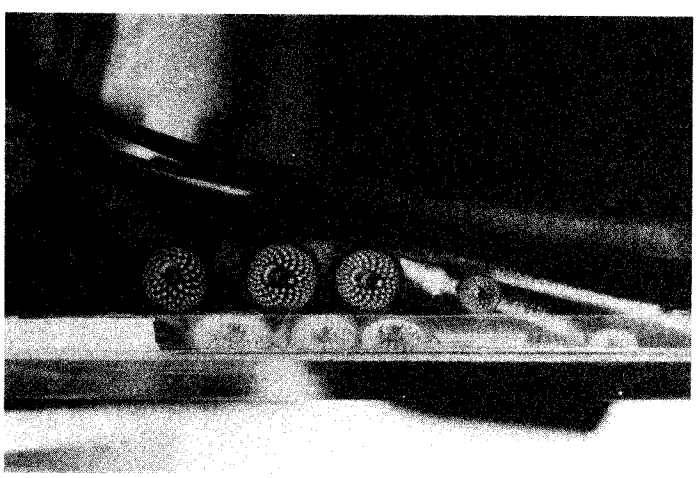
Letters should be mailed to the Editor of *Notices*, American Mathematical Society, P.O. Box 6248, Providence, RI 02940, or sent by email to notices@math.ams.com, and will be acknowledged on receipt.

Lamprey Lingo

Mathematics Helps Biologists Understand Neural Networks

Nancy Kopell may not be wild about lampreys, but she has developed a certain mathematical fondness for their nervous systems. It turns out that biological study of the lamprey has provided a springboard for some sharp mathematical results in understanding central pattern generators in biological systems. Working with experimental biologists, Kopell, who is at Boston University, and G. Bard Ermentrout of the University of Pittsburgh are building a mathematical framework to understand these kinds of biological problems. Though their clearest success so far has been with the lamprey, they are also beginning to apply these ideas to other biological systems.

Resembling an eel but having a large sucker for a mouth, a lamprey is what one might call an aquatic vampire. To feed, the lamprey attaches its mouth to a fish, pierces its flesh, and sucks its blood. Not the most endearing of creatures, lampreys also don't make for very interesting aquarium life: they spend most of their time with their mouths stuck to the side of the tank. As Kopell puts it, "Lampreys are not beloved by anyone but experimentalists."



Lampreys in a tank. (Photo courtesy of Avis Cohen, University of Maryland)

Collections of Oscillators

Kopell and Ermentrout are not trying to model the whole lamprey. Instead, they're looking at one of the animal's main occupations, swimming, and trying to understand mathematically how it executes this rhythmic behavior. Lampreys swim by undulation, by mechanical waves of contraction that travel through their muscles. These mechanical waves, in turn, are caused by waves of neural action regulated by a central pattern generator. Central pattern generators are neural networks that govern rhythmic biological processes such as swimming, walking, and chewing. The central pattern generator governing swimming in lampreys is one of the simplest and most widely studied.

Central pattern generators can be modeled as collections of coupled biological oscillators. These oscillators differ from mechanical oscillators like the pendulum. If you push an undamped pendulum, it will change its amplitude. By contrast, biological oscillators have limit cycles: if you "push" a biological oscillator, it has a characteristic amplitude to which it will tend to return. Such oscillators arise in a wide variety of applications in biology. For example, Ermentrout has used these kinds of ideas to model the human intestine and the behavior of a swarm of fireflies. Kopell came to work on oscillators from a different route, through study of reaction-diffusion equations associated to certain oscillating chemical reactions.

In 1982, Avis Cohen, a biologist then at Cornell University and now at the University of Maryland, wrote a paper with two mathematicians, Philip Holmes and Richard Rand of Cornell University, on modeling the lamprey spinal cord as a chain of coupled oscillators. A few years later, Cohen was editing a book on central pattern generators, and she asked Kopell to write a chapter on the application of oscillators to this area of research. She sent Kopell a big carton of reprints and preprints of biology papers on central pattern generators. Kopell says she was "feeling a little crazy" and had some extra time, so she read through them, "understanding about every fourth word" and asking Cohen many questions. "The mathematics didn't exist," she notes. "It's not even that there were very well-defined questions. But I had a very strong intuition at that point that the systems-level questions that were raised by these networks could be amenable to mathematical analysis."

Early work by Kopell and Ermentrout on the lamprey central pattern generator for swimming attracted the interest of a number of experimental biologists, particularly Karen Sigvardt of the University of California at Davis and

Thelma Williams of St. George's Hospital Medical School in London. Sigvardt and Williams work in different but related areas focusing on understanding the central pattern generator for swimming in lampreys. The main experiments utilize a preparation consisting of an isolated lamprey spinal cord, stripped of the brain and all muscle. When bathed in the appropriate physiological fluid, with an excitatory amino acid present, the cord produces the same traveling waves of electrical activity as in the intact animal. These traveling waves also occur for fairly short sections of the cord, with approximately the same phase lag per unit length of the spinal cord. The phase lags do not change when the frequency of the oscillators is changed in the isolated spinal cord, or, in the case of the intact animal, when the swimming speed is changed. These results imply that short sections of the cord know how to "swim"—that is, the electrical activity observed in a short section reflects the role that section plays in swimming. In addition, the wavelength does not change as the frequency (or swimming speed) changes.

Making Mathematical Predictions

Ermentrout and Kopell used these constraints to produce a general model consisting of a chain of neural oscillators with nearest-neighbor coupling. The particular type of coupling used is crucial. For example, the simplest sort of diffusive coupling operates on differences in potential between the two oscillators, so that, if the two are in the same state, there is no difference in potential and they are functionally uncoupled. By contrast, in what Ermentrout and Kopell have called "synaptic" coupling, the two oscillators continue to influence one another's potential even when they are in the same state, thereby speeding up or slowing down their rhythm. This was the essential property needed for the lamprey application. In addition, to get a wave traveling from one end of the chain to the other, they also made the assumption that the coupling in one direction is dominant over the other.

Are these the kinds of features responsible for the patterns observed in the lamprey spinal cord? To begin to answer this question, Ermentrout and Kopell devised a mathematical "experiment" in which the frequency of the oscillators is entrained by forcing one end of the chain. They found that forcing the chain at one end made it possible to entrain the frequency above or below the natural frequency, whereas forcing at the other end permitted entraining only at or above the natural frequency. "And [the result] was very sharp," Ermentrout notes. "It wasn't a little bit above and a little bit below—it was very sharp. That was a big prediction about the model that was not obvious." The asymmetry in the entrainment pattern occurs whenever the coupling in one direction dominates the coupling in the other.

Sigvardt and Williams had worked on this kind of forcing experiment before the collaboration with the mathematicians. Once Ermentrout and Kopell became involved, the biologists decided to redo the experiments with a different design that would provide a more direct test of the mathematical predictions. "When we did the experiments, I didn't know what outcome would or would not match the mathematics," Williams recalls. "And then as we began to analyze the data, it became very clear that there was something quite extraordinary there. And I've been hooked ever since."

In the biological experiment, a lamprey spinal cord was placed in a chemical bath, with only one end of the cord free to move. A small motor was attached to periodically force that end of the cord. The cord has mechano-receptors which are independent of the muscle and which react when the cord is bent, creating electrical activity in the cord in the vicinity of the bend. The coordinating system in the cord then causes this electrical activity to propagate down the cord in a traveling wave. The results reflected the mathematics: when the motor is connected to the tail end of the spinal cord, the frequency can be entrained above or below the natural frequency, whereas if the motor is at the head end, the frequency can be entrained only at or above the natural frequency. The mathematics then suggested that the tail-to-head coupling is stronger than the head-to-tail coupling.

Surprising Results

Sigvardt and Williams were surprised at the results. "These predictions seemed to have no biological basis, no biological reason," says Williams. "They were rather wild... There is no way a biologist, without this kind of mathematical construction, could predict this outcome." Sigvardt notes that the experimental techniques had been around for at least twenty years, but "basically all the experiments said was, look, we have a system and we can entrain it. [Biologists] didn't know what it meant... But when Nancy and Bard did the mathematics and found that it made predictions, then we were able to do the experiments and have some way to interpret what it meant." In fact, the premise of dominance of tail-to-head connections ran counter to what biologists thought was going on: because the wave travels from head to tail, they figured head-to-tail connections would be stronger. "It was just an intuitively reasonable hypothesis," says Sigvardt. "This is really a drastic change in our thinking about how a head-to-tail wave might happen."

The entrainment experiment has provided only indirect evidence of the dominance of tail-to-head coupling; direct evidence would involve examination of the actual neural fibers in the lamprey. Up till now, biologists have not done much examination of tail-to-head fibers. "Our results all of a sudden said that the ascending [tail-to-head] coupling was in fact the thing that determines what the phase lag is," Sigvardt says, "and therefore we had to go back and look for ascending fibers because we really had never paid much attention to them before." Other questions also arise: Are there more fibers that go head to tail than tail to head? Over how many segments do the fibers extend? How strong are the connections these fibers provide? Further biological experiments should shed light on these kinds of questions.

Ermentrout and Kopell have also looked at other ways to couple the oscillators in order to investigate how details of the anatomy affect the ability of the network to solve

functional problems. For example, they have refined the model to add multiple nearest-neighbor coupling, in which each oscillator is connected to more than two nearby neighbors. This addition helps the network regulate phase lags when some of the frequencies along the cord are nonuniform.

Another coupling device is to model each oscillator as a collection of cells, rather than as one cell, and to assume the cells are connected in a network. Says Ermentrout, "You [can] make the coupling between two networks distributed, so that each cell within the network connects to only a few other cells in another network, but there are many such connections." This way of "averaging" the coupling between oscillators helps avoid certain pathologies that can arise in the rhythm. "Averaging can easily be done anatomically by making distributed connections between networks of cells," he notes. "It's not at all physiologically unreasonable, and the mathematical benefits are many. However, it's clear that the creature was not devising its connections to make it easier for mathematicians to study it twenty million years later."

Long Range Interactions

One of the mysteries that still remains is why the wavelength of the traveling wave is equal to the lamprey's body length. Nearest-neighbor or multiple nearest-neighbor coupling is sufficient to insure that the wavelength remains the same, but does not insure that that wavelength is one body length. The question of the regulation of wavelength has motivated Ermentrout and Kopell to look at "long range interactions"—connections that run over one or one-half a lamprey body length. Other issues are involved as well, including the existence of long neural fibers in the lamprey and certain observations of its various developmental stages.

The basic idea is to combine excitatory local connections with inhibitory global connections. In the case of two identical, coupled neural oscillators, signals from one oscillator that tend to excite the other will generally synchronize the two; signals that tend to inhibit the other oscillator will generally make them go into antiphase. Using nearest-neighbor coupling that would ordinarily induce synchronization, one then superimposes inhibitory connections that run from the oscillators on the ends to oscillators near the middle. Ermentrout and Kopell have shown mathematically that this interplay between the local and global coupling provides a mechanism for producing the correct wavelength.

What about the fact that a short section of the lamprey spinal cord "knows how to swim" and produces the correct phase lags even when it's separated from the rest of the cord? "Obviously, if you cut the cord into little bits, you've destroyed those [long range] connections," Ermentrout notes, so there is nothing to make the system maintain the correct wavelength. One possible explanation is that, in a developing lamprey, the long range connections provide a "teacher signal" by which individual segments can "learn" the appropriate phase lags. Ermentrout and Kopell are working on theoretical approaches to these ideas.

Moving beyond the simple case of nearest-neighbor coupling to include long range interactions results in an unwieldy number of possibilities for the architecture. Sigvardt and Williams are developing a variety of experiments to divine clues about constraints on the kinds of long range connections possible. Anatomical experiments to locate neural fibers should provide some qualitative information about the connections. However, the presence of fibers does not necessarily imply that those fibers actually function during swimming. Therefore a second, complementary set of experiments attempts to measure how far signals from a single oscillator travel: the oscillators in one half (say, the head half) of the spinal cord are "turned on" with excitatory amino acids while the other half (the tail half) is "quiet." Measurements are made of how far down the quiet part of the spinal cord the electrical signals travel. The experiment is reversed, with the head half quiet and the tail half activated. Comparing results from the two experiments should then give a measure of the relative strength of ascending versus descending coupling. A third set of experiments provides more details: injecting dye into single cells of the central pattern generator shows precisely how far up or down the cord the individual neurons can send their signals.

Biological "Mathware"

It was surprising to the mathematicians and the biologists alike that this simple framework of a chain of oscillators, which Kopell likes to call "mathware," could make predictions about what was happening biologically. "That's what we always thought was very nice," Ermentrout says. "Most people believe that these really simplistic models cannot make very sharp predictions. But this is an example where a very general model does make a very sharp prediction." As the interplay between the mathematics and the experiments produce sharper and clearer details, one can hang the details on this framework. "One really important function of the math so far has been to keep raising questions and sharpening them," Kopell notes. "You get answers out, and the answers provoke the next question and the next experiment." Helping to figure out which qualitative features are important has been the main function of the mathematics.

This approach can be more fruitful than trying to accommodate all the details at the outset. "The classical approach from neurophysiology [is] to develop a very large database about all of the cells in the network and all of their connections, and the physiological and pharmacological properties of the cells and their connections," Kopell points out. "What has been happening, though, is that even people working with small networks have discovered that even when they build this tremendous database, . . . the knowledge about the properties of the individual cells simply wasn't giving them the understanding they hoped would emerge about how the network operates." Sigvardt notes that, with the classical approach, biologists "were stuck. One of the big problems with nervous systems is that there is a lot of information about how individual cells work and what nervous systems

do. But to leap from single cells to how groups of neurons produce a behavior is a big problem in biology."

The mathware has provided insight beyond the prediction in the entrainment experiment. The model of the chain of oscillators helped to focus on what determined the behavior of the system—before, biologists were uncertain of what produced and regulated the traveling waves. The mathematics also suggested a function for some parts of known anatomy. For example, earlier anatomical work had pointed to the possibility of multiple nearest-neighbor coupling, but it was unclear how those connections functioned. The mathematics showed how these connections are related to maintaining a tighter regulation on the phase lags than on the frequencies. In addition, the mathematics suggested functional reasons for further microstructure in the oscillators.

As for the mathematics itself, Ermentrout and Kopell note that the applications have not been "off the shelf," they've had to create new mathematics to fit this set of problems. "There's a great deal of mathematics in the literature about collections of mechanical oscillators and mechanical systems," Kopell notes, but these biological networks don't have that kind of structure. "But [they have] other kinds of structure which we try to use and exploit, in particular the stability in the limit cycles." The methods they used combined standard techniques like averaging theory and invariant manifold theory with less standard geometric methods that were created to suit the problems at hand. In particular, they did a fair amount of work on the geometry associated with singularly perturbed systems. Kopell notes that the dynamical systems viewpoint has proven useful, but "one doesn't simply use dynamical systems theorems. One has to develop the right theorems that work for the equations" that arise. "This [research] really produced nontrivial and difficult theorems," Ermentrout observes. "But also, it's wonderful that it's working out to have a whole lot to do with the physiology as well."

Lobster Applications

In considering ways of extending these ideas to other biological networks, Kopell has been closely following the work of Eve Marder, a biologist at Brandeis University. Marder does research on the central pattern generator for the stomatogastric ganglion of lobsters, which controls muscles for ingestion and digestion of food. A lobster's stomach has tiny "teeth," and this network creates a pattern of activity in the muscles that causes the teeth to chew and grind up food in different ways. As networks go, this one is fairly small—only about thirty cells, compared to about 100,000 in the lamprey preparation. However, Marder observes that it's been more difficult to approach the lobster preparation mathematically because many more details and data are available than in the case of the lamprey. The problems are more specific and complicated, making it difficult to know which details can be ignored and which ones can't.

Kopell has been studying some of the data coming out of the lobster preparation, and it's turning out to be very different from the lamprey work, where the geometry was much simpler. In the stomatogastric ganglion, there is such a highly complex web of networks and subnetworks that "one wouldn't be tempted to think of it only in terms of geometry," Kopell notes. "It's clear that one has to take into account more than the fact that there [are thirty cells] and they are connected—in other words, one needs much more than a wiring diagram. What one has no idea yet without thinking hard about it is, how much more than the wiring diagram do you need? And that's exactly the question that's being explored in an experimental and mathematical way."

Finding the Right Group

Both the mathematicians and the biologists agree that finding the right group was the key to successful interactions. Says Ermentrout, "I would say the important things were having willing biologists who were really interested in listening, seriously listening, along with mathematicians who were willing to change the theory to meet the experiments." "One of the strengths of our group is that we have diverse people who communicate well with each other," says Sigvardt, noting that it's unusual to have senior researchers collaborating in this way. "It's been a wonderful experience... We all feel that we'll be collaborating like this for a long time to come."

Williams reports that her research has become much more exciting because of the collaboration. Though her Ph.D. was in physiology, her bachelor's degree was in physics. She's always had an interest in mathematical applications and has in recent years been taking mathematics courses to facilitate her research, "but this is the first time that mathematics has been involved in the basic ideas of my research." In fact, she was a coauthor with Ermentrout and Kopell in a paper that appeared in a mathematical journal. This connection to mathematics has a special, personal aspect for her: while in college in the 1960s, she was discouraged from going into mathematics and went into biology instead. She is currently working toward a mathematics degree and is also collaborating with two British mathematicians, Graham Bowtell of City University in London and John Carling at St. George's Hospital Medical School, on modeling the lamprey body and fluid dynamics of lamprey swimming.

"It was a leap of faith to intuit that the mathematics actually could end up giving biologists insight into these networks that they work so closely with," Kopell remarks. "I sensed it was going to be true, but you don't know until you try to do it. And the fact that a fair number of biologists have come in and joined us and have found it to be a useful way of organizing the way they go about their activities—that's been tremendously exciting, to get talented biologists to take it seriously."

Allyn Jackson
Staff Writer

Nancy Kopell will present the Emmy Noether Lecture of the Association for Women in Mathematics at the Joint Mathematics Meetings in Baltimore, January 8–11, 1992.

Mathematics Strategy Review in the United Kingdom

Adrian F. M. Smith

Adrian F. M. Smith is Professor of Statistics in the Department of Mathematics, Imperial College, London, SW7 2BZ. He was Chair of the SERC Mathematics Committee from 1988–1991 and a member of the Mathematics Strategy Review Panel.

Increasing concerns were expressed in the United Kingdom (UK) in the late 1980s about the level of support for the mathematical sciences. In response to these concerns, a Mathematics Strategy Review Panel was set up by the Science and Engineering Research Council (SERC). This Panel, chaired by Sir John Kingman, FRS, was given the following terms of reference:

"i) *to examine the current policies of the Mathematics Committee in its support of research and training*;

ii) *to recommend appropriate strategies and options for the future support of UK mathematics, taking into account both the needs of the subject (in academia and industry) and the political and funding constraints*;

iii) *to comment on the ability of currently available support to meet the needs identified*;

iv) *to quantify any increase in support levels required to provide, for the foreseeable future, the minimum level of activity consistent with meeting the needs of industry and retaining academic mathematics in the UK at the present level of quality vis-a-vis the rest of the world.*"

The Panel's report, "Mathematics: strategy for the future," was published in August 1991, and included a series of recommendations to the SERC and other UK bodies. The main purpose of this article is to summarize the report and its findings. However, because the current UK system for funding research in higher education institutes is substantially different from that in the U.S.A., it is appropriate to begin with some general background.

Academic research in the mathematical sciences in the UK is funded by the UK government at higher education institutes (universities and polytechnics), partly through direct funding to the institutes and partly through funding to groups and individuals by national Research Councils (predominantly the SERC). Most research activity is focused on the university sector and the Report concentrates mainly on that sector. The direct funding of the institutes provides twelve-month salaries for faculty, secretarial and technical infrastructure and baseline provision of research resources such as libraries and equipment. In the case of universities, funds are allocated to institutes by a body called the Universities Funding Council (UFC). One part of the UFC formula includes a per student unit resource figure which varies across academic subject areas, the institute total being then determined by its subject matter mix. The mathematical sciences are regarded as a "low cost" subject, with a unit of resource set at around half of that of physics and biology and, when translated into a teaching component, substantially lower than the figure for humanities.

The funding provided by the SERC takes one of the following forms: provision of (typically one-year) M.Sc. studentships, of which there are currently about 200 per annum in the mathematical sciences; provision of (typically three-year) Ph.D. studentships, of which there are currently just under 200 in the mathematical sciences; funding of postdoctoral fellows for two to five years, of which there are around twelve in mathematics; funding of research assistants (mainly at postdoctoral level, but some at programmer level), and/or equipment (almost entirely in the form of graphics workstations), and/or travel money, and/or support of overseas visitors. M.Sc. studentships are awarded, on the basis of periodic national review, to specific departments to support agreed master's programmes. Ph.D. studentships are awarded competitively to individual students to work with specific supervisors in specific departments. All other funding is awarded competitively after peer group refereeing of detailed research proposals. One of the main differences between SERC and NSF funding arrangements is that the SERC does not provide any salary support to the principal investigators, who are deemed to be on a twelve-month salary provided by UFC funding.

Against this background, the Strategy Panel Report begins by asking "Why mathematics?" Not surprisingly, it concludes, after wide discussions with academia and industry in the UK, and after seeking an international perspective, that

"*The need for mathematics and mathematicians is an expanding and all-pervasive aspect of a modern science-based economy.*"

But, pursuing a devil's advocate role, the Report goes on to ask, in the context of the UK, "Why mathematics research?". After all, it has been argued that

"*... research is carried out world-wide, and most of it is freely published. It might be said that a particular country can lift the new mathematics it requires from the corpus of global research rather than needing to support a major national research activity.*"

The Report concludes that such an approach is doomed to failure and that there is an inescapable need for an expert national community able to appreciate and evaluate the work of others and to contribute equally:

"*... a nation which requires access to the cutting edge of mathematics will maximize its chances by having an active mathematical research community which gives it membership of the global club.*"

But how big a mathematical science community does the UK require? And what resources does it need?

In answer to the first question, the Report begins by noting that the mathematical sciences (unlike, perhaps, some other areas of science and technology) cannot be 'rationalized' by abandoning, root and branch, support for some areas of the subject. Instead, it stresses the unexpected and unanticipated interconnections among branches of the subject and the need to maintain breadth as well as depth of coverage. In the current financial and political climate of the UK (end of the 1980s), the Strategy Panel saw little point in developing a detailed argument for a substantial expansion of the mathematics community in universities. However, the Report is very clear that

"*any decline below the current level of research activity could set in train a dangerous spiral of contraction, with the irreversible losses of vital sectors of the knowledge base.*"

The detailed analysis and subsequent recommendations of the Report are therefore focused on

"*the minimal, but crucial, strategy of maintaining an internationally competitive UK research mathematical community at about its present size.*"

At present, there are some 1,500 mathematical science faculty in UK universities (including statistics and operational research, but excluding computer science). In addition, there are typically around 140 postdoctoral researchers on three-year contracts, some holding fellowships, others employed as research assistants on projects.

A key strategic issue identified in the Report is the need to ensure the future availability of sufficient appropriately trained Ph.D.s to take up these postdoctoral fellowships and research assistantships, and to replace current academic staff as they retire or leave the UK university system. The minimal requirement is seen by the Report to be a flow sufficient to sustain the postdoctoral and permanent faculty members at their current numbers.

In order to understand the quantitative implications of this minimalist strategy, the Panel commissioned a demographic study. This was based on a complete age-profile of current UK academic staff in the three sub-areas of pure mathematics, applied mathematics, statistics, and operational research, together with empirically based assumptions about leaving rates. In light of the findings of this study (detailed in the Report), the Panel concluded that:

"*Even without considering further demand from outside the UK, the current supply of mathematics Ph.D.s is seen to be dangerously inadequate. However, the situation is actually much worse than this since demand for UK mathematics Ph.D.s from other countries, notably the U.S.A., is high and increasing dramatically as U.S. universities take active steps to meet their own demand-supply gap in restocking the university mathematics system.*"

However, in the UK (in contrast to the U.S.A.?) there is a potential silver lining to this particular cloud!

"*The Strategy Panel concluded that there is a clear and pressing need to increase the number of Ph.D.s in the UK and that the problem is one which can readily be solved by appropriate action from the SERC. There is ... a large pool of well-qualified mathematics graduates capable of doing mathematics Ph.D.s, but currently unable to obtain studentships. In recent years there has been a substantial excess of demand from this pool of good quality graduates and the Panel was clear that any increase in studentship provision would translate directly into an actual increase in Ph.D. numbers.*"

The Report recommended to the SERC that the number of available studentships be increased by 50%.

But, in addition to the manpower strategy, there are major concerns about the underpinning unit of financial resource. In particular, the Report concludes that both the UFC and SERC baseline assumptions about funding requirements in mathematics are fundamentally flawed. This is largely a consequence of failing to take into account the recent and escalating trend towards a substantial "experimental" component in mathematics research, with a corresponding increase in equipment needs. In the words of the Report:

"*Mathematics can no longer be regarded as largely a 'pencil-and-paper' or 'chalk-and-talk' subject and the Panel regarded it as of the utmost importance that this fact be clearly recognized ... ... Specialized computing equipment—typically in the form of a powerful graphics workstation—is now an essential resource in many areas of mathematical research. ... This fundamental and irreversible shift towards being an 'experimental' subject has changed the nature of a great deal of mathematical activity and, as a consequence, the resource needs of the subject.*"

The Report recommends to the UFC that it increase its per capita resource unit for mathematics to a level closer to that used for computer science. It recommends to the SERC that it double the baseline funding available for competitive project grants to take account of the quantal change in equipment needs in the subject.

The Report's recommendations regarding studentships and funding are now under consideration by the various "powers-that-be". One can but hope that those who tread the corridors of power pay appropriate attention to the detailed arguments of the Report and the Strategy Panel's observation that

"*...unlike in some other subject areas, cost effective solutions with high marginal utility are available for relatively small increases in SERC commitment.*"

Mathematics: strategy for the future. **Report of the UK SERC Mathematics Strategy Review Panel, Chaired by Sir John Kingman, FRS. Copies of the report can be obtained from Publications Department, SERC, Polaris House, North Star Avenue, Swindon, SN2 1ET, UK.**

Computers and Mathematics

Edited by Keith Devlin

This month's column

Donald Knuth's TEX program has clearly changed the way many of us function as mathematicians, be it in writing our papers and reports, authoring books, or preparing our classroom handouts and examinations. Announcements of meetings on electronic bulletin boards are now often in TEX format for the reader to copy, process, and print off. And increasingly there is a tendency to make use of common TEX commands to express mathematical formulas in an otherwise normal text communication by electronic mail. I know I am not alone in spending a lot of my time these days sitting in front of a computer screen, not *computing* in the normally understood sense of that word, but simply writing lectures and papers (and occasionally introductory paragraphs for the "Computers and Mathematics" column), the kinds of activities that were previously done with pencil and paper.

I still believe that by far the greatest long-term impact of the computer on mathematical research will be its role in the communication network, enabling mathematicians spread around the globe to share their ideas both rapidly and on a large scale. At the moment, TEX, together with its variants, seems to have taken on a significant role in that process, providing a universal standard for the transmission of mathematical documents over an electronic medium that handles little more than ASCII characters entered at a typewriter keyboard. Thus, it seems to me that TEX has taken on a quite significant role beyond the convenience of being able to produce typeset mathematical documents rapidly.

From its beginnings under Jon Barwise's stewardship, this column has run a number of articles on TEX. Two of them have been by Michael Doob. His article "TEX and Typesetting — An Author's View" appeared in *Notices*, Volume 36, Number 9 (November 1989), pp. 1203-1204. That was followed by "TEX and the Single CPU", in Volume 37, Number 3 (March 1990), pp. 270–273. The second of those two articles was devoted to TEX implementations available on the Macintosh. This month's lead article is a sequel dealing with PC versions of TEX, and entitled, appropriately enough, "TEX and the Single CPU, II".

Following Doob's article, Ian Stewart reviews the dynamical systems package *Kaos* and Raymond Smith looks at *Theorist*.

Editor's address:

Professor Keith Devlin
Department of Mathematics
and Computer Science
Colby College
Waterville, Maine 04901

Correspondence by electronic mail is preferred, to:

kjdevlin@colby.edu

TEX and the Single CPU, II

Michael Doob*

"A woman can never be too rich or too thin."
—Duchess of Windsor (1941)

"A computer can never have too much memory or too fast a CPU." —Michael Doob (1991)

Over the past several years, TEX has evolved from an almost experimental mathematical typesetting program of interest to computer-oriented scientists to a working tool that may be used by the ordinary mathematician with no particular expertise (or, perhaps, even interest) in operating computers. It is now relatively easy to set up TEX on small microcomputers like the Macintosh or the IBM-PC. The first part of this article reviewed the implementations currently available on the Macintosh; we now continue with those that will run on PC compatibles.

The situation is more complicated when considering the PC because of the greater variety of hardware configurations. The chip used as the central processor (8086, 8088, 80286, 80386), the time it takes to read a block of data from the hard disk (usually between 18 and 95 milliseconds), and the type of video board used (CGA, EGA, MCGA, VGA, Hercules), and the amount of RAM available will all dramatically affect the speed with which TEX runs on a particular machine. In addition, the type of printer used (PostScript or HP laser, 9 or 24 pin dot matrix) must be considered also. For this reason, any comments (either here or elsewhere) concerning the speed of TEX running on a PC must be taken with a grain of salt. A faster CPU or more RAM will always be beneficial. Nonetheless, we shall have some comparative comments to make (more information about the speed of TEX implementations on the IBM-PC can be found in the article [NE]).

Remember how documents are produced using TEX: the author writes the *source* file with an editor. This is used as input for the TEX program, which makes a ***DVI*** file; it

*Michael Doob is a Professor of Mathematics at the University of Manitoba.

is only machine readable. An important property of TEX is that the same source file will produce the same DVI file no matter what implementation of TEX is being used (some implementations, however, are considerably faster at doing this than others). Another program, a ***device driver*** takes the DVI file and makes a new file that allows readable output on a printer, terminal screen, phototypesetter or similar device. A different device driver is needed for each output device.

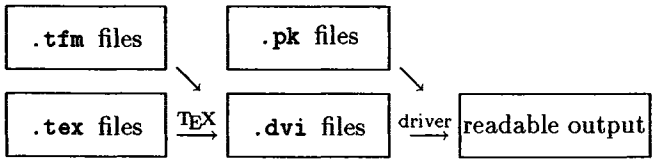
And so several different pieces of software must be acquired to get a fully working system. Specifically, it is necessary to get: (1) the TEX program itself, so that a DVI file can be produced; (2) a previewer, that is, a device driver to look at the TEX output on the computer screen, and (3) a device driver to print the TEX output on the printer.

Files Big and Small

A few words about the different files used by TEX are also needed here. Most files are identified by the extension in the file name. The source file written by the author, for example, usually has the extension `.tex`. When TEX is run, it uses the `.tex` file plus what are called *TEX font metric* (`.tfm`) files. These auxiliary files contain information about the characters such as their height and width. You need one `.tfm` file for each font (such as roman, bold face, or italic) used. The minimum form of TEX uses 16 fonts and every implementation of TEX comes with these `.tfm` files. The sixteen standard fonts are displayed in Appendix F of *The TEXbook* [DK] (of course everything that you would ever want to know about TEX and probably much more can be found in that source). The `.tfm` files are relatively small, and shouldn't take up more than about 120 kilobytes on your hard disk.

The `.dvi` file is the file produced by TEX using the `.tex` source file and the `.tfm` files. The device driver needs to use the `.dvi` file, of course, but also uses other files, usually with the extension `.pk` to actually find the right shape of the character on the device being used for printing the output. You'll need one `.pk` file for each font and size used. Hence, you not only need more such files, but they also tend to be bigger. A full set of `.pk` files may take several megabytes.

Hence, you will need an appropriate set of both `.tfm` and `.pk` files. This is less daunting than might be expected at first, since they are included with the software. Here's an overview of the situation:



The point of bringing up all of this this alphabet soup is the following: if you want to use only the minimum fonts, you will never have any problem. If you want to use other fonts (such as a sans serif one), you will have to be sure that you have the corresponding `.tfm` and `.pk` files. If you intend to use a macro package such as LATEX or AMS-TEX, you must be sure that your implementation is complete.

The situation is further complicated by the different existing methods of obtaining the software: it is possible to order the TEX program plus the drivers for viewing and printing the TEX output directly from software companies selling a complete coordinated package, to get the programs through the mail on floppy disks for only the cost of the media, or to get either source files or executables from listservers, via electronic mail, or by `ftp` file transfers.

Given this somewhat complex situation, the purpose of this review is to help the new user of TEX make intelligent choices from what is available. In order to get answers, sometimes the most important thing is asking the right questions. As we will see, what is a reasonable choice for one person might be wrong for another. So our goal will not be to say that one implementation is perfect (alas, if we could only say that!), but rather to give the framework for each situation. It should also be added that there is something of a North American bias here. Nonetheless, most of the packages mentioned here are also available in Europe, and, to some extent, elsewhere. There is also some software not easily available in North America which will not be discussed here.

Before starting to think about software, it is necessary to consider hardware. What is the minimum equipment necessary to run TEX on a PC compatible? You should have 640K of RAM and 5–10 megabytes of free space on a hard disk. With the dramatic drop in the cost of memory, it is unlikely that anyone would have a machine now that wouldn't meet these minimal requirements. Of course, faster CPUs, disk caches, expanded memory, and extra disk space can improve performance (but a math coprocessor will have relatively little effect).

Commercial Implementations

Let's first consider the different commercial implementations. The starting question is obvious: if it is possible to get all the software for free, why would anyone ever pay for it? There are several advantages offered by the software companies: generally speaking, the implementation is complete with *all* of the fonts used by TEX, the documentation is better, the programs used for running TEX, previewing on the screen and printing are better coordinated, and the different pieces of software can be loaded into your computer easily by supplied batch programs that do all of the work. There are, generally speaking, fewer problems encountered with loading commercial implementations. The quickest route for the novice is probably to use one of the commercial implementations. This having been said, one does not have to be a computer guru to use the free versions. Here's a rough rule: are you at ease changing the `autoexec.bat` and `config.sys` files, and are you at ease changing the `path`, `files`, and `buffers` parameters on your system? Have you defined environmental variables for your system? If so, and if you are willing to spend a little time setting up your system, you should have no trouble at all getting started with

a noncommercial system. Even if you haven't used these parts of your computer, if you are at ease installing other types of software such as a major word processing package or a compiler, then you'll probably install a noncommercial version without much trouble.

The commercial implementations fall into several distinct groups. The first could be called the old veterans of TEX. The products of Arbortext and PCTEX have been available for several years, and this is reflected in the maturity of their products. Both vendors supply batch files that allow for easy loading of the software. The speed at which both versions run are comparable. The Arbortext TEX package also includes a rough previewer that allows viewing the first pages of a document while the later pages are still being processed, a real plus if it is necessary to work on long documents. PCTEX can be run using a window menu that can be invoked to set different parameters for a given job, a convenience if TEX is to be used only occasionally.

The next group consists of somewhat newer implementations that have appeared within the last two years. These include CTEX and an implementation whose name and phone number are identical: 1-800-USA-BOOKS. Both of these were slower than those in the first group; on average it took about twice as long to run TEX on a long document that included an equal mixture of mathematics and text as those in the first group. The documentation was not as good and it was somewhat more awkward to get the software loaded into the computer. That having been said, they were both less expensive, especially 1-800-USA-BOOKS. In particular, the latter implementation has put together an integrated set of public domain programs. This does represent an alternate way to get started with TEX at a lower price.

The third group consists of an older implementation, TurboTEX, and a newer one, ScripTek. Both of these took substantially longer to run than those of the previous group. ScripTek was the only implementation that had the ability to both load and unload the various pieces of TEX software from the system; this could be very useful in a situation where disk space is at a premium. TurboTEX was quite different in the way it handled `.pk` files. Only one such file comes with the software, but the companion program, Metafont, is included, which allows the user to make the remaining ones (this could be a time-consuming procedure).

The last implementation, Vector TEX (also called VTEX) is very different from the others, and, in a sense, is in a class of its own. Instead of using the usual `.pk` files, it uses vectors to represent the different characters to be printed. This allows a far greater variety of characters, and uses only a fraction of the disk space. A typical implementation of TEX will usually come on about 15 floppy disks; Vector TEX comes on two. It is possible that the future direction of TEX is being shown in this implementation. But, and this is a big but, the files are not directly compatible with the standard TEX of today, and the conversion will add an extra level of complication. A review of Vector TEX [JC] can be found in the February issue of *Notices*. It was also slower than those of the first group.

Sources for Commercial Versions of TEX

Here are the addresses, phone numbers, and costs of the different commercial versions:

Arbortext
Suite 300
535 W. William Street
Ann Arbor, MI 48103
313-996-3566
TEX: $249
Previewer: $149
Printer driver: $225

CTEX
Oregon House Software, Inc.
12894 Rices Crossing Road
Oregon House, CA 95962
916-692-1377
TEX: $129
Previewer: $125
Printer driver: $129

PCTEX
12 Madrona Avenue
Mill Valley, CA 94941
415-388-8853
TEX: $249
Previewer: $139
Printer driver: $195

ScripTek
P. O. Box 5310
Kansas City, MO 64131
913-383-5022
TEX: $125
Previewer: included with TEX
Printer driver: included with TEX

TurboTEX
Kinch Computer Company
501 S. Meadow Street
Ithaca, NY 14850
607-273-0222
TEX: $150
Previewer: $120
Printer driver: included with TEX

Vector TEX
MicroPress Inc.
Suite 2N
67-30 Clyde Street
Forest Hills, NY 11375
718-575-1816
TEX: $279
Previewer: included with TEX
Printer driver: included with TEX

1-800-USA-BOOKS
148 Harbor View South, Dept. 1009
Lawrence, NY 11559-1908
1-800-872-2665
TEX: $38.50
Previewer: included with TEX
Printer driver: included with TEX

Public Domain Versions of TEX

Now let's turn our attention to the versions of TEX available for free. There are two first-rate up-to-date versions available in the public domain. These are SBTEX and EMTEX. Of the two, SBTEX is easier to install; it also comes with an editor that can be used with small files, and a previewer *that uses only the* 16 *basic fonts*. In addition, SBTEX is a *very* fast implementation. There is also a companion Metafont program, SBMF, available.

EMTEX, on the other hand, is a more complicated but more complete package. It contains everything for TEX, Metafont, a full previewer, and a printer driver for HP Laserjet printers. Viewed as a total package, it is really a quite remarkable piece of software; its availability for free is all the more pleasing.

DOSTEX is another implementation available, but it is not in the same league as the ones mentioned above.

While we are not primarily interested in drivers, there is another source for TEX previewers and printer drivers; this is what is sometimes called the "Utah" collection, and it is available by `ftp` by anonymous logon to `science.utah.edu`. In particular, there are drivers for PostScript and HP printers.

There is one other source of TEX software that deserves special mention: Jon Radel, P. O. Box 2276, Reston, VA 22090-0276, distributes a great variety of MSDOS TEX software for only $3.50 per diskette. Obviously this is a nonprofit operation. A catalogue can be purchased for $.75 plus a self addressed stamped #10 envelope. Prices are a bit higher for destinations outside of the range of the U.S. Postal Service.

Sources for Public Domain Versions of TEX

EmTEX
Jon Radel
P. O. Box 2276
Reston, VA 22090-0276
or `msdos.archive.umich.edu`

SBTEX
Jon Radel
P. O. Box 2276
Reston, VA 22090-0276
or `wsmr-simtel20.army.mil`

DOSTEX
Jon Radel
P. O. Box 2276
Reston, VA 22090-0276
or `wsmr-simtel20.army.mil`

Appended to this article (on the following two pages) are some samples of output produced by several drivers using the same DVI file. All but one are screen dumps from an EGA monitor attached to an IBM-AT, and they are rather rough, although legible. The last is the output from a laser printer (HP Laser Jet II) with a 300 dot per inch resolution. This article itself is produced from a DVI file with a driver that gives about 1200 dot per inch resolution. Both in principle and in practice it is possible to use one DVI file for many different output devices.

References

[JC] John L. Casti, "VTEX typesetting package." *Notices of the American Mathematical Society*, Vol. 38, 1991, 105–109.

[DK] Donald E. Knuth, *The TEXbook*. Addison-Wesley Publishing Company, Reading, Massachusetts, 1984.

[NE] Erich Neuwirth, "TEX Implementations of IBM PCs: Comparative Timings". *TUGboat*, Vol. 11, 1990, 578–580.

Reviews of Mathematical Software

Kaotic Dynamics

Reviewed by Ian Stewart*

Kaos is a dynamical system toolkit with interactive graphic interface developed by J. Guckenheimer (Cornell) and S. Kim (Pohang).

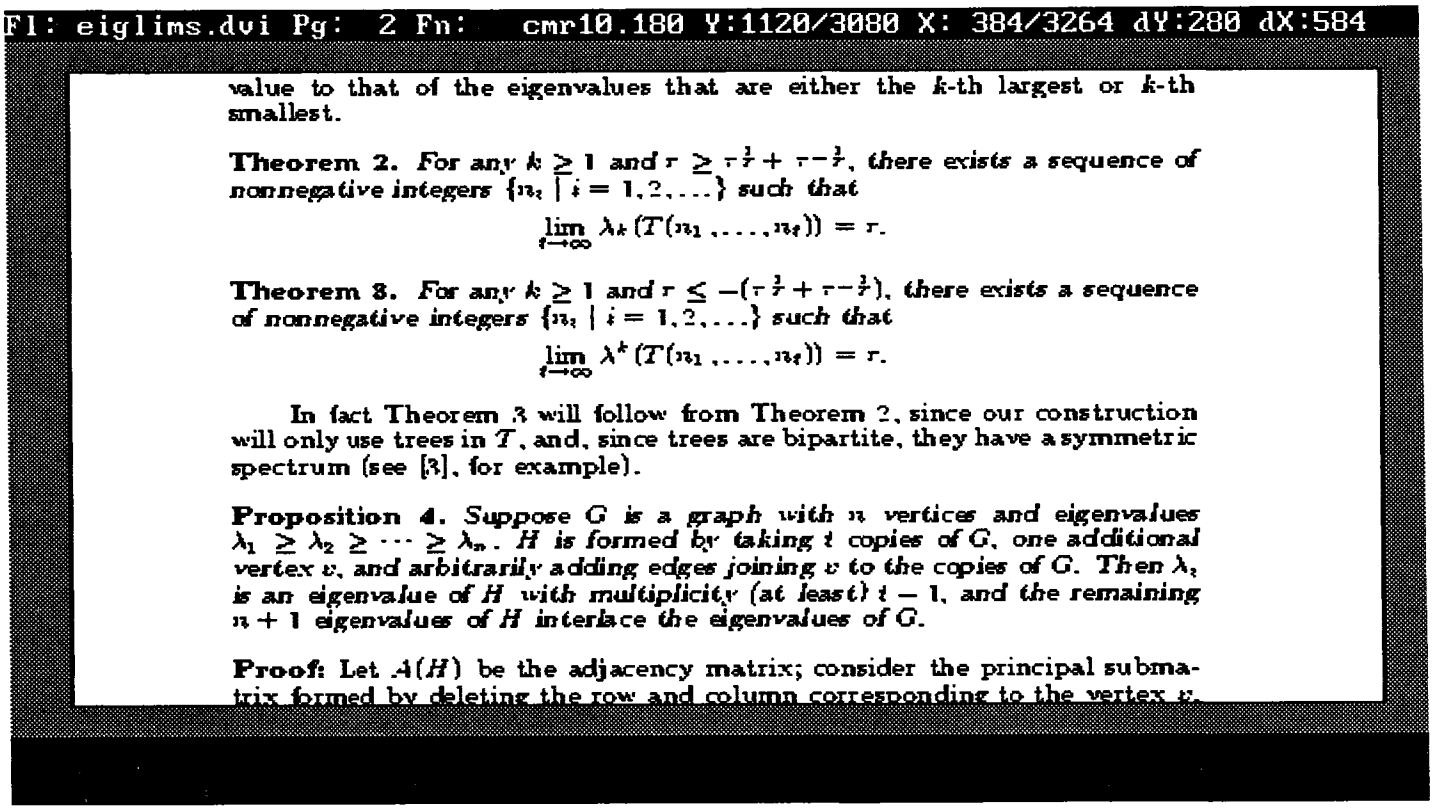
It sat on the desk, accusingly. An antiquated Sun 3/50, its name was Gauss. That much I knew.

And precious little else.

After a while a corner of the veil was drawn back from the mysteries of email. Through Gauss I could now talk to the world, albeit erratically. I learned how to hook up my Mac, and Gauss and Garfield had a whale of a time swapping files. I got some rudimentary Unix under my belt. Under protest I learned enough TEX to prepare a chapter for a book. *Maple* proved moderately useful, but more often than not as a party trick for visitors. The most useful thing I did on it was to check a teenage hand calcuation of 2^{256}. To my astonishment it was correct.

At no time did I feel I was fully exploiting the potential of my machine, geriatric though it may have been. How could I justify upgrading to a SparcStation if I couldn't do anything sensible with a Sun-3?

*Ian Stewart is Professor of Mathematics at Warwick University in England. He is the author of a number of books on mathematics, ranging from graduate and undergraduate level textbooks to popular-market books such as the recent *Does God Play Dice?* He also writes regularly for *Scientific American*.



An example of ScripTek.

Theorem 2. *For any $k \geq 1$ and $r \geq r^{\frac{1}{2}} + r^{-\frac{1}{2}}$, there exists a sequence of nonnegative integers $\{n_i \mid i = 1, 2, \ldots\}$ such that*

$$\lim_{t \to \infty} \lambda_k(T(n_1, \ldots, n_t)) = r.$$

Theorem 3. *For any $k \geq 1$ and $r \leq -(r^{\frac{1}{2}} + r^{-\frac{1}{2}})$, there exists a sequence of nonnegative integers $\{n_i \mid i = 1, 2, \ldots\}$ such that*

$$\lim_{t \to \infty} \lambda^k(T(n_1, \ldots, n_t)) = r.$$

In fact Theorem 3 will follow from Theorem 2, since our construction will only use trees in T, and, since trees are bipartite, they have a symmetric spectrum (see [3], for example).

Proposition 4. *Suppose G is a graph with n vertices and eigenvalues $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_n$. H is formed by taking t copies of G, one additional vertex v, and arbitrarily adding edges joining v to the copies of G. Then λ_i*

An example of Arbortext.

value to that of the eigenvalues that are either the k-th largest or k-th smallest.

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An example of PCTEX.

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Proof: Let $A(H)$ be the adjacency matrix; consider the principal submatrix formed by deleting the row and column corresponding to the vertex v. The eigenvalues of this matrix consists of each λ_i with multiplicity t, and the eigenvalues of H must interlace these eigenvalues. ∎

This simple result, surprisingly enough, is actually sufficiently strong to produce our first result.

An example of output from a 300 DPI Laser Printer.

Enter Kaos

Salvation arrived in the form of *Kaos*, a dynamical systems toolkit of considerable versatility and style. With *Kaos*, I could paint phase portraits, manipulate mappings, anatomize attractors, slice sections, and brew bifurcation diagrams. I could also have listed Liapunov exponents, ferreted out Fourier coefficients, sketched stable manifolds, or fabricated fractal dimensions; but I've not yet needed those, so I haven't learned how. Given the excellent manual and the well-designed user-interface, I don't think it would take much time to learn if I ever needed these facilities.

Kaos is available from gucken@mssun7.msi.cornell.edu by email. It comes as C source code. To use it effectively, you've got to be able to commit rudimentary programming in C. If you understand C thoroughly, you can play all sorts of tricks.

When you open up *Kaos*, you get a screen resembling Figure 1. There are several windows for graphic output and others that list parameter values, etc. These values can be changed using the mouse.

Rather than describe *Kaos* in the abstract, let me show you four problems that I've used it on, and what it did for me.

Symmetric Chaos

Discrete dynamics with symmetry is determined by a mapping $f : X \to X$ which commutes with the action of a group G, so that $f(\gamma x) = \gamma f(x)$ for all $\gamma \in G$, $x \in X$. If f is iterated, then typically the successive images of a point x settle down towards some attractor A, which ranges in complexity from a single point to an intricately structured chaotic set. The symmetry of f places constraints on the form of the attractor. In particular, we can define the symmetry group Σ_A of A to be the set of $\gamma \in G$ that leaves A invariant, that is, such that $\gamma(A) = A$.

Suppose that the map has additional parameters, $f : X \to \Lambda \times X$. As a parameter $\lambda \in \Lambda$ varies, the shapes of attractors (they may not be unique) change. Any change in the *topology*

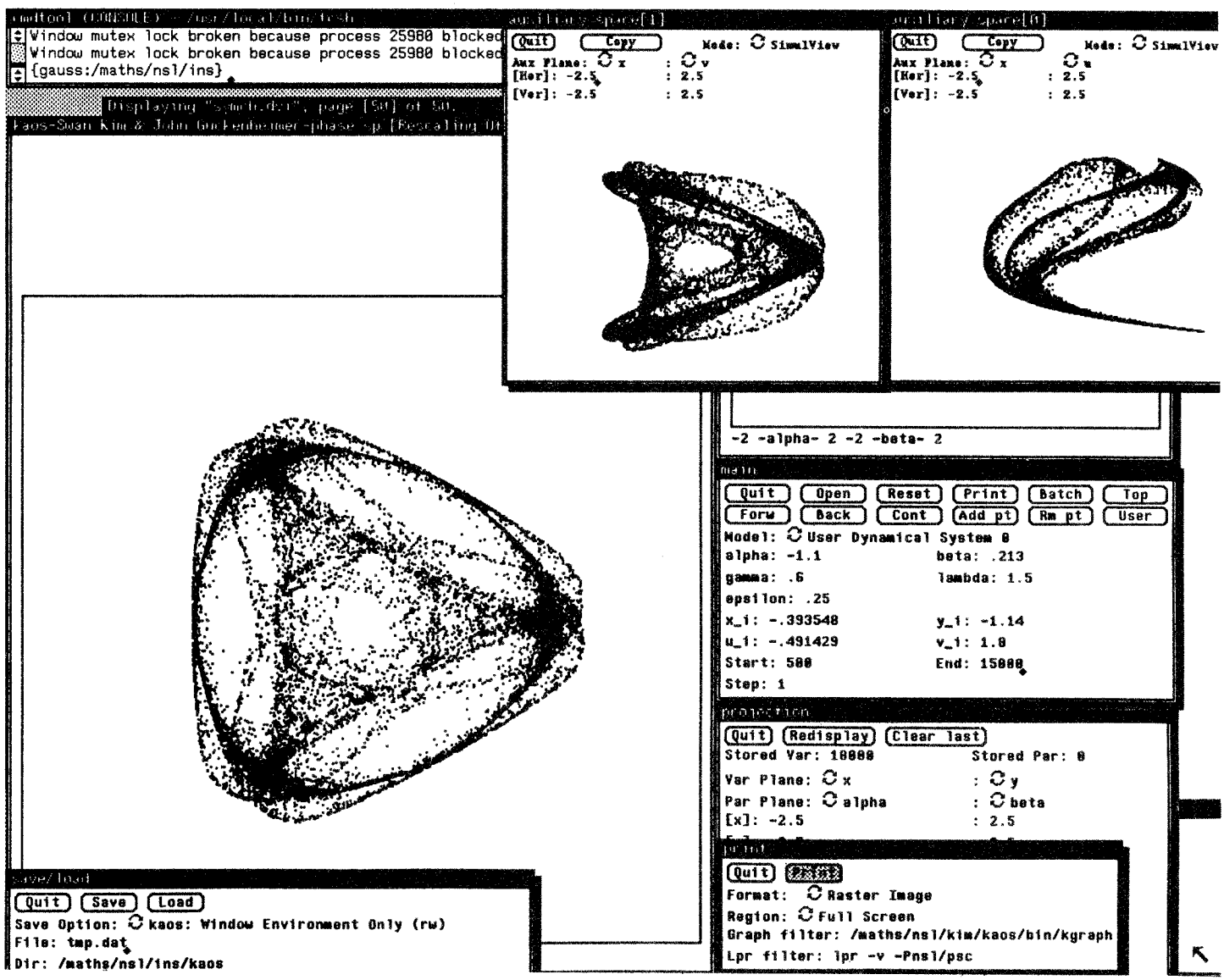


Figure 1: A typical *Kaos* screen.

of A is called a bifurcation. Standard types of bifurcation include *symmetry-breaking*, where the attractor (usually just a point) loses symmetry by moving around inside X. Chaotic attractors can undergo the reverse process, *symmetry-creation*, when symmetrically related copies expand and merge. This phenomenon is called a crisis by Grebogi *et al.* [7] and its prevalence in symmetric dynamics is explained by a theorem of Chossat and Golubitsky [3]. As those authors remark, it seems to be involved in the formation of patterned turbulence in fluid flows: see also King and Stewart [8]. Symmetry-increasing crises have been observed experimentally in electronic circuits, Ashwin [1].

Kaos can easily be persuaded to demonstrate all of these phenomena. For example, consider the family of mappings

$$f(z,\lambda) = (\alpha u + \beta v + \lambda)z + \gamma \bar{z}^{n-1}. \tag{1}$$

introduced by Chossat and Golubitsky [3]. For all values of the parameters $\alpha, \beta, \gamma, \lambda$ these maps have $\mathbf{D}_n$ symmetry. Field and Golubitsky [6] have produced high-resolution computer pictures of the attractors of (marty) in which pixels are colour-coded according to how many times the point lands on them. This gives an impression of the invariant measure on the attractor

We here fix $n = 3$, so that the map (marty) has the symmetry group $\mathbf{D}_3$ of an equilateral triangle. The task at hand is to draw attractors of (marty) for various parameter values. To do this, *Kaos* is customized so that it knows how to draw the dynamics of this mapping. This involves editing one of three files which specify user-defined mappings, including parameters. The structure of the files is straightforward and designed for easy editing. Then *Kaos* is recompiled using a `make` command, which takes a minute or so. All this is explained clearly in the manual and caused very few problems.

Using the mouse to select from on-screen menus and buttons, *Kaos* can be told to iterate this map and display the results. Parameter values are set by selecting appropriate screen areas and typing them in. Initial conditions can be chosen in the same way for high precision, or more simply by clicking the mouse when the cursor is in the appropriate position in the phase plane, which forms the main window on the screen. Control commands allow further initial conditions to be chosen, or orbits or the entire window to be erased. You can select a rectangle and zoom in on it (repeatedly), again, just by tweaking the mouse. Printing the screen or a specific window is just a matter of clicking on the appropriate button.

Figure 2a shows an attractor with a single reflectional symmetry. A slight change in parameters produces Figure 2b, with full $\mathbf{D}_3$ symmetry. This transition is a symmetry-increasing crisis. Part of the explanation is that before the crisis there are actually three symmetrically related copies of the first attractor (as there must be by symmetry), and *Kaos* happily draws these, Figure 2c.

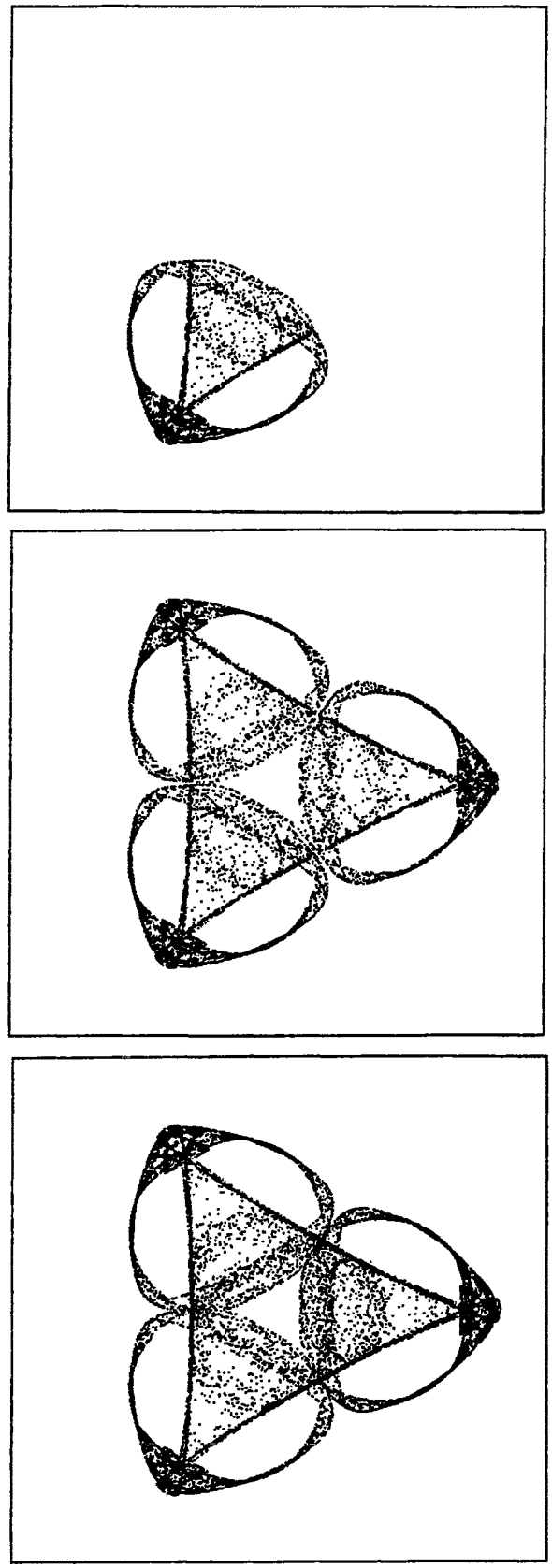


Figure 2: Symmetry-increasing crisis in the mapping (1). (a) $\alpha = -1.1, \beta = .212, \gamma = .6, \lambda = 1.89$. (One attractor shown.) (b) $\alpha = -1.1, \beta = .212, \gamma = .6, \lambda = 1.89$. (Three conjugate attractors shown.) (c) $\alpha = -1.1, \beta = .213, \gamma = .6, \lambda = 1.89$. (One attractor shown.)

Using *Kaos*, we were able to study symmetric chaos in maps of this sort in some detail (see King and Stewart [8]). For example, we obtained numerical evidence for chaotic attractors for $\mathbf{D}_3$-symmetric *diffeomorphisms* on $\mathbf{R}^4$. We also found a chaotic attractor with $\mathbf{Z}_3$ symmetry in $\mathbf{R}^2$. This symmetry group cannot occur for a point attractor of a system in the plane with $\mathbf{D}_3$ symmetry, and shows that the range of symmetries that are possible is greater for chaotic attractors. A satisfactory general description of the range of possible symmetry groups Σ_A of attractors A, for mappings that commute with an arbitrary group G, remains an open question.

Hamiltonian Caustics

A Hamiltonian system with two degrees of freedom often possesses invariant tori upon which there is a dense orbit. If projected into configuration space the torus exhibits singularities, which form the envelope of the projection of the dense orbit. Delos [5] observed that such projections can show 'corners,' that is, singularities equivalent to $(x, y) \mapsto (x^2, y^2)$, the gradient mapping defined by the function $x^3 + y^3$. At first sight, this behaviour is suprising and 'non-generic;' but, in fact, it occurs as a result of the special constraints that occur in the system. Montaldi [10] shows it to be a consequence of the time-reversibility of classical Hamiltonian systems.

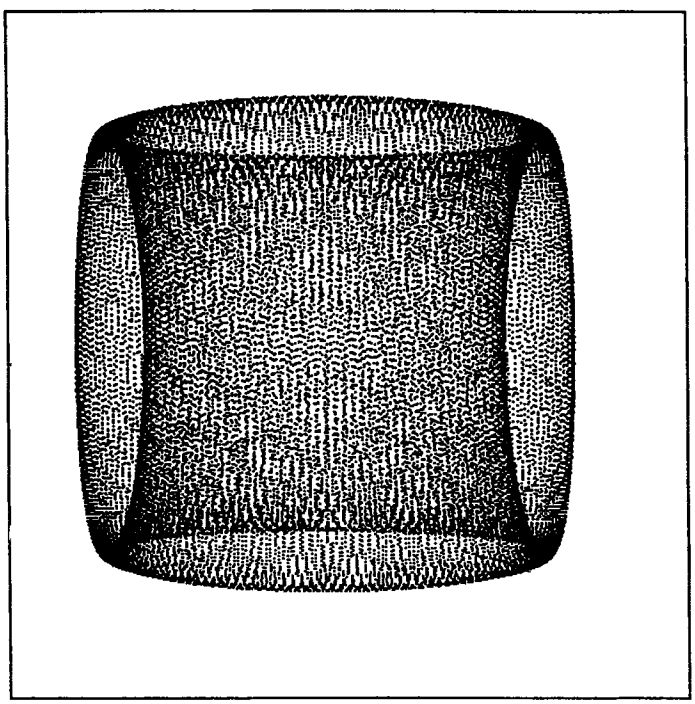


Figure 3: Counterexample to a conjecture of Delos.

Delos conjectured that the analogous singularity for systems with three degrees of freedom should be equivalent to a corner of a cube: $(x, y, z) \mapsto (x^2, y^2, z^{2)})$, the gradient mapping defined by the function $x^3 + y^3 + z^3$. Montaldi shows that this conjecture is *false*, and that the picture is more subtle: the function should be $x^3 + y^3 + z^3 + \mu xyz$ for a parameter μ which generically is non-zero. The proof involves the machinery of Lagrangian singularities.

To check this contention, *Kaos* was used to produce a Poincaré section of the singularity. Take the Hamiltonian

$$H(p, q) = 0.5(p_1^2 + q_1^2 + 0.55(p_2^2 + q_2^2 + 0.625(p_3^2 + q_3^2 + q_1 q_2 q_3)$$

and integrate numerically, starting from the initial conditions $p = (0, 0, 0)$, $q = (0.2, 0.2, 0.2)$. The condition $p = 0$ is required to make the trajectory symmetric under time reversal $t \mapsto -t$. *Kaos* is equipped with a variety of symplectic integrators, but in this case fourth order Runge-Kutta was more than adequate. Then draw a Poincaré section to see a slice through the singularity. The result, shown in Figure 3, is the shape predicted by Montaldi. If Delos's conjecture were true, the picture would be a square.

Symmetry-locking

Krupa and Roberts [9] have developed symmetric versions of symbolic dynamics and kneading theory to study circle maps that are symmetric under the action of the dihedral group $\mathbf{D}_n$. Examples are the family of *Arnold maps*

$$f_{\omega\mu} : \mathbf{S}^1 \to \mathbf{S}^1$$

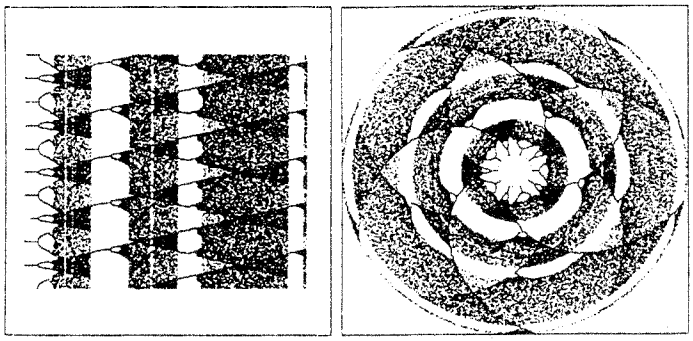
defined by

$$f_{\omega\mu}(x) = x + \omega - \frac{\mu}{2\pi k} \sin 2\pi k x \,(\text{mod } 1). \tag{2}$$

This has a cyclic symmetry group $G = \mathbf{Z}_k$ defined by $x \mapsto x + \frac{s}{k}, s = 0, \ldots, k-1$. Moreover, for certain values of ω the map (2) has a further symmetry. For example, if $\omega = 0, \frac{1}{2}$, then $f_{\omega\mu}$ is equivariant under $x \mapsto \quad x$. This leads to a type of $\mathbf{D}_k$-symmetry in which the group actions on source and target are different.

Krupa and Roberts analyse how the symmetry group of the attractor for (2) varies with the parameters ω and μ. In King and Stewart [8], we again used *Kaos* to investigate the behaviour numerically. A minor snag is that *Kaos* does not *directly* provide facilities for drawing bifurcation diagrams. This is easily overcome by treating the bifurcation parameter λ as a dynamic variable and 'ramping' it; that is, increasing it by a very small amount (here 0.0001) at each iteration.

Figure 4 (see next page) is an example of the results. In the left-hand diagram, μ runs horizontally and the coordinate x on the circle runs vertically from 0 to 1, so top and bottom are identified. The second diagram is a polar coordinate version, in which μ is the radial coordinate and the angular variable is $2\pi x$. For the polar plot, we used *Kaos*'s facility for user-defined functions.



(a) (b)

Figure 4: Bifurcation diagrams for an Arnold map. (a) Cartesian, (b) Polar.

Hexapod Gaits

It has long been recognised that animal gaits, such as the bound of a kangaroo or the trot of a horse, possess a degree of symmetry. This has been formalized by Schöner *et al.* [11] and by Collins and Stewart [4] as invariance under a combination of limb-permutation and time-translation. For example, the trot of a horse is invariant under interchange of front and back pairs of legs, and also under left/right reflection followed by time-translation of half a gait period. The second paper cited also suggests that symmetries of gaits are related to symmetry-breaking bifurcations in the dynamics of neural networks (central pattern generators, or CPGs) controlling the limbs.

Appropriate CPGs can be modelled as a network of coupled more-or-less identical oscillators. A recent unpublished application to hexapod gaits, Wood [12], uses *Kaos* to study the system of equations

$$\dot{x}_p = -4x_p + y_p + (x_p^2 + y_p^2)(Px_p - Qy_p) \\ -4\mu(x_{p-1} + x_{p+1}) + 2\mu(y_{p-1} + y_{p+1})$$

$$\dot{y}_p = -x_p - 4y_p + (x_p^2 + y_p^2)(Py_p + Qx_p) \\ -2\mu(x_{p-1} + x_{p+1}) - 4\mu(y_{p-1} + y_{p+1})$$

where $0 \le p \le 5$ and p is taken modulo 6. These are the equations for a hexagonal network of nonlinear oscillators of a particular form, modelling a CPG for insect gaits.

Kaos was used to draw time-series of the x-coordinates of all six oscillators, varying against time. The software does not have an explicit facility for displaying simultaneous time series; but, again, the user-defined functions come to the rescue. It is easy to define a function that, at successive increments of time, cycles through the six x-coordinates, and translates them to six different origins. Sample results are shown in Figure 5, which shows the tripod gait commonly observed in cockroaches (oscillators are alternately in phase and half a period out of phase), and Figure 6, which exhibits what appears to be chaos. One new phenomenon observed in this system, which would have gone unnoticed were it not for the use of *Kaos*, is 'phase-slipping,' where the phase lags of phase-locked oscillations undergo continuous variations.

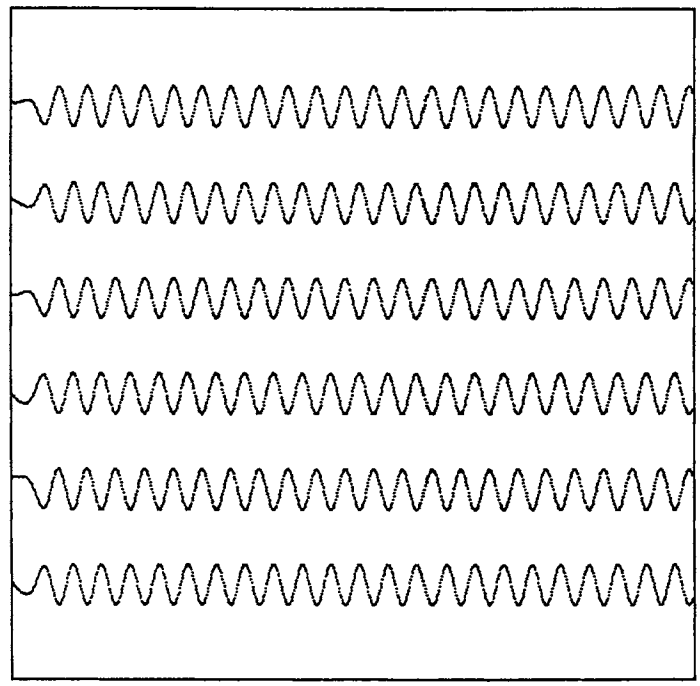


Figure 5: Tripod gait in a model of insect locomotion.

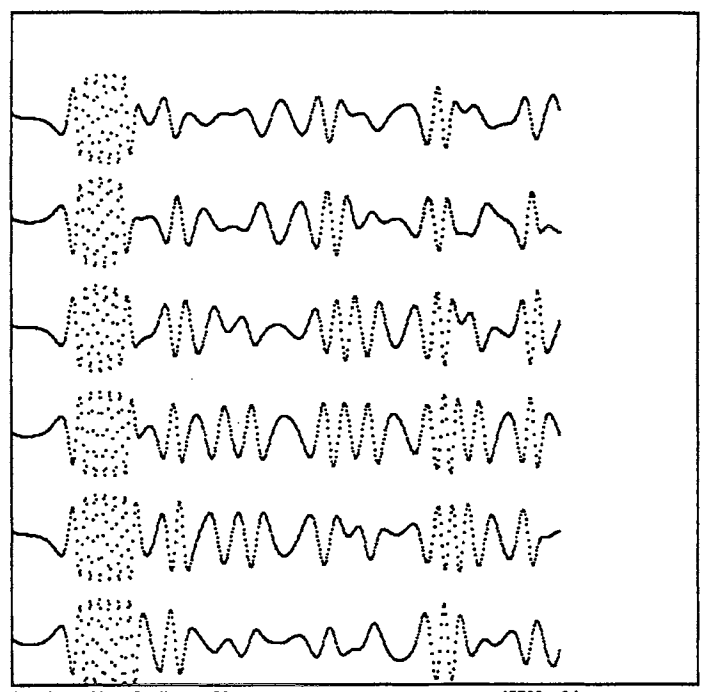


Figure 6: Chaos in a model of insect locomotion.

Final Remarks

Kaos comes with a lot of useful built-in facilities, and is sufficiently flexible that it can often be tweaked to

add more. Moreover, because source code is available, substantial modifications can be made by those adept at C programming. For example, one of our graduate students equipped it with a bipolar coordinate system, to study fluid flow between eccentric cylinders. The software has also been used, without difficulty, by computer-illiterate final year undergraduates working on applied mathematics projects, such as the dynamics of a compost heap.

Kaos is easy to use, suprisingly bug-free, and constitutes a powerful tool for research in nonlinear dynamics.

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Theorist

Reviewed by Raymond F. Smith*

In a review of *Milo* (*Notices*, October 1989) I discussed my search for a Macintosh program that would both provide me with high-quality printed mathematical output and the power of a computer algebra system. I described my ideal program, and then noted that *Milo* did not live up to this ideal. There were two sorts of problems: *Milo*'s word processing capabilities were limited and the symbols could have looked better. The *Milo* computer algebra system was a beginning, but not anywhere near what I wanted. *Theorist* 1.11, developed by Allan Bonadino Associates/Prescience Corporation, 939 Howard Street, #306, San Francisco, CA 94103, is a significant step towards the ideal program. This program provides mouse-oriented symbolic manipulation and excellent graphing capabilities, but is not designed to be a word processor.

Theorist runs on a Macintosh computer with a minimum of one megabyte of memory. Included is a version designed for the Mac II family and SE/30 that takes advantage of their math coprocessors. For the purposes of this review, I used the second version on an SE/30 with four megabytes of memory running under MultiFinder.

Any review reflects the biases of the author, and I certainly have mine. I am a professor and associate academic dean at a liberal arts college that is heavily involved in the use of computers (primarily Macintoshes) in everything from writing to integrated physics labs. My department has an NSF-funded Macintosh lab which we currently use for *Maple* labs in precalculus, calculus, and a few upper-division courses. The emphasis in our classes is on the use of a computer as a tool to aid in the deeper understanding of mathematical concepts. I have also participated in one of Don Small's NSF-funded workshops on using computer algebra systems in calculus.

The Program

Most computer algebra systems (for example *Maple* and *Mathematica*) have a structure which requires the user to learn a wide variety of commands before being able to use the program. Novices often spend a considerable amount of time overcoming minor syntax errors, which, for students at least, can be extremely frustrating. *Theorist*, on the other hand, is a computer algebra system which mimics the ways in which humans do mathematics. Mathematical expressions are displayed in a *Theorist* document (called a notebook) in the same way that we write them on paper and may be manipulated by selecting portions of them and either choosing a command from an appropriate menu or, in certain cases, by dragging the selected item around the screen.

Let me begin a description of the program by looking at some simple examples. To solve $3x + 2y = 5$ for y, the user simply types in the expression, selects the y (using the mouse in standard Macintosh fashion), and then holds down the command key while dragging the selected portion all the way to the left of the equation. The expression $y = -\frac{3}{2}x + 5$ is then displayed on the next line. To compute the integral of the sine function, the user selects the integral sign from the palette displayed at the top of the screen, types in $\sin(x) * d * x$ (the *'s indicate multiplication and distinguish the differential from a variable named "dx"), selects the entire integral, and chooses Simplify from the Manipulations menu. The result is displayed on the next line as

$$\int \sin(x)\,dx = \cos(x) + c_{100}.$$

The constant of integration may be suppressed through the choice of an appropriate option. The definite integral

*Raymond F. Smith is Professor of Mathematics and Associate Dean for the Liberal Education Program at Whittier College. This is the fourth review he has written for this column.

is just as easy, with the result being given in $F(b) - F(a)$ format (or numerically if that option is chosen).

Theorist has built-in commands that will expand and simplify algebraic expressions, factor polynomials and integers, calculate Taylor polynomials, expand sums and products, solve quadratics, differentiate most functions, do straightforward integration, integrate by parts, produce very nice two and three-dimensional graphs, manipulate matrices, etc. In addition to a wide variety of pre-defined functions, *Theorist* allows the user to create new functions (for instance through piecewise definition or recursively) which then may be manipulated just as the predefined ones can. Although the number of "straightforward" integrations that *Theorist* knows is relatively small, the program comes with a large library of integration formulas which may be copied into a *Theorist* notebook so that they become available to the user. In addition, there are notebooks defining trigonometric substitutions, Laplace transforms, functions used in number theory, and a variety of special functions.

Theorist displays its results in outline format. Each new operation produces an expression which is printed as a daughter to the original expression. These outline elements may be selected and moved to new positions in the notebook. Thus the user can experiment with a variety of approaches to a problem and then reorganize the appropriate portions into a document with some logical sense-again mimicking the way humans usually do mathematics.

Rather than spending an inordinate amount of time trying to describe a program that works intuitively, I will proceed to a discussion of the benchmarks that have become standard in reviews of computer algebra systems in this column. I have given detailed descriptions of the process used in solving some of these problems in the hope that these will allow the reader to gain a better feel for the program.

Benchmarks

These benchmarks were introduced by Simon and Wilson (*Notices*, September 1988, pp. 978–1001) and extended by Herman (*Notices*, November 1988, pp. 1334–1344) and Simon (*Notices*, September 1990, pp. 861–868). The reader is again warned that these are not a scientifically selected set of problems, but rather should give the reader a better feeling for how the program works.

Roots. Find the roots of $x^3 - x^2 - x - 1 = 0$. I typed in the equation, using the "Fortranish" option which allows input in standard programming syntax, selected the left-hand side, and chose Factor on the Manipulate menu. The result was the factored equation in symbolic form. I then applied Calculate to the result, getting the solution below: (I have included 6 decimal places, the program will print up to 19.)

$$(x + 0.419643 + 0.606291i)(x + 0.419643 - 0.606291i)\times$$
$$(x - 1.839287) = 0$$

System. Solve the nonlinear system

$$\sin(x) + y^2 + \ln(z) = 7$$
$$3x + 2^y - z^3 = -1$$
$$x + y + z = 5$$

As *Theorist* does not have a direct nonlinear numerical routine, it took me a considerable amount of time to figure out how to do this. I eventually found the section of the manual that presented an approach. The process turned out to be simple. I entered the three expressions, solved the third for x, and substituted this expression into the first two equations—by selecting the modified third equation, holding down the Command key and dragging the expression over the equation I wanted to substitute it into. I then moved (by dragging) all of the terms in the first two equations to the right side, leaving equations of the form $0 = f(y, z)$. I then created new variables (zero_1 and zero_2), setting them equal to the two expressions. The process then was to use the Graph menu to create what the manual calls a "Zero Contour" plot for the two functions. The intersections of the two contours represent (of course) solutions to the system of two equations. At this stage, I used graph features to focus in on an intersection point. Once I had a graph with a unique intersection point, I chose the Find Roots option from the Graph menu. This gave the y and z coordinates of that intersection. The final step was to substitute (by dragging) these two values into the third equation and then solve the resulting equation for x. I found a second root by looking for another intersection point on the graph. I have included a printout of the notebook I used for this process (see next page).

Integer Factoring. Find the integer factors of the eighteen digit number 236789456789432678. I typed and selected the number and then chose Factor from the Manipulate window. It took a couple of minutes to print

$$236789456789432678 = 2 * 3038281 * 38967669019$$

When I tried to factor 12345681432098803, a product of nearly equal 9-digit primes, *Theorist* worked for about 30 minutes before I gave up. I should note that *Maple* was able to factor the second number in a few seconds.

Although *Theorist* does not have a direct command to test for primes, it will indicate primality by printing a number in unfactored form after attempting to factor it. *Theorist* works with integers of up to 19 digits, though, as indicated above, work with large integers can be slow.

GCD. Find the greatest common divisor of two 15 digit integers. I opened the Number Theory notebook in which a gcd function is defined (recursively using mod). Typing in gcd(1565624319111123,442677773754356), selecting it, and then choosing Calculate produced no result. I then read a comment in the Number Theory notebook, and discovered that this routine will only work for ten-digit numbers (at least on the Mac II version of the program). I tried the same operation with 15656243 and 44267777, getting the gcd of 1 almost instantly.

Lissajou. Graph $x = \sin(2t + 0.6)$, $y = \sin(5t)$ as t ranges over $[0, 2\pi]$. I simply typed in the two equations on

separate lines, selected them both (using shift-click), selected the Parametric option from the Graph menu, answered a question about independent and dependent variables, and was presented with a nicely drawn graph in a short time. An important feature is that changing values in the defining statements automatically changes the graph. One can also change the limits for t as well as the size of the graph very easily.

Non Linear System **page 1a**

Declarations

To solve the nonlinear system, first enter the three equations, and then perform some algebraic manipulations.

$x+y+z=5$

$x=-y-z+5$

$\sin(x)+y^2+\ln(z)=7$

$\ln(z)+\sin(-y-z+5)+y^2=7$

$0=-\ln(z)-\sin(-y-z+5)-y^2+7$

$3x+2^y-z^3=-1$

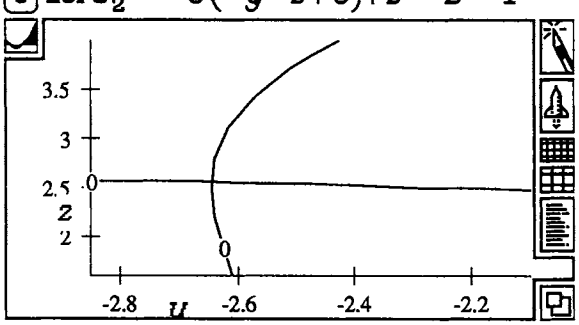
$3(-y-z+5)-z^3+2^y=-1$

$0=-3(-y-z+5)+z^3-2^y-1$

Next define two new functions of y and z and create a "Zero Contour" plot, looking for intersection points.

$\text{zero}_1=-\ln(z)-\sin(-y-z+5)-y^2+7$

$\text{zero}_2=-3(-y-z+5)+z^3-2^y-1$



Use Find Roots to get the intersection points, and then substitute back into the first equation to find the solution. Repeat for a second solution.

$y=2.3959314023778$

$z=2.0050148409816$

$x+4.4009462433594=5$

$x=0.59905375664057$

$y=-2.6442371270278$

$z=2.5438243971411$

$x-0.10041272988678=5$

$x=5.1004127298868$

General Graphing. I graphed the two functions introduced by Herman. Plotting

$$y=\frac{\sqrt{4-x^2}}{x^2(1-x^2)}$$

was as easy as doing the Lissajou curve. Various changes in the x and y limits gave satisfactory results; there were no problems with the intervals on which the function is not defined.

Plotting the function

$$z=\frac{x^2-y^2}{x^2+y^2}$$

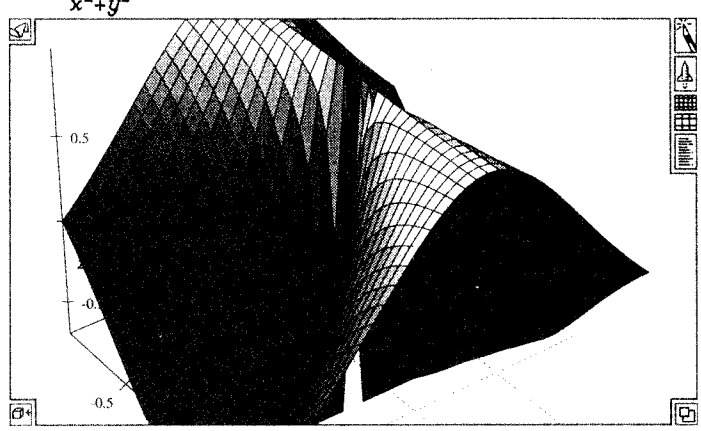
on $-1\le x\le 1, -1\le y\le 1$ was also easy. The user is able to change the view simply by dragging a "hand" cursor over the image. A little work with the mouse and some adjustment of boundaries and mesh size gave the result shown here. I also used the color graphing option on a Mac IIcx and was quite pleased with the results. Although drawing the graphs (especially when a fine mesh was used) took up to 30 seconds, the results were worth the wait.

3d graph eg **page 1a**

Declarations

A three-dimensional graph

$z=\frac{x^2-y^2}{x^2+y^2}$



Hilbert. What is the largest Hilbert matrix $H=[1/(i+j-=1)]_{j=1}^{n}$ which can be successfully inverted? I created the matrix by first selecting a 4×4 matrix and then repeatedly adding rows and columns. Selecting the entire matrix and then using Select In under the Edit menu allowed me to access all of the individual entries at once. I could then easily create the matrix since there is an option that allows the user to use the row number or column number as part of an entry in the matrix. I then let $M=1/H$, substituted the value of H into this expression (by dragging it), and used the calculate option to find numerical values for the entries in M. Finally, letting $N=MH$ (and again substituting values for M and H) allowed me to find the value of the ERR function as defined by Simon and Wilson. I should

note that M, N, and H were defined as linear operators so that *Theorist* interpreted matrix operations correctly.

I first tried this with a 10×10 matrix, getting an approximate value for ERR of 10^{-7}. When I let $n = 11$, I was not allowed to create the matrix as I had reached the limit on the number of items I could select. I did finally create a 20×20 matrix by selecting portions of the matrix. In this case, using Finder so that I had sufficient memory, I was able to "invert" the matrix in about 30 seconds. The ERR was on the order of 10^{-3}. The matrix manipulations operations were simple to use and the results were reasonable, taking less than 30 seconds to complete. One point to mention here is that operations on small matrices are easy to use and the display is very nice.

Inverse Squares. Evaluate

$$\sum_{k=1}^{8000} \frac{1}{k^2}$$

I used the palette to create the summation template, and then typed in the limits and expression. I selected the entire summation and chose Calculate. In about 15 seconds the following result was printed:

$$\sum_{k=1}^{8000} \frac{1}{k^2} = 1.644809074660400911$$

Gibbs. Study the nth Gibbs function

$$f_n(x) = \sum_{k=1}^{n} \frac{\sin(2k-1)x}{2k-1}$$

graphically and analytically. In particular, look at f_{20}. I defined the expression using the summation notation, substituted $n = 20$ into the general formula, expanded it, and then plotted it. The plot took about five seconds. I was also able to substitute new values of n into the definition and then add these new functions to the plot. The program allows four different kinds of lines, so that it is easy to distinguish the various functions.

Finding $\int_1^2 f_{20}(x)\,dx$ was also easy. I had only to create the integral (using the palette), substitute the expanded version of f_{20} into the integral, select the integral, and choose Simplify from the Manipulate menu. This gave me the integral symbolically. I then used Calculate to find the numeric value of the integral. All of this was done very quickly. There is no direct command for finding extrema, but one can very easily replot graphs on small intervals to determine extrema visually. It is also an easy matter to find derivatives, plot them, and then find values of roots by focusing in on them and using the Fund Roots option as described earlier.

I also solve this problem, with similar results, by defining the function $f(x, n)$ and then performing the various operations. This was, in fact, an easier way to work with various values of n, but I did not figure out how to do it until late in the process of writing the review.

Text

Although *Theorist* is not a word processing program, it does allow the user to insert comments throughout a notebook. These are entered in "Comment Propositions" which are set off by a special symbol. Each comment is a single paragraph. The text in the comment may be formatted using standard Macintosh procedures. These comments certainly allow the user a significant amount of freedom to explain the mathematics being used, though they are probably not sufficient for use in a test and certainly inadequate for a professional paper.

Documentation

The documentation consists of two manuals: a reference guide listing all commands with examples, and a learning guide with a number of tutorial exercises. I had difficulty finding references to particular commands, and thus took much longer than I should have to discover the power of the program. A particular case is the discussion of Find Roots which I did not find until I had been working with *Theorist* for nearly two months. A better indexing system is clearly needed. I would suggest a major rethinking of the organization of the guides.

Minor Quibbles

I have a few relatively minor concerns about points in the program. The only derivative symbol that is available is the partial derivative, though one can build normal derivatives as fractions. When simplified, polynomials are always written in decreasing order of exponents, but symbolic constants are always printed to the left while numeric constants are left on the right. It is particularly frustrating to see Taylor polynomials and partial sums of other infinite series written in decreasing order. There is no limit operation. I would hope that this will be added in future versions of the program.

I'm not happy with the way that *Theorist* works with long expressions. Each expression is printed on a single line, extending as far to the right as is necessary. On the screen, one can simply use the scroll bar to be able to see any portion of an expression. When printed, though, *Theorist* uses extra sheets of paper to print wide expressions (for slightly wide expressions the user may choose to print sideways). In addition to the obvious problem of having to lay several sheets together to study wide expressions, there is the added problem that printing splits expressions according to width, not according to any mathematical sense. Thus an integral sign might be on one page and the integrand on the next. I would like to see some sort of an option that would allow printing (and screen images) to continue to the next line with breaks at reasonable points in an expression. I should note that there is an Auto Collapsar option that will only print a portion of expanded sums and products. The

problem with this is that it only displays the first term so that it is difficult to see the pattern.

Summary

I started out being somewhat skeptical of *Theorist*, primarily because the relatively weak documentation made it difficult to see how to solve all but the most rudimentary problems. I surprised myself in the end. I am quite happy with the program. It has a variety of powerful features that allow a user to experiment with mathematics—for example, searching for roots, or defining a difference function and plotting it, varying either x or h—in a relatively painless way. It does not have the speed or variety of routines that *Maple* or *Mathematica* have, but it makes up for this in its intuitive approach to doing mathematics.

Those of us who are using computer algebra systems as teaching tools in calculus often find ourselves trying to defend their use to our colleagues who feel that by not forcing students to do all of the algebraic manipulations necessary to solve the traditional problems of calculus we are robbing them of an important part of their mathematical education. *Theorist* provides a sort of intermediate approach. Although it will do most algebraic manipulations, students have to decide which ones to do. For example, integration of most functions is not just a simple matter of issuing an integrate command. The user must select the parts in integration by parts, ask *Theorist* to perform a partial fractions decomposition, do u-substitutions where necessary, and often load appropriate integral tables. Thus users must really think about the mathematical operations necessary to solve a problem, not simply ask the machine to do all of their work for them. It seems to me that the approach presented in *Theorist* will go a long way towards the goal of providing students and professional mathematicians alike a useful tool in expanding their understanding of mathematical concepts while relieving them of much tedious work.

Inside the AMS

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.

[1] These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, 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 April 1988 *Notices*, pages 532-533.

The survey questionnaire was designed by the AMS Library Committee, consisting of Nancy D. Anderson (Co-chair), Richard A. Askey, Robert S. Doran, Dorothy McGarry, James L. Rovnyak (Co-chair), George B. Seligman, Mary Ann Southern, and John W. Weigel II. To comment on this report or seek additional data from the AMS Library Survey, write Nancy D. Anderson, Mathematics Library, University of Illinois, 1409 West Green Street, Urbana, IL 61801, or James L. Rovnyak, Department of Mathematics, Mathematics-Astronomy Building, University of Virginia, Charlottesville, VA 22903-3199.

Mathematics Research Libraries: A 1990 Snapshot

Nancy D. Anderson and James L. Rovnyak

The health of mathematics libraries is of concern not only to mathematicians, who see libraries as a vital part of the infrastructure of mathematics, but also to librarians faced with problems such as spiraling journal costs and space shortages. These problems come at a time of budget cutbacks which aggravate the situation in many institutions. Prospects for the future are not entirely bleak, however. For example, new opportunities exist in the area of electronic media and database searching. Hard data on mathematics libraries are scarce, and as libraries evolve into the 1990s it will be helpful to establish some basic information.

This report is a summary of results from an AMS Library Survey of Group I, II, III and VI departments (see the accompanying box for definitions). Questionnaires were sent out in the fall of 1990. For data concerning mathematics libraries in non-doctoral institutions, see the report by the Conference Board of the Mathematical Sciences on the Survey of Undergraduate Programs in the Mathematical Sciences and Computer Science, 1990, currently in preparation (see News and Announcements, this issue).

The Library Survey was directed to chairs of mathematics departments who were asked to forward the questionnaire to their mathematics library. A few institutions have more than one mathematics library, and, where known, these were surveyed separately. Therefore, data are accordingly broken into subgroups I-1, I-2, II-1, II-2, etc., where a library is classified -1 or -2 depending on whether it is the larger or smaller of two mathematics libraries in one institution. All libraries identified as departmental reading rooms were given the -2 classification. The focus of this survey was on academic libraries. A few public, governmental, and industrial libraries were invited to supply data. One of those did respond, but their data are not included.

The response rate for Group I was 35 libraries (32 in I-1, 3 in I-2) from 33 of 39 institutions (85%). In Group II, returns were received from 34 libraries (28 in II-1, 6 in II-2) in 32 of 43 institutions (74%). In Group III, returns were received from 57 libraries (55 in III-1, 2 in III-2) in 57 of 86 institutions (66%). There were returns from 12 libraries

in 12 of 25 institutions in Group VI (48%).

Questionnaires were intended to be filled out by librarians, who were asked to consult with experienced mathematics faculty library users on attitudinal questions. In institutions where the mathematics library is part of a combined subject, science/engineering, or general library, the data refer only to mathematics holdings.

Libraries have a variety of structures, and the first question is, simply, what are they?

A Branch library containing only mathematics
B Departmental reading room
C Branch library containing mathematics together with one or several of the mathematical sciences, such as statistics, computer science, etc.
D Branch library containing mathematics together with one or several sciences such as physics, astronomy, etc.
E Part of a science/engineering library
F Part of a general library
G Other, such as mathematics education

TABLE 1
Type of Library

	A	B	C	D	E	F	G	Total
Group I:	5	2	15	7	3	3	0	35
Group II:	3	5	8	4	9	5	0	34
Group III:	1	2	6	5	15	27	1	57
Group VI:	1	0	4	0	5	2	0	12
Total	10	9	33	16	32	37	1	138

The subject branch libraries (A-D in Table 1) comprise 83% of the total in Group I, 50% in Group II, 25% in Group III, and 42% in Group VI. Over all groups, 93% of the subject branch libraries are located in the same building as the mathematics faculty. If all libraries are counted (A–G in Table 1), then in Group I, 83% report that the mathematics library is housed in the same building as the mathematics faculty, 59% in Group II, 28% in Group III, and 55% in Group VI.

Excluding departmental reading rooms, most mathematics libraries have a professional librarian at least part time. There are some exceptions: 4 in Group I, 3 in Group II, 8 in Group III, and 2 in Group VI have none.

The Library Survey did not request circulation figures. Respondents were asked to describe the level of usage by three different groups (Table 2).

What are the characteristics of a good mathematics library? Respondents were invited to name mathematics libraries they felt were among the best in the world. The top nominees in the United States were Princeton (36), Harvard (30), Berkeley (27), Illinois (27), Michigan (20). These were followed by Brown (12), Courant (9), Stanford (8), Chicago (7), MIT (7), Institute for Advanced Study (7), Yale (6), Cornell (5), Wisconsin (5), and the Library of Congress (5). The foreign institutions most frequently cited were Oberwolfach (10), Cambridge (9), Göttingen (7), Mittag-Leffler (5), and Oxford (5).

TABLE 2
Level of Usage by (A) Math Faculty and Graduate Students, (B) Other Nonmath Faculty and Graduate Students, (C) Undergraduates

Group I:	None	Light	Moderate	Heavy	Very Heavy
(A) Math			15%	47%	38%
(B) Other		15%	47%	35%	3%
(C) Undergrads	3%	38%	44%	16%	

Group II:	None	Light	Moderate	Heavy	Very Heavy
(A) Math			40%	37%	23%
(B) Other	3%	20%	40%	33%	3%
(C) Undergrads	14%	42%	29%	14%	

Group III:	None	Light	Moderate	Heavy	Very Heavy
(A) Math	2%	15%	39%	37%	7%
(B) Other	2%	38%	48%	12%	
(C) Undergrads	8%	54%	31%	4%	4%

Group VI:	None	Light	Moderate	Heavy	Very Heavy
(A) Math		11%	22%	33%	33%
(B) Other		25%	50%	25%	
(C) Undergrads	17%		83%		

No doubt many will find their favorite mathematics library not on the list, perhaps unjustly, and the implied ranking by frequency of citation can be argued in many cases. The point is not to name the "best" mathematics libraries, whatever that means, but to give an idea what the top standard should be. Returns were received from 12 of the American libraries named above. The median number of currently received mathematics journals for the group is 480; for 10 of the 12 able to supply the figure, the median number of volumes in the library is 39,500. Of the 12, 11 are of the subject branch type (A–D in Table 1), 11 are located in the same building as the mathematics faculty, and 11 have a professional librarian at least part time. In 8 of the 12, faculty do not have keys for after-hours access; these libraries are open an average of 90 hours per week when classes are in session. In 4 of the 12, faculty do have keys; these libraries are open an average of 55 hours per week when classes are in session.

The "best libraries" question had a second part: what qualities make such libraries the best? The question was unstructured, and respondents were free to express qualities in their own words. The responses are grouped into broad categories with frequency of citation indicated by numbers in parentheses at the end:

The Collection

Depth and breadth of the collection (73)
Good collection of older and historical materials, includes rare books (10)
MathSci and other electronic media inhouse, online catalog (8)
Complete runs of journals going back to first volume (7)

The Environment

Ease of use, access for browsing, current journal display, organization and arrangement of books, hours open (26)
Pleasant environment, quiet reading area, good lighting (12)
Location in or near the mathematics department, separate from the main library (11)
Adequate space, under one roof, nothing in remote storage (9)

The Staff and Support

Knowledgeable staff, good service, professional librarian (14)
Intelligent collection development, quick to get recent works, good coverage of international literature (9)
Adequate budget and institutional support (7)

The collection in a mathematics library includes current journals, back volumes of journals, books, electronic media, and microfiche and microfilm. Scope is variable; significant additional holdings in either statistics or computer science were reported in many cases. Some mathematics libraries further include such fields as operations research, actuarial mathematics, applied mathematics, mathematical physics, mechanics, applied statistics, and mathematics education.

The number of mathematics journals in the world is not exactly known. *Mathematical Reviews* looks at 1800 periodicals in selecting papers to review, and it reviews 400 journals cover-to-cover (see the Abbreviations of Names of Serials at the end of the annual *Author Index for Mathematical Reviews*; this list also includes monographic series). A recent list of mathematics journals, compiled by the Research Libraries Group and judged to be of significant value for scholarly inquiry, contains about 900 titles (for information write: RLG Long-Term Serials Project in Mathematics © 1989, The Research Libraries Group, Mountain View, CA 94041-1100).

The number of journal subscriptions is reported in Table 3. The total number of volumes including monographs is given in Table 4. See Table 6 (next page) for an overall rating of the collection.

Bound journals circulate in about 63% of the mathematics libraries, with varying policies on loan periods. About two thirds of the respondents said that they have a security system. Overall, 71% house bound mathematics journals together in one area, and 68% display current unbound journals separately from other subjects.

The powerful searching tools of electronic media are making their way into mathematics libraries. Most mathematics libraries for the Group I, II, III, and VI departments have their catalogs either partly or completely online; some libraries additionally maintain microform backups to parts of their catalogs and serials lists. Many mathematics libraries today offer access to MathSci in some form (Table 5, see next page).

TABLE 3
Number of Currently Received Mathematics Journal Titles

	I-1	I-2	II-1	II-2	III-1	III-2	VI	Total
0-49				1	3			4
50-99		2		1	9	1		13
100-149	1	1	1	1	10	1	2	17
150-199	1		4		8		2	15
200-249	2		4		8		2	16
250-299	7		5		7			19
300-349	2		4		5		4	15
350-399	4		5		1			10
400-449	1		2				1	4
450-499	3		2				1	6
500-549	8				2			10
550-599	1							1
600-649								
650-699								
700-749								
750-799	1		1					2
Median	393		293		168		272	261*

* This median excludes the I-2, II-2, III-2 libraries.

TABLE 4
Total Number of Mathematics Volumes (in thousands)

	I-1	I-2	II-1	II-2	III-1	III-2	VI	Total
0-4K				2		2		4
5-9K			1	1	7			9
10-14K					6		1	7
15-19K	2	1	4		7		1	15
20-24K	3	1	2		3			9
25-29K	2		5		7		1	15
30-34K	7		1		8		2	18
35-39K	5		2					7
40-44K	2		2		1			5
45-49K	1						1	2
50-54K	1		1		1			3
55-59K	1							1
60-64K	1							1
65-69K					1			1
70-74K								
75-80K	1							1
Median	34K		25K		20K		28K	26K*

* This median excludes the I-2, II-2, III-2 libraries.

Only about one third of the libraries reported any use of microfiche or microfilm. Microfiche and microfilm are used

to preserve archival copies of high-use journals, old journals and back runs, technical reports, and dissertations. Level of use is typically minimal. Modern technology offers other possibilities. For example, Cornell University in collaboration with Xerox and the Committee on Preservation and Access will scan old books, including 500 in mathematics, store the images in electronic form suitable for printing at 600 dpi, then reprint new copies of the books on acid-free paper to be returned to the library. Additional copies for other libraries and individuals can be printed from the electronic file.

TABLE 5
Electronic Media
Form of Catalog in the Mathematics Library

	I	II	III	VI	Total
manual only	3*	6**	6***		15
party online	20	12	21	4	57
access from offices (&)	16	12	14	2	44
completely online	14	16	30	7	67
access from offices	14	14	26	5	59

Products Available Inhouse in the Mathematics Library

	I	II	III	VI	Total
MathSci: Full database	2				2
access from offices	1				1
MathSci: CD ROM (@)	16	9	9	2	36
access from offices	1				1
SCI: CD ROM (#)	10	3	8	3	24
access from offices	1				1

Products Available via a Vendor in the Mathematics Library

	I	II	III	VI	Total
MathSci	25	20	34	6	85
SCI	22	21	34	7	84

* 1 in I-1, 2 in I-2
** 1 in II-1, 5 in II-2
*** 5 in III-1, 1 in III-2
& This is a subset of the previous line and means access from suitably equipped faculty offices.
@ There were many non-responses on this question, and the figures do not show sales of the MathSci CD ROM since the survey was run. These figures should be interpreted as a 1990 baseline; use is increasing rapidly.
# SCI = Science Citation Index

The environment or atmosphere for scholarly work is an important attribute of a mathematics library. Some mathematics libraries are a joy to use, others less so. Factors which can detract from the atmosphere are poor lighting, noise, too hot or too cold, crowding, inadequate seating, excessive socializing, or use as an undergraduate study area or departmental copy center (Table 7).

Shortage of space is one of the most serious problems facing mathematics libraries today (Table 8). Some collections are being split, with older works and back copies of journals being put in remote storage or stacks of other libraries. While the problem is common in libraries generally, it hits mathematics especially hard because older works in mathematics tend to retain their value longer than in most of the other sciences.

TABLE 6
Overall Rating of the Collection as it Serves the Research Programs of the Mathematics Department

Group I:	Poor	Fair	Good	Very Good	Excellent
Journals			21%	44%	35%
Monographs			18%	55%	27%
Electronic Media	14%	29%	29%	14%	14%

Group II:	Poor	Fair	Good	Very Good	Excellent
Journals	3%	10%	32%	45%	10%
Monographs	7%	14%	31%	38%	10%
Electronic Media	44%	22%	13%	13%	9%

Group III:	Poor	Fair	Good	Very Good	Excellent
Journals	8%	23%	33%	29%	8%
Monographs	11%	20%	30%	28%	11%
Electronic Media	27%	34%	18%	16%	5%

Group VI:	Poor	Fair	Good	Very Good	Excellent
Journals		17%	25%	42%	17%
Monographs	8%	33%	42%	17%	
Electronic Media	25%	75%			

TABLE 7
Overall Rating of the Environment as it Applies to the Atmosphere for Scholarship

	Poor	Fair	Good	Very Good	Excellent
I	2	6	7	17	3
II	2	5	8	12	4
III	6	21	12	13	4
VI		6	4	2	

TABLE 8
Describe Space Problem in the Mathematics Library

	None	Mild	Moderate	Severe	Crisis
Group I	3%	11%	26%	40%	20%
Group II	18%	3%	47%	21%	12%
Group III	18%	9%	25%	36%	13%
Group VI	8%	17%	33%	33%	8%

When quarters become cramped, librarians place books on top of stacks and radiators, in window sills and reading carrels, and on the floor. A serious space problem has implications for the usefulness of the collection, browsing older literature, and the environment for scholarly work. In a follow-up question (Table 9), librarians were asked to estimate the percentage of volumes in other locations because of the space shortage and to give the figure as a percentage of a whole if all volumes were under one roof.

TABLE 9
Percentage of Volumes in Other Locations due to Space Shortage

	I		II		III		VI	
	Bound Jrnls	Other	Bound Jrnls	Other	Bound Jrnls	Other	Bound Jrnls	Other
none	10	11	11	10	17	15	4	4
1-9%	5	6	4	5	2	5	3	
10-19%	4	5	6	2	8	4	1	1
20-29%	3				3	2		
30-39%					3			
40-49%	2	1			1			
50-59%						1		
60-69%	1				1	2		
70-79%					1			
80-89%		1		1*		1		
90-100%	1		3*	2*	1*	1*		

* All of these are departmental reading rooms. Otherwise, the high figures come from libraries that are seriously split.

The other area of great stress in mathematics libraries is money. The AMS Library Survey asked for budget figures, but it was difficult for respondents to provide figures that could be easily compared and tabulated. Partially in anticipation of this situation, librarians were given the opportunity to share their budget information with others willing to do the same. A special report which includes institutional budget figures will be circulated privately among the participating respondents.

Conclusions

There are many positive results. The median number of currently received mathematics journals in Group I, excluding departmental reading rooms and second libraries, is a healthy 393. The level of satisfaction in the overall rating of collections is positive in the Group I and II schools. Almost all mathematics libraries have their catalogs either completely or partly online, 62% have MathSci available through a vendor, and many are buying the MathSci CD ROM.

The fact that half of the Group I libraries responding subscribe to fewer than 393 journals is cause for concern. Much has been said regarding rapidly rising journal costs, and this low subscription rate is possibly due to the combination of higher costs and serious budget shortfalls.

An important problem that becomes apparent from the survey is the shortage of space. Unless more space is provided to house collections, it seems inevitable that the system as we know it will change, with older and lesser used works increasingly moved to other locations. In Group I, 60% of respondents report a severe to crisis space problem. The figure is a disturbing 50% for the group of libraries nominated as among the best in the world (based on 12 returns in this group). While shortage of space hits the older more comprehensive collections the hardest, few libraries are immune to the problem of where and how to shelve books and journals. Not only do individuals at the largest research universities benefit from the "home" collection, but mathematicians at smaller universities and colleges with fewer titles depend on these collections through interlibrary loan as well as personal visits. There is no indication that electronic media will significantly ease the space problem in library collections in the near future.

It is in the interest of mathematicians to help ensure that the comprehensive collections survive. Mathematicians need to concern themselves with advocating both the quality and adequacy of the collections and the space to hold them. In particular, they need to demand the required investment by the library and campus administrations.

Sponsored Membership Program

The American Mathematical Society has a sponsored membership program which allows individuals and organizations to "sponsor" eligible mathematicians for membership in the Society by paying their membership dues. This program enables individuals who may not otherwise be able to pay the dues to be members of the Society. Eligibility for sponsorship is limited to individuals residing in countries with currency restrictions or in developing countries. The individual being sponsored need not be a current member of the Society. The dues rate to be paid for the sponsored member will be one-half the higher ordinary dues rate. For 1992 the sponsored member dues rate will be $52.

If you know an individual whose membership you would like to sponsor or if you would like to learn more about the program, please contact Carol-Ann Blackwood, Membership Manager, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248 or via email to AMSMEM@MATH.AMS.COM.

Washington Outlook

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

The Effects of "Big Science" on Federal R&D in 1992 and Beyond

Congress has almost finished its work on the Fiscal Year 1992 budget as this column is being written, and once again, nondefense research and development emerged a winner, relatively speaking, from the annual budget process. At a time when federal discretionary spending has been capped to grow only at the level of inflation, policymakers, led by the Administration, have provided real increases to most R&D agencies—the seven largest of these received a combined 10 percent budget increase this year (see chart on following page).

The disaggregated figures, however, tell a somewhat different story. Those affected by research funding policy should take note of how the big R&D projects fared in this tight budget year. Explicit votes on the survival of NASA's Space Station and the Superconducting Super Collider (SSC) were taken in both the House and Senate; not surprisingly, the President's generous funding requests for the projects were affirmed.

The House appropriations subcommittee responsible for the NASA budget, as well as the National Science Foundation's, originally zeroed out station funding. But the funds were restored in the full House on a 240-173 vote after intense debate. In the Senate, the appropriations subcommittee, headed by a strong station supporter, provided full funding to the station, an action consistent with the wishes of the full Senate, which rejected an amendment to cancel the project, 35-64.

Ultimately, the station was fully funded at over $2 billion dollars, but other NASA projects suffered the consequences. The President had requested a 20 percent increase for space science programs. But the amendment that resurrected the space station reallocated funds from other NASA accounts, including space science, which will grow by only 6 percent this year.

The situation with the Superconducting Super Collider was similar, although the project did not receive all the funds requested. Its budget, however, was nearly doubled, after amendments to kill the project failed. Here, the Administration did not ask for large increases in the other DOE research accounts; in some cases Congress provided more than the amount requested. Nevertheless, while total energy R&D will grow by 14 percent this year, much of the new money will go to the SSC; spending for other DOE R&D programs will be closer to 8 percent higher than last year's amount.

What implications do the continuation of these projects have for continued growth in the core federal science programs? Debate over the extent to which funding for major R&D projects results in decreases for other science programs has been around as long as the major projects have. While some historical evidence suggests that small science flourishes when the Nation is undertaking major R&D initiatives, a new study suggests this might not hold true as the proliferation of major R&D projects continues in the early 1990s.

A recent report[1] from the Congressional Budget Office (CBO) notes that current spending on the three most expensive federal R&D projects takes up a larger share of the total nondefense R&D budget than at any time since the early 1980s, when expenditures on space shuttle development peaked. Furthermore, the Administration's spending plans for these projects—the Space Station, the Superconducting Super Collider, and the Earth Observation System—would, if fully enacted, result in an increase from 8 percent to 15 percent the share of the total nondefense R&D budget devoted to these projects during the early 1990s.

While the Administration also projects growth in the overall nondefense R&D budget, it is not clear that these large projects will not crowd out funding for core research programs. In fact, CBO finds that in the early 1980s, expensive R&D projects appear to have reduced funds available for the base science program.

The outlook for the base science program is particularly grim when one considers that the spending caps in effect during this period allow for no real growth in the total

[1]Congressional Budget Office, "Large Nondefense R&D Projects in the Budget: 1980–1996," July 1991.

federal budget. It is doubtful Congress will allocate as much money to overall R&D as the President requests. (The President's requests for the items listed in the chart below added up to approximately $400 million more than the combined appropriation for those items.)

Cost overruns in the large projects might force budgeters to look for funding from existing programs. CBO used the Administration's cost estimates for the projects: $30 billion for the station, and $8.2 billion for the SSC. Congressional hearings revealed earlier this year that the true costs, including operating costs, of the station could exceed $100 billion. And independent estimates of the SSC's pricetag go as high as $12 billion.

It remains to be seen how the core federal science programs will hold up in light of these trends. The Administration supports the goal of doubling the National Science Foundation budget. But the Secretary of Energy has told the Office of Energy Research to prepare for no-growth budgets. In any event, if small science budgets see slower growth in the years ahead, it will be difficult to determine precisely how much the big science projects are to blame, but blamed they will be.

1992 Budget Results of Selected R&D Agencies

	FY 1991 current	FY 1992 appropriation	percent change
NIH	8,276.7	9,010.4	9%
NASA R&D	6,023.6	6,413.8	6%
DOE ENERGY R&D	3,717.3	4,251.2	14%
NSF	2,313.0	2,574.0	11%
USDA R&D	1,177.7	1,271.9	8%
EPA R&D	254.9	323.0	27%
NIST	215.3	246.7	15%
TOTAL	21,978.5	24,091.0	10%

Dollar figures in millions

NIH=National Institutes of Health; NASA=National Aeronautics and Space Administration; DOE=Department of Energy; NSF=National Science Foundation; USDA=Department of Agriculture; NIST=National Institute of Standards and Technology; EPA=Environmental Protection Agency

Source: House and Senate Appropriations Committees

News and Announcements

Phillip Griffiths Heads IAS

For the first time in its sixty-year history, the Institute for Advanced Study (IAS) in Princeton has a mathematician at its helm. Phillip A. Griffiths, formerly provost of Duke University, took over as director of the Institute this summer. Griffiths' arrival coincides with a number of changes in the mathematical life of the Institute, including increased attention to applied mathematics and plans for a new mathematics building.

"I think the Institute is really a unique place," Griffiths says. "Over the last half century, the Institute has made a major contribution to mathematics, not just in this country but worldwide. And this is a tradition that I want to build on and enhance, especially to diversify the scientific program a bit." Griffiths, who was a graduate student at Princeton and was on the faculty there for five years, has visited the Institute a number of times during his career, "so it's not an unfamiliar institution." "The research and the opportunities for young and midcareer faculty coming to the Institute to interact with the permanent faculty here, to participate in the programs, is quite special," he remarks.

Griffiths is well known for his important work in algebraic geometry. Recognized as the founder of modern Hodge theory, he also produced fundamental results in the area of algebraic cycles. In addition, within the algebraic geometry community, he has been one of the most prodigious producers of Ph.D.s: while on the faculties of the University of California at Berkeley and Harvard and Princeton Universities, he oversaw the dissertations of more than twenty-five students who went on to make major contributions to Hodge theory and related fields.

In recent years, Griffiths has become an important figure in science policy matters involving mathematics, an interest he intends to maintain while at the Institute. He served as chair of the Board on Mathematical Sciences of the National Research Council (NRC) through a productive period that included the issuing of the second "David Report" and the initiation of the Mathematical Sciences Department Chairs' Colloquium, held each fall in Washington, DC. In addition, the Board has initiated a number of studies in core and applied mathematics. Now that he is off the Board, Griffiths will become chair of the NRC Commission on Physical Sciences, Mathematics, and Applications, the larger NRC entity overseeing the Board. In addition, Griffiths sits on the National Science Board, the governing body of the National Science Foundation—this is the first time in a number of years that there have been any mathematicians on that board. In addition, he has testified before the various Congressional committees and has been influential in Washington science policy circles.

Robert Langlands, who is on the permanent faculty at IAS, says that the Institute is fortunate to have a director who not only is a distinguished mathematician, but also has experience with policy matters. "The Institute is very special in American mathematical life and should have ties to it at all levels," he notes. "We have to foster research, so we can't remain too distant from policymaking." Although IAS is a private institution with an endowment that supports the permanent faculty, it depends on granting agencies, such as the National Science Foundation, for funds for visitors. In addition, Langlands notes, Griffiths' experience as an administrator will prove indispensable at the Institute, since its four schools—Mathematics, Natural Sciences, Historical Studies, and Social Science—form a community similar to that of a university.

In the past couple of years, the School of Mathematics has been broadening its scope to accommodate a wider range of mathematical topics. For example, the 1990-1991 academic year was devoted to algorithmic number theory and analytic number theory. The principals involved were Hendrik Lenstra and Carl Pomerance, both IAS members that year, in addition to permanent IAS faculty member Enrico Bombieri. This year, an even more ambitious program has been initiated in the theoretical and computational aspects of fluid dynamics, under the direction of distinguished Visiting Professor Alexandre Chorin; other senior members in this program include Bjorn Engquist, Andrew Majda, George Papanicolaou, and Vladimir Rokhlin as well as permanent IAS faculty member Thomas Spencer. To help meet the computational needs of this group, IAS has recently added substantially to its computing facilities.

"This is a big year for applied mathematics," says Spencer, who is interested in the fluid dynamics work because of connections between fluid flow and statistical mechanics. "The

Institute historically hasn't paid much attention to applied mathematics." In fact, he notes that even von Neumann was considered something of an "outcast" at the Institute because of his interest in computation. "Applied mathematics has had to develop new and exciting methods to solve the problems it's faced with," he notes, and the Institute has been responding to these new developments. "The Institute has changed in this way in the last five years, and it's been a slow evolution." With two new appointments to be made—to fill positions left open by the departure of John Milnor to the State University of New York at Stony Brook and the upcoming retirement of Armand Borel—there may be further evolution in the mathematical style and interests of the Institute.

Another change in the mathematical life at IAS will come with the new mathematics building, to be finished sometime over the next couple of years; the ground breaking took place on October 25. The building will bring all of the mathematics faculty and visitors under one roof—nowadays some visitor offices are in a separate building which is somewhat isolated from the main center of activity. The new building will provide the Institute's largest lecture hall, seating 225 people and will have accommodations for computing facilities. The building will be funded through private donations and fundraising efforts.

Griffiths is looking forward to participating in these changes, and not just as an observer. One of the reasons he took the position at the Institute was that, as provost at Duke, he couldn't spend enough time on research. He was raised in North Carolina and considers it his home, so going to Duke held special meaning for him. But he missed having "a third to a half my time to spend on mathematical projects," he remarks. "I'm already working on two problems that have been in my head for two years. For someone who has been active in mathematics and then gotten into other things, it's almost an indescribable pleasure to be back again."

MAA Prizes Awarded in Orono

The Mathematical Association of America presented an array of prizes at the opening banquet during the Joint Summer Meetings in Orono Maine in August 1992.

Six Lester R. Ford Awards were presented for excellent expository articles appearing in the *American Mathematical Monthly*. Each author receives a cash prize of $500. The following lists the names of the prize-winning authors, their affiliations, the titles of their articles, and the issue of the *Monthly* in which the articles appeared: MARCEL Y. BERGER, Institut des Hautes Etudes Scientifiques in Bûres-sur-Yvette, France, "Convexity," Vol. 97, 1990; RONALD L. GRAHAM, AT&T Bell Laboratories, and FRANCES YAO, Xerox Palo Alto Research Center, "A Whirlwind Tour of Computational Geometry," Vol. 97, 1990; JOYCE JUSTICZ, Emory University, EDWARD SCHEINERMAN, Johns Hopkins University, and PETER WINKLER, Bellcore, "Random Intervals," Vol. 97, 1990.

Four George Pólya Awards recognized excellent expository articles appearing in the *College Mathematics Journal*. Each author receives a cash prize of $500. The following lists the names of the prize-winning authors, their affiliations, the titles of their articles, and the issue of *CMJ* in which the articles appeared: WILLIAM B. GEARHART and HARRIS S. SHULTZ, California State University at Fullerton, "The Function $\frac{sinx}{x}$," Vol. 21, 1990; MARK FORD SCHILLING, California State University at Northridge, "The Longest Run of Heads," Vol. 21, 1990.

The Carl B. Allendoerfer Award of $500 recognized an excellent expository article appearing in the *Mathematics Magazine*. This year's award went to RANJAN ROY of Beloit College for his paper "The Discovery of the Series Formula for π by Leibniz, Gregory, and Nilakantha" (Vol. 63, 1990).

The Merten M. Hasse Prize of $1000 is awarded for an exceptional expository paper written by an author less than forty years of age at the time of publication. The prize is designed to be an encouragement to young mathematicians to take up the challenge of exposition and communication. This year's prize went to BARRY CIPRA for his paper "An Introduction to the Ising Model," which appeared in the *American Mathematical Monthly* (Vol. 94, 1987). Cipra, a freelance mathematics writer based in Northfield, Minnesota, is a contributing correspondent to *Science* magazine and writes regularly for *SIAM News*. He is author of a calculus supplement, *Misteaks and How to Find Them Before the Teacher Does*, published by Academic Press.

Presidential Young Investigator Awards Announced

The National Science Foundation (NSF) has selected 220 academic mathematicians, scientists, and engineers to receive Presidential Young Investigator (PYI) awards. The awards, which fund research by faculty members near the beginning of their careers, are intended to help universities attract and retain outstanding young Ph.D.s who might otherwise pursue non-teaching careers.

Each PYI award consists of an annual base NSF grant of $25,000, plus an additional amount of up to $37,500 of matching funds from the private sector, for a total of up to $100,000 per year over five years.

The PYI program has been replaced this year by two new programs, the NSF Young Investigator Awards and the Presidential Faculty Fellows program. These two programs will operate differently from the PYI program; for more information, see Funding News in the November issue of *Notices*, page 1149.

The following lists the names, affiliations, and research areas of those PYI awardees who receive part or all of their PYI grant through the NSF's Division of Mathematical Sciences.

ANTHONY BLOCH, Ohio State University, dynamical systems and control theory; RANDALL DOUGHERTY, Ohio State University, set theory and foundations; NOAM ELKIES, Harvard University, number theory; STEVEN N. EVANS, University of California at Berkeley, probability; MANOUSSOS GRILLAKIS, University of Maryland, hyperbolic partial differential equations;

JANIS HARDWICK, University of Michigan, biostatistics; JOHN LUECKE, University of Texas at Austin, knot theory. THOMAS MOUNTFORD, University of California at Los Angeles, probability, TAMAR SCHLICK, New York University, computational science; DONALD SCHWENDEMAN, Rensselaer Polytechnic Institute, computational fluid mechanics; MICHAEL SHELLEY, University of Chicago, computational fluid mechanics; CARLOS SIMPSON, Princeton University, algebraic geometry; ÉVA TARDOS, Cornell University, mathematical programming; and MARIUSZ WODZICKI, University of California at Berkeley, noncommutative geometry.

International Congress of Theoretical and Applied Mechanics

The 18th International Congress of Theoretical and Applied Mechanics will be held August 22-28, 1992, at Technion-Israel Institute of Technology in Haifa. The organizers have issued a final call for U.S. papers to be presented at the Congress.

Papers will be accepted in all areas of theoretical and applied mechanics, but the following three topics will receive special attention as subjects of mini-symposia: instabilities in solid and structural mechanics, sea surface mechanics and air-sea interaction, and biomechanics.

The submitting author should prepare six copies each of an *extended summary* of about 500 words and an *abstract* of 100–150 words. The abstract must by typed and double-spaced on a single page; the page should also carry the title of the paper and the full name and address of the author(s). The author should also prepare a *statement of preference* for lecture session or poster session.

The material described above should be submitted directly to the Congress Secretary **to arrive before January 15, 1992**: Professor A. Solan, Secretary, ICTAM 1992, Faculty of Mechanical Engineering, Technion-Israel Institute of Technology, Haifa 32000, Israel. More detailed announcements about the Congress are available by writing to the Secretary.

The U.S. National Committee for Theoretical and Applied Mechanics has some funds available for travel fellowships for U.S. authors of accepted papers. Fellowship applications may be obtained before December 15, 1991 from: Professor Thomas L. Geers, Department of Mechanical Engineering, University of Colorado, Boulder, CO 80309-0427; telephone 303-492-7151; fax 303-492-3498.

News from the Mathematical Sciences Research Institute

Berkeley, California

The schedule of activities for the Special Year in Complex Algebraic Geometry at the Mathematical Sciences Research Institute (MSRI) in Berkeley, California in 1992-1993 is as follows:

Workshops:

There will be 3 three-day intensive workshops at MSRI: September 21–23: Algebraic cycles (Organizers: A. Beilinson, W. Fulton); November 16–18: Higher dimensional geometry (Organizers: J. Kollár, S. Mori); December 2–4: Curves, abelian varieties and their moduli (Organizers: E. Arbarello, A. Beauville, J. Harris).

In addition, pending approval of funding, there will be 3 additional workshops related to the Complex Algebraic Geometry Year at MSRI: Vector Bundles (at UCLA organized by R. Lazarsfeld) in October 1992; Crystalline methods and Hodge theory (at U.C. Berkeley organized by A. Ogus) in March, 1993; Hodge theory (at UCLA organized by M. Green and J. Steenbrink) in late May 1993.

Themes:

The year will be loosely organized around themes, roughly one theme per month during the period September 1, 1992 through May 31, 1993. A tentative list of themes and the person(s) to contact are: September: Algebraic cycles (A. Beilinson, W. Fulton); October: Vector bundles (R. Lazarsfeld); November: Higher dimensional geometry (J. Kollár, S. Mori); December: Curves, abelian varieties and their moduli (E. Arbarello, A. Beauville, J. Harris); January: Surface theory, classical projective geometry (R. Friedman, J. Harris); February: (open); March: Enumerative and computational algebraic geometry (W. Fulton); March: Crystalline methods and Hodge theory (A. Beilinson, A. Ogus); April: (open); May: Singularity theory and Hodge theory (M. Green, J. Steenbrink).

News from the Mathematical Sciences Institute

Cornell University

The Mathematical Sciences Institute (MSI), the ARO Center of Excellence in Mathematical Sciences, and affiliated researchers at Cornell University are looking for postdoctoral research associates.

J.L. Lumley hopes to fill a position in Mechanical and Aerospace Engineering with a Ph.D. research associate having a strong background in dynamical systems theory, turbulence modeling, computational fluid dynamics, and the management of interdisciplinary projects involving large software systems and sophisticated analytic models. Please contact J.L. Lumley, 256 Upson Hall, Cornell University, Ithaca, NY 14853; 607-255-0995.

R. Durrett has a one-year position for a postdoctoral researcher in probability theory. It is expected that the successful candidate will participate in MSI research and Cornell graduate seminars. This position is reserved for researchers from groups underrepresented in academia. We are interested in attracting young researchers from historically black colleges and minority institutions. Senior researchers who have partial support are also encouraged to apply. While preference will be given to applicants with the Ph.D., MSI will also consider those with a masters degree and a strong commitment to returning to teaching and research following their year at Cornell. Please contact R. Durrett, MSI, 409 College Ave., Ithaca, NY 14853; 607-255-8282. (See our ad in this issue of *Notices*).

During the coming year, MSI will sponsor or cosponsor a number of workshops and conferences. The following have been scheduled. Unless otherwise indicated, for more infor-

mation please contact J. Chiment at jjc@cornellc.cit.cornell.edu.

MSI Director A. Nerode will organize the section on Hybrid Systems to be held as a part of the Second International Symposium of Artificial Intelligence and Mathematics. This symposium is to meet January 5–8, 1992 in Fort Lauderdale, FL. Contact F. Hoffman at hoffman@acc.fau.edu.

S.R.S. Varadhan of the Courant Institute will organize a workshop on Hydrodynamic Limits to meet at MSI April 19–21, 1992. This workshop is hosted by the MSI Center for Stochastic Analysis.

D. Griffeath of the University of Wisconsin, Madison will organize a workshop on Cellular Automata to meet at MSI May 10–12, 1992. This workshop is sponsored by the MSI Center for Stochastic Analysis.

C. Mueller of the University of Rochester will organize a workshop on Stochastic Partial Differential Equations to be hosted by the MSI Center for Stochastic Analysis in the late Spring of 1992. For information, contact C. Mueller: cmlr@uhura.cc.rochester.edu.

J. Remmel of UCSD and P. Clote of Boston College are organizers for the workshop on Feasible Mathematics II to meet at Cornell May 28–30, 1992.

A conference on Logical Analysis in Mathematics and Computer Science, organized by Cornell's R. Shore on the occasion of A. Nerode's 60th birthday, will meet at MSI June 1–3, 1992.

Cornell's M. Stillman and B. Sturmfels are organizers for the Regional Institute in Geometry/Computational Algebraic Geometry scheduled to meet July 6–13, 1992 at Amherst College. Contact D. Cox at dac@cs.amherst.edu. MSI/ACSyAM and the National Science Foundation are conference cosponsors.

MSI's A. Nerode is program chair for the symposium on Logical Foundations of Computer Science to meet July 20–24, 1992 at Tver University, USSR. Contact V.W. Marek at marek@ms.uky.edu.

MSI/ACSyAM's M. Sweedler is an organizer for the International Symposium on Symbolic and Algebraic Computation (ISSAC), sponsored by ACM, to be held July 27–29, 1992 at U.C. Berkeley. Contact Sweedler at jc5j@cornellc.cit.cornell.edu.

A. Nerode is an organizer for Jumelage '92 to meet at MSI October 15–17, 1992.

Finally, ACSyAM, The MSI Center for Symbolic Methods in Algorithmic Mathematics at Cornell University, is planning to emphasize Real Closed Fields during Academic Year 1992-1993. Contact M. Sweedler at MSI for details.

Major Mathematics Institute Opens in Canada

On November 8, 1991, funding was announced for a major new Canadian research institute, the Fields Institute for Research in Mathematical Sciences. The Institute is named in honor of the Canadian mathematician, John Charles Fields (1863–1932) who conceived the award bearing his name, the Fields Medal.

The Fields Institute is a joint effort of McMaster University, the University of Toronto, and the University of Waterloo. Other universities across Canada will be invited to affiliate with it. The Institute is funded by the Ontario Ministry of Colleges and Universities and the Committee for Collaborative Research Initiatives of the Natural Sciences and Engineering Research Council of Canada. The funding was granted specifically for the Institute and is in addition to government funding for individual research grants. The Institute is designed to increase activity in leading edge mathematical sciences research in Canada, to provide additional opportunities for graduate training, and to improve interaction with science and industry. It will also be a significant resource for school mathematics teachers and mathematics education.

Jerrold E. Marsden will assume the Directorship of the Institute, with John Chadam (McMaster University), Paul Selick (University of Toronto), and William F. Shadwick (University of Waterloo) as Associate Directors. Shadwick will also serve as Deputy Director.

The Institute will have no permanent faculty but will sponsor research programs of one or more academic terms in length, selected from proposals submitted to its Scientific Committee by the Canadian mathematical sciences community. Short courses for graduate students will be an integral part of every research program of the Institute.

In the current start-up year, the topic of concentration is control theory, focusing on stabilization, control, and design of flexible structures and control of mechanical systems. The program committee consists of B. Francis, I.A.K. Kupka, J.E. Marsden, W.F. Shadwick, and G. Zames. For the 1992-1993 academic year, there will be a program in dynamical systems and bifurcation, with a program committee consisting of J. Chadam, L. Glass, W.F. Langford, J.E. Marsden, and W.F. Shadwick.

A national call for proposals for programs for future years has been made. Programs will be selected from these proposals by the Fields Institute Scientific Committee, which, in addition to Marsden and Shadwick, includes the following individuals: James G. Arthur, (Mathematics), University of Toronto; Roger W. Brockett, (Applied Mathematics), Harvard University; Stephen A. Cook, (Computer Science), University of Toronto; Kenneth R. Davidson, (Pure Mathematics), University of Waterloo; Leon Glass, (Physiology), McGill University; Werner Israel, (Physics), University of Alberta; David Mumford, (Mathematics), Harvard University; Louis Nirenberg, (Mathematics), Courant Institute, New York University; and Victor Snaith, (Mathematics), McMaster University.

John Charles Fields was prominent in the international mathematical community of his time—in 1924, he organized the International Congress of Mathematicians in Toronto. He also received several distinctions for his research, including election to the Royal Society of Canada (1909) and the Royal Society of London (1913). He received his undergraduate training at the University of Toronto and his Ph.D. from Johns Hopkins University. After an extended period of research in Europe, he returned to Canada determined to recreate the research atmosphere he

had experienced in Paris, Göttingen, and Berlin. He was a true visionary in his understanding of the importance of basic research and graduate training. A strong advocate of public and private sector support for these activities, Fields succeeded in generating substantial funding for research from governments and industries of his day.

The Institute is located initially at the University of Waterloo while plans for a permanent site are developed. For more information, contact: Elizabeth Reidt, Fields Institute for Research in Mathematical Sciences, 6095 Mathematics and Computer Building, 200 University Avenue W., Waterloo, Ontario, Canada N2L 3G1; telephone 519-888-4405; electronic mail fic@math.waterloo.edu.

NSF-CBMS Regional Conferences for 1992

Contingent upon National Science Foundation (NSF) funding, the Conference Board of the Mathematical Sciences (CBMS) will sponsor six NSF-CBMS Regional Research Conferences between May and August of 1992.

Each five-day conference features a distinguished lecturer who delivers ten lectures on a topic of important current research in one focused area of the mathematical sciences. Support for about thirty participants is provided for each conference. In addition, conference organizers may invite both established researchers and interested newcomers, including postdoctoral researchers and graduate students.

Listed below are the titles of the 1992 conferences, followed by the names of the speakers, the dates and locations of the conferences, and contact people.

- *Turbulence of non-linear waves with applications to geophysics and oceanography*, Vladimir Zakharov. May 25–29, Case Western Reserve University. Contact: W. A. Woyczynski or D. E. Gurarie, 216-368-6942, waw@po.cwru.edu.
- *Hamiltonian graphs*, Roland Häggkvist. May 26–30, University of Louisville. Contact: M. S. Jacobson, 502-588-6826, msjaco01@ulkyvx.bitnet.
- *New function spaces and geometric analysis in several complex variables*, Steven G. Krantz. May 26–31, George Mason University. Contact: D. C. Struppa, F. Colonna, or D. Singman, 703-323-2477, dstruppa@gmuvax.gmu.edu.
- *Number theory and dynamical systems*, Jeffrey C. Lagarias. June 1–5, California State University at Fresno. Contact: R. M. Najar, 209-278-2462.
- *Uncertain reasoning*, Glenn Shafer. June 1–5, University of North Dakota at Grand Forks. Contact: L. B. Winrich, 701-777-4107, ud110744@ndsuvm1.bitnet.
- *Hopf algebras and their actions on rings*, Susan Montgomery. August 11–15, DePaul University. Contact: J. M. Bergen, 312-362-8248, matjmb@depaul.bitnet.

For those interested in organizing an NSF-CBMS Regional Conference for the summer of 1993, information may be found in the Funding News section of this issue of *Notices*.

Report from the Conference Board of the Mathematical Sciences

The 1990 version of the Conference Board of the Mathematical Sciences (CBMS) quintan year series of reports on undergraduate programs in mathematics, statistics, and computer science in both two and four-year institutions is in draft form. Publication is expected in early 1992.

Fall 1990 enrollment in four-year departments was 1,926,000 in mathematics. 45,000 in statistics and 317,000 in computer science. The full-time faculty totals were, for mathematics, 19,411, a 9% increase over 1985; for statistics, 735, unchanged from 1985; and for computer science, 5,318, a 48% increase over 1985. The mathematics department enrollment contained significant enrollments in statistics and computer science, teaching 72% of the 173,000 total statistics enrollment and 37% of the 491,000 total computer science enrollment. Both computer science and statistics total enrollments declined by more than 10% over 1985 figures; mathematics remained level.

In mathematics departments, enrollments in courses at the calculus-level and above (including advanced statistics and middle and upper level computer science) were 44% of the total department enrollment; the comparable percent for statistics was 36%; for computer science it was 35%.

The total number of Bachelor degrees awarded in mathematics and statistics departments was 19,191, a decrease of 5% from 1985 (mostly in joint mathematics-computer science degrees). Computer Science Bachelors degrees (awarded in mathematical sciences and computer science departments) totaled 21,126, a decrease of 27% from 1985.

Enrollment in mathematics programs in two-year colleges increased by 35% over 1985, reaching 1,392,000 in Fall 1990. Unfortunately, the 15% increase in full-time faculty over 1985 to a 1990 total of 7,222 failed to keep pace with enrollment. As a result, there were 13,680 part-time faculty in two-year institutions.

For the first time, faculty in mathematics departments were reported according to their teaching responsibilities. Those faculty teaching only mathematics/statistics courses totaled 16,090; those teaching only computer science courses equalled 1,492, while those regularly teaching both numbered 1829. It was interesting to note that the 16,090 number compares with the 15,655 mathematics department faculty total in 1970 when presumably fewer computer science courses were offered.

In 1990, women comprised 20% of the total mathematics department faculty, 14% of the statistics faculty, 16% of the computer science faculty, and 34% of the two-year faculty. Among faculty less than age 35, the percent of women faculty was 25, 24, 12, and 20 respectively.

The 1990 average age of faculty for mathematics departments was 45.6, for statistics department faculty 44.8, for computer science 41.9, and for two-year faculty 45.4.

In 1989-1990, the death and retirement percent for mathematics departmental faculty was 1.6%, for statistics departmental faculty 2.3%, and for

computer science departmental faculty .9%.

A more comprehensive synopsis will be presented in a subsequent article early in 1992.

Donald C. Rung, Survey Director,
"Statistical Abstracts of the Undergraduate Programs in the Mathematical Science and Computer Science, 1990-1991"
CBMS 1990-1991 *Survey*

Summer Mathematics Institutes for Undergraduates

The University of California at Berkeley and Mills College in Oakland, California will each offer a residential Summer Mathematics Institute for undergraduate students. The Institutes will run concurrently from June 15, 1992 to July 24, 1992. The goal of the Institutes is to increase the number of underrepresented minority and women students seeking careers requiring a Ph.D. in mathematics. Faculty members are urged to seek out students from underrepresented minority groups and women students of all ethnicities and encourage them to apply.

The Institute at U.C. Berkeley will involve about thirty minority students; the Institute at Mills College will involve about twenty-four women students. Both will provide the students with the opportunity to explore in depth two areas of mathematics. Seminars of about twelve students each will be led by active senior research mathematicians; the Mills seminars will be taught exclusively by women mathematicians. In the seminars, students will tackle challenging problems individually, in small groups, and in consultation with graduate student mentors. Weekly colloquia will provide a broad view of current work in mathematics and of career opportunities available to mathematicians. A wide range of distinguished mathematicians from many areas have served as seminar leaders or as colloquium speakers. In addition, informational workshops will assist students in making decisions about graduate school and direct them to sources of fellowships and financial aid available for graduate study.

The organizers of the Institutes are: Uri Treisman, University of Texas at Austin and the Dana Center for Mathematics Education at U.C. Berkeley; Leon Henkin, U.C. Berkeley and Mills College; and Lenore Blum, Mills College and the International Computer Science Institute. Funding for the Institutes is expected from the National Science Foundation.

The projected application deadline for both Institutes is **February 21, 1992**. For further information and application forms for the Institute for minority students at U.C. Berkeley, call 510-642-5881, or write to: 1992 Summer Mathematics Institute, PDP-230B Stephens Hall, Berkeley, CA 94720. For the Institute for women students at Mills, call 510-430-2226, or write to: 1992 Summer Mathematics Institute, Mills College, Oakland, CA 94613.

1992 SuperQuest Competition for Students

SuperQuest is a national science competition for high school students and teachers in which students develop science projects with the use of supercomputers. The 1992 competition is now under way.

SuperQuest teams are made up of one or two teacher coaches and three to four students from grades nine through twelve. Individual or group projects may be submitted. The problems can be in any area of science or mathematics, but must require computing resources for analyzing, modeling, or visualizing important aspects of the problem. Past SuperQuest projects have analyzed musical patterns, traffic jams, the formation of snowflakes, ultrasound surgery, and other topics.

Winning teams will travel to a supercomputer center in the summer of 1992 for a three-week summer institute on supercomputing and computational science, and their schools will receive network access time on a supercomputer to allow students ample resources to complete their projects. Stipends of $3000 for teacher coaches and $1000 for each student will be awarded to the winning teams.

SuperQuest is a partnership of the Cornell Theory Center, the National Center for Supercomputing Applications, and the University of Alabama/Alabama Supercomputer Network, and is supported by the National Science Foundation and corporate sponsors. For an application booklet, call 607-255-4859. The registration deadline is **March 2, 1992**.

Videos of Kenneth May

The University of Toronto has made available a series of ten videotapes of the noted mathematical historian Kenneth O. May. First presented on TV Ontario, these lectures are intended for a general audience, but will also interest students of the history and development of mathematics.

Because of copyright complexities, the series is not available from TV Ontario, and it cannot be duplicated, publicly broadcast, or shown commercially. However, the University of Ontario has made special arrangements to make the tapes available for educational use.

The ten, half-hour programs are collectively called "Rebels Who Count" and discuss the following figures from mathematical history: Galois, Cantor, Bolyai, Hamilton, Lewis Carroll, Peirce, Galileo, Gauss, Ramanujan, and Russell. All the programs are in black and white, and some are in an interview format. Some of the tapes are copies of old originals which were damaged in some sections and may not be clear throughout.

The set is available for $100 plus $5 for packing and shipping; individual tapes will not be sold. Orders may be sent in writing to: The Distribution Manager, The Media Centre, University of Toronto, 121 St. George Street, Toronto, Ontario, M5S 1A1, Canada.

Errata

Conditions in the Third World

The November 1991 issue of *Notices* carried the article, "Mathematics under Hardship Conditions in the Third World," by Neal Koblitz. Because of a typographical error, the meaning of one sentence of this article was reversed from what the author intended. The sentence in question appears on page 1128, in the second bulleted item

in the right-hand column, lines 9–11. The correct sentence is, "Mathematical institutions and individual mathematicians should not limit their ties to only the best known research centers."

Contributing Members

The following names represent contributing members of the Society who were not included in the list of contributing members in the annual Acknowledgment of Contributions in the September 1991 *Notices*. Akram Al-Droubi, Frances B. Bauer, Gilbert Baumslag, Peter B. Bjorklund, Francis R. Buianouckas, Robert C. Carson, Henry B. Cohen, Gerald P. Dinneen, Earl F. Ecklund, Robert L. Ellis, Edward R. Fadell, Edward E. Grace, Richard K. Greicar, George F. B. Haddad, George F. Haddix, Heini Halberstam, Neil J. Haynes, Robert J. Hemstead, William P. Kamp, Frank N. Kautzmann, James E. Kiefer, Arnold J. Mandell, Gary A. Martin, H. F. Mattson, James W. Mellender, Robert A. Morris, Yiannis N. Moschovakis, Donald P. Murphy, M. Zuhair Nashed, Paul Olum, John W. Petro, Matthias F. Reese, Marvin Rosenblum, David B. Singmaster, Ivar Stakgold, Culbreth Sudler, Earl W. Swokowski, James J. Woeppel, William B. Woolf.

Postdoctoral Positions

The date for the Postdoctoral Positions Research or Research/Teaching in the October 1991 issue of *Notices* was incorrectly listed as 1990-1991 on page 1019. It should have been listed as 1991-1992.

The University of Georgia's Department of Mathematics listed three postdoctoral positions in the October 1991 *Notices* on page 1019 for 1991-1992. It has no postdoctoral positions for 1991-1992.

Stipends for Study and Travel

In the Stipends for Study and Travel section of the October 1991 *Notices*, the nine-month salary for the University of California, San Diego's S.E. Warschawski Assistant Professorship was incorrectly listed on page 1035. The correct salary is $40,000.

The *Notices*' staff regrets any confusion or inconvenience these errors may have caused.

Funding Information for the Mathematical Sciences

Changes to NAS Exchange Programs

The National Academy of Sciences (NAS) sponsors exchanges of individual American scientists with colleagues from the USSR and Eastern Europe in a variety of scientific disciplines, including mathematics. Information about these programs may be found in the Stipends for Study and Travel section of *Notices*, which appears each year in the October issue. A restructuring of the program has occasioned this additional announcement.

Beginning in 1993, the NAS will initiate a number of changes in the exchange program. The new approach rests on the initiative of individual American scientists to make their own arrangements with colleagues abroad, including travel and living arrangements. NAS will then award travel grants to support the proposed collaborations which offer the highest potential payoff for international science. Because it will then support direct scientist-to-scientist linkages, NAS will therefore no longer arrange exchanges through counterpart Academies of Science in the region. In addition, support exchanges will no longer be allocated on the basis of country quotas. Finally, American applicants will no longer be restricted to visiting only those institutions which are acceptable to the Academies of that region, nor to hosting colleagues who work only within the systems of the Academies. They may propose interactions with any institutions of the region which are interested in the collaboration. These changes will require applicants to supply certain documentation that was not previously required.

For more information on the exchange program and these changes, contact: Office of International Affairs, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418; telephone 202-334-3680.

Research Opportunities for Women

The National Science Foundation sponsors a number of activities to provide support for women researchers in mathematics, science, and engineering. As a participant in these efforts, the Division of Mathematical Sciences (DMS) encourages women mathematicians to apply to the Research Opportunities for Women (ROW) program.

Three kinds of awards are available through ROW. *Research Planning Grants* support women who have not previously served as principal or co-principal investigators on federal research grants or whose research career has been interrupted. These grants provide limited support to facilitate preliminary studies and activities related to a research project. *Career Advancement Awards* assist in developing the careers of women researchers. Intended for women who have established research careers, these awards support women who wish to change research directions or who have had an interruption in their research. More information on these programs may be found in the Stipends for Study and Travel section of the October 1991 issue of *Notices*. The deadline for both is **January 15, 1992**.

Research Initiation Awards are one-time grants designed to provide opportunities for women to become actively engaged in research as independent investigators. Like the planning grants, these awards are available to women who have not been principal or co-principal investigators before. The procedure for applying is the same as for a regular research grant; checking a box on the proposal cover sheet indicates that the proposal should be considered for funding under the ROW program.

Gary Cornell and Jerrold Bebernes are the DMS program officers handling the ROW program, and they would be happy to provide program announcements and more information. They can be reached at: Division of Mathematical Sciences, Room 339, National Science Foundation, 1800 G Street, NW, Washington, DC 20550. Cornell's phone number is 202-357-3695 and his email address is gcornell@nsf.gov; for Bebernes, call 202-357-3686 and send email to jbebernes@nsf.gov.

Call for Proposals for NSF-CBMS Conferences

The Division of Mathematical Sciences of the National Science Foundation (NSF), with the cooperation of the Conference Board of the Mathematical Sciences (CBMS), intends to support from six to eight NSF-CBMS Regional Conferences in the summer of 1993. Over two hundred such conferences have been held in the twenty-three year history of this program. The mathematical sciences community is invited to submit proposals for the conferences.

Each five-day conference features a distinguished lecturer who delivers ten lectures on a topic of important current research in one sharply focused area

of the mathematical sciences. Support is provided for about thirty participants at each conference, and the conference organizer invites both established researchers and interested newcomers, including postdoctoral fellows, graduate students, and underrepresented groups.

The distinguishing features of this conference series are: the focus on a single important and timely area of research by a leading practitioner; the sustained effect on research conducted in the region in which the conference is held; a panel review of proposals to insure quality, breadth, and timeliness; and a published monograph based on the lectures to insure a wider audience than can attend the conference.

Colleges or universities with at least some research competence in the field of the proposal are eligible to apply. Since a major goal of these conferences is to attract new researchers into the field of the conference and to stimulate research activity, institutions interested in upgrading or improving their research efforts are especially encouraged to apply. Typically, awards range from $20,000 to $25,000. Titles and speakers for the 1992 Regional Conferences may be found in the News and Announcements section of this issue of *Notices*.

Proposals for 1993 conferences must arrive at NSF by *April 1, 1992*. Formal announcements of awards will be made by November 1, 1992. An information booklet, with instructions for proposal preparation, is available from: Conference Board of the Mathematical Sciences, 1529 Eighteenth Street, NW, Washington, DC 20036; telephone 202-293-1170.

ASA/NSF Research Fellowship

The National Science Foundation (NSF) is seeking senior researchers and recent doctorate recipients for a 1992-1993 American Statistical Association (ASA) Fellowship within the NSF's Division of Science Resources Studies (SRS).

The Fellow will conduct research at NSF in Washington, DC in support of current SRS institutional and population surveys. Examples of research topics are survey methodology, conceptualization and instrument design, data collection and reduction, quality improvement of surveys, confidentiality protection of data, and longitudinal survey design and analysis. The Fellow will be in charge of overall technical direction of the conduct of his or her research.

The fellowship stipend will be commensurate with qualifications and experience. Appointments will be for one year or a shorter period. The deadline for applications is **January 6, 1992.** For more information on applying, contact Carolee Bush, American Statistical Association, 1429 Duke Street, Alexandria, VA 22314-3402; telephone 703-684-1221. For information on research topics, contact Kenneth M. Brown, Division Director, Science Resources Studies, Room L-609, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-634-4027.

1992 AMS Elections

Nominations by Petition

Vice-President or Member-at-Large

One position of vice-president and member of the Council ex officio for a term of three years is to be filled in the election of 1992. The Council intends to nominate at least two candidates, among whom may be candidates nominated by petition as described in the rules and procedures.

Five positions of member-at-large of the Council for a term of three years are to be filled in the same election. The Council intends to nominate at least ten candidates, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions.

Prior to presentation to the Council, petitions in support of a candidate for the position of vice-president or of member-at-large of the Council must have at least 50 valid signatures and must conform to several rules and operational considerations, which are described below.

Editorial Boards Committee

Two places on the Editorial Boards Committee will be filled by election. There will be four continuing members of the Editorial Boards Committee.

The new members will be elected in a preferential ballot. The President will name at least four candidates for these two places, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations, described below, should be followed.

Nominating Committee

Three places on the Nominating Committee will be filled by election. There will be six continuing members of the Nominating Committee.

The new members will be elected in a preferential ballot. The President will name at least six candidates for these three places, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations, described below, should be followed.

Rules and Procedures

Use separate copies of the form for each candidate for vice-president, member-at-large, or member of the Nominating and Editorial Boards Committees.

1. To be considered, petitions must be addressed to Robert M. Fossum, Secretary, P. O. Box 6248, Providence, Rhode Island 02940, and must arrive by 28 February 1992.
2. The name of the candidate must be given as it appears in the *Combined Membership List*. If the name does not appear in the list, as in the case of a new member or by error, it must be as it appears in the mailing lists, for example on the mailing label of the *Notices*. If the name does not identify the candidate uniquely, append the member code, which may be obtained from the candidate's mailing label or the Providence office.
3. The petition for a single candidate may consist of several sheets each bearing the statement of the petition, including the name of the position, and signatures. The name of the candidate must be exactly the same on all sheets.
4. On the next page is a sample form for petitions. Copies may be obtained from the Secretary; however, petitioners may make and use photocopies or reasonable facsimiles.
5. A signature is valid when it is clearly that of the member whose name and address is given in the left-hand column.
6. The signature may be in the style chosen by the signer. However, the printed name and address will be checked against the *Combined Membership List* and the mailing lists. No attempt will be made to match variants of names with the form of name in the CML. A name neither in the CML nor on the mailing lists is not that of a member. (Example: The name Robert M. Fossum is that of a member. The name R. Fossum appears not to be.)
7. When a petition meeting these various requirements appears, the Secretary will ascertain whether the candidate agrees to stand for election to the position in question. Petitioners can facilitate this process by submitting a statement to this effect from the candidate along with the petition.

NOMINATION PETITION FOR 1992 ELECTION

The undersigned members of the American Mathematical Society propose the name of

_____

as a candidate for the position of (check one):

- ☐ **Vice-President**
- ☐ **Member-at-Large of the Council**
- ☐ **Member of the Nominating Committee**
- ☐ **Member of the Editorial Boards Committee**

of the American Mathematical Society for a term beginning 1 February, 1993.

Name and Address (printed or typed)	Signature
	Signature
	Signature
	Signature
	Signature
	Signature

CALL FOR SUGGESTIONS

There will be a number of contested seats in the 1992 AMS elections.
Your suggestions are wanted by

THE NOMINATING COMMITTEE
for vice-president, trustee, and five
members-at-large of the council
and by

THE PRESIDENT
for three Nominating Committee members and two
Editorial Boards Committee members

In Addition

THE EDITORIAL BOARDS COMMITTEE
requests suggestions for appointments to various editorial boards
of Society publications.

Send your suggestions for any of the above to:

Robert M. Fossum, Secretary
American Mathematical Society
Department of Mathematics
University of Illinois
1409 West Green Street
Urbana, IL 61801

Baltimore Meetings
January 8–11, 1992

Preliminary Program

The preliminary program for the Baltimore Joint Mathematics Meetings follows. Participants who preregistered by November 18 and who so elected will have their badge and the final program mailed to them before the meetings. All other registrants will receive the final program at the meetings. Participants who have not yet registered should read the information in the October and November issues of *Notices* and the October issue of *Focus* for further details. The additional information below is to assist those who will register at the meetings and those preregistrants who elected not to receive their badge and final program by mail.

Program Updates

AMS Sessions

Mathematics libraries, present and future: This panel is sponsored by the AMS Library Committee and will explore results and implications of the AMS survey of mathematics libraries in doctoral-granting insitutions in the United States and Canada. Panelists included **Keith R. Dennis**, Cornell University; **Steven Rockey**, Cornell University; **Nancy D. Anderson**, University of Illinois, Urbana-Champaign; and **James L. Rovnyak**, University of Virginia. The Library Committee particularly seeks reaction and comment from the mathematics community on the AMS library survey and how the committee may serve the community with its activities. The panel discussion will take place Thursday at 9:00 a.m.

Employment in Industry for Mathematicians: This panel at 7:00 p.m. on Friday will be moderated by **James G. Glimm**, SUNY at Stony Brook. Panelists include **Peter Castro**, Eastman-Kodak; **Ruth Gonazalez**, Exxon Production Research Co; **Charles Sampson**, Eli Lilly Co. The following issues will be addressed: skills needed for industrial employment; rewards (not necessarily monetary); creativity and discovery in industry research; societal benefits. There will be an opportunity for participants to ask questions and hear responses from the panelists.

MAA Sessions

Educational mathematics Ph.D. program: This informal discussion with **Richard M. Grassl** and **Igor Szczyrba** about this program at the University of Northern Colorado will take place Friday from 8:00 a.m. to 10:55 a.m. This program was designed jointly by mathematicians and mathematics educators. It uniquely combines a broad range of graduate courses in mathematics with meaningful educational seminars and culminates in a thesis that studies, in particular, the impact of advanced mathematical content on the teaching of mathematics at lower levels.

Other Organizations

The **Joint Policy Board for Mathematics** will hold its annual public policy address on Thursday, January 9, at 7:00 p.m. **Walter E. Massey**, Director of the National Science Foundation, will be the featured speaker. The talk will be followed by an open reception at 8:00 p.m.

Registration at the Meetings

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

Registration fees: Registration fees may be paid at the meetings in cash, by personal or travelers' check, or by VISA or MasterCard credit card. Canadian checks must be marked for payment in U.S. funds. Although other credit cards are being accepted by hotels for housing payments, only VISA or MasterCard can be accepted for registration. Letters verifying attendance at the meetings can be obtained from the cashier or at the Registration Assistance section of the registration desk.

Please note that there will be TWO registration cashiers on Tuesday and Wednesday, January 8 and 9. One cashier will accept cash and checks only and the other credit cards only. Participants should take care to get into the line for the cashier accepting their desired method of payment at the onset. Unfortunately, it will not be possible for the credit card cashier to provide a cash

register receipt, and the only proof of payment will be the participant's copy of the credit card charge slip.

Participants wishing to attend sessions for one day only may take advantage of a one-day fee which is equal to 55% of the on-site registration fee for either members or nonmembers. These special fees are effective daily, January 8 through 11, and are available at the meetings to members and nonmembers only. These one-day fees are not applicable to student, unemployed, or emeritus participants, whose fees for registration at the meetings are listed below.

Joint Mathematics Meetings

Member of AMS, Canadian Mathematical Society, MAA	$137
Emeritus Member of AMS, MAA	$ 33
Nonmember	$212
Student/Unemployed	$ 33

Joint Mathematics Meetings One Day

Member of AMS, CMS, MAA	$ 75
Nonmember	$117

Employment Register

Employer	$175
Additional interviewer (each)	$ 80
Applicant	$ 60
Employer posting fee	$ 30

AMS Short Course

Student/Unemployed	$ 30
All Other Participants	$ 75
Emeritus Member of AMS, MAA	$ 30

MAA Minicourses
(if openings available)

Minicourses # 1, 2, 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 16	$ 36
Minicourses # 7, 8, 9	$ 60
Minicourse # 17	$ 30

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

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

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

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

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

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

Registration Dates, Times, and Locations

AMS Short Course
Constellation Ballroom Foyer, Hyatt Regency Baltimore

Monday, January 6	9:00 a.m. to	2:30 p.m.
Tuesday, January 7	8:30 a.m. to	11:30 a.m.

Joint Mathematics Meetings
[and MAA Minicourses (until filled)]
Sharp Street Lobby, Baltimore Convention Center

Tuesday, January 7	3:00 p.m. to	7:00 p.m.
Wednesday-Friday, January 8-10	7:30 a.m. to	4:00 p.m.
Saturday, January 11	7:30 a.m. to	3:00 p.m.

Accommodations

Participants who did not reserve a room during preregistration but who would like to obtain a room at one of the hotels listed on pages 966 and 967 in the October issue of *Notices* and pages 26 and 27 in the October issue of *Focus* should call the hotels directly **after December 20**. However, after that date the Service Bureau can no longer guarantee availability of rooms or of the special convention rates.

Special Airfares Correction

The special discounted fares on USAir published in the October issues of *Notices* (p. 970) and *Focus* should have been listed as 40% off regular roundtrip coach fares instead of 45%. This error was not the fault of TRAVCON. We apologize for any inconvenience this may have caused.

Program of the Sessions

The time limit for each AMS contributed paper in the sessions is ten minutes, with a five-minute break between papers. In AMS special sessions and MAA contributed paper sessions, the time limit for each paper varies from session to session and within sessions, and breaks between papers, while usually ten minutes, are at the discretion of the organizer. 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 January 1992 issue of *Abstracts of papers presented to the American Mathematical Society*. Abstracts for invited addresses, if provided by the speaker, are in the front of the issue. In the journal, AMS papers are ordered according to the numbers in parentheses following the listings below. MAA papers are ordered alphabetically by author in each session.

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

Monday, January 6

AMS Short Course

9:00 a.m.–4:45 p.m.

9:00 a.m. Short Course Registration

10:30 a.m. Introduction

10:45 a.m. (1) *Mathematical approaches to DNA structure and function.*
Nicholas Cozzarelli, University of California, Berkeley

1:30 p.m. (2) *Geometry and topology of DNA and DNA-protein interactions.*
James H. White, University of California, Los Angeles

3:00 p.m. (3) *Knot theory and DNA.*
De Witt L. Sumners, Florida State University

4:15 p.m. Discussion period

Tuesday, January 7

MAA Board of Governors

8:00 a.m.–4:00 p.m.

AMS Short Course

8:30 a.m.–3:45 p.m.

8:30 a.m. Short Course Registration

9:00 a.m. (4) *The topology of polymers.*
Stuart G. Whittington, University of Toronto

10:45 a.m. (5) *Knots and chemistry.*
Jonathan K. Simon, University of Iowa

2:00 p.m. (6) *Knots and physics.*
Louis H. Kauffman, University of Illinois, Chicago

3:15 p.m. Discussion period

AWM Workshop

9:00 a.m.–4:30 p.m.

AMS Council

2:00 p.m.–7:00 p.m.

MAA Section Officers

7:00 p.m.–9:00 p.m.

Wednesday, January 8

AMS Special Session on Designs and Codes, I

8:00 a.m.–10:50 a.m.

8:00 a.m. (7) *Designs, codes and difference sets.* Preliminary report.
J. F. Dillon, National Security Agency, Maryland (871-05-577)

8:30 a.m. (8) *Difference sets in non-abelian groups.* Preliminary report.
Ken W. Smith, Central Michigan University (871-05-530)

9:00 a.m. (9) *The field of a difference set.* Preliminary report.
Robert L. McFarland, University of Minnesota, Duluth (871-05-575)

9:30 a.m. (10) *There is no* (324, 153, 72)*-difference set in* $Z_2^2 \times Z_3^2 \times Z_9$ *or* $Z_4 \times Z_3^2 \times Z_9$. Preliminary report.
Jonathan Jedwab*, Hewlett Packard Laboratories, United Kingdom, and **James A. Davis**, University of Richmond (871-05-461) (Sponsored by John F. Dillon)

10:00 a.m. (11) *Almost difference sets and reversible divisible difference sets.*
James A. Davis, University of Richmond (871-05-96)

10:30 a.m. (12) *On difference sets in groups of order* 100. Preliminary report.
Richard M. Stafford*, National Security Agency, Maryland, and **Ken W. Smith**, Central Michigan University (871-05-578) (Sponsored by John F. Dillon)

Wednesday, January 8 (cont'd)

AMS Special Session on Classical Real Analysis, I

8:00 a.m.–10:50 a.m.

8:00 a.m. (13) *Some problems concerning the Hausdorff dimension of graphs.* **R. Daniel Mauldin**, University of North Texas (871-28-153)

8:30 a.m. (14) *The relative grid dimension of continuous functions.* **G. Petruska**, University of Witwaterstrand, South Africa (871-26-637)

9:00 a.m. (15) *Differentiability and integrability in dimensions with repect to alpha-regular intervals.* **Jiri Jarnik*** and **Jaroslav Kurzweil**, Czechoslovakia Academy of Science, Czechoslovakia (871-26-636)

9:30 a.m. (16) *Expansions in series of Legendre functions.* **Eric Russell Love***, University of Melbourne, Australia, and **Maxwell Norman Hunter**, Royal Melbourne Institute of Technology, Australia (871-41-628) (Sponsored by Brian S. Thomson)

10:00 a.m. (17) *I-density continuous functions.* **Krzysztof Ciesielski**, West Virginia University (871-26-43) (Sponsored by Lee M. Larson)

10:30 a.m. (18) *Measure and category - one more difference.* **Wladyslaw Wilczynski**, University of Lodz, Poland (871-26-599)

AMS Special Session on Index Theory, I

8:00 a.m.–10:50 a.m.

8:00 a.m. (19) *Nilpotency of Connes' periodicity operator and idempotent conjectures.* **Ronghui Ji**, Indiana University-Purdue University, Indianapolis (871-46-175)

8:30 a.m. (20) *Equivariant index theory for non-compact group actions.* Preliminary report. **Jeffrey S. Fox***, State University of New York, Albany, and **Peter Haskell**, Virginia Polytech Institute & State University (871-58-574)

9:00 a.m. (21) *L^2 index theorems for certain transversally elliptic operators.* **Jeffrey Fox**, University of Colorado, Boulder, and **Peter Haskell***, Virginia Polytechnic Institute and State University (871-58-53)

9:30 a.m. (22) *The universal proper G-space and applications to index theory.* **Paul Baum**, Pennsylvania State University, University Park (871-58-356)

10:00 a.m. (23) *Baum-Connes conjecture for p-adic groups.* Preliminary report. **Roger Plymen**, University of Manchester, England (871-19-210)

10:30 a.m. (24) *Bounded geometry and index theory.* **Jonathan Block***, University of Pennsylvania, and **Shmuel Weinberger**, University of Chicago (871-58-462) (Sponsored by Jonathan M. Rosenberg)

MAA Minicourse #1: Part A

8:00 a.m.–10:00 a.m.

Alternatives to the lecture method in collegiate mathematics. **Julian Weissglass**, University of California, Santa Barbara

MAA Minicourse #2: Part A

8:00 a.m.–10:00 a.m.

The Harvard calculus reform project: hands-on experience with the project materials. **Deborah Hughes Hallett**, Harvard University, **Sheldon P. Gordon**, Suffolk Community College, **William McCallum**, University of Arizona, and **Thomas W. Tucker**, Colgate University

MAA Minicourse #3: Part A

8:00 a.m.–10:00 a.m.

Using history in teaching calculus. **V. Frederick Rickey**, Bowling Green State University

AMS Session on Abelian Groups and Semigroups

8:00 a.m.–10:25 a.m.

8:00 a.m. (25) *Extensions of pseudo-free groups.* Preliminary report. **Heather Ries**, State University of New York, Binghamton (871-18-567)

8:15 a.m. (26) *On lattice isomorphism of mixed Abelian groups.* **Kazem Mahdavi***, State University of New York, College at Potsdam, and **John Poland**, Carleton University (871-20-112)

8:30 a.m. (27) *Completions and categorical compactness for classes of groups.* **Temple H. Fay** and **Gary L. Walls***, University of Southern Mississippi (871-20-106)

8:45 a.m. (28) *Alligned valuations for finite valuated Abelian p-groups.* Preliminary report. **Lorenz J. Hughes**, New Mexico State University, Las Cruces (871-20-632) (Sponsored by Roger H. Hunter)

9:00 a.m. (29) *Autoprojectivities of finite triply generated Abelian p-groups.* **Charles Holmes**, Miami University (871-20-569)

9:15 a.m. (30) *On the near Frattini subgroup of the amalgamated free product of finitely generated Abelian groups.* **Mohammad K. Azarian**, University of Evansville (871-20-11)

9:30 a.m. (31) *The characteristics of Artinian semisimple semigroup rings.* **Yue-Chan Phoebe Ho**, Central Missouri State University (871-20-477)

9:45 a.m. (32) *Some presentations of completely regular semigroups.*
K. S. Ajan, Marquette University (871-20-485)

10:00 a.m. (33) *Some characterizations of the hereditary pretorsion class of semigroup automata.*
Clement S. Lam, University of Iowa (871-20-109)

10:15 a.m. (34) *On the lattice of proper right congruences of a semigroup.*
Eun-Ho Lee, University of Iowa (871-20-308)

AMS Session on Partial Differential Equations, I

8:00 a.m.–10:55 a.m.

8:00 a.m. (35) *On the dynamics of domains, disclinations and walls in liquid crystal materials.*
M. Carme Calderer, Pennsylvania State University, University Park (871-35-538)

8:15 a.m. (36) *An existence theorem for differential inclusions on Banach space.*
N. U. Ahmed, University of Ottawa, (871-35-551)

8:30 a.m. (37) *Group analysis of the heat equation in higher dimensions.*
S. K. Rai, University of Arkansas, Fayetteville, and **C. C. A. Sastri***, Dalhousie University, (871-35-556)

8:45 a.m. (38) *Branches of oscillatory solutions for a radially symmetric semipositone problem.*
Alfonso Castro* and **R. Shivaji**, Mississippi State University (871-35-583)

9:00 a.m. (39) *The inverse scattering problem for time-harmonic acoustic waves in an inhomogeneous medium with complex refraction index.*
Andrzej W. Kedzierawski, Delaware State College (871-35-610)

9:15 a.m. (40) *Motions of partial differential equations.*
Andrzej W. Kedzierawski and **N. R. Nandakumar***, Delaware State College (871-35-604)

9:30 a.m. (41) *The regularized layered medium equation.* Preliminary report.
L. A. Packer* and **R. E. Showalter**, University of Texas, Austin (871-35-626)

9:45 a.m. (42) *Numerical investigations of the stability of equilibrium states of water and contaminant flow.* Preliminary report.
David E. Noyes, Ball State University (871-35-364) (Sponsored by Jeffrey R. Anderson)

10:00 a.m. (43) *Modeling and analysis for laser beam induced current images of semiconductors.*
Stavros Busenberg, Harvey Mudd College, **Weifu Fang*** and **Kazufumi Ito**, University of Southern California (871-35-388)

10:15 a.m. (44) *Global Mizohata structures.*
Howard Jacobowitz, Institute for Advanced Study (871-35-390)

10:30 a.m. (45) *Quenching for coupled semilinear singular parabolic third initial-boundary value problems.*
C. Y. Chang and **David T. Fung***, University of Southwestern Louisiana (871-35-438)

10:45 a.m. (46) *A scaling technique for finding the weighted analytic center of a polytope.*
David S. Atkinson, University of Illinois, Urbana-Champaign (871-49-198)

AMS Session on Set Theory and Foundations

8:00 a.m.–9:40 a.m.

8:00 a.m. (47) *Complete dense linear order with density $\aleph_1$.* Preliminary report.
Renling Jin, University of Wisconsin, Madison (871-03-27)

8:15 a.m. (48) *Transfinite recursion and Sherman's inequality.*
Jeffry L. Hirst, Appalachian State University (871-03-260)

8:30 a.m. (49) *Definable equivalence relations and algebraically closed value fields.*
Jan Holly, University of Illinois, Urbana-Champaign (871-03-387)

8:45 a.m. (50) *More reverse recursion theory.*
K. Kontostathis, Villanova University (871-03-437)

9:00 a.m. (51) *A note on lexicographically ordered space α_2.* Preliminary report.
Kandasamy Muthuvel, University of Wisconsin, Oshkosh (871-04-430)

9:15 a.m. (52) *Two topological equivalents of the axiom of choice.*
Eric Schechter, Vanderbilt University (871-04-282)

9:30 a.m. (53) *Sets consistently of first category.* Preliminary report.
Brian King, Augusta College (871-04-84)

AMS Session on Applied Mathematics, Mathematical Physics and Special Functions

8:00 a.m.–10:40 a.m.

8:00 a.m. (54) *Flow of an Oldroyd-B fluid between intersecting planes.*
R. Bhatnagar*, University of Pittsburgh, Greensburg, **K. R. Rajagopal** and **G. Gupta**, University of Pittsburgh, Pittsburgh (871-76-429)

8:15 a.m. (55) *Steady capillary-gravity waves in a two layer fluid over an obstruction - forced modified K-dV equation.*
Jeongwhan Choi, University of Wisconsin, Madison (871-76-444)

8:30 a.m. (56) *On hydrodynamic rotating flow of a two-phase fluid.*
Lokenath Debnath, University of Central Florida (871-76-158)

8:45 a.m. (57) *Asymptotics of resonances for three dimensional Schrodinger operator with nearly Coulomb potential.* Preliminary report.
Marianna Shubov, Texas Tech University (871-81-315)

9:00 a.m. (58) *Chern-Simons theory via path integrals.*
Dana S. Fine, University of Massachusetts, Dartmouth (871-81-564)

Wednesday, January 8 (cont'd)

9:15 a.m. (59) *Relation between polynomials orthogonal on the unit circle with respect to different weights.*
Mourad E. H. Ismail and **Richard Ruedemann***, University of South Florida (871-33-369)

9:30 a.m. (60) *Asymptotics of Pollaczek polynomials and their zeros.*
Mourad E. H. Ismail, University of South Florida (871-33-363)

9:45 a.m. (61) *A ring of permutable functions of several variables.*
H. B. Coonce, Mankato State University (871-33-03)

10:00 a.m. (62) *Integrals of products of ultraspherical, Hermite and Bessel functions.*
Mihr J. Shah, Kent State University (871-33-21)

10:15 a.m. (63) *The A_l and C_l Bailey transform and lemma.*
Stephen C. Milne* and **Glenn M. Lilly**, Ohio State University, Columbus (871-33-265)

10:30 a.m. (64) *Spontaneous bifurcation for the convective porous medium equation with a nonlinear source.*
Jeffrey R. Anderson, Ball State University (871-35-62)

AMS Session on General Topology

8:00 a.m.–10:40 a.m.

8:00 a.m. (65) *The preservation of pseudocompactness in products.*
David A. Lamb, University of Wisconsin, Madison (871-54-570)

8:15 a.m. (66) *Even homogeneity.*
Kathryn F. Porter, Saint Mary's College of California, Morango (871-54-571)

8:30 a.m. (67) *Countable spaces.*
M. Rajagopalan, Tennessee State University (871-54-367)

8:45 a.m. (68) *Separation axioms in bitopological spaces.* Preliminary report.
Jamuna P. Ambasht, Benedict College, and **Sanjay Tiwari***, (871-54-409) (Sponsored by Jamuna P. Ambasht)

9:00 a.m. (69) *On Datta's projective bitopological spaces.* Preliminary report.
Jamuna P. Ambasht, Benedict College (871-54-410)

9:15 a.m. (70) *Pseudocompact refinements of compact group topologies on Abelian groups.*
W. W. Comfort*, Wesleyan University, and **Dieter Remus**, Universitat Hannover, Germany (871-54-57)

9:30 a.m. (71) *Local contractibility in set convergence.*
Robert A. Johnson, Indiana State University (871-54-310)

9:45 a.m. (72) *Families of self-similar sets.* Preliminary report.
Gary Lewellen, Appalachian State University (871-54-157)

10:00 a.m. (73) *Covering properties of frames.* Preliminary report.
Peter Fletcher, Virginia Polytechnic Institute, **Worthen Hunsaker**, Southern Illinois University, and **William Lindgren***, Slippery Rock University of Pennsylvania (871-54-220) (Sponsored by Worthen N. Hunsaker)

10:15 a.m. (74) *Two approaches to quasi-uniformities for frames.* Preliminary report.
Peter Fletcher, Virginia Polytechnic Institute, **Worthen Hunsaker***, Southern Illinois University, and **William Lindgren**, Slippery Rock University of Pennsylvania (871-54-221)

10:30 a.m. (75) *Applications of the theory of locales to preimages of compact spaces.*
Andrew Molitor, Wesleyan University (871-54-226)

MAA Session on Mathematics Placement Testing Programs: Their Organization, Administration and Problems, I

8:00 a.m.–10:50 a.m.

8:00 a.m. (76) *College placement testing in mathematics.*
Rose Hamm, College of Charleston (871-00-745)

8:25 a.m. (77) *Mandated math placement.*
Jan Vandever, South Dakota State University (871-00-752)

8:50 a.m. (78) *The mathematics placement process at Bentley College.*
Karen J. Schroeder* and **Erland V. Sorensen**, Bentley College (871-00-750)

9:15 a.m. (79) *Placement procedure using regression analysis at the U. S. Coast Guard Academy.*
Ernest Manfred* and **George Rezendes**, United States Coast Guard Academy, Connecticut (871-00-749)

9:40 a.m. (80) *The mathematics placement program at Saint Mary's College.*
Mary V. Connolly, Saint Mary's College (871-00-742)

10:05 a.m. (81) *Mathematics placement at Cottey College.*
Susan Callahan, Cottey College (871-00-740)

10:30 a.m. (82) *A case for in-context placement testing.*
John H. Jenkins, Embry-Riddle Aeronautical University (871-00-748)

MAA Session on Innovations in Mathematics Courses for Business, I

8:00 a.m.–10:55 a.m.

8:00 a.m. (83) *A structured general approach for algebra word problem formulation.*
Arthur B. Kahn, University of Baltimore (871-00-773)

8:15 a.m. (84) *Using business mathematics in the news.*
Barry Schiller, Rhode Island College (871-00-784)

8:30 a.m. (85) *Algebra tutorial for Lotus spreadsheet: Basic.*
Roosevelt Gentry, Jackson State University (871-00-771)

8:45 a.m. (86) *Mathematical models in mathematics for business courses.*
Miguel Paredes and **James Petticrew***, University of Texas-Pan American (871-00-782)

9:05 a.m. (87) *Mathematical modeling.*
John M. Kellett, Gettysburg College (871-00-774)

9:20 a.m. (88) *An unholy alliance between the business and economics department and the mathematics and computer science department in teaching the basic statistics course.*
Ivory L. Lyons and **Sohindar S. Sachdev***, Elizabeth City State University, North Carolina (871-00-783)

9:40 a.m. (89) *Realistic data sets, software, and exploring data in elementary statistics.*
Melvin A. Nyman, Alma College (871-00-781)

10:00 a.m. (90) *The TI-81 calculator and the business calculus.*
Glenn E. Johnston, Morehead State University (871-00-772)

10:20 a.m. (91) *Some 'taxing' calculus problems.*
Mark Michael, King's College (871-00-777)

10:40 a.m. (92) *A maximum for a profit function.*
John I. Nassar, Muhlenberg College (871-00-780)

MAA Session on Using Spreadsheets to Teach Mathematics, I

8:00 a.m.–10:50 a.m.

8:00 a.m. (93) *The spreadsheet as a pedagogical tool.*
Robert S. Smith, Miami University (871-00-846)

8:25 a.m. (94) *Sampling distributions of means using @RISK.*
Elaine L. Tatham, University of Kansas (871-00-849)

8:50 a.m. (95) *Using spreadsheets to introduce liberal arts students to conditional probability.*
Joe Wimbish, Huntingdon College (871-00-851)

9:15 a.m. (96) *Spreadsheets in the teaching of mathematical modeling.* Preliminary report.
Mark Gruenwald, University of Evansville (871-00-834)

9:40 a.m. (97) *Spreadsheets in high school algebra (or college algebra).*
James Kulich, Elmhurst College (871-00-838)

10:05 a.m. (98) *Elementary row operators within a spreadsheet.*
David E. Flesner, Gettysburg College (871-00-832)

10:30 a.m. (99) *Detection of specific impulse - a problem in data analysis.*
William H. Ruckle, Clemson University (871-00-844)

MAA Panel Discussion

8:00 a.m.–9:20 a.m.

ICME - 7 (August 17-23, 1992).

MAA Committee on Mathematicians Outside Academia Panel Discussion

8:00 a.m.–9:20 a.m.

Mathematical life outside academia: Input from the real world.

AMS Committee on Science Policy and MAA Science Policy Committee Joint Panel Discussion

9:30 a.m.–10:55 a.m.

Values and rewards in the mathematics profession.

AMS Retiring Presidential Address

10:05 a.m.–10:55 a.m.

(100) *In search of symmetry.*
William Browder, Princeton University

AMS-MAA Invited Address

11:10 a.m.– noon

(101) *A new look at knot polynomials.*
Joan S. Birman, Columbia University (871-00-864)

AMS Colloquium Lectures: Lecture I

1:00 p.m.–2:00 p.m.

(102) *Automorphic forms and Hasse-Weil zeta-functions.*
Robert P. Langlands, Institute for Advanced Study

MAA Special Presentation

2:15 p.m.–3:05 p.m.

(103) *The philosophical legacy of John von Neumann.*
Nicholas A. Vonneuman, Meadowbrook, Pennsylvania (871-00-873)

Wednesday, January 8 (cont'd)

AMS Special Session on Designs and Codes, II

2:15 p.m.–6:05 p.m.

2:15 p.m. (104) *Greedy codes.*
Richard A. Brualdi, University of Wisconsin, Madison, and **Vera Pless***, University of Illinois, Chicago (871-05-98)

2:45 p.m. (105) *The weight distribution of a ternary code.*
George T. Kennedy, National Security Agency, Maryland (871-05-579) (Sponsored by John F. Dillon)

3:15 p.m. (106) *Weight enumerators of more irreducible cyclic binary codes.*
Robert L. Ward, National Security Agency, Maryland (871-11-48) (Sponsored by John F. Dillon)

3:45 p.m. (107) *A survey of generalized Hadamard matrices.*
Warwick de Launey, Electronics Research Laboratories, Australia (871-05-572) (Sponsored by John F. Dillon)

4:15 p.m. (108) *Weight distribution of multiples of a Reed-Solomon code generator polynomial.*
Gene A. Berg, Columbia, Maryland (871-94-321)

4:45 p.m. (109) *A bound for divisible codes.*
Harold N. Ward, University of Virginia (871-94-299)

5:15 p.m. (110) *Spherical designs in number theory and functional analysis.*
Bruce Reznick, University of Illinois, Urbana-Champaign (871-05-69)

5:45 p.m. (111) *On the error vectors implemented in code.*
Chul Kim, Kwangwooon University, Korea (871-68-60)

AMS Special Session on Classical Real Analysis, II

2:15 p.m.–6:05 p.m.

2:15 p.m. (112) *The classification of hyperfinite Borel equivalence relations.*
Alexander S. Kechris, California Institute of Technology (871-26-28)

2:45 p.m. (113) *On the σ-algebra of measurable rectangles.*
Arnold W. Miller, University of Wisconsin, Madison (871-04-75)

3:15 p.m. (114) *Note on porosity in Banach spaces.*
Victor Olevskii, Moscow, USSR (871-46-42) (Sponsored by Brian S. Thomson)

3:45 p.m. (115) *Symmetric porosity of Cantor sets.* Preliminary report.
Michael J. Evans, North Carolina State University, **Paul D. Humke**, Saint Olaf College, and **Karen Saxe***, Macalester College (871-26-52)

4:15 p.m. (116) *Symmetric porosity, dimension and derivates.*
Robert W. Vallin, North Carolina State University (871-26-40)

4:45 p.m. (117) *Uniqueness of rectangularly convergent trigonometric series.*
J. Marshall Ash, DePaul University, **Chris Freiling** and **Dan Rinne***, California State University, San Bernardino (871-42-61)

5:15 p.m. (118) *Limits of differentiable functions.*
Udayan B. Darji, North Carolina State University (871-26-39) (Sponsored by Brian S. Thomson)

5:45 p.m. (119) *Sequence conditions which imply approximate continuity.*
James Foran, University of Missouri, Kansas City (871-26-06)

AMS Special Session on Iteration and Factorization of Entire and Meromorphic Functions, I

2:15 p.m.–5:05 p.m.

2:15 p.m. (120) *Topolopy and dynamics of complex exponentials.* Preliminary report.
Robert L. Devaney, Boston University (871-30-164)

2:45 p.m. (121) *On the value distribution of composite entire functions.*
Kari Katajamaki, **Liisa Kinnunen** and **Ilpo Laine***, University of Joensuu, Finland (871-30-163)

3:15 p.m. (122) *Factorization of meromorphic functions.*
Fred Gross, University of Maryland, Baltimore County (871-30-382)

3:45 p.m. (123) *Some functional equations connected with the iteration theory.*
Alex Eremenko, Institute of Low Temperature Physics & Engineering, USSR (871-30-543)

4:15 p.m. (124) *Newton's method for meromorphic functions I, functions without zero as asymptotic value.*
Hartje Kriete, Ruhur University Bochum, Germany (871-30-545) (Sponsored by Chung-Chun Yang)

4:45 p.m. (125) *Newton's method for meromorphic functions* **II**, *failure of Newton's method for functions of finite order.*
Fritz V. Haeseler, University of Bremen, Germany (871-30-546) (Sponsored by Chung-Chun Yang)

AMS Special Session on Interaction of Harmonic Analysis, Signal Processing and Computational Mathematics, I

2:15 p.m.–6:05 p.m.

2:15 p.m. (126) *Signal analysis, stirling functions and the Riemann Zeta function.*
P. L. Butzer* and **M. Hauss**, Technical University of Aachen, Germany (871-41-318) (Sponsored by M. Z. Nashed)

2:45 p.m. (127) *Irregular and local sampling by Gabor frames and transforms*
John J. Benedetto, University of Maryland, College Park (871-42-95)

3:15 p.m. (128) *Smooth wavelets with compactly supported Fourier transforms.*
Aline Bonami, University of Orleans, France, **Fernando Soria**, University Autonoma de Madrid, Spain, and **Guido Weiss***, Washington University (871-42-372)

3:45 p.m. (129) *Algebraic calculation of phases from amplitude data.* Preliminary report.
D. J. Newman, Temple Univeristy and Prometheus, Inc., Sweden, and **H. S. Shapiro***, Royal Institute of Technology and Promethens, Inc., Sweden (871-42-362)

4:15 p.m. (130) *Wavelets, sampling, distributions and everything.*
Gilbert G. Walter, University of Wisconsin, Milwaukee (871-41-426)

4:45 p.m. (131) *Multi-level preconditioning.* Preliminary report.
Wolfgang Dahmen, Freie Universitaet, Germany (871-65-507) (Sponsored by M. Z. Nashed)

5:15 p.m. (132) *Generalization of the Paley-Weiner theorem.*
Amin Boumenir, King Fahd University, Saudi Arabia (871-42-320) (Sponsored by M. Z. Nashed)

5:45 p.m. (133) *Pseudo-biorthogonal bases and frames.*
Hidemitsu Ogawa, Tokyo Institute of Technology, Japan (871-43-319) (Sponsored by M. Z. Nashed)

AMS-MAA Special Session on Mathematics and Education Reform, I

2:15 p.m.–5:55 p.m.

2:15 p.m. (134) *An integrated science/mathematics major for pre-service elementary teachers.* Preliminary report.
John T. Kemper, University of St. Thomas (871-96-272)

2:40 p.m. (135) *Conceptual foundations of statistics: A technological and constructivist approach.*
Marsha Davis, Mount Holyoke College (871-62-255)

3:05 p.m. (136) *Supporting high ability students through the American Regions Mathematics League (AMRL)–Soviet Exchange Program.*
Mark Saul, Bronxville School, Bronxville, New York and American Regions Mathematics League, New York, New York (871-97-229) (Sponsored by Naomi Fisher)

3:30 p.m. (137) *Minority students' academic development in mathematics: Programmatic concerns and implications for mathematics education.*
Charles H. Roberts, Michigan State University (871-98-277) (Sponsored by Richard E. Phillips)

3:55 p.m. (138) *Small study groups for general student audiences.*
Richard J. Maher, Loyola University of Chicago (871-98-101)

4:20 p.m. (139) *Distance learning projects within the Nebraska systemic initiative.*
Donald W. Miller, University of Nebraska, Lincoln (871-97-230)

4:45 p.m. (140) *Problem solving: Comparing choices of natural language in elementary mathematics textbooks.*
R. Daniel Hurwitz* and **Regina Hartmann**, Skidmore College (871-96-529)

5:10 p.m. (141) *EVERY Student succeeds.*
Kenneth C. Millett, University of California, Santa Barbara (871-98-522)

5:35 p.m. (142) *Developing leadership for mathematics education: What is (should be) the University's role?*
Philip Wagreich, University of Illinois, Urbana-Champaign (871-98-600)

MAA Minicourse #4: Part A

2:15 p.m.–4:15 p.m.

Environmental modeling. **Robert McKelvey**, Environmental Research Lab EPA, Corvallis

MAA Minicourse #17

2:15 p.m.–4:15 p.m.

Advanced workshop on DERIVE. **David R. Stoutemyer**, University of Hawaii and Soft Warehouse, Inc.

AMS Session on Probability Theory and Stochastic Processes, I

2:15 p.m.–5:30 p.m.

2:15 p.m. (143) *Compound Poisson approximation for an urn problem.* Preliminary report.
Patrick Burghardt, Carnegie Mellon University, and **Amy Prengaman***, Johns Hopkins University (871-60-510) (Sponsored by Anant P. Godbole)

2:30 p.m. (144) *Correlation autoregressive sequences: A summary.*
Jay C. Hardin, National Aeronautics & Space Administration, Virginia, **Andrzje Makagon**, Michigan State University, East Lansing, and **Abol G. Miamee***, Hampton University (871-60-513)

2:45 p.m. (145) *Optimal Occupation in graphs.* Preliminary report.
Kyle Siegrist, University of Alabama, Huntsville (871-60-549)

3:00 p.m. (146) *Memoryless distributions on a class of semigroups.* Preliminary report.
Kyle Siegrist and **Leigh Lunsford***, University of Alabama, Huntsville (871-60-587)

3:15 p.m. (147) *Recent progress in exchangeability theory.*
Grant Izmirlian, Jr., University of Wisconsin, Madison (871-60-607)

3:30 p.m. (148) *Numerical calculation of multidimensional stable distributions.*
John P. Nolan*, American University, and **Balram Rajput**, University of Tennessee, Knoxville (871-60-625)

Wednesday, January 8 (cont'd)

3:45 p.m. (149) *Random orthogonal polynomials.* Preliminary report.
M. Sambandham*, Clark Atlanta University, and **A. Brania**, Morehouse College (871-60-357)

4:00 p.m. (150) *Random algebraic polynomials.* Preliminary report.
Henry Gore* and **M. Sambandham**, Morehouse College (871-60-358)

4:20 p.m. Break

4:35 p.m. (151) *On the number of cycles in a random non-equiprobable graph*[1].
V. F. Kolchin and **V. I. Khokhlov***, Academy of Sciences of the USSR, (871-60-416) (Sponsored by Paul W. Davis)

4:50 p.m. (152) *Stationary characteristics of a queue system with semi-Markovian flow of entrance function.*
Mikhail M. Novikov, (871-60-424)

5:05 p.m. (153) *A generalization of the birthday problem.*
M. Sayrafiezadeh, Medgar Evers College, City University of New York (871-98-298)

5:20 p.m. (154) *An identity on symmetric functions, and its application to majority-rule.*
Robert B. Feinberg, Baltimore, Maryland (871-05-354) (Sponsored by John F. Dillon)

AMS Session on Approximation Theory and Harmonic Analysis

2:15 p.m.–6:00 p.m.

2:15 p.m. (155) *Recurrence formulas for multivariate box splines and their moments.* Preliminary report.
Patrick J. Van Fleet, Vanderbilt University (871-41-445)

2:30 p.m. (156) *Monotone approximation with first-order linear differential operators.*
O. Shisha* and **C. Yang**, University of Rhode Island (871-41-525)

2:45 p.m. (157) *Multidimensional wavelets generated by fractal functions.* Preliminary report.
J Geronimo, Georgia Institute of Technology, **D. Hardin*** and **P. Massopust**, Vanderbilt University (871-41-590)

3:00 p.m. (158) *Three dimensional stationary phase method with non-degenerate stationary point on an edge.* Preliminary report.
David Kaminski, University of Lethbridge, England (871-41-121)

3:15 p.m. (159) *Interpolation of entire functions associated with some Freud's weights.*
Radwan Al-Jarrah*, Southwestern Oklahoma State University, and **Mohammed Hasan**, Yarmouk University, Jordan (871-41-314)

3:30 p.m. (160) *An unusual arctangent series approximation for* π.
Francine Abeles, Kean College of New Jersey (871-41-128)

3:45 p.m. (161) *A spectral Paley-Weiner theorem.*
William Bray, University of Maine, Orono (871-42-222)

4:00 p.m. (162) *A generalization of the Cantor-Lebesgue theorem.*
J. Marshall Ash*, DePaul University, **Robert P. Kaufman**, University of Illinois, Urbana-Champaign, and **Eric Rieders**, DePaul University (871-42-123)

4:10 p.m. Break

4:20 p.m. (163) *Almost everywhere summability of orthogonal expansions on the unit circle.*
Attila Mate, Brooklyn College, City University of New York (871-42-490)

4:35 p.m. (164) *Quadratic maps of* R^2 *which map* $A(R^2)$ *to the space of functions with uniformly invertible Fourier transforms.* Preliminary report.
Peter M. Jarvis, University of Wisconsin, Madison (871-42-480)

4:50 p.m. (165) *A Fourier series.* Preliminary report.
Javad Namazi, Fairleigh Dickinson University (871-42-463)

5:05 p.m. (166) *Perturbation results and the Franklin Wavelets.*
Kenneth F. Yarnall, University of South Carolina, Columbia (871-42-447)

5:20 p.m. (167) *Geometric dimension versus smoothness on the closed set* $[0,1]$.
Anca Deliu*, Georgia Institute of Technology, and **Mong-Shu Lee**, University of South Carolina, Columbia (871-42-383)

5:35 p.m. (168) *A note on pseudo-differential operators on weighted* L^p*-spaces over locally compact Vilenkin groups.*
H. Ombe, University of Puerto Rico, Rio Piedras (871-43-412)

5:50 p.m. (169) *Strong Boehmians.* Preliminary report.
Piotr Mikusinski* and **Ellen R. Dill**, University of Central Florida (871-44-113)

AMS Session on Category Theory and Nonassociative Algebra

2:15 p.m.–5:30 p.m.

2:15 p.m. (170) *Lie algebras associated to conditional expectation operators.*
Gregory Peterson, East Carolina University (871-16-274)

2:30 p.m. (171) *Isomorphism classes of noncommutative matrix Jordan algebras.* Preliminary report.
Robert B. Brown, Ohio State University, Columbus, and **Nora C. Hopkins***, Indiana State University (871-17-502)

2:45 p.m. (172) *Essential extensions of simple modules for Lie algebras of type A, D, and E.*
Randall P. Dahlberg, Allegheny College (871-17-499)

3:00 p.m. (173) *A generalization of the algebra of color.*
R. D. Schafer, Massachusetts Institute of Technology (871-17-110)

3:15 p.m. (174) *Lie algebras closed under non-Lie polynomials.* Preliminary report.
John Magnus, Sweet Briar College (871-17-503)

3:30 p.m. (175) *Imaginary roots of a Kac-Moody Lie algegra whose reflections preserve root multiplicities.* **Curtis Bennett**, Michigan State University (871-17-120)

3:45 p.m. (176) *Centroids and root systems.* **Duncan J. Melville**, Saint Lawrence University (871-17-379)

4:00 p.m. (177) *Representations of exceptional Lie algebras restricted to subalgebras.* **Krystina K. Leganza**, Ball State University (871-20-433)

4:10 p.m. Break

4:20 p.m. (178) *Weak ∞-groupoids and the homotopy category.* **Marek Golasinski**, Nicholas Copernicus University, (871-18-375)

4:35 p.m. (179) *Results concerning a categorical version of the Nobeling-Pontryagin theorem.* **Dmitri B. Shakhmatov**, Miami University, Oxford, OH (871-18-457) (Sponsored by Dennis K. Burke)

4:50 p.m. (180) *On Cartesian closed universal algebras.* **Vijaya Gompa**, Ball State University (871-18-329)

5:05 p.m. (181) *Tricategories.* Preliminary report. **Robert Gordon***, Temple University, Philadelphia, **A. J. Power**, University of Edinburgh, Scotland, and **R. H. Street**, Macquarie University, Australia (871-18-297)

5:20 p.m. (182) *A categorical setting for second-order mathematical structures.* Preliminary report. **Lawrence Neff Stout***, Illinois Wesleyan University, and **Ulrich Hohle**, Bergische University, Germany (871-18-289)

AMS Session on Complex Analysis, I

2:15 p.m.–6:00 p.m.

2:15 p.m. (183) *When is the composition of two power series even?* **Alan Horwitz***, Pennsylvania State University, Media, and **Lee Rubel**, University of Illinois, Urbana-Champaign (871-26-576)

2:30 p.m. (184) *Extremal results for a class of univalent functions.* **Robin Cunningham**, Trenton State College (871-30-219)

2:45 p.m. (185) *Sharp first order univalence criteria.* **Julian Gevirtz**, University of Chile, Chile (871-30-218)

3:00 p.m. (186) *On univalance of certain infinite products.* **E. P. Merkes**, University of Cincinnati, and **Mohammad Salmassi***, College of the Holy Cross (871-30-227)

3:15 p.m. (187) *Entire functions capable of mapping continuous, nonanalytic functions into the disc algebra.* Preliminary report. **Paul E. Fishback**, University of Wisconsin, Madison (871-30-326)

3:30 p.m. (188) *Uniformly convex functions.* Preliminary report. **Wancang Ma** and **David Minda***, University of Cincinnati (871-30-306)

3:45 p.m. (189) *Entire functions of order one and infinite type.* Preliminary report. **Badih Ghusayni**, North Central College (871-30-270)

4:00 p.m. (190) *Interpolation at maximal radii: A characterization of the binomial and exponential series.* **Faruk Abi-Khuzam**, American University of Beirut (871-30-105)

4:10 p.m. Break

4:20 p.m. (191) *A generalization of the Jacobi inversion formula and some applications.* **S. F. Keating**, Eastern Connecticut State University (871-46-638)

4:35 p.m. (192) *Quantitative Runge theorems for harmonic functions.* **Thomas Bagby**, Indiana University, and **Norman Levenberg***, University of Auckland, New Zealand (871-30-74)

4:50 p.m. (193) *A class on Ruscheweyh derivative of functions with negative coefficients.* **Igbal Ahmad** and **Yogesh K. Sharma***, Jamia Millia Islamia, India (871-30-14)

5:05 p.m. (194) *A verfication of an integral mean conjecture by Ruscheweyh.* **Roger W. Barnard** and **Kent Pearce***, Texas Tech University (871-30-476)

5:20 p.m. (195) *Discrete analytic polynomials defined via circle packings.* Preliminary report. **Tomasz Dubejko**, University of Tennessee, Knoxville (871-30-449)

5:35 p.m. (196) *On certain compact Riemann surfaces with a maximal number of automorphisms.* **Peter Turbek**, University of Wisconsin, Madison (871-30-435)

5:50 p.m. (197) *A note on functional roots.* Preliminary report. **R. Holzsager***, **L. Crone** and **I. L. Chang**, American University (871-30-432)

AMS Session on Differential Geometry

2:15 p.m.–5:30 p.m.

2:15 p.m. (198) *Minimal progress on problems in geometry.* Preliminary report. **Ray Killgrove***, San Diego State University, San Diego, CA, and **Rodolfo Tamez**, California State University - Los Angeles (871-51-161)

2:30 p.m. (199) *Double points on hyperbolic surfaces.* **Hanna M. Sandler**, American University (871-51-624)

2:45 p.m. (200) *The volume of n-simplex.* **Eung Chun Cho**, Kentucky State University (871-52-16)

3:00 p.m. (201) *Tangential and normal Euler numbers, complex points, and singularities of projections for oriented surfaces in 4-space.* **Thomas Banchoff**, Brown University, and **Frank Farris***, Santa Clara University (871-53-215)

3:15 p.m. (202) *An isometric deformation preserving the mean curvature.* **Ioannis M. Roussos**, Hamline University (871-53-148)

Wednesday, January 8 (cont'd)

3:30 p.m. (203) *Pairs of connections compatible with almost quasi-quaternion structures.*
Andrzej Bucki, Williamsport, Pennsylvania (871-53-338)

3:45 p.m. (204) *Pushforward measures for certain convex symplectic manifolds.* Preliminary report.
Elisa Prato, Princeton University (871-53-70)

4:00 p.m. (205) *The generic condition in relativity is generic.*
Steven G. Harris, Saint Louis University (871-53-456)

4:10 p.m. Break

4:20 p.m. (206) *Affine curves in the hyperbolic plane.*
Weiqi Gao, Southern Illinois University, Edwardsville (871-53-381)

4:35 p.m. (207) *All metric geometries on Lie groups of dimension 3 are known.*
Luis A. Cordero, University of Santiago, Spain, and **Phillip E. Parker***, Wichita State University (871-53-609)

4:50 p.m. (208) *Mean curvature cohomology and infinitesimal leaf geometry.*
Richard H. Escobales, Jr., Canisius College (871-53-558)

5:05 p.m. (209) *On resolving the multiplicity of tensor products of representations of the symplectic groups.* Preliminary report.
Eric Yiu-Ching Leung, University of Iowa (871-22-116)

5:20 p.m. (210) *The universal form of the branching rule for the symplectic groups.*
Mihalis Maliakas, University of Arkansas, Fayetteville (871-20-13)

AMS Session on Numerical Analysis

2:15 p.m.–5:45 p.m.

2:15 p.m. (211) *First order recurrence relations in two variables.*
M. H. Moadab, Virginia State University, **Firooz Khosraviyani*** and **John Abramowich**, University of Texas of the Permian Basin (871-65-559)

2:30 p.m. (212) *An efficient line search algorithm for unconstrained optimization.*
F. A. Potra and **Yixun Shi***, University of Iowa (871-65-621)

2:45 p.m. (213) *Parallel homotopy method and its properties for matrix eigenvalue problems.*
Liang Jiao Huang* and **Tien Yien Li**, Michigan State University (871-65-376)

3:00 p.m. (214) *Reduced continuity finite element approximations for convection dominated convection-diffusion equations.* Preliminary report.
Da-mu Cai, University of Wisconsin, Madison (871-65-377)

3:15 p.m. (215) *Fast solvers for finite difference approximations for the Stokes and Navier-Stokes equations.*
Dongho Shin* and **John C. Strikwerda**, University of Wisconsin, Madison (871-65-439)

3:30 p.m. (216) *Homotopy methods for eigenvalue problems of general matrices.*
Zhonggang Zeng, Michigan State University (871-65-440)

3:45 p.m. (217) *Real homotopies for solving real polynomial systems.*
T. Y. Li and **Xiaoshen Wang***, Michigan State University (871-65-441)

4:00 p.m. (218) *The semigroup stability of difference approximations for initial-boundary value problems.*
Lixin Wu, University of California, Los Angeles (871-65-443)

4:20 p.m. Break

4:35 p.m. (219) *An algorithm for symmetric tridiagonal eigenproblems.*
Kuiyuan Li*, University of West Florida, and **Tien-Yien Li**, Michigan State University (871-65-10)

4:50 p.m. (220) *Elimination of numerical instabilities.*
Ronald Mickens, Clark Atlanta University (871-65-83)

5:05 p.m. (221) *Numerical technique to solve nonlinear elliptic PDE's arising from semiconductor device modeling.*
John R. Rice, Purdue University, and **Rakesh K. Sharma***, Northern Illinois University (871-65-147)

5:20 p.m. (222) *Evolutionary methods for global optimization.*
Ben Goertzel, University of Nevada, Las Vegas (871-65-150) (Sponsored by Peter Shiue)

5:35 p.m. (223) *Modified form of calculus for supercomputers.* Preliminary report.
Krishnanand Verma, University of Wisconsin, Whitewater (871-68-631) (Sponsored by Bennette R. Harris)

AMS Session on Operator Theory

2:15 p.m.–6:00 p.m.

2:15 p.m. (224) *Dense Frechet subalgebras of operator algebra crossed products by Lie groups.*
Larry B. Schweitzer, University of California, Berkeley (871-46-02)

2:30 p.m. (225) *Spectral mapping theorems for fractionally integrated semigroups.*
Colin R. Day, University of South Carolina, Columbia (871-47-189)

2:45 p.m. (226) *Multiplicative perturbation of semigroup generators.*
J. R. Dorroh*, Louisiana State University, Baton Rouge, and **Albrecht Holderreith**, University of Tubingen, Germany (871-47-281)

3:00 p.m. (227) *Linear maps preserving lat, hyperlat, and commutant of operators.*
A. A. Jafarian*, University of New Haven, and **Ahmed R. Sourour**, University of Victoria (871-47-303)

3:15 p.m. (228) *The method of approximation-solvability of nonlinear equations in reflexive Banach spaces.* Preliminary report.
Ram Verma* and **Lokenath Debnath**, University of Central Florida (871-47-34)

3:30 p.m. (229) *Joint spectrum an H^∞-functional calculus for pairs of commuting contractions.* Preliminary report.
Alfredo Octavio, IVIC, Venezuela (871-47-19)

3:45 p.m. (230) *An extension of a theorem by Browder with applications to variational inequality problems.*
Charles Holly, University of Illinois, Urbana-Champaign (871-47-483)

4:00 p.m. (231) *On nonnegative solvability of linear operator equations.*
Harold Dean Victory, Jr.* and **Ruey-Jen Jang-Lewis**, Texas Tech University (871-47-482) (Sponsored by Roger W. Barnard)

4:10 p.m. Break

4:20 p.m. (232) *Implicit function theorems for nondifferentiable maps.*
P. S. Milojevic, New Jersey Institute of Technology (871-47-428)

4:35 p.m. (233) *The band generated by lattice homomorphisms.*
David C. Carothers*, Hope College, and **William A. Feldman**, University of Arkansas, Fayetteville (871-47-566)

4:50 p.m. (234) *The adjoint problem for coupled linear operators.*
Michael K. Kinyon, University of Utah (871-47-561)

5:05 p.m. (235) *Pure subjordan operators and simultaneous approximation by a polynomial and its derivative.*
Thomas R. Fanney, Virginia Wesleyan College (871-41-512)

5:20 p.m. (236) *Local and global bivariational gradients in function spaces.*
E. P. Hamilton*, Washington College, and **M. Z. Nashed**, University of Delaware (871-49-311)

5:35 p.m. (237) *Best approximation in function and operator spaces.*
Waleed M. Deeb*, Beverly Hills, California, and **Roshdi Khalil**, Kuwait University, Kuwait (871-41-629)

5:50 p.m. (238) *Mikusinski's mathematics.* Preliminary report.
John Synowiec, Indiana University, Northwest (871-01-160)

MAA Session on Mathematics Placement Testing Programs: Their Organization, Administration and Problems, II

2:15 p.m.–5:05 p.m.

2:15 p.m. (239) *Predicting success in college mathematics.*
Hope Florence and **Hugh Haynsworth***, University of Charleston (871-00-747)

2:40 p.m. (240) *Placement test development and implementation.*
Samuel Thompson* and **Lindsey Court**, University of Maryland (871-00-751)

3:05 p.m. (241) *Effective placement: More than a good test.*
A. Ferzola*, **N. Lakshmanan**, **D. S. Martin** and **P. M. Perdes**, University of Scranton (871-00-744)

3:30 p.m. (242) *The University of Wisconsin System Placement Testing Program.*
Allan S. Cohen and **John G. Harvey***, University of Wisconsin, Madison (871-00-746)

3:55 p.m. (243) *Statewide placement testing as a long-term process.*
David E. Boliver, Jr., Trenton State College (871-00-739)

4:20 p.m. (244) *Mathematics placement testing programs: Their organization, administration, and problems.*
Franklin Demana, Ohio State University, Columbus (871-00-743)

4:45 p.m. (245) *The placement testing program at the University of Arkansas.*
Allan C. Cochran* and **Scott M. Jordan**, University of Arkansas, Fayetteville (871-00-741)

MAA Session on The "seven-into-four" Problem, I

2:15 p.m.–4:10 p.m.

2:15 p.m. (246) *7 into 4: Principles, proposals, progress.* Preliminary report.
Stephen B. Maurer, Swarthmore College (871-00-764)

2:30 p.m. (247) *A small college's solution to the seven into four problem.*
Glenn Adamson, Ottawa University (871-00-753)

2:45 p.m. (248) *Shake and bake of undergraduate mathematics curriculum.*
S. C. Bhatnagar, University of Nevada, Las Vegas (871-00-756)

3:00 p.m. (249) *Multiple techinques and multiple applications.*
Russell Jay Hendel, Dowling College (871-00-759)

3:15 p.m. (250) *A curriculum for the first two years.*
Susan Hurley* and **Thomas H. Rousseau**, Siena College (871-00-760)

3:30 p.m. (251) *Discrete mathematics in the first two years: How and why.*
Herbert E. Kasube, Bradley University (871-00-761)

3:45 p.m. (252) *Multivariable Calculus* II, *a "five into four" experience.*
Richard D. Neidinger, Davidson College (871-00-765)

4:00 p.m. (253) *Accelerating calculus through Taylor's approximations.*
M. Sayrafiezadeh, Medgar Evers College, City University of New York (871-00-767)

Wednesday, January 8 (cont'd)

MAA Session on Innovations in Mathematics Courses for Business, II

2:15 p.m.–4:10 p.m.

2:15 p.m. (254) *Business majors as self-confident users of mathematics.*
Catherine M. Murphy, Purdue University, Calumet Campus (871-00-779)

2:30 p.m. (255) *Histogram races for introductory business statistics.*
Iris Brann Fetta, Clemson University (871-00-770)

2:45 p.m. (256) *Spreadsheet laboratory exercises in business calculus.*
Coreen L. Mett, Radford University (871-00-775)

3:00 p.m. (257) *Linear programming - a pedagogically sound approach.*
Richard Mitchell, University of Wisconsin, Stevens Point (871-00-778)

3:15 p.m. (258) *The content and organization of applied calculus.*
Denny Burzynski, West Valley College (871-00-768)

3:30 p.m. (259) *A new approach to business statistics.*
Philip R. Meyers, New York, New York (871-00-776)

3:45 p.m. (260) *A role for business applications in a calculus course.*
John A. Ferling, Claremont McKenna College (871-00-769)

4:00 p.m. (261) *Consultant corner: Decision making and writing in mathematics for business.*
James J. Reynolds*, Clarion University of Pennsylvania, and **Ronald J. Harshbarger**, Georgia Southern University (871-00-860)

MAA Session on Using Spreadsheets to Teach Mathematics, II

2:15 p.m.–5:55 p.m.

2:15 p.m. (262) *Spreadsheets, amortization of loans, and lines in precalculus.*
James Sandefur, Georgetown University (871-00-845)

2:40 p.m. (263) *Using spreadsheets in math.*
Donald R. Snow, Brigham Young University (871-00-847)

3:05 p.m. (264) *Using spreadsheet to teach permutations and combinations.*
Susan T. Dean* and **George T. Crocker**, Samford University (871-00-828)

3:30 p.m. (265) *Experiences with the use of spreadsheets in applied mathematics teaching.*
John W. Perram, Odense University, Denmark (871-00-840)

3:55 p.m. (266) *Cayley tables on a spreadsheet.*
R. G. Dean, Stephen F. Austin State University (871-00-827)

4:20 p.m. (267) *Mathematical analysis of mortgage derivative securities using spreadsheets.*
Matthew J. Hassett, Arizona State University, Tempe (871-00-835)

4:45 p.m. (268) *Spreadsheets bring order to chaos.*
Marilyn B. Durkin* and **Barbara C. Nevils**, Bentley College (871-00-831)

5:10 p.m. (269) *Spreadsheets as mathematical tools of first choice.*
Gary E. Davis, LaTrobe University, Australia (871-00-825)

5:35 p.m. (270) *Solving systems of equations using Lotus* 1-2-3.
Edgar N. Howell, Hazard Community College (871-00-836)

AMS Special Session on Index Theory, II

2:30 p.m.–5:20 p.m.

2:30 p.m. (271) *Higher eta-invariants.*
John Lott, University of Michigan, Ann Arbor (871-58-401)

3:00 p.m. (272) *Spectral invariants and L^2-analytic torsions.*
Donggeng Gong* and **Joel Pincus**, State University of New York, Stony Brook (871-47-402)

3:30 p.m. (273) *Von Neumann Index Theorems for manifolds with boundary.*
Mohan Ramachandram, Purdue University, West Lafayette (871-58-459) (Sponsored by Jonathan M. Rosenberg)

4:00 p.m. (274) *Invariants of stratified spaces and stratifiable maps.*
Julius Shaneson, University of Pennsylvania (871-57-284) (Sponsored by Jonathan M. Rosenberg)

4:30 p.m. (275) *Singular spaces and subspaces.*
Sylvain Cappell, New York University-Courant Institute (871-57-283)

5:00 p.m. (276) *Controlled homotopy equivalences almost preserve strata.* Preliminary report.
Frank Quinn, Virginia Polytechnic Institute and State University (871-58-582)

MAA Invited Address

3:20 p.m.–4:10 p.m.

(277) *Linear algebra, geometry, and supercomputing.*
James W. Demmel, University of California, Berkeley (871-00-872)

AWM Panel Discussion

3:20 p.m.–4:20 p.m.

Graduate education.

AMS Special Session on Environmental Modeling, I

4:15 p.m.–6:10 p.m.

4:15 p.m. (278) *Conceptual issues in the conservation of biological diversity.* **Robert McKelvey**, University of Montana (871-92-595) (Sponsored by B. A. Fusaro)

5:05 p.m. (279) *System theoretic approach to the greenhouse effect.* **J. Filar***, University of Maryland, Baltimore County, and **R. Braddock**, Griffith University, Australia (871-92-597) (Sponsored by B. A. Fusaro)

5:40 p.m. (280) *Predicting radon measurements by regression.* **M. K. King*** and **J. Haller**, Theta Technologies Incorporated, Tennessee (871-92-592) (Sponsored by B. A. Fusaro)

AWM Business Meeting and Prize Session

4:20 p.m.–4:50 p.m.

AMS Invited Address

4:25 p.m.–5:15 p.m.

(281) *On the border of symplectic geometry and complex analysis.* **Yakov M. Eliashberg**, Stanford University (871-00-868)

MAA Minicourse #5: Part A

4:30 p.m.–6:30 p.m.

Using group projects in calculus. **Stephen Hilbert**, **John Maceli**, **Eric Robinson**, **Diane Schwartz** and **Stanley Seltzer**, Ithaca College

MAA Minicourse #6: Part A

4:30 p.m.–6:30 p.m.

Introduction to research in the teaching and learning of undergraduate mathematics: examples in calculus. **Joan Ferrini-Mundy**, University of New Hampshire, and **Kathleen Heid**, Pennsylvania State University

NSF Session

5:45 p.m.–6:45 p.m.

The changing environment for NSF funding of research and education.

AMS-MAA Joint Presentation

7:15 p.m.–8:15 p.m.

7:15 p.m. (282) *The agency that came in from the cold.* **Richard J. Shaker**, National Security Agency

AMS Josiah Willard Gibbs Lecture

8:30 p.m.–9:30 p.m.

(283) *Approaching the limit: Mathematics and myth in statistical physics.* **Michael E. Fisher**, University of Maryland, College Park (871-00-867)

Thursday, January 9

AMS Special Session on Designs and Codes, III

8:00 a.m.–10:50 a.m.

8:00 a.m. (284) *Finite geometry's contributions to coding theory.* **E. F. Assmus, Jr.**, Lehigh University (871-05-291)

8:30 a.m. (285) *Designs and codes from unitals.* **J. D. Key**, Clemson University (871-20-253)

9:00 a.m. (286) *Quasi-symmetric designs and the Smith normal form.* Preliminary report. **A. Blokhuis**, Eindhoven University of Technology, The Netherlands, and **A. R. Calderbank***, AT&T Bell Laboratories, Murray Hill, New Jersey (871-05-176)

9:30 a.m. (287) *Constructing 5-designs from Golay subcodes.* **Christine G. Barton**, National Security Agency, Maryland (871-05-573) (Sponsored by John F. Dillon)

10:00 a.m. (288) *Exponential number of quasi-symmetric designs and codes meeting the Grey-Rankin bound.* **Vladimir Tonchev***, Michigan Technological University, and **Dieter Jungnickel**, University Giessen, Germany (871-05-608)

10:30 a.m. (289) *A recursive method for construction of designs.* **D. K. Ray-Chaudhuri*** and **Tianbao Zhu**, Ohio State University, Columbus (871-05-500)

AMS Special Session on Iteration and Factorization of Entire and Meromorphic Functions, II

8:00 a.m.–10:20 a.m.

8:00 a.m. (290) *On the fix-points and factorizations of entire functions.* Preliminary report. **Chung-Chun Yang***, Hong Kong Universty of Science and Technology, Hong Kong, and **Jian-hua Zheng**, Academia Sinica, People's Republic of China (871-30-162)

Thursday, January 9 (cont'd)

8:30 a.m. (291) *Factorization of determinants of Laplacians on spheres.*
J. R. Quine* and **Junesang Choi**, Florida State University (871-30-85)

9:00 a.m. (292) *On the iterate of e^z.* Preliminary report.
Jian-Ying Zhou, Beijing University, Peoples Republic of China (871-30-165) (Sponsored by Chung-Chun Yang)

9:30 a.m. (293) *Dynamics of critically finite entire functions.*
Misha Yu Lyubich, State University of New York, Stony Brook (871-30-606)

10:00 a.m. (294) *On the intersection of Julia sets.* Preliminary report.
C. T. Chong, National University of Singapore, Singapore (871-30-167)

AMS Special Session on Interaction of Harmonic Analysis, Signal Processing and Computational Mathematics, II

8:00 a.m.–10:50 a.m.

8:00 a.m. (295) *Optical wavelet networks.*
Walter Schempp, University of Siegen, Germany (871-43-602) (Sponsored by M. Z. Nashed)

8:30 a.m. (296) *Sampling, interpolation and the Nyquist density in some function spaces related to signal analysis.* Preliminary report.
Kristian Seip, University of Trondheim, Norway (871-30-339)

9:00 a.m. (297) *New optimal multilayer neural networks in a generalized Fock space setting.*
Rui J. P. DeFigueiredo, University of California, Irvine, CA (871-43-337) (Sponsored by M. Z. Nashed)

9:30 a.m. (298) *Time-band-time limiting operators, restricted polynomial expansions, and approximation.*
Marci Perlstadt, Drexel University (871-41-427)

10:00 a.m. (299) *Wavelet based approximation in the optimal control of distributed parameter systems.*
Chris Brislawn*, Los Alamos National Laboratory, and **I. G. Rosen**, University of Southern California (871-49-08)

10:30 a.m. (300) *Multiresolutions and wavelets: Algebraic structure and families in relation with Shannon's sampling theory and the Gabor transform.*
Akram Aldroubi*, Mathematics and Signal Processing Group, Maryland, and **Michael Unser**, National Institute of Health, Maryland (871-42-205)

AMS Special Session on Index Theory, III

8:00 a.m.–10:50 a.m.

8:00 a.m. (301) *Applications of the Lipschitz G-signature theorem.*
Jonathan Rosenberg, University of Maryland, College Park (871-58-405)

8:30 a.m. (302) *The Novikov conjecture via controlled topology.* Preliminary report.
Steven C. Ferry, State University of New York, Binghamton (871-57-496)

9:00 a.m. (303) *Asymptotic morphisms and index theory.* Preliminary report.
Nigel Higson, Pennsylvania State University, University Park (871-19-460)

9:30 a.m. (304) *An index formula for transversally elliptic operators relative to a compact Lie group action.* Preliminary report.
Guoliang Yu, Mathematical Sciences Research Institute, Berkeley, CA (871-58-403)

10:00 a.m. (305) *Higher relative eta invariants.*
Ronald G. Douglas, State University of New York, Stony Brook (871-58-373)

10:30 a.m. (306) *Spatially nontemperate pseudodifferential operators, Fredholm theory, and index.*
Houshang H. Sohrab, Towson State University (871-35-51)

AMS Special Session on Symplectic Topology, I

8:00 a.m.–10:55 a.m.

8:00 a.m. (307) *Dissipation induced instability.*
Tudor Ratiu, University of California, Santa Cruz (871-58-407)

8:50 a.m. (308) *J-holomorphic curves in simplectic 4-manifolds.*
Dusa McDuff, State University of New York, Stony Brook (871-53-539)

9:35 a.m. (309) *Symplectic fixed point theorems for toric manifolds.*
Alexander B. Givental, University of California, Berkeley, CA (871-98-497) (Sponsored by Yakov Eliashberg)

10:25 a.m. (310) *Nonholonomic reduction.*
Larry Bates* and **Jedrzej Sniatycki**, University of Calgary (871-58-404) (Sponsored by Yakov Eliashberg)

AMS-MAA Special Session on Mathematics and Education Reform, II

8:00 a.m.–10:55 a.m.

8:00 a.m. (311) *Integrating problem solving and technology into mathematics teaching: A leadership and training project.*
Elias Toubassi, University of Arizona, Tucson (871-98-276) (Sponsored by Naomi Fisher)

8:25 a.m. (312) *A description of a special in-service calculus course for high school teachers.* **Peter Braunfeld**, University of Illinois, Urbana-Champaign (871-97-254) (Sponsored by Steven B. Bank)

8:50 a.m. (313) *Enhancing mathematics education using technology - the Arizona experience.* **David Lovelock**, University of Arizona (871-98-531)

9:15 a.m. (314) *Geometry and the imagination.* **Jane Gilman**, Rutgers University, Newark (871-98-366)

9:40 a.m. (315) *Assessment and mathematics education reform.* Preliminary report. **Alfred Manaster**, University of California at San Diego, La Jolla (871-97-521)

10:05 a.m. (316) *Real mathematics from the start.* **Nancy N. Casey***, Washington State University, and **Michael Fellows**, University of Victoria (871-96-519) (Sponsored by Naomi Fisher)

10:30 a.m. (317) *Resources for mathematics reform.* **Mark Driscoll**, Educational Development Center, Massachusetts (871-96-212)

MAA Minicourse #1: Part B

8:00 a.m.–10:00 a.m.

Alternatives to the lecture method in collegiate mathematics. **Julian Weissglass**, University of California, Santa Barbara

MAA Minicourse #8: Part A

8:00 a.m.–10:00 a.m.

CAS laboratory projects for first year calculus using DERIVE. **Carl L. Leinbach**, Gettysburg College, and **Marvin L. Brubaker**, Messiah College

AMS Session on Algebraic Topology and Manifolds

8:00 a.m.–10:55 a.m.

8:00 a.m. (318) *All 3-plane complex Grassmanian manifolds are connected-wise prime.* Preliminary report. **John Ferdinands**, Calvin College (871-55-266)

8:15 a.m. (319) *Minimal models and symplectic topology.* **Gregory Lupton*** and **John Oprea**, Cleveland State University (871-55-77)

8:30 a.m. (320) *Some results on the Alpha invariant.* Preliminary report. **Gregory A. Fredricks***, Lewis & Clark College, and **Jeff C. Lutgen**, University of Oregon (871-57-389)

8:45 a.m. (321) *Unlinking two component links.* **Peter Kohn**, University of Texas, Austin (871-57-614)

9:00 a.m. (322) *The differential topology of locally compact sets.* Preliminary report. **R. Mansfield**, **H. Movahedi-Lankarani*** and **R. Wells**, Pennsylvania State University, University Park (871-57-511)

9:15 a.m. (323) *Generalization of a Bieberbach's theorem.* **Kyung Bai Lee**, University of Oklahoma, Norman (871-57-290)

9:30 a.m. (324) *Index theory for short ranged fields in higher dimensions.* **Nicolae Anghel**, University of North Texas (871-58-232)

9:45 a.m. (325) *A necessary and sufficient condition for a system of nonlinear equations to have a unique solution.* **Chung-Wu Ho**, Southern Illinois University, Edwardsville (871-58-305)

10:00 a.m. (326) *Homoclinic contours of differential systems.* Preliminary report. **Zhivko S. Athanassov**, Bulgarian Academy of Sciences, Bulgaria (871-58-414)

10:15 a.m. (327) *A counterexample to the* 3*-dimensional Poincaré conjecture.* III. Preliminary report. **F. D. Lonergan**, Webster, Massachusettts (871-55-201)

10:30 a.m. (328) *The algebra structure of* $P(l)_*SO(2^{l+1}-1)$. **Vidhyanath Rao**, Ohio State University, Newark (871-55-45)

10:45 a.m. (329) *A characterization of convex functions.* **The Luc Dinh**, Institute of Mathematics, Socialist Republic of Vietnam, and **Srinivasa Swaminathan***, Dalhousie University (871-46-181)

AMS Session on Finite Differences and Functional Equations

8:00 a.m.–10:10 a.m.

8:00 a.m. (330) *On the map function.* **Vojislav Stojkovic**, Morgan State University (871-68-627)

8:15 a.m. (331) *Inner product spaces and functional equations.* **PL. Kannappan**, University of Waterloo (871-39-296)

8:30 a.m. (332) *Asymptotic behavior of solutions of Poincaré difference equations.* **William F. Trench**, Trinity University (871-39-26)

8:45 a.m. (333) *The existence of scaling distributions and functions.* Preliminary report. **Christopher Heil***, Massachusetts Institute of Technology, and **David Colella**, MITRE, Virginia (871-39-555)

9:00 a.m. (334) *Continuous solutions of dilation equations.* Preliminary report. **David Colella***, MITRE, Virginia, and **Christopher Heil**, Massachusetts Institute of Technology (871-39-563) (Sponsored by George Benke)

9:15 a.m. (335) *Global attractivity and linearized oscillations for delay difference equations.* **Gerasimos Ladas**, University of Rhode Island (871-39-124)

Thursday, January 9 (cont'd)

9:30 a.m. (336) *On sup-continuous triangle functions.*
Thomas Riedel, University of Louisville (871-39-413)

9:45 a.m. (337) *Cauchy difference - A generalization of Hosszu functional equation.*
P. L. Kannappan, University of Waterloo, and **P. K. Sahoo***, University of Louisville (871-39-615)

10:00 a.m. (338) *Generalizations of Jensen's functional equation in distributions.*
Elias Y. Deeba*, University of Houston, Downtown, and **E. L. Koh**, University of Regina (871-39-38)

AMS Session on Partial Differential Equations, II

8:00 a.m.–10:55 a.m.

8:00 a.m. (339) *Exact controllability and uniform stabilization of the Kirchoff plate with boundary feedback acting via bending moments.*
Mary Ann Horn, University of Virginia (871-35-55)

8:15 a.m. (340) *The Ginzburg-Landau equation: Posted in a quarter plane.*
Charles Bu, University of Illinois, Urbana-Champaign (871-35-92)

8:30 a.m. (341) *A parabolic problem modelling axially symmetric thermoelastic contact.*
Kevin T. Andrews* and **Meir Shillor**, Oakland University (871-35-94)

8:45 a.m. (342) *Solutions of Bergers' equation via quasi-solutions.*
Michael McAsey*, Bradley University, and **Lee A. Rubel**, University of Illinois, Urbana-Champaign (871-35-257)

9:00 a.m. (343) *Blow-up of solutions for nonlinear parabolic boundary value problems.*
Hongwei Chen, Christopher Newport Collge (871-35-304)

9:15 a.m. (344) *An absorption problem in the presence of salt.* Preliminary report.
Tommy Meyers, U S Army Engineer Waterways, Mississippi, and **Seth F. Oppenheimer***, Mississippi State University (871-35-331)

9:30 a.m. (345) *Boundary-value contact problems as a division of mathematical physics.*
Boris Belinskiy, Jacksonville, Florida (871-35-340)

9:45 a.m. (346) *Parabolic quenching for non-smooth convex domains.*
C. Y. Chan and **Lan Ke***, University of Southwestern Louisiana (871-35-200)

10:00 a.m. (347) *Large deviation for the Burgers equation with small viscosity.* Preliminary report.
Arjuna I. Ranasinghe* and **Mou H. Chang**, University of Alabama, Huntsville (871-35-142)

10:15 a.m. (348) *Positivity conditions for quadratic forms.*
Jimin Tian, Washington State University (871-49-537)

10:30 a.m. (349) *Numerical, constrained optimization methods.*
John Gregory* and **Cantian Lin**, Southern Illinois University, Carbondale (871-49-370) (Sponsored by Ronald C. Grimmer)

10:45 a.m. (350) *Boundary controlability for conservative evolutions governed by P.D.E.*
Daniel Tataru, University of Virginia (871-49-82)

AMS Session on Probability Theory and Stochastic Processes, II

8:00 a.m.–10:55 a.m.

8:00 a.m. (351) *Multi-type branching random walk.*
Jinhua Tao, University of Wisconsin, Madison (871-60-448)

8:15 a.m. (352) *Markov gambling problems - minimizing time to a goal.* Preliminary report.
Michael G. Monticino*, University of North Texas, and **Victor C. Pestien**, University of Miami (871-60-451)

8:30 a.m. (353) *Local variations of the sticky Brownian motion.*
Madjid Amir, University of Minnesota, Duluth (871-60-465)

8:45 a.m. (354) *The differentiability of the sample paths of a strongly harmonizable random field.* Preliminary report.
Randall J. Swift, University of California, Riverside (871-60-472)

9:00 a.m. (355) *Waiting times: The general Ergodic case.*
Paul C. Shields, University of Toledo and Eötvos Loránd University, Hungary (871-60-24)

9:15 a.m. (356) *Linear transformations of Wiener integrals.*
Chull Park, Miami University, Oxford, and **David Skoug***, University of Nebraska, Lincoln (871-60-71)

9:30 a.m. (357) *Random filters that preserve strict stability of random inputs.* Preliminary report.
Weibin Zeng, University of Louisville (871-60-316)

9:45 a.m. (358) *On generalized maximal functions.*
Bernd S. W. Schroeder, Kansas State University (871-60-126)

10:00 a.m. (359) *Generalized stochastic integrals of multiparameter processes.*
Mylan Redfern* and **David Betounes**, University of Southern Mississippi (871-60-355)

10:15 a.m. (360) *Two branches of the generalized Weibull distribution.* Preliminary report.
Manmohan S. Arora, University of Bahrain, Bahrain (871-62-196)

10:30 a.m. (361) *On measures of association as measures of positive dependence.*
Roger B. Nelsen, Lewis & Clark College (871-62-183)

10:45 a.m. (362) *A rank test for a single peak in monthly data.*
Osvaldo Marrero, Villanova University (871-62-127)

MAA Session on Research in Undergraduate Education, I

8:00 a.m.–10:55 a.m.

8:00 a.m. (363) *Ethnographic teacher-research in the mathematics classroom.* **Bill Rosenthal**, Ursinus College (871-00-730)

8:20 a.m. (364) *A study of professors teaching calculus.* **Mordechai Lawrence Friedman**, Bernard M. Baruch College, City University of New York (871-00-714)

8:40 a.m. (365) *Conveying the function concept: A theoretical analysis and review of the literature.* **Susanna S. Epp**, DePaul University (871-00-711)

9:00 a.m. (366) *An action to process approach to solving algebra word problems.* **Albert A. Cuoco**, Education Development Center, Massachusetts (871-00-708)

9:20 a.m. (367) *College students' understanding of recursion.* Preliminary report. **Eric W. Hart**, Maharishi International University (871-00-716)

9:40 a.m. (368) *Elicitation and analysis of undergraduates' constructs of mathematics and mathematics teaching.* **John E. Owens**, University of Alabama, Tuscaloosa (871-00-727)

10:00 a.m. (369) *Student growth goals in undergraduate mathematics education.* **Richard D. West**, United States Military Academy, West Point (871-00-737)

10:20 a.m. (370) *Math myths: Instructional implications.* **Victor U. Odafe**, University of Hartford (871-00-725)

10:40 a.m. (371) *A test of mathematical abilities of students completing high school.* **Gontran Ervynck**, Katholieke University, Belgium (871-00-712)

AMS Special Session on Bergman Spaces, I

8:30 a.m.–11:00 a.m.

8:30 a.m. (372) *Harmonic Bergman spaces.* **Sheldon Axler**, Michigan State University (871-46-173)

9:00 a.m. (373) *Open problems in the factoring theory of the Bergman spaces.* Preliminary report. **Hakan Hedenmalm**, Uppsala University, Sweden (871-30-172) (Sponsored by Boris Korenblum)

9:30 a.m. (374) *Contractive zero-divisors in Bergman spaces.* **Peter Duren***, University of Michigan, Ann Arbor, **Dmitry Khavinson**, University of Arkansas, Fayetteville, **Harold S. Shapiro**, Royal Institute of Technology, Sweden, and **Carl Sundberg**, University of Tennessee, Knoxville (871-30-516)

10:00 a.m. (375) *Invariant subspaces of Bergman spaces and the biharmonic equation.* II. Preliminary report. **Peter Duren**, University of Michigan, Ann Arbor, **Dmitry Khavinson***, University of Arkansas, Fayetteville, **Harold S. Shapiro**, Royal Institute of Technology, Sweden, and **Carl Sundberg**, University of Tennessee, Knoxville (871-30-32)

10:30 a.m. (376) *Expansive multipliers in the Bergman space.* **Boris Korenblum**, State University of New York, Albany, and **Michael Stessin***, Northwestern University (871-30-174)

MAA Panel Discussion

8:30 a.m.–9:50 a.m.

Curriculum initiatives: statistics, geometry, environment, assessment, and quantitative literacy.

MAA Visiting Lectures Committee Panel Discussion

8:30 a.m.–9:50 a.m.

How to start and maintain a departmental colloquium.

AWM Emmy Noether Lecture

9:00 a.m.–9:50 a.m.

(377) *Oscillators and networks of them: Which differences make a difference?* **Nancy J. Kopell**, Boston University

MAA Session on Environmental Mathematics, I

9:00 a.m.–10:55 a.m.

9:00 a.m. (378) *Modeling the depletion of natural resources.* **Michael Olinick**, Middlebury College (871-00-856)

9:30 a.m. (379) *A model for the dynamics of subdivided populations.* **Roland H. Lamberson***, Humboldt State University, and **Lee Badger**, Weber State University (871-00-855)

10:00 a.m. (380) *Elementary mathematical modelling of environmental problems.* **S. C. Bhatnagar**, University of Nevada, Las Vegas (871-00-853)

10:30 a.m. (381) *Traffic flow at the Lackawanna Recycling Center.* **Anthony D. Berard, Jr.**, King's College (871-00-852)

Thursday, January 9 (cont'd)

AMS Library Committee Panel Discussion

9:00 a.m.–10:00 a.m.

Mathematics libraries, present and future.

MAA Invited Address

10:05 a.m.–10:55 a.m.

(382) *Wavelets making waves in mathematics and engineering.*
Ingrid Daubechies, AT&T Bell Laboratories, Murray Hill, New Jersey and Rutgers University, New Brunswick

AMS-MAA Environmental Address

11:10 a.m.– noon

(383) *Problems of scale in ecology.*
Simon A. Levin, Cornell University (871-00-865)

AMS Colloquium Lectures: Lecture II

1:00 p.m.–2:00 p.m.

(384) *Automorphic forms and Hasse-Weil zeta-functions.*
Robert P. Langlands, Institute for Advanced Study

AMS Invited Address

2:15 p.m.–3:05 p.m.

(385) *Holomorphic maps from $\mathbb{C}^n$ to $\mathbb{C}^n$.*
Walter Rudin, University of Wisconsin, Madison (871-00-869)

MAA Special Presentation

2:15 p.m.–3:15 p.m.

(386) *The art of mental calculation.*
Arthur T. Benjamin, Harvey Mudd College

AMS Special Session on Classical Real Analysis, III

2:15 p.m.–4:05 p.m.

2:15 p.m. (387) *A characterization of infinite omega-limit sets for functions of zero topological entropy.*
A. M. Bruckner*, University of California, Santa Barbara, and **J. Smital**, Komensky University, Czechoslovakia (871-26-29)

2:45 p.m. (388) *Special alpha limit sets and global attractors.*
Michael W. Hero, Bradley University (871-26-58)

3:15 p.m. (389) *Homeomorphic restrictions of smooth endomorphisms of an interval.*
K. M. Brucks*, University of Wisconsin, Milwaukee, **M. V. Otero-Espinar**, Campus Universitario, Spain, and **C. Tresser**, IBM T. J. Watson Research Center, Yorktown Heights, New York (871-34-59)

3:45 p.m. (390) *Ergodic theory and differentiation.* Preliminary report.
Richard J. O'Malley, University of Wisconsin-Milwaukee (871-26-103) (Sponsored by Paul D. Humke)

AMS Special Session on Iteration and Factorization of Entire and Meromorphic Functions, III

2:15 p.m.–3:05 p.m.

2:15 p.m. (391) *Combinatorics of limit sets of Kleinian groups.* Preliminary report.
Linda Keen*, Herbert H. Lehman College, City University of New York, and **Caroline Series**, Warwick University, England (871-30-547)

2:45 p.m. (392) *On the size of Julia sets.* Preliminary report.
A. Hinkkanen, University of Illinois, Urbana-Champaign (871-30-544)

AMS Special Session on Interaction of Harmonic Analysis, Signal Processing and Computational Mathematics, III

2:15 p.m.–4:20 p.m.

2:15 p.m. (393) *Time-frequency and time-space methods in mathematics and signal processing.*
Yves F. Meyer, University of Paris IX, France (871-42-258)

3:05 p.m. (394) *Orthonormal wavelets on the interval.*
Ingrid Daubechies, AT&T Bell Laboratories, New Jersey (871-46-541)

3:35 p.m. (395) *The optimal coefficients in Daubechies wavelets.*
Gilbert Strang, Massachusetts Institute of Technology (871-41-231)

4:00 p.m. (396) *Multiresolution analyses, regular sampling, and summability.*
W. R. Madych, University of Connecticut, Storrs (871-94-526)

AMS Special Session on Symplectic Topology, II

2:15 p.m.–4:10 p.m.

2:15 p.m. (397) *A heat equation approach for constructing contact structures.* Preliminary report. **Steven J. Altschuler**, Australian National University, Australia (871-58-408)

2:55 p.m. (398) *Chains in the Heisenberg Group.* I. Preliminary report. **William M. Goldman***, University of Maryland, College Park, and **Robert R. Miner**, University of Oklahoma (871-51-137)

3:40 p.m. (399) *Chains in the Heinenberg group.* II. Preliminary report. **William M. Goldman**, University of Maryland, College Park, and **Robert R. Miner***, University of Oklahoma, Norman (871-51-187)

MAA Minicourse #2: Part B

2:15 p.m.–4:15 p.m.

The Harvard calculus reform project: hands-on experience with the project materials. **Deborah Hughes Hallett**, Harvard University, **Sheldon P. Gordon**, Suffolk Community College, **William McCallum**, University of Arizona, and **Thomas W. Tucker**, Colgate University

MAA Minicourse #3: Part B

2:15 p.m.–4:15 p.m.

Using history in teaching calculus. **V. Frederick Rickey**, Bowling Green State University

MAA Minicourse #4: Part B

2:15 p.m.–4:15 p.m.

Environmental modeling. **Robert McKelvey**, Environmental Research Lab EPA, Corvallis

MAA Minicourse #9: Part A

2:15 p.m.–4:15 p.m.

Learning abstract algebra by programming in ISETL. **Ed Dubinsky**, Purdue University, and **Uri Leron**, Technion-IIT

AMS Session on Application of Mathematics to Social and Biological Sciences and Systems Theory, I

2:15 p.m.–4:10 p.m.

2:15 p.m. (400) *The pricing of risky corporate debt to be issued at par value.* **Arnold L. Langsen**, **Franklin Lowenthal**, California State University, Hayward, and **Clark T. Benson***, National Security Agency, Maryland (871-90-580) (Sponsored by John F. Dillon)

2:30 p.m. (401) *The effects of non-uniform inhibitor production on one-dimensional tissue growth.* **Sophia A. Maggelakis**, Rochester Institute of Technology (871-92-540)

2:45 p.m. (402) *Disease transmission models with density-dependent demographics.* **Linda Q. Gao*** and **Herbert W. Hethcote**, University of Iowa (871-92-380)

3:00 p.m. (403) *Some SIRS epidemic models with varying population size.* **Jinshi Zhou**, University of Iowa (871-92-384)

3:15 p.m. (404) *Formulation and theoretical and numerical studies of functional differential equation models for fatal infectious diseases.* **Ende Zhang**, University of Wisconsin, Madison (871-92-481)

3:30 p.m. (405) *Global stability of a delay differential equation arising from epidemiology.* **Xiaodong Lin***, University of Waterloo, and **Pauline Van Den Driessche**, University of Victoria (871-92-486)

3:45 p.m. (406) *On partial controllability of the time delay systems.* **Ali Ansari**, Virginia State University (871-93-588)

4:00 p.m. (407) *Discrete observability of the wave equation.* Preliminary report. **Alisa A. DeStefano**, Dartmouth College (871-93-601)

AMS Session on Complex Analysis, II

2:15 p.m.–3:55 p.m.

2:15 p.m. (408) *Riemann derivatives.* **William Haloupek**, University of Wisconsin, Madison, WI (871-30-581) (Sponsored by Michael N. Bleicher)

2:30 p.m. (409) *Spherical linear invariance and uniform local spherical convexity.* Preliminary report. **Wancang Ma*** and **David Minda**, University of Cincinnati (871-30-535)

2:45 p.m. (410) *Compactifications of planar graphs.* Preliminary report. **Sam Northshield**, State University of New York, College at Plattsburgh (871-31-264)

3:00 p.m. (411) *Mobius-Invariant spaces and algebras in polydiscs.* **H. Turgay Kaptanoglu**, University of Wisconsin, Madison (871-32-442)

Thursday, January 9 (cont'd)

3:15 p.m. (412) *Peak-interpolation set for $A^\infty(U^n)$.*
Likang Guo, University of Wisconsin, Madison, WI (871-32-450)

3:30 p.m. (413) *On the complex Frobenius theorem.*
Lilia Apostolova, Bulgarian Academy of Science, Bulgaria (871-32-168)

3:45 p.m. (414) *Schanuel functions and algebraic differential equations.*
Georg Martin Reinhart, University of Illinois, Urbana-Champaign (871-30-639)

AMS Session on History and Education

2:15 p.m.–4:10 p.m.

2:15 p.m. (415) *Computer graphics in precalculus.*
Darius Movasseghi, Medgar Evers College, City University of New York (871-98-368) (Sponsored by Mahmoud Sayrafiezadeh)

2:30 p.m. (416) *Reform in the theory of equations.*
James W. Petticrew, University of Texas-Pan American (871-98-125)

2:45 p.m. (417) *A second year of workshop sessions in large calculus classes at UCSD.*
Al Shenk, University of California at San Diego, La Jolla (871-98-313)

3:00 p.m. (418) *Implementing calculus as formal laboratory courses using MATHEMATICA.*
John W. Davenport*, **Arthur G. Sparks** and **James P. Braselton**, Georgia Southern University (871-98-509) (Sponsored by Arthur G. Sparks)

3:15 p.m. (419) *John Colson's two-way numbers.*
J. J. Tattersall, Providence College (871-01-18)

3:30 p.m. (420) *On an equal basis: Working with graduate assistants to develop calculus classes which incorporate projects.*
David J. Pengelley* and **Douglas S. Kurtz**, New Mexico State University, Las Cruces (871-35-93)

3:45 p.m. (421) *Mathematics for health careers.*
David A. Palkovich, Oklahoma City Community College (871-98-634)

4:00 p.m. (422) *Preachment versus apprenticeship.*
Arnold E. Ross, Ohio State University, Columbus (871-97-37)

AMS Session on Number Theory, I

2:15 p.m.–3:55 p.m.

2:15 p.m. (423) *Matrices associated with arithmetical functions.* Preliminary report.
Keith Bourque* and **Steve Ligh**, University of Southwestern Louisiana (871-11-197)

2:30 p.m. (424) *An algebra of exponents.* Preliminary report.
Joseph Arkin, U.S. Military Academy, New York (871-11-159)

2:45 p.m. (425) *On consecutive Niven numbers.*
Curtis Cooper* and **Robert E. Kennedy**, Central Missouri State University (871-11-286)

3:00 p.m. (426) *On the natural density of the digit numbers.*
Robert E. Kennedy* and **Curtis Cooper**, Central Missouri State University (871-11-285)

3:15 p.m. (427) *Patterns in prime and compounded powers. Phase I.* Preliminary report.
Nivia Colon Diaz, Puerto Rico (871-11-630) (Sponsored by Bennette R. Harris)

3:30 p.m. (428) *On a special sequence concerning the radix expansion map.*
Wun-Seng Chou*, Academia Sinica, Taiwan, and **Peter Shiue**, University of Nevada, Las Vegas (871-11-470)

3:45 p.m. (429) *The remarkable number* 648.
Robert O. Stanton, Saint James University (871-11-473)

AMS Session on Topological Groups and Lie Groups

2:15 p.m.–4:10 p.m.

2:15 p.m. (430) *Extra-large Artin groups are biautomatic.*
David E. Peifer, University of Illinois, Urbana-Champaign (871-20-492)

2:30 p.m. (431) *The Howe/Kirillov orbit methods for some Gelfand pairs.*
Jeffrey L. Hakim, American University (871-20-623)

2:45 p.m. (432) *Measures on nilpotent co-adjoint orbits.* Preliminary report.
Donald R. King, Northeastern University (871-22-81)

3:00 p.m. (433) *Quadratic equations over $C(6)$ groups.*
Martin Greendlinger, Temple University, Philadelphia (871-20-468)

3:15 p.m. (434) *Limit axioms for wide varieties of topological groups.*
R. D. Kopperman*, City College, City University of New York, and **S. A. Morris**, University of Wollongong, Australia (871-22-598)

3:30 p.m. (435) *Points very close to the smallest ideal of βS.*
Amha T. Lisan*, Louisiana State University, Baton Rouge, and **Neil Hindman**, Howard University (871-22-385)

3:45 p.m. (436) *A resolution of the multiplicity problem for $GL(N, C)$.* Preliminary report.
Randall Wills, Southeastern Louisiana University, Hammond, LA (871-22-453) (Sponsored by Edgar N. Reyes)

4:00 p.m. (437) *Normal structure property in generalized James spaces.*
M. A. Khamsi*, University of Texas, El Paso, and **S. Swaminathan**, Dalhousie University (871-46-182)

MAA Session on A Toolbox for Liberal Arts Mathematics Courses, I

2:15 p.m.–4:00 p.m.

2:15 p.m. Introduction

2:20 p.m. (438) *Innumerancy for liberal arts students.* **Gloria Dion**, Pennsylvania State Univeristy, Ogontz Campus (871-00-797)

2:35 p.m. (439) *Freshman seminar at Hamline University.* **Nadine C. Myers**, Hamline University (871-00-811)

2:50 p.m. (440) *Mathematical modeling in the liberal arts.* **Roland Minton**, Roanoke College (871-00-810)

3:05 p.m. (441) *Fractals in the liberal arts mathematics course.* **Peter Tannenbaum**, California State University, Fresno (871-00-817)

3:20 p.m. (442) *Fractals for liberal arts students.* **Kay Gura***, Ramapo College, and **Rowan Lindley**, Westchester Community College (871-00-805)

3:35 p.m. (443) *Applications, a good way to learn to use mathematics effectively.* **Chantal Shafroth**, North Carolina Central University (871-00-814)

3:50 p.m. (444) *Integrating quality and productivity in introductory statistics courses.* **Mary H. Hudson**, Samford University (871-00-806)

MAA Session on Using Spreadsheets to Teach Mathematics, III

2:15 p.m.–4:00 p.m.

2:15 p.m. (445) *A spreadsheet-based finite mathematics course.* **Stephen D. Comer**, The Citadel (871-00-824)

2:40 p.m. (446) *Least squares approximation using a spreadsheet.* **Luz Maria DeAlba**, Drake University (871-00-826)

3:05 p.m. (447) *Using spreadsheets as a tool in the upper secondary mathematics curriculum.* **Jonathan Choate**, Groton School, Massachusetts (871-00-823)

3:30 p.m. (448) *Teaching with spreadsheets: Advance applications and creative graphics.* **Deane Arganbright**, Whitworth College (871-00-821)

MAA COMET and CTUM Panel Discussion

2:15 p.m.–4:10 p.m.

Preparing teachers of mathematics.

MAA ad hoc Committee on Guidelines Panel Discussion

2:15 p.m.–4:10 p.m.

Guidelines for undergraduate mathematics programs.

AMS Invited Address

3:20 p.m.–4:10 p.m.

(449) *Waves in elastic-plastic materials.* **Michael Shearer**, North Carolina State University (871-00-870)

AMS Prize Session and Business Meeting

4:25 p.m.–6:00 p.m.

COMAP Council Meeting

6:15 p.m.–8:15 p.m.

MAA Minicourse, #5: Part B

7:00 p.m.–9:00 p.m.

Using group projects in calculus. **Stephen Hilbert**, **John Maceli**, **Eric Robinson**, **Diane Schwartz** and **Stanley Seltzer**, Ithaca College

MAA Minicourse #7: Part A

7:00 p.m.–9:00 p.m.

Using NETPAD software to teach and learn about graphs. **Nathaniel Dean**, Bellcore, and **Joseph G. Rosenstein**, Rutgers University

MAA Minicourse #10: Part A

7:00 p.m.–9:00 p.m.

How to make effective use of inexpensive pocket computers to develop the concepts and techniques of calculus. **Franklin Demana** and **Bert K. Waits**, Ohio State University

AMS-MAA Panel Discussion

7:00 p.m.–10:00 p.m.

Undergraduate linear algebra.

Thursday, January 9 (cont'd)

Joint Policy Board for Mathematics Session

7:00 p.m.–8:00 p.m.

7:00 p.m. (450) *Title to be announced.*
Walter E. Massey, National Science Foundation

Friday, January 10

AMS Special Session on Bergman Spaces, II

8:00 a.m.–10:50 a.m.

8:00 a.m. (451) *A sharp estimate for $A^{p,\alpha}$ functions in $\mathbb{C}^n$.*
Dragan Vukotić, University of Michigan, Ann Arbor (871-30-278)

8:30 a.m. (452) *Random analytic functions in Bergman spaces.*
Gregory Bomash, Michigan State University (871-30-171)

9:00 a.m. (453) *Majorization and domination in the Bergman space.*
Boris Korenblum, State University of New York, Albany, and **Kendall Richards***, Southwestern University (871-30-207)

9:30 a.m. (454) *Outer functions in the Bergman space.* Preliminary report.
Boris Korenblum, State University of New York, Albany (871-30-144)

10:00 a.m. (455) *Cyclic vectors for the shift on Bergman spaces.*
John Akeroyd, University of Arkansas, Fayetteville (871-30-97) (Sponsored by Peter L. Duren)

10:30 a.m. (456) *Solvability of boundary value problems using Fock space estimates.*
Dmitry Khavinson, University of Arkansas, Fayetteville, and **Harold S. Shapiro***, Royal Institute of Technology, Sweden (871-30-517)

AMS Special Session on Invariant Theory, I

8:00 a.m.–10:55 a.m.

8:00 a.m. (457) *Unipotent actions on affine space.*
Dennis M. Snow, University of Notre Dame (871-14-406)

8:30 a.m. (458) *Another look at Dickson's invariants for finite linear groups.* Preliminary report.
James E. Humphreys, University of Massachusetts, Amherst (871-20-138)

9:00 a.m. (459) *Minimal nilpotent orbits, symmetric pairs, differential operators.* Preliminary report.
Ranee Brylinski*, Pennsylvania State University, University Park, and **Bertram Kostant**, Massachusetts Institute of Technology (871-22-498)

9:30 a.m. (460) *Embeddings of homegeneous spaces and quotients of embeddings of groups.*
Lex Renner, University of Western Ontario (871-14-228)

10:00 a.m. (461) *Highest weight vectors in tensor products.* Preliminary report.
Roger Howe, Yale University (871-15-72)

10:30 a.m. (462) *Most modules of covariants are not Cohen-Macaulay.*
Michel Brion, Institut Fourier de Mathematics, France (871-13-251) (Sponsored by Frank D. Grosshans)

AMS Special Session on Stability and Control, I

8:00 a.m.–10:50 a.m.

8:00 a.m. (463) *Optimal stabilization.*
V. Lakshmikantham, Florida Institute of Technology (871-49-267)

8:30 a.m. (464) *Higher derivatives of Lyapunov functions and stability analysis.*
S. Sivasundaram, Embry-Riddle Aeronautical University (871-34-108)

9:00 a.m. (465) *Instability for autonomous functional differential equations.* Preliminary report.
John R. Haddock* and **Younhee Ko**, Memphis State University (871-34-333)

9:30 a.m. (466) *Invariance, stability and viability in control systems.* Preliminary report.
Emilio Roxin, University of Rhode Island (871-49-145)

10:00 a.m. (467) *Stability of impulsive differential systems.*
S. K. Kaul, University of Regina, and **S. Leela***, State University of New York, College at Geneseo (871-34-117)

10:30 a.m. (468) *Parabolic quenching phenomena.*
C. Y. Chan, University of Southwestern Louisiana (871-35-208)

AMS Special Session on Algebraic Topology, I

8:00 a.m.–10:50 a.m.

8:00 a.m. (469) *Combinatorial homotopy and multiple groupoids.*
Jean-Pierre Meyer* and **Gabrielle Abramson**, Johns Hopkins University, Baltimore (871-55-243)

8:30 a.m. (470) *v_1-periodic homotopy groups of $Sp(n)$.*
Martin Bendersky, Hunter College, City University of New York, **Donald M. Davis***, Lehigh University, and **Mark Mahowald**, Northwestern University (871-55-236)

9:00 a.m. (471) *The homology of elementary Abelian groups and the cohomology of the Steenrod algebra.*
J. Michael Boardman, Johns Hopkins University, Baltimore (871-55-235)

9:30 a.m. (472) *Rational functions and divisor spaces.*
Martin A. Guest, University of Rochester (871-55-237)

10:00 a.m. (473) *Free representations of 2-groups by signed permutation matrices.*
Michael E. Hoffman, United States Naval Academy, Maryland (871-55-238)

10:30 a.m. (474) *The periodic Hopf ring of connective Morava K-theory.*
Richard Kramer, Wayne State University (871-55-239)

AMS-MAA Special Session on Mathematics and Education Reform, III

8:00 a.m.–10:55 a.m.

8:00 a.m. (475) *An overview of vertically integrated projects.*
Judith S. Sunley, National Science Foundation (871-98-436)

8:05 a.m. (476) *DIMACS, a vertically integrated center.*
Daniel Gorenstein, Rutgers University, Piscataway (871-97-523)

8:20 a.m. (477) *DIMACS education programs.* Preliminary report.
Joseph G. Rosenstein, Rutgers University, New Brunswick (871-97-520) (Sponsored by Daniel Gorenstein)

8:40 a.m. (478) *The geometry center.*
Albert Marden, University of Minnesota, Minneapolis (871-99-301)

8:55 a.m. (479) *Vertically integrated education programs at the geometry center, Minneapolis, MN.*
Harvey Keynes, University of Minnesota, Minneapolis (871-98-256)

9:15 a.m. (480) *Regional institute in dynamical systems at Boston University.*
Robert L. Devaney, Boston University (871-98-233)

9:30 a.m. (481) *Report on contemporary mathematics and technology as a driving force for educational reform.*
Jonathan Choate, Groton School, Groton, Massachusetts (871-98-195) (Sponsored by Harvey B. Keynes)

9:45 a.m. (482) *The Regional Geometry Institute, Park City: A mathematician's apology.*
Herb Clemens, University of Utah (871-98-273)

10:00 a.m. (483) *The regional geometry institute as a cross-cultural experience.*
Naomi D. Fisher, University of Illinois, Chicago (871-97-211)

10:15 a.m. (484) *Geometry in the machine age: The five college regional geometry institute.*
Donal O'Shea, Mount Holyoke College (871-98-589)

10:30 a.m. (485) *The education side of the Five Colleges Regional Geometry Institute.*
P. Martin Conway, Granby, Massachusetts (871-97-618) (Sponsored by Naomi Fisher)

10:40 a.m. Comments and Questions

MAA Minicourse #11: Part A

8:00 a.m.–10:00 a.m.

Instituting a mathematics placement program: creating order out of chaos in freshman mathematics.
Philip C. Curtis, Jr., University of California, Los Angeles

MAA Minicourse #12: Part A

8:00 a.m.–10:00 a.m.

Mathematical modeling with a spreadsheet.
Stephen D. Comer and **Hughes B. Hoyle III**, The Citadel

MAA Minicourse #13: Part A

8:00 a.m.–10:00 a.m.

Integrating calculus and physics for freshmen.
Joan R. Hundhausen and **F. Richard Yeatts**, Colorado School of Mines

MAA Minicourse #14: Part A

8:00 a.m.–10:00 a.m.

The Fibonacci and Catalan numbers.
Ralph P. Grimaldi, Rose-Hulman Institute of Technology

AMS Session on Applications of Mathematics to Social and Biological Sciences and Systems Theory, II

8:00 a.m.–10:55 a.m.

8:00 a.m. (486) *Non-linear predictability in time series of vectors.*
Harold M. Hastings, Hofstra University (871-93-431)

8:15 a.m. (487) *Global exponential stabilization for a non-linearly perturbed Kirchoff plate.*
Mary E. Bradley, University of Louisville (871-93-446)

8:30 a.m. (488) *A convolution method for two-dimensional inverse heat conduction problem.*
Shishen Xie*, University of Houston, Downtown, and **Clyde F. Martin**, Texas Tech University (871-93-491)

8:45 a.m. (489) *Polynomials in discrete dynamical systems.* Preliminary report.
M. Hadi Moadab, Virginia State University (871-93-504)

9:00 a.m. (490) *Inverses of holomorphic matrices.*
John Jones, Jr., Air Force Institute of Technology, Ohio (871-93-20)

Friday, January 10 (cont'd)

9:15 a.m. (491) *Direct methods in the calculus of variations via orthogonal polynomials.*
Mohsen Razzaghi, Mississippi State University (871-93-293) (Sponsored by Thomas L. Miller)

9:30 a.m. (492) *Norm quadratic residue codes.*
Dorothy W. Andreoli and **Philip D. Tiu***, Dartmouth College (871-94-622)

9:45 a.m. (493) *Null spaces and detection of topology errors in electric power networks.*
K. A. Clements and **P. W. Davis***, Worcester Polytechnic Institute (871-94-417)

10:00 a.m. (494) *Hankel-type transforms: Additivity of supports under convolution and signal reconstruction.* Preliminary report.
Michael Rawn, Manchester College (871-94-155) (Sponsored by Deborah L. Hustin)

10:15 a.m. (495) *Elliptic equations and global integrability of the gradient.*
Craig A. Nolder, Florida State University (871-98-493)

10:30 a.m. (496) *Polar coordinates and the mean value theorem.*
Morteza Shafii-Mousavi, Indiana University, South Bend (871-98-192)

10:45 a.m. (497) *Solstice: An electronic journal of geography and mathematics.*
Sandra Lach Arlinghaus, Institute of Mathematical Geography, Michigan (871-99-73)

AMS Session on Graph Theory

8:00 a.m.–10:55 a.m.

8:00 a.m. (498) *Almost all Steinhaus graphs have diameter two.*
Neal Brand, University of North Texas (871-05-151)

8:15 a.m. (499) *On the number of maximum genus embedddings of almost all graphs.*
Saul Stahl, University of Kansas (871-05-295)

8:30 a.m. (500) *Coloring Cayley graphs with the Tutte polynomial.*
Nancy Celniker, Whittier College (871-05-275)

8:45 a.m. (501) *Spans of T-colorings and simple T-sets.*
David Carlton, Harvard University (871-05-269) (Sponsored by Joseph A. Gallian)

9:00 a.m. (502) *Parity subgraph, shortest cycle cover and postman tour.*
Cun-Quan Zhang, West Virginia University (871-05-107)

9:15 a.m. (503) *Subtree and substar intersection numbers.*
Yi-Wu Chang, University of Illinois, Urbana-Champaign (871-05-489)

9:30 a.m. (504) *Forbidden subgraphs of graphs uniquely Hamiltonian-connected from a vertex.*
Patti Frazer Lock, Saint Lawrence University (871-05-478)

9:45 a.m. (505) *n-vertex graphs.*
Virginia Wright, Emory University (871-05-455) (Sponsored by Joseph A. Gallian)

10:00 a.m. (506) *The leafage of chordal graphs.*
In-Jen Lin, University of Illinois, Urbana-Champaign (871-05-454)

10:15 a.m. (507) *On the 1-factor graph of a graph.*
John C. George, Lubbock, Texas (871-05-378)

10:30 a.m. (508) *On Eulerian embeddings.*
Tomas Dvorak*, University of South Carolina, **Ivan Havel** and **Petr Liebl**, Czechoslovak Academy of Sciences, Czechoslovakia (871-05-565) (Sponsored by A. R. Schep)

10:45 a.m. (509) *A generalization of Vizing's Theorem on domination.*
Jason Fulman, Harvard University (871-05-534) (Sponsored by Joseph A. Gallian)

MAA Session on Research in Undergraduate Education, II

8:00 a.m.–10:55 a.m.

8:00 a.m. (510) *Writing to learn mathematics.*
Peggie A. Smith, University of the District of Columbia (871-00-816)

8:20 a.m. (511) *Writing proofs.*
Russell Jay Hendel, Dowling College (871-00-717)

8:40 a.m. (512) *Metacognitive behavior in four types of mathematics problems. An expert-novice study.*
Jack Bookman, Duke University (871-00-703)

9:00 a.m. (513) *A time to remain silent: Silence and speech in the mathematics classroom.*
Margaret Murray, Virginia Polytechnic Institute and State University (871-00-723)

9:20 a.m. (514) *The instructor's "mistake" is the student's gain: Social learning and problem-solving in the classroom.*
Harriet Edwards, California State University, Fullerton (871-00-709)

9:40 a.m. (515) *An evaluation of grading the work of peers as a means of learning higher-level mathematics skills.*
Vincent P. Schielack, Jr., Texas A & M University, College Station (871-00-731)

10:00 a.m. (516) *Collegiate mathematics education: An application for intelligent technology.*
Richard O'Lander, St. John's University (871-00-726)

10:20 a.m. (517) *Writing and mathematical apprenticeship.*
Anne E. Brown, Saint Mary's College (871-00-704)

10:40 a.m. (518) *Poincaré in mathematics education.*
Simon Quint, Stockton State College (871-00-729)

MAA Session on A Toolbox for Liberal Arts Mathematics Courses, II

8:00 a.m.–10:55 a.m.

8:00 a.m. (519) *Videotapes, films and research papers = A successful mathematics course for liberal arts students.*
Marguerite Gravez, Pennsylvania State University, Allentown Campus (871-00-803)

8:15 a.m. (520) *Mathematical experiences for reluctant students.*
JoAnne S. Growney, Bloomsburg University (871-00-804)

8:30 a.m. (521) *Flexible format and content plans for finite mathematics.*
Emelie Kenney, Siena College (871-00-808)

8:45 a.m. (522) *A new core mathematics course.*
George T. Crocker, Samford University (871-00-796)

9:00 a.m. (523) *Cluster of courses in art, mathematics, and composition offered at Lock Haven University - Fall* 1991.
Dean Wagner, Lock Haven University of Pennsylvania (871-00-819)

9:15 a.m. (524) *What every college student should know about chaos!*
Richard Barshinger, Pennsylvania State University, Dunmore (871-00-792)

9:30 a.m. (525) *Dynamical systems as an introduction to mathematics.*
Mysore S. Jagadish, Barry University (871-00-861)

9:45 a.m. (526) *Strategies using writing in mathematics.*
Peggie A. Smith, University of the District of Columbia (871-00-862)

10:00 a.m. (527) *Learning to enjoy mathematics: Techniques for teaching 'mathematical investigations'.*
Gail Kaplan, Washington College (871-00-807)

10:15 a.m. (528) *From sewer pipes to point set: An experiential introduction to topology.*
Victor J. Donnay, Bryn Mawr College (871-00-798)

10:30 a.m. (529) *Lanchester combat models.*
Alan Levine, Franklin and Marshall College (871-00-809)

10:45 a.m. (530) *Mr. Markov plays 'Chutes and Ladders'.*
Steven Gadbois, Rhodes College (871-00-799)

MAA Informal Discussion

8:00 a.m.–10:55 a.m.

Educational mathematics Ph.D. program.

MAA Panel Discussion

8:00 a.m.–9:20 a.m.

Statistics for the twenty-first century.

MAA CTUM Panel Discussion

8:00 a.m.–9:20 a.m.

The source book for college mathematics teaching.

AMS Invited Address

9:00 a.m.–9:50 a.m.

(531) *Lie groups and ergodic theory.*
Marina Ratner, University of California, Berkeley

Strengthening Underrepresented Minority Mathematics Achievement Workshop

9:00 a.m.–10:55 a.m.

MAA CUPM Subcommittee on Calculus Reform and the First Two Years Panel Discussion

9:30 a.m.–10:55 a.m.

Site testing of new calculus projects.

MAA ad hoc Committee on Mathematics and the Environment Panel Discussion

9:30 a.m.–10:55 a.m.

Getting started.

CSP Invited Address

10:05 a.m.–10:55 a.m.

AMS-MAA Invited Address

11:10 a.m.– noon

(532) *Optimization for extended services for heat transfer.*
J. Ernest Wilkins, Jr., Clark Atlanta University (871-00-866)

NAM Cox-Talbot Address

noon –1:00 p.m.

(533) *Ethomathematics; A natural focus for NAM.*
Gloria Gilmer, Math-Tech. Inc.

Friday, January 10 (cont'd)

AMS Colloquium Lectures: Lecture III

1:00 p.m.–2:00 p.m.

(534) *Finite models for percolation.*
Robert P. Langlands, Institute for Advanced Study

AMS Special Session on Preparing for Future College Teaching, I

1:00 p.m.–4:15 p.m.

1:00 p.m. (535) *A teaching seminar for graduate students.*
Robert H. McDowell, Washington University (871-98-135)

1:30 p.m. (536) *Oregon State University's proseminar on preparation for college teaching.*
Mary Flahive* and **Dennis Garity**, Oregon State University (871-98-136)

2:00 p.m. (537) *Thematic seminars and perspective courses.*
M. Zuhair Nashed, University of Delaware (871-98-325)

2:40 p.m. (538) *The Dartmouth teaching seminar: How has it worked and where do we go from here?*
Kenneth P. Bogart, Dartmouth College (871-98-44)

3:05 p.m. (539) *Preparation for college teaching.*
Joel V. Brawley, Clemson University (871-98-134)

3:30 p.m. (540) *Alternative teaching methods and the international graduate student.*
E. P. Merkes, University of Cincinnati (871-98-54)

3:55 p.m. (541) *The preparation for college teaching of mathematics - a personal experience.*
Herbert E. Kasube, Bradley University (871-98-36)

AMS Special Session on Bergman Spaces, III

1:00 p.m.–3:50 p.m.

1:00 p.m. (542) *Hankel operators on Bergman spaces of the unit disk.*
Daniel H. Luecking, University of Arkansas, Fayetteville (871-47-23)

1:30 p.m. (543) *Weighted Bergman projections on the polydisc.*
Kehe Zhu, State University of New York, Albany (871-32-206)

2:00 p.m. (544) *Extremal functions in the Dirichlet space.*
Stefan Richter* and **Carl Sundberg**, University of Tennessee, Knoxville (871-47-341)

2:30 p.m. (545) *Hankel operators of higher weight.* Preliminary report.
Jaak Peetre, University of Stockholm, Sweden, and **Richard Rochberg***, Washington University (871-30-271)

3:00 p.m. (546) *Representations of the norms in Bergman-Selberg spaces on strips and half planes.*
Saburou Saitoh, Gunma University, Japan (871-30-203)

3:30 p.m. (547) *A^p_α classes of caloric functions in half-spaces and boundedness of Bergman-type operator.*
Ashot Djrbashian, Los Angeles, California (871-47-141)

AMS Special Session on History of Mathematics, I

1:00 p.m.–3:05 p.m.

1:00 p.m. (548) *What's new in the history of mathematics?*
Frank Swetz, Pennsylvania State University, Harrisburg (871-01-353) (Sponsored by Victor J. Katz)

1:45 p.m. (549) *The life and work of Joaquim Gomes de Sousa.*
Ubiratan D'Ambrosio, Universidade Estadual de Campinas, Brazil (871-01-65)

2:30 p.m. (550) *Cayley's derivation of Euclidean from projective geometry and the adjunction argument in invariant theory.*
Paul R. Wolfson, West Chester University of Pennsylvania (871-01-359)

AMS Special Session on Environmental Modeling, II

1:00 p.m.–2:50 p.m.

1:00 p.m. (551) *Thresholds in persistance of territorial species.*
Roland H. Lamberson* and **Joseph E. Carroll**, Humboldt State University (871-92-594) (Sponsored by B. A. Fusaro)

1:40 p.m. (552) *Optimal control of parabolic PDE governing beaver populations.*
Suzanne Lenhart, University of Tennessee, Knoxville (871-92-593)

2:20 p.m. (553) *Traffic congestion and urban land use.*
Frederic Y. M. Wan, University of Washington (871-92-596)

AMS Special Session on Invariant Theory, II

1:00 p.m.–4:10 p.m.

1:00 p.m. (554) *The life and work of James Joseph Sylvester* (1814–1897): *An overview.*
Karen Hunger Parshall, University of Virginia (871-01-300)

1:25 p.m. (555) *Sylvester's proof of Newton's rule for the number of imaginary roots.*
Joseph P. S. Kung, University of North Texas (871-06-146)

1:50 p.m. (556) *Symmetry classes of functions.*
Gian-Carlo Rota, Massachusetts Institute of Technology (871-20-605)

2:15 p.m. (557) *Invariants of four medials and invariants of lines.*
Rosa Q. Huang, University of Michigan, Ann Arbor (871-13-542)

2:45 p.m. (558) *Equivalence and invariant theory.* Preliminary report.
Peter J. Olver, University of Minnesota, Minneapolis (871-13-139)

3:15 p.m. (559) *Invariance and invariants in applied discrete geometry.*
Walter J. Whiteley, Champlain Regional College and University of Montreal (871-51-252) (Sponsored by Frank D. Grosshans)

3:40 p.m. (560) *Capelli's theory and supersymmetric algebras.*
Andrea Brini*, University of Bologna, Italy, and **Antonio Teolis**, ENEA, Bologna, Italy (871-05-343) (Sponsored by Frank D. Grosshans)

AMS Special Session on Function Theoretic Methods in Partial Differential Equations, I

1:00 p.m.–4:10 p.m.

1:00 p.m. (561) *Half Dirichlet problems for the Dirac operator in the unit ball of* $\mathbb{R}^n$. Preliminary report.
Heinrich Begehr*, Freie University of Berlin, Germany, and **Z. Xu**, Fudan University, China (871-35-130) (Sponsored by Peter A. McCoy)

1:30 p.m. (562) *The planar oil cap problem.*
Robert P. Gilbert*, University of Delaware, and **Guo-Chun Wen**, Peking University, China (871-35-524)

2:00 p.m. (563) *On the use of Bergman operators in the theory of minimal surfaces.*
Erwin O. Kreyszig, Carleton University, (871-35-100)

2:30 p.m. (564) *Reproducing kernel methods for ill-posed problems involving partial differential operators.* Preliminary report.
M. Zuhair Nashed, University of Delaware (871-35-324)

3:00 p.m. (565) *Analytic representations with wavelet expansions.*
Gilbert G. Walter, University of Wisconsin, Milwaukee (871-30-554)

3:30 p.m. (566) *Sampling theorems associated with Dirichlet and Neumann problems for Schrodinger equation.*
Ahmed I. Zayed, University of Central Florida (871-35-322)

3:55 p.m. (567) *A simple solution method for the first boundary value problem of the polyharmonic equation.*
Steven H. Schot, American University (871-31-01)

AMS Special Session on Stability and Control, II

1:00 p.m.–3:20 p.m.

1:00 p.m. (568) *A generalization of the Kalman-Yakubovic lemma.*
A. V. Balakrishnan, University of California, Los Angeles (871-93-268)

1:30 p.m. (569) *A block-parallel Newton's method: Convergence and control applications.*
D. D. Siljak* and **A. Zecevic**, Santa Clara University (871-93-423) (Sponsored by Seenith Sivasundaram)

2:00 p.m. (570) *Robust stability of distributed parameter countrol systems.* Preliminary report.
G. S. Ladde*, University of Texas, Arlington, and **I-Tsung Li**, General Dynamics, Michigan (871-93-41)

2:30 p.m. (571) *Bilinear control systems with special structure.*
Otomar Hájek, Case Western Reserve University (871-49-30)

3:00 p.m. (572) *Uniform boundary stabilizability of von Karman plate with a light viscous damping.*
M. Bradley and **I. Lasiecka***, University of Virginia (871-35-169)

AMS Special Session on Algebraic Topology, II

1:00 p.m.–3:50 p.m.

1:00 p.m. (573) *On the category of BP-unstable modules.*
Takuji Kashiwabara, Johns Hopkins University, Baltimore (871-55-386)

1:30 p.m. (574) *Life without the telescope conjecture.*
Douglas C. Ravenel, University of Rochester (871-55-245)

2:00 p.m. (575) *Lin's theorem and localization of finite complexes.*
Hal Sadofsky, Johns Hopkins University, Baltimore (871-55-246)

2:30 p.m. (576) *The telescope of a Thom spectrum.*
Mark Mahowald, Northwestern University, and **Paul Shick***, John Carroll University (871-55-247)

3:00 p.m. (577) *The length of Dyer-Lashof operations and stable Postnikov systems.* Preliminary report.
Michael Slack, University of Virginia (871-55-248)

3:30 p.m. (578) *A Bousfield localization approach to unstable periodic homotopy groups.*
Robert D. Thompson, Northwestern University (871-55-249)

AMS Special Session on Symplectic Topology, III

1:00 p.m.–4:10 p.m.

1:00 p.m. (579) *Symplectic mapping problems.* Preliminary report.
Lisa Traynor, State University of New York, Stony Brook (871-53-495)

1:40 p.m. (580) *Uniqueness of symplectic blow-ups in rational or ruled symplectic* 4*-manifolds.*
Francois Lalonde, University of Quebec at Montreal, (871-53-344) (Sponsored by Yakov Eliashberg)

2:25 p.m. (581) *On the dual billiard map.*
Serge Tabachnikov, University of Arkansas, Fayetteville (871-58-46)

Friday, January 10 (cont'd)

3:00 p.m. (582) *An isoperimetric inequality and pseudo-holomorphic curves.* Preliminary report. **Jon Wolfson**, Michigan State University (871-53-178)

3:40 p.m. Discussion

AMS Session on Group Theory

1:00 p.m.–3:10 p.m.

1:00 p.m. (583) *Subdirectly reducible groups and edge-minimal graphs with given automorphism group.* **Albert J. Goodman**, University of Chicago (871-20-186)

1:15 p.m. (584) *Finite groups with special 2-generator property.* **Tuval Foguel**, University of Illinois, Urbana-Champaign (871-20-191)

1:30 p.m. (585) *On union of fuzzy subgroups.* **Ravinder Kumar*** and **Husni H. Saleh**, Alcorn State University (871-20-214)

1:45 p.m. (586) *Anagrams in groups.* Preliminary report. **Lawren Smithline**, Harvard University (871-20-223) (Sponsored by Gary J. Sherman)

2:00 p.m. (587) *The tensor product of a semilattice with a semilattice generated by a poset.* **James A. Anderson**, University of South Carolina, Spartanburg (871-20-154)

2:15 p.m. (588) *The finite basis problem for identities of representations of finite groups over a commutative noetherian ring.* Preliminary report. **Samuel M. Vovsi**, Rutgers University, New Brunswick (871-20-351)

2:30 p.m. (589) *Finite groups.* Preliminary report. **Catherine Sugar***, Pomona College, **Eric Wepsic**, Harvard University, and **David Patrick**, Carnegie-Mellon University (871-20-335) (Sponsored by Gary J. Sherman)

2:45 p.m. (590) *Cyclicizers, centralizers, and normalizers.* Preliminary report. **David Patrick***, Carnegie-Mellon University, and **Eric Wepsic**, Harvard University (871-20-312) (Sponsored by Gary J. Sherman)

3:00 p.m. (591) *A_4-rewritability.* **Eric Wepsic***, Harvard University, Cambridge, Massachusetts, **Kevin O'Bryant**, Rose-Hulman Institute of Technology, Terre Haute, Indiana, and **Lawren Smithline**, Harvard University (871-20-419) (Sponsored by Gary J. Sherman)

AMS Session on Number Theory, II

1:00 p.m.–3:55 p.m.

1:00 p.m. (592) *Diophantine relations between rings of S-integers of algebraic functions in one variable over constant fields of positive characterictic.* **Alexandra Shlapentokh**, York College, City University of New York (871-11-548)

1:15 p.m. (593) *The total zeta function of an order in a general algebra.* Preliminary report. **Michael D. Seyfried**, Shippensburg University of Pennsylvania (871-11-586)

1:30 p.m. (594) *Evaluation of $\zeta(-n)$ and $L(-n)$ by the Euler transformation.* **Jonathan D. Sondow**, Yeshiva University (871-11-466)

1:45 p.m. (595) *Normic criteria for p-extensions of p-regular fields.* **Ruth I. Berger**, Memphis State University (871-11-488)

2:00 p.m. (596) *Solitary Galois extensions of algebraic number fields.* Preliminary report. **Leonid Stern**, Towson State University (871-11-09)

2:15 p.m. (597) *Real even symmetric forms.* **William R. Harris**, University of Illinois, Urbana-Champaign (871-11-68)

2:30 p.m. (598) *p-adic poles and p-Eisenstein behavior of higher order Bernoulli polynomials.* **Arnold Adelberg**, Grinnell College (871-11-307)

2:45 p.m. (599) *Indefinite quadratic and hermitian forms and associated modular forms.* Preliminary report. **Y. Sankaran**, Sanatana Dharma College, India (871-11-156) (Sponsored by Yegnaseshan Sitaraman)

3:00 p.m. (600) *On unit solutions of the equation (1)x+y+z=xyz in totally imaginary quartic fields.* **Jonathan Gordon**, University of Illinois at Urbana-Champaign, **Liang-Cheng Zhang**, Southwest Missouri State University, and **Hugh M. Edgar***, San Jose State University (871-11-202)

3:15 p.m. (601) *A new formulation of the Goldbach conjecture.* **Larry J. Gerstein**, University of California, Santa Barbara (871-11-199)

3:30 p.m. (602) *Steinitz classes of tamely ramified nonabelian extentions of algebraic number fields of degree p^3.* Preliminary report. **James Carter**, University of Illinois, Urbana-Champaign (871-11-487)

3:45 p.m. (603) *On the minimal polynomials of rational exponential sums.* **Charles H. Toll**, National Security Agency, Fort Meade, Maryland (871-12-185)

AMS Session on Ordinary Differential Equations, I

1:00 p.m.–4:25 p.m.

1:00 p.m. (604) *Solution in the large of a certain differential equation containing arbitrary number of regular singular points.* **T. K. Puttaswamy**, Ball State University (871-34-553)

1:15 p.m. (605) *Quadratic dynamical systems and algebras.* **Arthur A. Sagle***, University of Hawaii, Hilo, and **Michael Kinyon**, University of Utah (871-34-560)

1:30 p.m. (606) *Monotone method for nonlinear first order integrodifferential system.* Preliminary report. **Josaphat A. Uvah**, University of West Florida (871-34-619)

1:45 p.m. (607) *Stability results for impulsive differential systems with applications to population growth models.* **Xinzhi Liu**, University of Waterloo (871-34-04)

2:00 p.m. (608) *Spectral inequalities.* **Philip Savoye**, Mansfield University (871-34-05)

2:15 p.m. (609) *A constructive method for a class of inverse spectral problems.* **K. Shantha Jayawardena**, Iowa State University (871-34-56)

2:30 p.m. (610) *On a nonlinear anti-periodic two-point boundary value problem.* **Yong Huang**, Ohio State University, Marion (871-34-111)

2:45 p.m. (611) *Singular perturbations of integrodifferential equations in Banach Space.* **Hetao Liu**, Southern Illinois University (871-34-262)

3:00 p.m. (612) *Methods for reflection coefficient problems with turning points at infinity.* **Jishan Hu**, West Virginia University (871-34-292) (Sponsored by Michael E. Mays)

3:15 p.m. (613) *Steady-state diffusion in nonhomogeneous environments with nonlinear interface conditions.* Preliminary report. **V. Anuradha**, **J. B. Garner*** and **R. Shivaji**, Mississippi State University (871-34-330)

3:30 p.m. (614) *A result on the asymptotic behavior of solutions of a class of higher order neutral delay equations.* **John R. Graef***, **Paul W. Spikes**, Mississippi State University, and **Myron K. Grammatikopoulos**, University of Ioannina, Greece (871-34-334)

3:45 p.m. (615) *The maximal and minimal operator norms on the unitization of Banach algebra.* **A. K. Gaur**, Duquesne University (871-46-591)

4:00 p.m. (616) *Control of flexible systems by a mathematical programming approach.* **M. Nouri-Moghadam***, Pennsylvania State University, Lehman, and **I. S. Sadek**, University of North Carolina, Wilmington (871-93-50)

4:15 p.m. (617) *Asymptotic stability of a linear damped wave equation.* **Bo Zhang**, Southern Illinois University, Carbondale (871-35-35)

AMS Session on Real Functions

1:00 p.m.–4:10 p.m.

1:00 p.m. (618) *Functions continuous is λ-variation.* **Franciszek Prus-Wisniowski**, Syracuse University (871-26-617) (Sponsored by Daniel Waterman)

1:15 p.m. (619) *On sets of symmetric points.* **Lin Hammill**, Simon Fraser University (871-26-458) (Sponsored by Brian S. Thomson)

1:30 p.m. (620) *Generalization of a Hardy-Littlewood-Polya inequality.* **Parviz Khajeh-Khalili**, Christopher Newport College (871-26-474)

1:45 p.m. (621) *Mean value properties for symmetrically differentiable functions.* Preliminary report. **Michael J. Evans***, North Carolina State University, and **Shusheng Fu**, Fuzhou University, People's Republic of China (871-26-47)

2:00 p.m. (622) *Double and iterated limits with applications to generalized integrals.* Preliminary report. **Cheng-Ming Lee**, University of Wisconsin, Milwaukee (871-26-64)

2:15 p.m. (623) *On Peano differentiable functions.* **Hajrudin Fejzic**, Michigan State University (871-26-66)

2:30 p.m. (624) *Intersection of continuous functions with smooth functions.* Preliminary report. **Jack B. Brown**, Auburn University, Auburn (871-26-263)

2:45 p.m. (625) *Different methods for representing Walsh functions.* **Nasser Dastrange**, Buena Vista College (871-26-328)

3:00 p.m. (626) *Coincident self similar sets and their Hausdorff dimension.* Preliminary report. **Mark Smiley**, Goucher College, Towson, MD (871-28-532)

3:15 p.m. (627) *The packing measure and the symmetric derivation basis measure.* **Sandra Meinershagen**, Northwest Missouri State University (871-28-12)

3:30 p.m. (628) *Integration and $\mathcal{P}$-Cauchy sequences.* **Russell A. Gordon**, Whitman College (871-28-22)

3:45 p.m. (629) *On convergence of the average* $(1/N)\sum_{n=1}^{n} f(T^n x)g(S^n x)h(R^n x)$. Preliminary report. **Qing Zhang**, Ohio State University, Columbus (871-28-91)

4:00 p.m. (630) *Groupoid homomorphisms and conjugacy of skew product actions.* Preliminary report. **Raymond C. Fabec**, Louisiana State University, Baton Rouge, and **Edgar N. Reyes***, Southeastern Louisiana University, (871-28-190)

MAA Session on The "seven-into-four" Problem, II

1:00 p.m.–3:55 p.m.

1:00 p.m. (631) *A core mathematics program with discrete mathematics before calculus.* **David C. Arney*** and **Frank R. Giordano**, United States Military Academy, West Point (871-00-754)

1:30 p.m. (632) *A calculus lab for elementary statistics.* **Richard J. Cleary**, Cornell University and St. Michael's College (871-00-757)

2:00 p.m. (633) *AUGMENT: Augsburg's new lower-division program for mathematics and science majors.* **Larry Copes*** and **Suzanne Doree**, Augsburg College (871-00-758)

Friday, January 10 (cont'd)

2:30 p.m. (634) *The first two years of college mathematica.* **W. Davis**, Ohio State University, Columbus, **H. Porta***, University of Illinois, Urbana-Champaign, **P. Tannenbaum**, California State University, Fresno, and **J. J. Uhl**, University of Illinois, Urbana-Champaign (871-00-766)

3:00 p.m. (635) *7 goes into 4 with a positive remainder.* **John M. Kellett**, Gettysburg College (871-00-762)

3:30 p.m. (636) *A 2 credit (!!) linear algebra?* **Richard Barshinger**, Pennsylvania State University, Dunmore (871-00-755)

3:45 p.m. (637) *The mathematics curriculum at Gannon University.* **Gerald A. Kraus**, Gannon University (871-00-763)

MAA Session on A Toolbox for Liberal Arts Mathematics Courses, III

1:00 p.m.–3:55 p.m.

1:00 p.m. (638) *Mathematical thinking in liberal arts.* **S. C. Bhatnagar**, University of Nevada, Las Vegas (871-00-793)

1:15 p.m. (639) *Mathematical ideas for liberal arts students.* **Stefanos Gialamas**, Columbia College (871-00-800)

1:30 p.m. (640) *Mathematics and culture: A liberal arts mathematics course.* **Kathleen M. Shannon**, Salisbury State University (871-00-815)

1:45 p.m. (641) *Great problems of mathematics: A course based on original sources.* **Reinhard C. Laubenbacher** and **David J. Pengelley***, New Mexico State University, Las Cruces (871-00-812)

2:00 p.m. (642) *Cooperative learning assignment sampler.* **Regina Baron Brunner**, Cedar Crest College (871-00-794)

2:15 p.m. (643) *How to make small group dynamics work in a liberal arts mathematics course.* **Tracy Goodson-Epsy**, Trevecca Nazarene College (871-00-802)

2:30 p.m. (644) *Constructing concepts with collaborative groups and computers in liberal arts mathematics courses.* **Joe Wimbish**, Huntingdon College (871-00-820)

2:45 p.m. (645) *Computer simulation of chaotic billiards.* **Deborah Cousins***, **Reena Freedman**, **Eli Fulton**, **Abby Kay** and **Que Van**, Bryn Mawr College (871-00-795)

3:00 p.m. (646) *Experiences with computer laboratory exercises in a survey of mathematics course.* **Judy E. Ackerman*** and **Zdanna Skalsky**, Montgomery College (871-00-791)

3:15 p.m. (647) *Sets: Tools to promote thinking.* **Waldo A. Torres**, Cayey University College (871-00-818)

3:30 p.m. (648) *Proof as a topic for psychology students.* **Paul M. Perdew**, University of Scranton (871-00-813)

3:45 p.m. (649) *The classics of astronomy understood through mathematics.* **Louise A. Golland**, University of Chicago Computing Organizations (871-00-801)

MAA Minicourse #9: Part B

2:00 p.m.–4:00 p.m.

Learning abstract algebra by programming in ISETL. **Ed Dubinsky**, Purdue University, and **Uri Leron**, Technion-IIT

MAA Minicourse #11: Part B

2:00 p.m.–4:00 p.m.

Instituting a mathematics placement program: creating order out of chaos in freshman mathematics. **Philip C. Curtis, Jr.**, University of California, Los Angeles

MAA Committee on Student Chapters and ad hoc Committee on Mathematics and the Environment Student Workshop

2:00 p.m.–4:00 p.m.

Environmental mathematics.

AMS and Board on Mathematical Sciences Joint Panel Discussion

2:00 p.m.–3:30 p.m.

Educating mathematicians.

Association of Research Libraries Session

2:00 p.m.–4:00 p.m.

Electronic delivery of scientific and technical information to scientists.

MAA Invited Address

2:15 p.m.–3:05 p.m.

(650) *Real numbers with bounded partial quotients.* **Jeffrey Shallit**, University of Waterloo

RMMC Board of Directors

2:15 p.m.–4:10 p.m.

MAA Retiring Presidential Address

3:20 p.m.–4:10 p.m.

(651) *Mathematics goes public.*
Lida K. Barrett, Mississippi State University

MAA Prize Session and Business Meeting

4:25 p.m.–5:30 p.m.

AMS Session for Reviewers for Mathematical Reviews

6:00 p.m.–7:00 p.m.

MAA Minicourse #15: Part A

7:00 p.m.–9:00 p.m.

Why, when and how to use CAS calculators in calculus and linear algebra instruction. **John Kenelly** and **Donald R. LaTorre**, Clemson University

MAA Minicourse #16: Part A

7:00 p.m.–9:00 p.m.

Challenging students with research projects in calculus.
Douglas Kurtz and **David Pengelley**, New Mexico State University

AMS Panel Discussion

7:00 p.m.–8:30 p.m.

Employment in industry for mathematicians.

MAA Special Presentation of Poetry Reading

7:00 p.m.–10:00 p.m.

Second Annual MAA Student Chapters' Lecture

7:30 p.m.–8:20 p.m.

(652) *Contemporary problems in graph theoy.*
Carolyn R. Mahoney, California State University, San Marcos

MAA CAS Workshop Reunion

7:30 p.m.–9:00 p.m.

MAA Committee on the Participation of Women Special Presentation

7:30 p.m.–9:30 p.m.

New 1991 skits.

AMS Committee on Science Policy Panel Discussion

8:30 p.m.–10:00 p.m.

PhD employment: is there a crisis?

Saturday, January 11

AMS Special Session on Invariant Theory, III

8:00 a.m.–10:55 a.m.

8:00 a.m. (653) *Invariants of vector-valued symmetric and hermitian forms.*
Thomas Garrity and **Robert Mizner***, Williams College (871-15-119)

8:25 a.m. (654) *$SO(2)$ invariants of a set of 2×2 matrices.*
Helmer Aslaksen, National University of Singapore, Republic of Singapore (871-15-07)

8:50 a.m. (655) *Algebraic group actions on flag varieties.* Preliminary report.
Jozsef Horvath, West Chester University of Pennsylvania (871-14-193)

9:15 a.m. (656) *Some determinantal identities.*
Lin Tan, West Chester University of Pennsylvania (871-13-633)

9:40 a.m. (657) *Moduli space constructors for complete intersections.*
Amassa Fauntleroy, North Carolina State University, Raleigh (871-13-612)

10:05 a.m. (658) *Syzygies and the Moyal algebra.* Preliminary report.
Joseph P. Brennan, North Dakota State University, Fargo (871-13-611)

Saturday, January 11 (cont'd)

10:30 a.m. (659) *When is a ring of torus invariants a polynomial ring?*
David L. Wehlau, University of Toronto (871-22-494)

AMS Special Session on Function Theoretic Methods in Partial Differential Equations, II

8:00 a.m.–11:00 a.m.

8:00 a.m. (660) *Applications of function theoretic methods.* Preliminary report.
Peter A. McCoy, United States Naval Academy (871-35-90)

8:30 a.m. (661) *Intrinsic Dirac operators in C^n.*
John Ryan, University of Arkansas, Fayetteville (871-35-179)

9:00 a.m. (662) *A function theoretic method for inhomogeneous second order elliptic systems and its applications to thermo-elastic problems.*
Yongzhi Xu, University of Minnesota, Minneapolis (871-35-80)

9:30 a.m. (663) *Gradients derived by variational means.*
J. W. Neuberger, University of North Texas (871-35-180)

10:00 a.m. (664) *The two-dimensional stability of plane couette flow.* Preliminary report.
Isom H. Herron, Howard University (871-76-342)

10:30 a.m. (665) *Uniform stabilization of planar networks of Timoshenko beams.*
John E. Lagnese, Georgetown University (871-35-616)

AMS Special Session on Stability and Control, III

8:00 a.m.–9:50 a.m.

8:00 a.m. (666) *On mathematical models of hysteresis.*
I. D. Mayergoyz, University of Maryland, College Park (871-93-49) (Sponsored by Seenith Sivasundaram)

8:30 a.m. (667) *On a certain type of Higher Order Maximum Principle (HMP).*
Urszula Ledzewicz-Kowalewska, Southern Illinois University, Edwardsville (871-49-514)

9:00 a.m. (668) *Global stability via perturbing Lyapunov functions.* Preliminary report.
A. S. Vatsala*, University of Southwestern Louisiana, and **S. G. Rajalakshmi**, Southwest Missouri State University (871-34-506)

9:30 a.m. (669) *Nonlinear variation of parameters formula for matrix differential equations.*
Donald W. Fausett, Florida Institute of Technology (871-34-332) (Sponsored by V. Lakshmikantham)

AMS Special Session on Algebraic Topology, III

8:00 a.m.–10:50 a.m.

8:00 a.m. (670) *The K-theory localization of loops on an odd sphere and applications.*
Lisa Langsetmo, Northwestern University (871-55-240)

8:30 a.m. (671) *On the double transfer.*
Nori Minami, University of Alabama, Tuscaloosa (871-55-241) (Sponsored by W. S. Wilson)

9:00 a.m. (672) *A-generators for the Dickson algebra.* Preliminary report.
Nguyen H. V. Hung, University of Hanoi, Socialist Republic of Vietnam, and **Franklin P. Peterson***, Massachusetts Institute of Technology (871-55-244)

9:30 a.m. (673) *MU^* of mapping-class groups.*
Jack Morava, Johns Hopkins University, Baltimore, Maryland (871-55-242)

10:00 a.m. (674) *The Brown-Peterson homology of the classifying spaces BO and $BO(n)$.*
Dung Yung Yan, Johns Hopkins University, Baltimore, MD (871-55-250)

10:30 a.m. (675) *The p-period of a p-periodic group of finite virtual cohomological dimension.* Preliminary report.
Yining Xia, Ohio State University, Columbus (871-55-99)

AMS Special Session on Symplectic Topology, IV

8:00 a.m.–10:55 a.m.

8:00 a.m. (676) *Complex structures on the tangent bundles of Riemannian manifolds.*
Laszlo Lempert*, Purdue University, West Lafayette, and **Robert Szoke**, Eotvos University, Hungary (871-32-194)

8:45 a.m. (677) *Seifert fibration on aspherical CR manifolds.*
Yoshinobu Kamishima, Kumamoto University, Japan (871-57-287)

9:25 a.m. (678) *Symplectic displacement energy for Lagrangian submanifolds.*
Leonid Polterovich, Tel-Aviv University, Israel (871-58-288) (Sponsored by Yakov Eliashberg)

10:10 a.m. (679) *Symplectic topology of minimal Lagrangian submanifolds in Einstein-Kahler manifolds.* Preliminary report.
Yong-Geun Oh, Institute for Advanced Study (871-53-170)

MAA Minicourse #8: Part B

8:00 a.m.–10:00 a.m.

CAS laboratory projects for first year calculus using DERIVE.
Carl L. Leinbach, Gettysburg College, and **Marvin L. Brubaker**, Messiah College

AMS Session on Commutative Algebra

8:00 a.m.–10:40 a.m.

8:00 a.m. (680) *Some remarks on primal ideals.* Preliminary report.
J. H. Kim, East Carolina University (871-13-309)

8:15 a.m. (681) *Idempotent computation over finite fields.*
Richard A. Davis, National Security Agency, Ft. Meade, Maryland (871-13-184) (Sponsored by John F. Dillon)

8:30 a.m. (682) *Integer valued rational functions.* Preliminary report.
K. Alan Loper, Ohio State University, Newark (871-13-365)

8:45 a.m. (683) *On the lengths of factorizations of elements in an algebraic number ring.* Preliminary report.
Scott Chapman*, Trinity University, and **William W. Smith**, University of North Carolina, Chapel Hill (871-13-469)

9:00 a.m. (684) *Hilbert polynomial of a certain ladder determinantal ideal.*
Devadatta M. Kulkarni, Oakland University (871-13-88)

9:15 a.m. (685) *Determinantal rings associated with symmetric matrices: A counterexample.*
Janet Andersen, Hope College (871-13-280)

9:30 a.m. (686) *Projective resolutions of generic order ideals.*
Saeja Oh Kim, University of Massachusetts, Dartmouth (871-13-475)

9:45 a.m. (687) *Sheaf cohomology of generic hyperplane arrangements.* Preliminary report.
Keith A. Brandt, University of Wisconsin, Madison (871-13-484)

10:00 a.m. (688) *Valuations defined by Ostrowski nets.* Preliminary report.
David M. Mathews, North Carolina State University, Raleigh (871-13-536)

10:15 a.m. (689) *On relations between Jacobians and resultants of polynomials in two variables.*
T. Sakkalis, Oakland University (871-14-122)

10:30 a.m. (690) *Characterizing an algebraic automorphism by the radical of its minimal polynomial.*
Mowaffaq Hajja, Yarmouk University, Jordan (871-12-467)

AMS Session on Linear and Associative Algebra

8:00 a.m.–10:40 a.m.

8:00 a.m. (691) *The gap of the graff of a semisimple matrix.*
Javad F. Habibi, Muskingum College (871-15-515)

8:15 a.m. (692) *Distance and parallelism between flats in* $\mathbf{R}^n$.
Arthur M. Dupré, Rutgers University, New Brunswick, and **Seymour Kass***, University of Massachusetts, Boston (871-15-425)

8:30 a.m. (693) *A representation of solutions of difference equations and applications.*
R. Kit Kittappa, Millersville University (871-15-501)

8:45 a.m. (694) *On the matrix power* X^n *over finite fields.* Preliminary report.
Maria T. Acosta-de-Orozco*, Pennsylvania State University, Beaver Campus, and **Javier Gomez-Calderon**, Pennsylvania State University, New Kensington Campus (871-15-317)

9:00 a.m. (695) *An inversion relation of multinomial type.* Preliminary report.
Daniel Moak*, **Konrad Heuvers**, Michigan Technical University, **K.P.S. Bhaskara Rao**, Indian Statistical Institute, India, and **Karen Collins**, Wesleyan University (871-15-352)

9:15 a.m. (696) *Weak semiprime rings.*
Hossain Khabazian, Isfahan University of Technology, Iran (871-16-613)

9:30 a.m. (697) *t-Noetherian t-fully right bounded rings.* Preliminary report.
Heakyung Lee*, Winthrop College, and **Peter Vachuska**, University of Wisconsin, Milwaukee (871-16-89)

9:45 a.m. (698) *Homological dimensions of idealizer and subidealizer rings.* Preliminary report.
John Koker, University of Wisconsin, Oshkosh (871-16-418)

10:00 a.m. (699) *A Brauer homomorphism for generic Hecke algebras of type* A_n. Preliminary report.
Lenny Jones, Shippensburg University of Pennsylvania (871-16-585) (Sponsored by Michael D. Seyfried)

10:15 a.m. (700) *Blocks in tame near-rings.*
Gary L. Peterson, James Madison University (871-16-259)

10:30 a.m. (701) *Morphism near-rings of metacyclic groups.*
J. J. Malone*, Worcester Polytechnic Institute, and **Gordon Mason**, University of New Brunswick (871-16-415)

AMS Session on Ordinary Differential Equations, II

8:00 a.m.–10:25 a.m.

8:00 a.m. (702) *Asymptotic stability of Volterra difference equations.* Preliminary report.
Saber Elaydi, Trinity University (871-34-336)

8:15 a.m. (703) *Stability of neural nets.*
Semen Koksal*, Florida Institute of Technology, and **S. Sivasundaram**, Embry-Riddle Aeronautical University (871-34-346)

8:30 a.m. (704) *Existence and comparison results for dynamic systems on time scale.*
Billur Kaymakcalan, Florida Institute of Technology (871-34-347)

8:45 a.m. (705) *Controllability of impulsive differential equations.*
Farzana McRae, Florida Institute of Technology (871-34-348)

9:00 a.m. (706) *On Kronecker product self-adjoint boundary value problems.*
Michael D. Shaw*, Florida Institute of Technology, and **K. N. Murty**, Andhra University, (871-34-349)

Saturday, January 11 (cont'd)

9:15 a.m. (707) *A variation of Lyapunov second method to impulsive differential equations.*
J. Vasundhara Devi, Florida Institute of Technology (871-34-350)

9:30 a.m. (708) *A new survey of quadratic systems.* Preliminary report.
Jinghuang Tian, Academia Sinica, Peoples Republic of China (871-34-188)

9:45 a.m. (709) *A result on a feedback system of ordinary differential equations.*
A. S. Elkhader, Northern State University (871-34-224)

10:00 a.m. (710) *Differentiation of solutions of difference equations with respect to right focal boundary values.*
Anjali Datta and **Johnny Henderson***, Auburn University, Auburn (871-34-216)

10:15 a.m. (711) *Solvability and unsolvability of boundary value problems.*
Ann DeBortoli*, Auburn University, Montgomery, and **Johnny Henderson**, Auburn University, Auburn (871-34-217)

MAA Session on Reseach in Undergraduate Education, III

8:00 a.m.–10:55 a.m.

8:00 a.m. (712) *Some effects of computer programming and computer graphics on the conceptual knowledge and problem solving strategies of calculus students - an example.*
Fredric Tufte, University of Wisconsin, Platteville (871-00-736)

8:20 a.m. (713) *The power of visualization algebra and precalculus.*
Iris Brann Fetta, Clemson University (871-00-713)

8:40 a.m. (714) *The effects of computer/calculator graphing and discovery style teaching in differential calculus.*
George Emese, Ohio State University, Columbus (871-00-710)

9:00 a.m. (715) *Concept development and problem solving in a calculus class immersed in the computer algebra system mathematica.*
Deborah A. Crocker, Miami University (871-00-707)

9:20 a.m. (716) *Trying it again: A hands-on abstract algebra course for high school teachers.* Preliminary report.
Uri Leron, Technion-Israel Institute of Technology, Israel (871-00-719)

9:40 a.m. (717) *Microworlds, scripts and ISETL.*
John Daly and **Jack Narayan***, State University of New York, College at Oswego (871-00-724)

10:00 a.m. (718) *A role for ISETL in assisting liberal arts students in understanding sets and logic.*
Joe Wimbish, Huntingdon College (871-00-738)

10:20 a.m. (719) *Computer-based linear algebra.*
Mazen Shahin*, College Misericordia, and **Donald Muench**, Saint John Fisher College (871-00-733)

10:40 a.m. (720) *A new approach to teaching linear algebra using ISETL.*
Donald L. Muench*, Saint John Fisher College, and **Mazen Shahin**, College Misericordia (871-00-722)

MAA CUPM Subcommittee on Symbolic Computer Systems and CCIME Special Presentation

8:00 a.m.–8:50 a.m.

Processes and symbols in the mind.

AMS Special Session on History of Mathematics, II

8:15 a.m.–10:50 a.m.

8:15 a.m. (721) *The foundations of the method of fluxions in 18th century Britain.*
Erik Sageng, Saint John's College (871-01-31) (Sponsored by Victor J. Katz)

8:55 a.m. (722) *Conflicts in mathematics and mathematical education at German technical colleges around 1900.* Preliminary report.
Susann Hensel, Friedrich-Schiller University, Germany (871-01-234) (Sponsored by David E. Rowe)

9:35 a.m. (723) *Ramanujan and Hardy in England.*
Robert Kanigel, Baltimore, Maryland (871-01-149) (Sponsored by Victor J. Katz)

10:15 a.m. (724) *Computers, mathematics, and theoretical computer science,* 1950–70.
Michael S. Mahoney, Princeton University (871-01-102) (Sponsored by Victor J. Katz)

AMS Special Session on Bergman Spaces, IV

8:30 a.m.–10:20 a.m.

8:30 a.m. (725) *The Bloch constant of bounded holomorphic functions in several variables.*
Joel M. Cohen, University of Maryland, College Park, and **Flavia Colonna***, George Mason University (871-32-67)

9:00 a.m. (726) *Extremal functions and an inequality of Chang and Marshall.* Preliminary report.
V. V. Andreev and **A. Matheson***, Lamar University (871-30-78)

9:30 a.m. (727) *S. Bergman's theory of doubly-orthogonal systems of functions and systems of 'differential solutions'.* Preliminary report.
Valentin V. Andreev, Lamar University (871-47-79)

10:00 a.m. (728) *The commutant of a certain compression.*
William T. Ross, Lafayette College (871-47-17)

MAA Session on Actuarial Mathematics Education and Research, I

8:30 a.m.–10:45 a.m.

8:30 a.m. (729) *An actuarial program at a large university.*
James W. Daniel, University of Texas, Austin (871-00-785)

8:45 a.m. (730) *An actuarial science program at a small college.*
Bryan V. Hearsey, Lebanon Valley College (871-00-788)

9:00 a.m. (731) *Question and answer session on establishing and running actuarial programs.*
James W. Daniel, University of Texas, Austin (871-00-786)

9:35 a.m. (732) *Postulates for the internal rate of return of an investment project.*
David Promislow* and **David Spring**, York University (871-00-789)

10:00 a.m. (733) *Using graphics calculators in the elementary statistics classroom.*
Richard Stephens, Western Carolina University (871-00-790)

10:25 a.m. (734) *Mathematical analysis of mortgage portfolios for the actuarial student.*
Matthew J. Hassett, Arizona State University, Tempe (871-00-787)

AMS Committee on Education Panel Discussion

8:30 a.m.–10:00 a.m.

Directions for AMS action in education.

MAA/NAM Panel Discussion

8:30 a.m.–10:00 a.m.

The fate of minority mathematics students.

MAA Invited Address

9:00 a.m.–9:50 a.m.

(735) *Teaching linear algebra: Must the fog always roll in?*
David Carlson, San Diego State University, San Diego (871-00-871)

AMS Special Session on Preparing for Future College Teaching, II

9:00 a.m.–10:50 a.m.

9:00 a.m. (736) *The transition from graduate student to junior faculty.*
Bettye Anne Case, Florida State University (871-98-398)

9:30 a.m. (737) *Aspects of assessment of future college teachers of mathematics.*
Donald W. Bushaw, Washington State University (871-98-133)

10:00 a.m. (738) *Mathematical content and teaching.*
Guido L. Weiss*, Washington University, and **Stephen B. Rodi**, Austin Community College (871-98-391) (Sponsored by Bettye A. Case)

10:30 a.m. (739) *Preparing college teachers: What mathematics can learn from other disciplines.*
Brian Lekander, Washington, DC (871-98-397) (Sponsored by Bettye A. Case)

MAA Committee on Student Chapters and ad hoc Committee on Mathematics and the Environment Student Workshop

9:00 a.m.–11:00 a.m.

Environmental mathematics.

NAM Business Meeting

10:00 a.m.–10:55 a.m.

MAA Invited Address

10:05 a.m.–10:55 a.m.

(740) *Problems in Mathematics: East Asian and the United States.*
Harold Stevenson, University of Michigan, Ann Arbor

AMS-MAA Invited Address

11:10 a.m.– noon

(741) *The current interface of geometry and elementary particle physics.*
I. M. Singer, Massachusetts Institute of Technology

Saturday, January 11 (cont'd)

AMS Special Session on History of Mathematics, III

1:00 p.m.–4:20 p.m.

1:00 p.m. (742) *Father Pavel Florensky and modern Soviet mathematics.*
Charles E. Ford, Saint Louis University (871-01-323)

1:40 p.m. (743) *Theorem on representation of semigroups by transformations. History of the proof* (1918–1926).
Boris M. Schein, University of Arkansas, Fayetteville (871-01-177)

2:25 p.m. (744) *Affine and projective transformations in the medieval east.*
Boris A. Rosenfeld, Pennsylvania State University, University Park (871-01-302)

3:10 p.m. (745) *Emile Picard, the method of successive approximations, and the development of an international style in mathematics.*
Thomas Archibald, Acadia University (871-01-131)

3:50 p.m. (746) *Women in the American Mathematical Research Community:* 1891–1906.
Della Dumbaugh Fenster* and **Karen Hunger Parshall**, University of Virginia (871-01-209)

AMS Special Session on Interaction of Harmonic Analysis Signal Processing and Computational Mathematics, IV

1:00 p.m.–5:30 p.m.

1:00 p.m. (747) *Hankel operators on wavelet components of orthogonal decomposition of* $L^2(\mathbf{R}^2)$.
C. K. Chui and **Xin Li***, Texas A & M University, College Station (871-41-345)

1:25 p.m. (748) *On Gibbs phenomena in the general orthogonal expansion.* Preliminary report.
Abdul J. Jerri, Clarkson University (871-65-374)

1:50 p.m. (749) *Applications of the theory of reproducing kernels to approximation theory.*
Saburou Saitoh* and **Du-Won Byun**, Gunma University, Japan (871-41-204)

2:15 p.m. (750) *Computing the spectrum of* SL_2 *over a finite field.*
John D. Lafferty*, IBM T. J. Watson Research Center, Yorktown Heights, New York, and **Daniel Rockmore**, Harvard University (871-20-76)

2:40 p.m. (751) *A method to determine stability margins in nonlinear rotordynamics.*
R. A. Zalik, Auburn University, Auburn (871-70-360)

3:05 p.m. (752) *Convolution equations, deconvolution, sampling, and the Gabor and wavelet transforms.*
Stephen D. Casey, American University (871-43-603)

3:30 p.m. (753) *Tychonov-Phillips regularization applied to nonuniform sampling.*
Marcel Zwaan, Shell Oil, The Netherlands (871-40-464) (Sponsored by M. Z. Nashed)

3:55 p.m. (754) *On the phase and the magnitude squared distributions of the wavelet transform of a multi-component signal.* Preliminary report.
Shubha Kadambe, A I duPont Institute, Delaware (871-43-527) (Sponsored by M. Z. Nashed)

4:20 p.m. (755) *Reproducing kernels and conformal mapping.* Preliminary report.
Mohamad Rashidi Razali, University Technology Malaysia, Malaysia (871-45-518)

4:45 p.m. (756) *Probabilistic discrete wavelet approximation.* Preliminary report.
G. A. Anastassiou*, Memphis State University, and **X. M. Yu**, Southwest Missouri University (871-41-114)

5:10 p.m. (757) *Hybrid symbolic/numeric computation of the generalized inverse on part of its spectrum.*
David H. Wood, University of Delaware (871-15-118)

MAA Minicourse #6: Part B

1:00 p.m.–3:00 p.m.

Introduction to research in the teaching and learning of undergraduate mathematics: examples in calculus. **Joan Ferrini-Mundy**, University of New Hampshire, and **Kathleen Heid**, Pennsylvania State University

MAA Minicourse #7: Part B

1:00 p.m.–3:00 p.m.

Using NETPAD software to teach and learn about graphs. **Nathaniel Dean**, Bellcore, and **Joseph G. Rosenstein**, Rutgers University

MAA Minicourse #10: Part B

1:00 p.m.–3:00 p.m.

How to make effective use of inexpensive pocket computers to develop the concepts and techniques of calculus. **Franklin Demana** and **Bert K. Waits**, Ohio State University

MAA Minicourse #12: Part B

1:00 p.m.–3:00 p.m.

Mathematical modeling with a spreadsheet. **Stephen D. Comer** and **Hughes B. Hoyle III**, The Citadel

MAA Minicourse #13: Part B

1:00 p.m.–3:00 p.m.

Integrating calculus and physics for freshmen. **Joan R. Hundhausen** and **F. Richard Yeatts**, Colorado School of Mines

AMS Session on Combinatorics

1:00 p.m.–5:05 p.m.

1:00 p.m. (758) *Rado's theorem for commutative rings.* **Vitaly Bergelson**, Ohio State University, Columbus, **Walter Deuber**, University of Bielefeld, Germany, **Neil Hindman***, Howard University, and **Hanno Lefmann**, University of Bielefeld, Germany (871-05-261)

1:15 p.m. (759) *Domination in grids.* Preliminary report. **David Moulton**, University of California, Berkeley, and **Jared Wunsch***, Princeton University (871-05-279) (Sponsored by Joseph A. Gallian)

1:30 p.m. (760) *The army problem for triangular solitaire.* **John Duncan***, University of Arkansas, Fayetteville, and **Donald Hayes**, Bentonville High School, Arkansas (871-90-420)

1:45 p.m. (761) *An equivalence relation for linear recursive sequences.* Preliminary report. **Sherwood Washburn**, Seton Hall University (871-05-225)

2:00 p.m. (762) *Forbidden subsequences.* **Zvezdelina E. Stankova**, Bryn Mawr College (871-05-213) (Sponsored by Joseph A. Gallian)

2:15 p.m. (763) *An algorithm to generate random cyclic Mendolsohn designs.* **D. C. Simmons, III**, University of North Texas (871-05-152)

2:30 p.m. (764) *Towards a q-cross product of posets.* **Kathy J. Dempsey*** and **Bruce E. Sagan**, Michigan State University (871-05-25)

2:45 p.m. (765) *Some aspects of metabelian Moufang loops.* Preliminary report. **Jon Phillips**, Iowa State University (871-05-15)

3:00 p.m. (766) *A combinatorial proof of the Weyl character formula.* **Steve Wei*** and **David Bressoud**, Pennsylvania State University, Mont Alto Campus (871-05-63)

3:15 p.m. (767) *Heursitic solution procedures for single machine scheduling.* **Bahram Alidaee**, West Texas State University, Canyon, TX (871-05-361) (Sponsored by Randy L. Combs)

3:25 p.m. Break

3:40 p.m. (768) *On partitions and posets.* **Zhu-Xin Hu**, University of Illinois, Urbana-Champaign (871-05-584)

3:55 p.m. (769) *Involutionary monomial transforms on rectangular arrays.* **Phillip J. Chase**, National Security Agency, Maryland (871-05-562)

4:10 p.m. (770) *Filtration transforms of multiplicative lattices.* **Monty B. Taylor**, University of Texas-Pan American (871-06-434)

4:25 p.m. (771) *Interval dimension and the predecessor successor relation of an ordered set.* **Larry J. Langley**, Dartmouth College (871-06-620)

4:40 p.m. (772) *Factorization and modifications of dependence systems.* **Marcin Jan Schroeder**, Southern Illinois University, Carbondale (871-06-568)

4:55 p.m. (773) *A shell for modelling certain nonlinear programming problems.* **Richard D. Jarvinen**, Winona State University (871-90-533)

AMS Session on Functional Analysis

1:00 p.m.–5:20 p.m.

1:00 p.m. (774) *The Radon transform on finite upper half planes.* Preliminary report. **Elinor Velasquez**, University of California, Berkeley (871-44-371)

1:15 p.m. (775) *On a class of multivalued Volterra integral equations.* **Sergiu Aizicovici***, Ohio University, Athens, and **Nikolaos S. Papageorgiou**, Florida Institute of Technology (871-45-411)

1:30 p.m. (776) *Integral operators on the section space of a Banach bundle.* **J. W. Kitchen**, Duke University, and **D. A. Robbins***, Trinity College (871-46-143)

1:45 p.m. (777) *A cone in a Hilbert space is lattical and correct if and only if it is an isotone projection cone.* **S. J. Bernau**, University of Texas, El Paso (871-46-508)

2:00 p.m. (778) *Finitely additive measures and ideals in $C_b(\mathbf{H})$.* Preliminary report. **J. Connor*** and **M. A. Swardson**, Ohio University, Athens (871-46-550)

2:15 p.m. (779) *Nonlinear positive operators on Banach lattices.* Preliminary report. **William Feldman**, University of Arkansas, Fayetteville (871-46-552)

2:30 p.m. (780) *Commutants of Toeplitz operators on the Bergman space.* **Zeljko Cuckovic**, Michigan State University (871-46-557)

2:45 p.m. (781) *Separably determined operator ideals and weakly precompact adjoints.* **Catherine Abbott**, Francis Marion College, **Elizabeth Bator** and **Paul Lewis***, University of North Texas (871-46-421)

3:00 p.m. (782) *Operators having weakly precompact adjoints.* **Elizabeth Bator*** and **Paul Lewis**, University of North Texas (871-46-422)

3:15 p.m. (783) *Landstad duality for C^*-coactions.* **John C. Quigg**, Arizona State University (871-46-479)

3:25 p.m. Break

Saturday, January 11 (cont'd)

3:40 p.m. (784) *Spectral factorization of rectangular rational matrix functions with application to discrete Wiener-Hopf equations.*
Marek Rakowski, Southwestern Oklahoma State University (871-46-505)

3:55 p.m. (785) *Special atomic decomposition of Besov spaces on fractal sets.*
Geraldo De Souza*, Auburn University, and **Archil Gulisashvili**, Georgian Academy of Sciences, USSR (871-46-33) (Sponsored by Jack B. Brown)

4:10 p.m. (786) *A precursor of the Krein-Rutman theorem.*
John J. Saccoman, Seton Hall University (871-46-87)

4:25 p.m. (787) *Analytic almost periodic structures in uniform algebra spectra.*
Toma Tonev, University of Montana (871-46-294)

4:40 p.m. (788) *Complex extreme measurable selections.*
Douglas Mupasiri, Miami University of Ohio (871-46-327)

4:55 p.m. (789) *A characterization of all solutions to a perturbed Laplace equation.*
John Kelingos and **Peter R. Massopust***, Vanderbilt University (871-46-129)

5:10 p.m. (790) *Eigenvalue and eigenfunction asymptotics for regular Sturm-Liouville problems.*
Charles T. Fulton*, Florida Institute of Technology, and **Steven A. Pruess**, Colorado School of Mines, Golden (871-45-471)

MAA Session on Research in Undergraduate Education, IV

1:00 p.m.–5:15 p.m.

1:00 p.m. (791) *Computer/cooperative based calculus for management, the social and life science students.*
Keith Schwingendorf*, Purdue University, North Central, **Joe Wimbish**, Huntingdon College, and **Julie Hawks-Hoover**, Purdue University, West Lafayette (871-00-732)

1:20 p.m. (792) *A classroom experiment using small groups.*
Joseph F. Conrad, Pennsylvania State University, Altoona (871-00-706)

1:40 p.m. (793) *The use of teamwork in undergraduate math classes: A pilot study at University of Wisconsin, Whitewater.*
Mohammad Ahmadi, University of Wisconsin, Whitewater (871-00-700)

2:00 p.m. (794) *The effects of using Logo to teach geometry on student achievement and attitudes.*
Gail Gallitano, University of Nevada, Las Vegas and Shippensburg University of Pennsylvania (871-00-715)

2:20 p.m. (795) *Modern techniques in modern geometries.*
James Smart, San Jose State University (871-00-735)

2:40 p.m. (796) *A survey concerning undergraduate geometry courses taken by prospective secondary mathematics teachers in selected colleges and universities in the United States.*
Donovan R. Lichtenberg*, University of South Florida, **E. Ray Phillips**, Middle Tennessee State University, and **Betty K. Lichtenberg**, University of South Florida (871-00-720)

3:00 p.m. (797) *Effect of industrial mentors in summer NSF Young Scholars Program at Colorado School of Mines: Prospects for undergraduates in mathematics education.*
Barbara Bath, Colorado School of Mines, Golden, and **Claudette Bradley***, University of Alaska, Fairbanks (871-00-701)

3:20 p.m. (798) *Women in honors mathematics: Perceptions and choices.*
David T. Burkam, University of Michigan, Ann Arbor (871-00-705)

3:40 p.m. (799) *Women in undergraduate mathematics: Correlates of success.*
Pat Shure, University of Michigan, Ann Arbor (871-00-734)

4:00 p.m. (800) *Women mathematics and physics concentrators: Expectations and encouragement.*
Oksana Malanchuk*, **David T. Burkam** and **Pat Shure**, University of Michigan, Ann Arbor (871-00-721)

4:20 p.m. (801) *The relationship between math anxiety and selected cognitive factors.*
Patricia Preston, Pellissippi State Technical Community College (871-00-728)

4:40 p.m. (802) *Long-term effectiveness of the calculus workshop model: Initial findings and their implications.*
Martin V. Bonsangue, Mt. San Antonio College (871-00-702)

5:00 p.m. (803) *Assessment of calculus dissemination and reform efforts.*
Gerald Kulm*, **Vincent P. Schielack, Jr.**, **Mary Ellen Foley**, **Warren Page** and **Edward Kifer**, Texas A & M University, College Station (871-00-718)

MAA Session on Using Spreadsheets to Teach Mathematics, IV

1:00 p.m.–5:05 p.m.

1:00 p.m. (804) *Algebra tutorial for excel spreadsheet: Basic.*
Roosevelt Gentry, Jackson State University (871-00-833)

1:25 p.m. (805) *Using a spreadsheet to test, to validate, and to count.*
James F. Ramaley, Ziff-Davis Publishing Company, New York, New York (871-00-843)

1:50 p.m. (806) *Spreadsheets and linear algebra.*
James W. Petticrew, University of Texas - Pan American (871-00-841)

2:15 p.m. (807) *The spreadsheet as a learning tool in calculus.*
Louise McNertney Berard, Wilkes University (871-00-822)

2:40 p.m. (808) *Spreadsheets as a new paradigm for representing mathematical formulas.*
Erich Neuwirth, University of Vienna, Austria (871-00-839)

3:05 p.m. (809) *Using spreadsheets in linear programming for the simplex algorithm.*
David S. Tucker, Midwestern State University (871-00-850)

3:30 p.m. (810) *Spreadsheet visualization of 2-D iterated maps: The Henon attractor and the Devil's Staircase.*
Richard A. Di Dio, LaSalle University (871-00-830)

3:55 p.m. (811) *Continuous and discrete population models: Where's the chaos.*
Robert Decker, University of Hartford (871-00-829)

4:20 p.m. (812) *The implementation of spreadsheets in calculus.*
Laura L. Kelleher* and **Frank P. Battles**, Massachusetts Maritime Academy, Massachusetts (871-00-837)

4:45 p.m. (813) *The spreadsheet can lead to conjectures.*
H. W. Straley* and **William Skillcorn**, Woodberry Forest School, Virginia (871-00-848)

MAA Session on Environmental Mathematics, II

1:00 p.m.–2:55 p.m.

1:00 p.m. (814) *Teaching environmental mathematics in standard mathematics courses.*
Lothar A. Dohse, University of North Carolina, Asheville (871-00-854)

1:30 p.m. (815) *From algebra to earth algebra.*
Christopher Schaufele* and **Nancy Zumoff**, Kennesaw State College (871-00-859)

2:00 p.m. (816) *Mathematics for a small planet.*
R. H. Schwartz, City University of New York, College of Staten Island (871-00-857)

2:30 p.m. (817) *Environmental mathematics in an applied mathematical optimization course.*
Robert B. Wenger, University of Wisconsin, Green Bay (871-00-858)

CEEB-MAA College Board Committee on Mutual Concerns Panel Discussion

1:00 p.m.–3:00 p.m.

The advanced placement calculus program: a pump or a filter?

MAA CUPM Subcommittee on Symbolic Computer Systems Panel Discussion

1:00 p.m.–3:00 p.m.

Future directions in symbolic computing software.

MAA Poetry Reading and Calculus/Art Presentation

1:00 p.m.–2:00 p.m.

The calculus virgin.

NAM Session

1:00 p.m.–3:00 p.m.

Presentations by recent doctoral recipients.

AMS Special Session on Preparing for Future College Teaching, III

1:10 p.m.–5:15 p.m.

1:10 p.m. (818) *Local support for Ph.D teaching projects.* Preliminary report.
Richard D. Ringeisen, Clemson University (871-98-104)

1:35 p.m. (819) *Survey information about the graduate student cohort and related departmental characteristics.*
Annette Blackwelder* and **Bettye Anne Case**, Florida State University (871-98-140)

2:00 p.m. (820) *Source materials for seminars on the role of undergraduate mathematics faculty.*
Stephen B. Rodi, Austin Community College (871-98-132) (Sponsored by Bettye A. Case)

2:40 p.m. (821) *Theory and practice of teacher training: An apprenticeship model.*
Daniel L. Goroff, Harvard University (871-98-393)

3:05 p.m. (822) *The college fellow program as professional development.*
Diane Herrmann, University of Chicago (871-98-394)

3:30 p.m. (823) *Master's programs in mathematics for two-year college teachers.*
Ann E. Watkins, California State University, Northridge (871-98-396) (Sponsored by Bettye A. Case)

3:55 p.m. (824) *The academic preparation of two-year college mathematics faculty.*
Gregory D. Foley, Sam Houston State University (871-98-400) (Sponsored by Bettye A. Case)

4:20 p.m. Discussion

4:35 p.m. (825) *Acquainting graduate students with research in undergraduate mathematics education.*
John Selden* and **Annie Selden**, Tennessee Technological University (871-98-392)

5:00 p.m. (826) *Preparation for college mathematics teaching: The West Point Model from a visiting professor's perspective.*
Edith H. Luchins, United States Military Academy, West Point (871-98-399)

Saturday, January 11 (cont'd)

AMS Invited Address

2:15 p.m.–3:05 p.m.

(827) *Title to be announced.*
I. Gelfand, Rutgers University, New Brunswick

MAA Minicourse #9: Part C

3:30 p.m.–5:30 p.m.

Learning abstract algebra by programming in ISETL. **Ed Dubinsky**, Purdue University, and **Uri Leron**, Technion IIT

MAA Minicourse #14: Part B

3:30 p.m.–5:30 p.m.

The Fibonacci and Catalan numbers. **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology

MAA Minicourse #15: Part B

3:30 p.m.–5:30 p.m.

Why, when and how to use CAS calculators in calculus and linear algebra instruction. **John Kenelly** and **Donald R. LaTorre**, Clemson University

MAA Minicourse #16: Part B

3:30 p.m.–5:30 p.m.

Challenging students with research projects in calculus. **Douglas Kurtz** and **David Pengelley**, New Mexico State University

Lance W. Small
AMS Associate Secretary
La Jolla, California

Kenneth A. Ross
MAA Associate Secretary
Eugene, Oregon

Presenters of Papers

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

◇ AMS-MAA Invited Lecturer
• AMS Invited Lecturer
✠ AMS Retiring Presidential Address
★ MAA Retiring Presidential Address
○ MAA Invited Lecturer
□ AWM Emmy Noether Lecturer
■ NAM Cox-Talbot Address
∗ AMS Special Session Speaker

Joint Summer Research Conferences in the Mathematical Sciences

Mount Holyoke College, South Hadley, Massachusetts, June 13 to July 24, 1992

The 1992 Joint Summer Research Conferences in the Mathematical Sciences will be held at Mount Holyoke College, South Hadley, Massachusetts, from June 13 to July 24. It is anticipated that the series of conferences will be supported by grants from the National Science Foundation and other agencies.

There will be nine conferences in nine different areas of mathematics. The topics and organizers for the conferences were selected by the AMS, Institute of Mathematical Statistics (IMS), and the Society for Industrial and Applied Mathematics (SIAM) Committee on Joint Summer Research Conferences in the Mathematical Sciences. The selections were based on suggestions made by the members of the committee and individuals submitting proposals. The committee considered it important that the conferences represent diverse areas of mathematical activity, with emphasis on areas currently especially active, and paid careful attention to subjects in which there is important interdisciplinary activity at present.

The conferences emulate the scientific structure of those held throughout the year at Oberwolfach. These conferences are intended to complement the Society's program of annual Summer Institutes and Summer Seminars, which have a larger attendance and are substantially broader in scope. The conferences are research conferences and are not intended to provide an entree to a field in which a participant has not already worked.

It is expected that funding will be available for a limited number of participants in each conference. Others, in addition to those funded, will be welcome, within the limitations of the facilities of the campus. In the spring, a brochure of information will be mailed to all who are requesting to attend the conferences. The brochure will include information on room and board rates, the residence and dining hall facilities, travel, local information, and a Residence Housing Form to use to request on-campus accommodations. Information on off-campus housing will also be included in the brochure. Participants will be responsible for making their own housing and travel arrangements. Each participant will be required to pay nominal registration and social fees.

Those interested in attending one of the conferences should send the following information to the Summer Research Conference Coordinator, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940 or by email: CAK@MATH.AMS.COM on the Internet.

Please type or print the following:

1. Title and dates of conference desired
2. Full name
3. Mailing address
4. Telephone number and area code for office, home and electronic-mail addresses, FAX number
5. A short paragraph describing your scientific background relevant to the topic of the conference
6. Financial assistance requested; please estimate cost of travel
7. Indicate if support is not required and if interested in attending even if support is not offered.

The deadline for receipt of requests for information is March 2, 1992. Requests to attend will be forwarded to the Organizing Committee for each conference for consideration after the deadline of March 2. All applicants will receive a formal invitation, Brochure of Information, notification of financial assistance, and a tentative scientific program (if the Chairman has prepared one in advance; otherwise programs will be distributed at registration) from the AMS by April 15. Funds available for these conferences are limited and individuals who can obtain support from other sources should do so. The allocation of grant funds is administered by the AMS office, and the logistical planning for the conferences is also done by the AMS. However, it is the responsibility of the Chairman of the Organizing Committee of each conference to determine the amount of support participants will be awarded. This decision is **not** made by the AMS. Women and members of minority groups are encouraged to apply and participate in these conferences.

Any questions concerning the scientific portion of the conference should be directed to the chair or any member of the Organizing Committee.

The Joint Summer Research Conferences in the Mathematical Sciences are under the direction of the AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences. The following committee members chose the topics for the 1992 conferences: John A. Burns, Fan R. K. Chung, Leonard Evens, Martin Golubitsky, Anthony W. Knapp, Peter W. K. Li, Emanuel Parzen, Stewart B. Priddy, Michael Shub and Gregg J. Zuckerman.

N.B. Lectures begin on Sunday morning and run through Thursday. Check-in for housing begins on Saturday. No lectures are held on Saturday.

Saturday, June 13 to Friday, June 19
Conformal field theory, topological field theory, and quantum groups
MOSHE FLATO (University de Dijon), Co-Chair
JAMES LEPOWSKY (Rutgers University), Co-Chair
PAUL SALLY (University of Chicago), Co-Chair

Saturday, June 20 to Friday, June 26
Cohomology, representations and actions of finite groups
JON F. CARLSON (University of Georgia), Chair

Saturday, June 20 to Friday, June 26
Nielsen theory and dynamical systems
CHRISTOPHER MCCORD (University of Cincinnati), Chair

Saturday, June 27 to Friday, July 3
The Penrose transform and analytic cohomology in representation theory
ROBERT J. BASTON (Oxford University, England) Co-Chair
MICHAEL G. EASTWOOD (Adelaide University, Australia) Co-Chair

Saturday, June 27 to Friday, July 3
Wavelets and applications
CHARLES K. CHUI (Texas A & M University), Co-Chair
STEPHAN MALLAT (Courant Institute of Mathematical Sciences, New York University), Co-Chair

Saturday, July 4 to Friday, July 10
Commutative algebra: Syzygies, multiplicities and birational algebra
WILLIAM HEINZER (Purdue University), Co-Chair
CRAIG HUNEKE (Purdue University), Co-Chair
JUDITH D. SALLY (Northwestern University), Co-Chair

Saturday, July 11 to Friday, July 17
Change-point problems
EDWARD CARLSTEIN (University of North Carolina), Co-Chair
HANS-GEORG MÜLLER (University of California, Davis), Co-Chair
DAVID SIEGMUND (Stanford University), Co-Chair

Saturday, July 11 to Friday, July 17
Control and identification of partial differential equations
H. T. BANKS (University of Southern California), Co-Chair
K. ITO (University of Southern California), Co-Chair

Saturday, July 18 to Friday, July 24
Adaptive designs
STEVE DURHAM (University of South Carolina), Co-chair
NANCY FLOURNOY (The American University), Co-chair

1992 Summer Research Institute

Quadratic forms and division algebras: Connections with algebraic K-theory and algebraic geometry

University of California, Santa Barbara, July 6–24

The fortieth Summer Research Institute sponsored by the American Mathematical Society will be devoted to *Quadratic forms and division algebras: Connections with algebraic K-theory and algebraic geometry* and will take place at the University of California, Santa Barbara. Members of the Organizing Committee are: **Richard Elman**, University of California, Los Angeles; **Burton I. Fein**, Oregon State University; **William Jacob** (co-chair), University of California, Santa Barbara; **T.-Y. Lam**, University of California, Berkeley; **Wayne Raskind**, University of Arizona; **Alex Rosenberg** (co-chair), University of California, Santa Barbara; **David Saltman**, University of Texas at Austin; and **Adrian Wadsworth**, University of California, San Diego.

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

This topic was selected by the 1991 AMS Committee on Summer Institutes and Special Symposia whose members at the time were: **Lawrence Craig Evens**, **Nicholas Katz** (chair), **Barbara Lee Keyfitz**, **Brian Parshall**, **Francois Treves**, and **Edward Witten**.

During the 1980's the closely related subjects of the algebraic theory of quadratic forms and the theory of finite-dimensional division algebras benefited greatly from developments in algebraic K-theory and algebraic geometry. The organizers of the institute are particularly interested in stimulating further progress along these lines by having two special lecture series, one devoted to algebraic K-theory and the other to algebraic geometry. In addition there will be research lectures on the two principal themes; quadratic forms and division algebras.

The Organizing Committee plans to invite six distinguished lecturers, each to give a one-week series of lectures either on *Algebraic K-theory* or *Algebraic geometry* and their connections to the institute topics. Two of these lectures will be given each morning during the three-week duration. These lectures will focus on the hows and whys of these tools and should be accessible to advanced graduate students. The exact topics are not yet known and will be decided by the invited lecturers. Possible topics include: etale cohomology, K-theory of quadric hypersurfaces and twisted forms of linear algebraic groups, generalized class field theories, and Witt groups of schemes. A tentative list of speakers who have agreed to be principal lecturers includes J.-L. Colliot-Thélène, A. S. Merkurjev, A. A. Suslin, and R. Swan.

During the afternoons the institute will have specialty lectures. These lectures will be on current research in the algebraic theory of quadratic forms, the theory of finite-dimensional division algebras, and related topics. Since it is likely that some participants will not attend the institute for the full three-week period, one week will be scheduled with quadratic forms emphasis and another with division algebra emphasis. However, it is planned to have these topics mixed as much as possible in order to encourage interaction. In addition to the research lectures, small seminars will be organized. There is particular interest in encouraging the participation of advanced graduate students, and seminars will be organized to help these students absorb the content of the lectures. Faculty with advanced graduate students should write to William Jacob, Department of Mathematics, University of California, Santa Barbara, Santa Barbara CA 93106, regarding support for these students. Questions regarding the scientific program should be directed to William Jacob at the above address.

The institute will be held on the campus of the University of California, Santa Barbara. Participants will be housed in university apartments which are considerably more comfortable than traditional dormitory housing. The lecture halls, beach, restaurants, and grocery stores are all located within a 20-minute walk from the apartments. Downtown Santa Barbara is accessible by express bus service from the campus. Persons with severe mobility problems should contact Professor Jacob at the above address as soon as possible since housing adjacent to the lecture halls is extremely limited. All facilities will be accessible to the handicapped.

Information on housing, dining, travel, and the local area will be sent to invited participants in the spring. Each participant will pay a registration fee and a social fee to cover the costs of social events scheduled during the institute.

Those interested in receiving an invitation to participate in the institute should send the following information to Summer Institute Conference Coordinator, American Mathematical Society, Post Office Box 6887, Providence, RI 02940, **prior to April 1, 1992** or through electronic mail to WSD@MATH.AMS.COM.

Please type or print the following:

1. Full name
2. Mailing address
3. Telephone number and area code for office and home, FAX number, and electronic mail address
4. Which week or weeks you wish to attend

5. Your scientific background relevant to the institute topic
6. Financial assistance requested
7. Indicate if support is not required, and whether interested in attending even if support is not offered.

Requests for invitations will be forwarded to the Organizing Committee for consideration up to the deadline of April 1. All applicants will receive formal invitations. Participants receiving financial support will be notified beginning in mid-May.

1992 Summer Seminar in Applied Mathematics

Exploiting Symmetry in Applied and Numerical Analysis

Colorado State University, July 26 – August 1

The twenty-second AMS-SIAM Summer Seminar in Applied Mathematics will be held July 26 – August 1, 1992 at Colorado State University, Fort Collins, Colorado. The seminar will be sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics, and the Department of Mathematics at Colorado State University. It is anticipated that it will be supported by grants from federal agencies. The proceedings of the seminar will be published by the American Mathematical Society in the *Lectures in Applied Mathematics* series.

The aim of the conference is to provide a wide-ranging survey of the exploitation of symmetry in applied and numerical analysis. The seminar will have both an entry level summer school component intended for young researchers and a frontier level research aspect. A number of the anticipated participants will be experts from foreign countries.

A purpose of the seminar is to stimulate interaction between aspects of Applied Mathematics (e.g., PDEs, integral equations, bifurcation), Numerical Mathematics (e.g., numerical linear algebra, boundary and finite element methods), Pure Mathematics (e.g., representation theory of groups), and Classical Physics (e.g., Taylor and Bénard problems).

The tentative list of invited speakers includes **William F. Ames**, Georgia Institute of Technology; **Dieter Armbruster**, Arizona State University; **George W. Bluman**, University of British Columbia; **Alain Bossavit**, Electricité de France; **Fritz H. Busse**, University of Bayreuth, Germany; **Pascal Chossat**, University of Nice, France; **Peter A. Clarkson**, University of Exeter; **John David Crawford**, University of Pittsburgh; **Gerhard Dangelmayr**, University of Tübingen, Germany; **Michael Dellnitz**, University of Houston; **Timothy J. Healey**, Cornell University; **Henry Hermes**, University of Colorado; **Darryl D. Holm**, Los Alamos National Laboratories; **Gérard Iooss**, University of Nice, France; **Edgar Knobloch**, University of California, Berkeley; **P. S. Krishnaprasad**, University of Maryland, College Park; **Jan Mandel**, University of Colorado, Denver; **Ian Melbourne**, University of Houston; **Hans-Detlef Mittelmann**, Arizona State University; **K. Murota**, University of Tokyo; **Heinz-Otto Peitgen**, University of Bremen, Germany; **Tudor Ratiu**, University of California, Santa Cruz; **Werner C. Rheinboldt**, University of Pittsburgh; **Duane Sather**, University of Colorado; **David Sattinger**, University of Minnesota; **Jürgen Scheurle**, University of Hamburg, Germany; **André Vanderbauwhede**, University of Ghent, Belgium; **Bodo Werner**, University of Hamburg, Germany.

The Organizing Committee consists of **Martin Golubitsky**, University of Houston; **Klaus W. Kirchgässner**, University of Stuttgart, Germany; **Peter J. Olver**, University of Minnesota; and the local organizers **Eugene L. Allgower** (Co-chairman), **Kurt Georg** (Co-chairman), and **Rick Miranda** (Co-chairman), Colorado State University.

Those interested in attending the Seminar should send the following information to Donna Salter, Conference Coordinator, American Mathematical Society, P.O. Box 6887, Providence, R.I. 02940, email: DLS@MATH.AMS.COM, **before May 6, 1992**. Please type or print the following:

1. Full name;
2. Mailing address;
3. Telephone number and area code for office and home;
4. email address if available;
5. Anticipated arrival and departure dates;
6. Your scientific background relevant to the topic of the seminar;
7. Financial assistance requested (please estimate cost of travel), indicate if support is not required, and if interested in attending even if support is not offered.

Participants who wish to apply for a grant-in-aid should so indicate; however, funds available for the seminar are very limited and individuals who can obtain support from other sources should do so. Graduate students who have completed at least one year of graduate school are encouraged to participate.

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.

Springfield, MO, March 1992

Alexander Eremenko
Julia Knight
Peter J. Olver
Ernst A. Ruh

Tuscaloosa, AL, March 1992

Jane M. Hawkins
Charles A. Micchelli
Serge Ochanine
Peter M. Winkler

Bethlehem, PA, April 1992

Jean-Luc Brylinski
Ingrid Daubechies
Edward Y. Miller
Douglas C. Ravenel

Cambridge, England, June 1992

(Joint meeting with the London Mathematical Society)

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

Dayton, OH, October 1992

Martin Golubitsky
Jonathan I. Hall
Louis H. Kauffman
J. T. Stafford

Invited addresses at Sectional Meetings are selected by the Section Program Committee, usually twelve to eighteen months in advance of a meeting. Members wishing to nominate candidates for invited addresses should send the relevant information to the Associate Secretary for the Section who will forward it to the Section Program Committee.

Organizers and Topics of Special Sessions

The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of *Notices* went to the printer. The section below entitled **Information for Organizers** describes the timetable for announcing the existence of Special Sessions.

March 1992 Meeting in Tuscaloosa, Alabama
Southeastern Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: December 12, 1991

Richard C. Brown, *Spectral theory of ordinary and partial differential operators*
Jon M. Corson, Martyn Russell Dixon, Martin J. Evans, and Frank Roehl, *Infinite groups and group rings*
Dwight A. Duffus and Peter M. Winkler, *Combinatorial problems on partially ordered sets*
Karma K. Dajani, Jane M. Hawkins, Karl Petersen, and Mate Wierdl, *Ergodic theory and dynamical systems*
Alan Hopenwasser and Cecelia Laurie, *Operator algebras*
Vo Thanh Liem and Bruce S. Trace, *Geometric topology*
Kai-Ching Lin, Tavan T. Trent, James Li-Ming Wang, and Zhijian Wu, *Harmonic analysis and related topics*
Charles A. Micchelli and R. A. Zalik, *Approximation theory: modern methods*

March 1992 Meeting in Springfield, Missouri
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: Expired
Deadline for consideration: December 12, 1991

Nakhle Habib Asmar and Stephen John Montgomery-Smith, *Harmonic analysis*
Margaret M. Bayer, *Combinatorics and discrete geometry*
Wenxiang Chen and Shou Chuan Hu, *Partial differential equations*
William J. Heinzer, Craig Hunecke, and Kishor M. Shah, *Commutative algebra*
Luis Hernandez and Ernst A. Ruh, *The geometry of connections*
Jerry A. Johnson and Benny D. Evans, *Microcomputers in the upper division and graduate curriculum*
Niky Kamran and Peter J. Olver, *Lie algebras, cohomology, and new applications to quantum mechanics*
Ellen Maycock Parker, *C^*– algebras and algebraic topology*
Boris M. Schein, *Semigroups*
Vera B. Stanojevic, *Fourier analysis*
Xingping Sun and Xiang Min Yu, *Approximation theory*

David Wright, *Automorphisms of affines spaces*
Jang-Mei Wu, *Classical complex analysis*

April 1992 Meeting in Bethlehem, Pennsylvania
Eastern Section
Associate Secretary: W. Wistar Comfort
Deadline for organizers: Expired
Deadline for consideration: January 2, 1992

Edward F. Assmus, Jr. and Jennifer D. Key, *Finite geometry*
Grahame Bennett, Jeffrey S. Connor, and Andrew K. Snyder, *Sequence spaces*
Jean-Luc Brylinski and Dennis A. McLaughlin, *Characteristic classes, algebraic K-theory, and field theory*
Donald M. Davis and Douglas C. Ravenel, *Homotopy theory*
David L. Johnson and Penny D. Smith, *Geometric analysis*
Xiao-Song Lin, *New invariants of links and 3-manifolds*
Lee J. Stanley, *Set theory*
Joseph E. Yukich, *Stochastic processes*

June 1992 Meeting in Cambridge, England
(Joint Meeting with the London Mathematical Society)
Associate Secretary: Robert M. Fossum
Deadline for organizers: Expired
Deadline for consideration: February 7, 1992

Béla Bollobás and Ronald L. Graham, *Probabilistic combinatorics*
John Coates, *Number theory*
Richard D. James, *The microstructure of crystals*
W. B. Raymond Lickorish, *Geometric topology in low dimensions*
William M. Kantor and Jan Saxl, *Groups: finite and algebraic*

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

Joanne M. Dombrowski and Richard Mercer, *Operator theory and operator algebras*
Anthony B. Evans and Terry A. McKee, *Combinatorics and graph theory*
Louis H. Kauffman, *Knots and topological quantum field theory*
Joe D. Mashburn, *Set-theoretic topology*

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

March 1993 Meeting in Knoxville, Tennessee
Southeastern Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: June 26, 1992
Deadline for consideration: To be announced

April 1993 Meeting in Salt Lake City, Utah
Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: July 9, 1992
Deadline for consideration: To be announced

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

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

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

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

March 1994 Meeting in Lexington, Kentucky
Southeastern Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: June 18, 1992
Deadline for consideration: To be announced

March 1994 Meeting in Manhattan, Kansas
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 25, 1993
Deadline for consideration: To be announced

January 1995 Meeting in Denver, Colorado
Associate Secretary: Andy R. Magid
Deadline for organizers: April 20, 1994
Deadline for consideration: To be announced

March 1995 Meeting in Chicago, Illinois
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 24, 1994
Deadline for consideration: To be announced

January 1996 Meeting in Orlando, Florida
Associate Secretary: Lance W. Small
Deadline for organizers: April 12, 1995
Deadline for consideration: To be announced

Information for Organizers

Special Sessions at Annual and Summer Meetings are held under the supervision of the Program Committee for National Meetings (PCNM). They are administered by the Associate Secretary in charge of that meeting with staff assistance from the Meetings Department 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 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 (Meetings Department, American Mathematical Society, P. O. Box 6887, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Electronic submission of abstracts is available to those who use the TEX typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to **abs-request@math.ams.com.** Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Electronic Abstracts, American Mathematical

Society, Publications Division, P.O. Box 6248, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain TEX, AMS-TEX, or the LATEX package.

Number of Papers Presented
Joint Authorship

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

An individual may contribute only one abstract by title in any one issue of *Abstracts*, but joint authors are treated as a separate category. Thus, in addition to abstracts from two individual authors, one joint abstract by them may also be accepted for an issue.

Site Selection for Sectional Meetings

Sectional Meeting sites are recommended by the Associate Secretary for the Section and approved by the Committee of Associate Secretaries and Secretary. Recommendations are usually made eighteen to twenty-four months in advance. Host departments supply local information, ten to twelve rooms with overhead projectors for contributed paper sessions and Special Sessions, an auditorium with twin overhead projectors for invited addresses, and registration clerks. The Society partially reimburses for the rental of facilities and equipment, and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the Associate Secretary for the Section.

Joint Meeting with the London Mathematical Society

Preliminary information

Cambridge, England, June 29–July 1, 1992

The two Societies are very gratified by the interest that has been shown in the Joint Meetings to be held in Cambridge, England, from Monday, June 29, to Wednesday, July 1, 1992. It seems possible that more people will wish to attend the meeting than had been originally expected. Whilst this is welcomed, it might cause problems in Cambridge both with housing and with lecture room accommodation. The first announcement of the meeting, with details of the scientific program, will appear in the January 1992 *Notices*. It will specify preregistration by May 1, 1992. All participants must preregister in advance of the meeting. Intending participants are urged to preregister at the earliest opportunity. If the number of preregistrations approaches the greatest number that the Local Organizing Committee feels can be accommodated in Cambridge, then the two Soceities might have to consider closing preregistration.

Mathematics Sessions at the AAAS Annual Meeting Chicago, IL, February 6–11, 1992

The annual meeting of the American Association for the Advancement of Science (AAAS), February 6–11, 1992 in Chicago, Illinois will feature many outstanding expository talks by prominent mathematicians. These talks include the following symposia (three-hour sessions) and invited addresses cosponsored by Section A (Mathematics) of the AAAS and the Society. In addition to supporting speakers in mathematical symposia, AMS has a committee to act as a liaison with the AAAS. The Society believes that strengthening its ties with the AAAS helps to create new opportunities for mathematicians to interact with scientists from all disciplines.

The names and affiliations of the organizers follow (speakers' names are given in parentheses):

- *Patterns and order*, organized by **Charles Radin**, University of Texas, Austin; and **Marjorie Senechal**, Smith College. (David S. Griffeath, Leo Kadanoff, Charles Radin, Marjorie Senechal.)
- *Wavelets and their applications*, organized by **Ingrid Daubechies**, Rutgers University and AT&T Bell Labs; **Stephane Mallat**, New York University, Courant Institute; and **Martin Vetterli**, Columbia University. (Ronald R. Coifman, Ingrid Daubechies, Stephane Mallat, H. L. Resnikoff, Martin Vetterli.)
- *Mathematics and computers*, organized by **Jon Barwise**, Indiana University; and **Keith Devlin**, Colby College. (Thomas Banchoff, Michael Freedman, Albert Marden, Clifford Pickover, Dana Scott, Stephen Wolfram.)
- *Parallel processing: Parallel computers, mathematics, and science*, organized by **Jill P. Mesirov**, Thinking Machines, Inc. (W. Daniel Hillis, Tom Leighton, Greg McRae, James A. Sethian.)
- *Revolution in undergraduate science and mathematics education?*, organized by **Charlene D'Avanzo**; **Merle Bruno**; **Ed Dubinsky**, Purdue University; and **Warren Page**, New York City Technical College, CUNY. (Charlene D'Avanzo, Tom Dick, Ed Dubinsky, Theodore Ducas, James J. Kaput, Lauret Savoy.)
- *Mathematical modeling and environmental concerns*, organized by **Ben A. Fusaro**, Salisbury State University. (George Carrier, Richard E. Ewing, James G. Glimm, Simon A. Levin, Robert W. McKelvey, Charles Tier.)
- *Confidentiality in databases*, organized by **Kathryn M. Chaloner**, University of Minnesota; **George T. Duncan**, Carnegie Mellon University; and **Arjen Lensta**, Bellcore. (Joseph Buhler, George T. Duncan, Sallie Keller-McNulty, Sumitra Mukherjee, Elizabeth A. Unger, Yacov Yacobi.)
- *Frontiers of physical sciences: Self-organization of excitable 2-D cellular automata*, by **David S. Griffeath**, University of Wisconsin, Madison.

In addition, section A of the AAAS will sponsor various symposia that will especially interest mathematicians and mathematics educators. These symposia include:

- *Statistics don't lie, but...*
- *Statistical modeling and analysis*
- *The "Access to Algebra" initiative*
- *Science and math education in central cities*
- *Applications of massively parallel computing*
- *Whose science and math is it anyway? Multicultural perspectives*
- *Scientific research in science education*
- *Innovation in precollege science and math delivery*
- *Presidential awardees make science and math live!*

The above symposia represent only a few of the approximately 150 AAAS program offerings that will broaden the perspectives of students and professionals alike. Indeed, AAAS annual meetings showcase American science and deserve greater mathematical participation. The Section A Committee seeks organizers and speakers who can present substantial new material in understandable ways. This task is not easy, but the outstanding success of the mathematics symposia at last year's AAAS annual meeting in Washington, DC proved that effort and inspiration can accomplish wonders. The 1991 mathematics program demonstrated that first-rate mathematical researchers can also effectively reach a broad and diverse scientific audience.

Section A of the AAAS knows that increasing the representation and participation of mathematicians at AAAS annual meetings offers an important means for deepening public awareness and appreciation of the manifold ways that mathematics contributes to science and society.

For details about the symposia, see the November 15, 1991 issue of *Science*. Participants are invited to attend the Section A committee meeting, 11:30 a.m. to 1:30 p.m., February 9, 1992 in the Wright Room, Hyatt Regency. This meeting is open to all who wish to stimulate interest in activities of the mathematical sciences within the AAAS. Symposia proposals for future AAAS meetings should be sent to: Warren Page, Secretary of Section A, AAAS, Department of Mathematics, New York City Technical College, CUNY, 300 Jay St., Brooklyn, NY 11201.

Mathematical Sciences Meetings and Conferences

THIS SECTION contains announcements of meetings and conferences of interest to some segment of the mathematical public, including *ad hoc*, local, or regional meetings, and meetings or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. (Information on meetings of the Society, and on meetings sponsored by the Society, will be found inside the front cover.)

AN ANNOUNCEMENT will be published in *Notices* if it contains a call for papers, and specifies the place, date, subject (when applicable), and the speakers; a second full announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in each issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

IN GENERAL, announcements of meetings and conferences held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of *Notices*, care of the American Mathematical Society in Providence.

DEADLINES for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

EFFECTIVE with the 1990 volume of *Notices*, the complete list of Mathematical Sciences Meetings and Conferences will be published only in the September issue. In all other issues, only meetings and conferences for the twelve-month period following the month of that issue will appear. As new information is received for meetings and conferences that will occur later than the twelve-month period, it will be announced at the end of the listing in the next possible issue. That information will not be repeated until the date of the meeting or conference falls within the twelve-month period.

1991–1992. **Mittag-Leffler Institute Academic Program for 1991–1992: Combinatorics**, Djursholm, Sweden. (Apr. 1991, p. 359)

* 1991–1992. **1991-1992 Special Year on Automorphic Forms in Number Theory**, Centre de Recherches Mathématiques, Université de Montréal. (Please note corrections to Sep. 1991, p. 832)

CHAIRMAN: R. Murty (McGill Univ.), previously incorrectly listed as J. Arthur.

INVITED SPEAKERS: J. Arthur (Univ. of Toronto) will be the principle speaker (Aisenstadt Chair) during the Spring of 1992.

1991–1992. **DIMACS Special Year: Graph Theory and Algorithms**, Center for Discrete Mathematics, Rutgers, The State University of New Jersey. (Oct. 1991, p. 1005)

1992

1992. **IMACS Symposium on Symbolic Computation in Engineering Design**, IDN, Lille, France. (Jul./Aug. 1990, p. 746)

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

Spring 1992. **International Conference on Finite Elements and Boundary Elements in Geophysics**, Monteray, CA. (Oct. 1990, p. 1141)

Spring 1992. **IMACS Symposium on Mathematical Modelling**, Wiener Neustadt, Germany. (May/Jun. 1991, p. 475)

Spring 1992. **Third IMACS International Conference on Expert Systems in Numerical Computing**, Purdue University, West Lafayette, IN. (May/Jun. 1991, p. 475)

Spring 1992. **DIMACS Workshop on Expander Graphs: Theory and Applications**, Center for Discrete Mathematics, Rutgers, The State University of New Jersey. (Oct. 1991, p. 1007)

January 1992

1–11. **Mathematische Optimierung**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

3–6. **International Conference on Random Mappings, Partitions, and Permutations**, University of Southern California, Los Angeles, CA. (Sep. 1991, p. 835)

3–6. **Short Conference on Topology**, Kansas State University, Manhattan, KS. (Nov. 1991, p. 1165)

3–7. **Seventh Texas International Symposium on Approximation Theory**, Austin, TX. (Sep. 1991, p. 835)

* 3–10. **Third European Symposium on Analysis and Probability**, Paris, France.

PROGRAM: The symposium will be divided into two parts. The first part (Jan. 3-4) will be devoted to round tables. The second part (Jan. 6-10) will consist of seven fifty-minute formal conferences each day.

ORGANIZERS: P. Malliavin, M. Yor.

INVITED SPEAKERS: H. Airault (Paris), S. Albeverio (Bochum), M. Barlow (Cambridge, G.B.), R. Buckdahn (Berlin), D. Elworthy (Warwick), J.P. Kahane (Orsay), S. Kotani (Tokyo), W. Hansen (Bielefeld), L. Hudson (Nottingham), W. Kendall (Warwick), G. Lawler (Durham, U.S.), J.F. Le Gall (Paris), Y. Le Jan (Paris), T. Lyons (Edinburgh), P.A. Meyer (Strasbourg), S. Molchanov (Irvine), N. Nagasawa (Zurich), D. Nualart (Barcelone), M. Okada (Sendai), B. Oksendale (Oslo), M. Pinsky (Evanston), S. Shigekawa (Kyoto), J. Zambrini (Lisbonne).

INFORMATION: P. Malliavin, 10 rue Saint Louis en l'Isle, 75004 Paris; FAX: 33.1.44.27.53.45.

5–8. **Second Caribbean Conference on the Fluid Dynamics**, University of the West Indies, St. Augustine, Trinidad. (Jan. 1991, p. 51)

5–8. **Second International Symposium on Artificial Intelligence and Mathematics**, Fort Lauderdale, FL. (Oct. 1991, p. 1007)

*5–11. **Mathematische Optimierung**, Oberwolfach, Federal Republic of Germany.

CHAIRMEN: B. Korte, Bonn; K. Ritter, München.
INFORMATION: Mathematisches Forschungsinstitut Oberwolfach Geschäftsstelle: Alberstrasse 24 D-7800 Freiburg im Breisgau.

6–7. **AMS Short Course on "New Scientific Applications of Geometry and Topology"**, Baltimore, MD. (Jul./Aug. 1991, p. 643)

6–17. **Topology Workshop**, Pontifical Catholic University, Rio de Janeiro, Brazil. (Oct. 1991, p. 1007)

6–17. **International Research Workshop on Banach Space Theory**, Merida, Venezuela. (Jul./Aug. 1991, p. 643)

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

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

12–18. **Applied Dynamics and Bifurcation**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

13–15. **DIMACS Workshop: Graph Embeddings and Parallel Architectures**, Center for Discrete Mathematics, Rutgers, The State University of New Jersey. (Oct. 1991, p. 1007)

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

*13–17. **Analyse Complexe et Géometrie**, Marseille, France.

CHAIRMAN: J. Detraz, Marseille.
INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

15–17. **Workshop on Stochastics and Analysis**, Universität Zürich, Zürich, Switzerland. (May/Jun. 1991, p. 475)

17. **Joint Meeting with the Edinburgh Mathematical Society**, International Centre for Mathematical Sciences, Edinburgh, Scotland. (Oct. 1991, p. 1008)

*19–22. **Nineteenth Annual ACM SIGPLAN-SIGACT Symposium on the Principles of Programming (POPL)**, Albuquerque, NM.

INFORMATION: P. Mishra, 2426 Computer Science Bldg., SUNY Stony Brook, NY 11794-4400; 516-632-8450; email: mishra@sbcs.sunysb.edu.

19–25. **Modelltheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

*20–25. **Théorems de Lefschetz**, Marseille, France.

CHAIRMAN: F. El Zein, Paris.
INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

26–February 1. **Applied and Computational Convexity**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

27–29. **Third ACM-SIAM Symposium on Discrete Algorithms**, Orlando, FL. (Feb. 1991, p. 146)

27–31. **Conference on Scientific Computing**, Benin-City, Nigeria. (Nov. 1991, p. 1165)

*27–31. **Théorie des Modeles**, Marseille, France.

CHAIRMAN: D. Lascar, Paris.
INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

*27–February 1. **A Colloque Franco-Sovietique de Theorie des Modeles**, C.I.R.M., Luminy, France.

ORGANIZERS: D. Lascar (Paris VII), B. Poizat (Paris VI), B. Baijanov (Alma-Ata), and T. Mustafin (Karaganda).
INFORMATION: D. Lascar, Equipe de Logique Mathematique, CNRS URA 753, Tour 45, 5 etage, couloir 45-55, 2 place Jussieu 75251, Paris cedex 05 France; email: dl@frmap711.bitnet, poizat@frmap711.bitnet or logique@frmap711.bitnet.

February 1992

*1–2. **First Southern California Geometric Analysis Seminar**, University of California, Irvine.

INVITED SPEAKERS: *Tentative*: C. Croke (U. Penn, MSRI), W.-Y. Hsiang (UC Berkeley), R. Schoen (Stanford), C. Taubes (Harvard), G. Tian (Courant).
INFORMATION: P. Li, Dept. of Math., Univ. of California, Irvine, CA 92717; pli@oac.uci.edu; 714-856-7049; FAX: 714-856-7993.

2–8. **Thermodynamische Materialtheorien**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

3. **Joint Meeting of the ICMS and the Royal Society of Edinburgh**, International Centre for Mathematical Sciences, Edinburgh, Scotland. (Oct. 1991, p. 1008)

3–7. **Eighth International Conference on Data Engineering**, Phoenix, AZ. (Jul./Aug. 1991, p. 643)

3–7. **Twenty-third Southeastern International Conference on Combinatorics, Graph Theory, and Computing**, Florida Atlantic University, Boca Raton, FL. (Nov. 1991, p. 1166)

9–15. **Numerical Methods for Parallel Computing**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

10–11. **Workshop on Amenable Ergodic Theory**, Mathematical Sciences Research Institute (MSRI), Berkeley, CA. (May/Jun. 1991, p. 475)

*11–13. **International Symposium on Algebraic Geometry and Related Topics**, Incheon, Korea.

PROGRAM: The symposium will consist of a series of lectures by invited speakers.
ORGANIZERS: J.-H. Yang (Inha Univ.), Y. Namikawa (Nagoya Univ.), J.-S. Pak (Kyungbook Univ.), K. Ueno (Kyoto Univ.)
INVITED SPEAKERS: Japan: S. Mori (RIMS), S. Mukai (Nagoya Univ.), K. Saito (RIMS); Germany: E. Freitag (Heidelberg Univ.); U.S.A.: W. Schmid, Y.-T. Siu, and S.-T. Yau of Harvard Univ.
INFORMATION: J.-H. Yang, Dept. of Math., Inha Univ., Incheon 402-751, Republic of Korea; FAX: 82(Korea)-32-863-1333; email: ba12@krinha.bitnet.

*11–14. **Tenth International Conference on Computing Methods in Applied Sciences and Engineering**, Paris, France.

INFORMATION: INRIA-Rocquencourt, Bureau des Colloques, Domaine de Voluceau-Rocquencourt-BP 105, F-78153 Le Chesnay Cedex.

16–22. **Funktiontheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

17–22. **Informatics '92**, Havana, Cuba. (Sep. 1991, p. 836)

23–29. **p-Adische Analysis und Anwendungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 51)

24–28. **IEEE Computer Society COMPCON Spring '92**, San Francisco, CA. (Jan. 1990, p. 62)

24–28. **Elliptic Curves and Related Topics**, Sainte-Adèle, Québec, Canada. (Please note correction to Sep. 1991, p. 836)

24–March 1. **IMA Workshop on Iterative Methods for Sparse and Structured Problems**, University of Minnesota, Minneapolis, MN. (Jul./Aug. 1991, p. 643)

March 1992

1–7. **Klassifizierende Räume und Anwendungen der Steenrod-Algebra**, Oberwolfach, Germany. (Jan. 1991, p. 52)

2–6. **Workshop on Interfaces between Physics and Mathematics**, University of Vienna, Austria. (Nov. 1991, p. 1166)

3–5. **ACM 1992 Computer Science Conference**, Kansas City, Missouri. (Jul./Aug. 1991, p. 644)

5–6. **Twenty-third SIGCSE ('92) Technical Symposium**, Kansas City, MO. (Jul./Aug. 1991, p. 644)

*7–8. **Fifteenth Annual Texas Partial Differential Equations Conference**, University of North Texas, Denton, TX.

PROGRAM: In keeping with tradition, the conference will have no principle speakers, and all talks will be 20 minutes in length. Talks will be held on Saturday afternoon and Sunday morning.
CALL FOR PAPERS: Submit title and short abstract (preferably by email) by February 20, 1992.
INFORMATION: H. Warchall, Math. Dept., Box 5116, Univ. of North Texas, Denton, TX 76203-5116; 817-565-2155; FAX: 817-565-4919; hankw@vaxa.acs.unt.edu or hankw@untvax.bitnet.

8–14. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

*9–11. **Minisymposium on Dynamical Systems**, Helsinki, Finland.

PROGRAM: The focus will be on the mathematics of dynamical systems. Independent lecture series of four to five hours each will be given by M. Benedicks (Stockholm), G. Keller (Erlangen), and B. Kitchens (IBM Research, NY). Participants will be provided an opportunity for short oral presentations.
ORGANIZERS: K. Eloranta, G. Högnäs and E. Nummelin.
INFORMATION: K. Eloranta via email: kelorant@hila.hut.fi or E. Nummelin, Dept. of Math., Univ. of Helsinki, Hallitusk. 15, 00100 Helsinki, Finland.

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

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

*13–15. **Permian Basin Supercomputing Conference 1992**, University of Texas of the Permian Basin, Odessa, TX. (Please note change from Nov. 1991, p. 1166)

INVITED SPEAKERS: Please note the correct spelling of G. McMechan's (Univ. of Texas) last name.

15–21. **Regelungstheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

*19–22. **1991-1992 Annual Meeting of the Association for Symbolic Logic**, Duke Univ., Durham, NC.

CALL FOR PAPERS: Abstracts of contributed papers (300 words double spaced) should be submitted to the program chair at the address below by January 15, 1992.
INFORMATION: A. Langen, Staff Asst., Dept. of Math., Duke Univ., Room 135 Physics Bldg., Science Dr., Durham, NC 27706; email: langen@math.duke.edu; 919-660-2825; or S.D. Friedman (Program Chair), Dept. of Math., MIT, Cambridge, MA 92139; email: sdf@bourbaki.mit.edu; or R. Hodel (Arrangements Chair), Dept. of Math., Duke Univ., Durham, NC 27706.

20–21. **Central Section**, Southwest Missouri State University, Springfield, MO.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

*21–27. **Workshop on Fluid Dynamics and Statistical Physics**, Institute for Advanced Study, Princeton, NJ. (Please note addition of Invited Speakers from Jul./Aug. 1991, p. 644)

INVITED SPEAKERS: J. Bell, Lawrence Livermore Nat'l. Lab.; A. Chorin, Inst. for Advanced Study; P. Constantin, Univ. of Chicago; P. Dimotakis, California Inst. of Tech.; C. Foias, Indiana Univ. at Bloomington; J. Glimm, State Univ. of NY at Stony Brook; L. Kadanoff, Univ. of Chicago; R. Kraichnan; A. Libchaber, NEC Research Inst.; A. Majda, Inst. for Advanced Study; J. McWilliams, NCAR; S. Orszag, Princeton Univ.; Y. Pomeau, Ecole Normale Superieure; R. Robert, Univ. de Lyon; E. Siggia, Cornell Univ.; P. Woodward, Univ. of Minnesota.

22–28. **Teichmüller-Theorie und Modulraume Riemannscher Flachen**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

22–28. **Georgia Tech.-UAB International Conference on Differential Equations and Mathematical Physics**, Atlanta, GA. (Jul./Aug. 1991, p. 644)

*23–27. **Elliptic Boundary Value Problems**, Rostock, Federal Republic of Germany.

INFORMATION: Conference Elliptic Boundary Value Problems, Univ. Rostock, FB Mathematik, Universitatsplatz 1, 0-2500 Rostock, Germany.

*23–April 10. **Representation of Lie Groups (Advanced Workshop)**, Trieste, Italy.

CHAIRMEN: J. Tirao, J. Rawnsley, Trieste.
INFORMATION: International Centre for Theoretical Physics, P.O. Box 586, Miramare, Strada Costiera 11, I-34100 Trieste.

24–26. **Data Compression Conference–DCC '92**, Snowbird, Utah. (Nov. 1991, p. 1167)

24–28. **GAMM Annual Meeting**, Leipzig, Germany. (Sep. 1991, p. 836)

24–28. **Algebraic Groups and Their Representations**, University of California, Los Angeles. (Oct. 1991, p. 1008)

25–28. **International Conference on Hamiltonian Dynamical Systems**, Univ. of Cincinnati, Cincinnati, OH. (Nov. 1991, p. 1167)

27–28. **Eighth South-Eastern Analysis Meeting (SEAM VIII)**, University of Tennessee, Knoxville, TN. (Sep. 1991, p. 836)

29–April 4. **Topologische Methoden in der Gruppentheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1991, p. 52)

29–April 5. **Sixth International Conference on Geometry**, University of Haifa, Israel (postponed from March 1991 because of the Gulf War). (Jul./Aug. 1991, p. 644)

30–31. **IMA International Conference on Mathematics in Industrial Maintenance**, Edinburgh, Scotland. (Nov. 1991, p. 1167)

30–April 2. **Thirty-fourth British Theoretical Mechanics Colloquium**, University of Keele, England. (Sep. 1991, p. 836)

30–April 3. **Workshop on Statistical Methods in Molecular Biology**, Mathematical Sciences Research Institute, Berkeley, CA. (Sep. 1991, p. 836)

April 1992

April 1992. **Eighth International Conference on Mathematical and Computer Modelling**, United States. (Sep. 1990, p. 939)

*2–4. **Twenty-sixth Annual Spring Topology Conference**, University of North Carolina, Charlotte, NC.

PROGRAM: All areas of topology will be covered. Some areas of special interest are general, point-set, and geometric topology, continua theory, and dynamical systems. This year's theme is the width and breadth of topology.
ORGANIZING COMMITTEE: D.C. Royster and N. Stavrakas.
INVITED SPEAKERS: W. Thurston, D. Fried, C. Gordon, L. Oversteegen, S. Ferry, J. Stasheff, S. Newhouse, J. van Mill, C. Pugh, D.W. Sumners, F. Connelly, F. Raymond, M. Reed, D. Shakhamtov, S. Watson.
CALL FOR PAPERS: Fifteen minute talks in all branches of topology are solicited. Send a TEX, LATEX, or AMS-TEX file via email, or a type-written (Camera-ready) abstract consisting of 200 or less words to the address below. Deadline for abstracts is March 1, 1992.
INFORMATION: D. Royster or N. Stavrakas Dept. of Math., UNC Charlotte, Charlotte, NC 28223; droyster@unccvax.uncc.edu or fma00dcr@unccvm.bitnet or fma00nmx@unccvm.bitnet; 704-547-4551.

3–4. **1992 Illinois Number Theory Conference**, University of Illinois, Urbana, IL. (Nov. 1991, p. 1167)

*3–4. **Sixteenth Annual Meeting of the Southeast-Atlantic Section of SIAM**, University of Alabama, Huntsville, AL.

INFORMATION: Jim Epperson at email:

epperson@math.uah.edu or call 205-895-6470.

*3–5. **Southeast Dynamical Systems Conference**, Raleigh, NC.

INVITED SPEAKERS: K. Alligood (George Mason), L. Bunimovich (Georgia Tech), S.-N. Chow (Georgia Tech), A. Fathi (Univ. of Florida), J. Guckenheimer (Cornell), X.-B. Lin (North Carolina State), C. Robinson (Northwestern), D. Shafer (Univ. of North Carolina, Charlotte), P. Takác (Vanderbilt).
INFORMATION: J. Selgrade or S. Schecter, Dept. of Math., Box 8205, North Carolina State Univ., Raleigh, NC 27695-8205; email: selgrade@ncsuvm.bitnet or schecter@matagh.ncsu.edu.

5–11. **Algebraische K-Theorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

5–11. **Informationstheorie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1991, p. 644)

*6–8. **Nineteenth Conference of the Standing Committee on Regional and Urban Statistics**, Prague, Czechoslovakia.

INFORMATION: ISI Permanent Office, 428 Prinses Beatrixlaan, P.O. Box 950, NL-2270 AZ Voorburg.

6–10. **IMA Workshop on Linear Algebra for Signal Processing**, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)

6–10. **Forty-fourth British Mathematical Colloquium**, University of Strathclyde, Glasgow, Scotland, UK. (Nov. 1991, p. 1167)

*6–10. **Second International Conference on p-Adic Functional Analysis**, Universidad de Santiago, Santiago, Chile.

PURPOSE: The main objectives of the conference are to present new research in the field of nonarchimedean functional analysis and promote interactions among researchers. The program will include plenary sessions for the presentation of new contributions and discussion sessions to present open problems and new trends of research.
ORGANIZERS: N. De Grande-De Kimpe (Vrije Univ., Brussel, Belgium), J. Martinez-Maurica (Univ. de Cantabria, Espana), W. Schikhof (Katholieke Univ. Nijmegen, The Netherlands).
INFORMATION: H.R. Henriquez, C. Lizama, or S. Navarro, Dept. of Math., Univ. de Santiago, Casilla 5659 - Correo 2, Santiago, Chile; FAX: 56-2-6813083; email: snavarro@usachvm1.

*6–10. **Complas III Third International Conference on Computational Plasticity, Fundamentals, and Applications**, Barcelona, Spain.

INFORMATION: E. Onate, COMPLAS III Secretariat, Centro Internacional de Metodos Numericos en Ingeniera, Modulo CI, Campus Norte UPC, Gran Capitan, s/n E-08034 Barcelona.

*7–8. **Tutorial on Polynomial Iterative Methods**, Denver, CO.

PURPOSE: This tutorial is designed to provide a basic understanding of the fundamentals of preconditioned polynomial iterative methods for the solution of large sparse linear systems. It will be structured around a series of lectures and computer workshops.
TUTORIAL TOPICS: Basic polynomial iterative methods, Chebychev-like methods, conjugate gradient-like methods, basic preconditioning—matrix splitting, iterative methods for nonsymmetric systems, preconditioning by incomplete decomposition, equivalent preconditioning.
INFORMATION: Send email to cm-info@copper.denver.colorado.edu.

7–10. **Twenty-third Annual Iranian Mathematics Conference**, Razi University, Bakhtaran, Iran. (Sep. 1991, p. 836)

7–10. **Statistics in Public Resources and Utilities, and in Care of the Environment (SPRUCE)**, Lisbon, Portugal. (Nov. 1991, p. 1167)

9–11. **Symplectic Topology**, University of Arkansas, Fayetteville, Arkansas. (Sep. 1991, p. 837)

*9–14. **Copper Mountain Conference on Iterative Methods**, Copper Mountain, CO.

PROGRAM: **Special Features**: Tutorial on polynomial iterative methods, student paper competition, preliminary proceedings, special journal issues in SISSC and SIMAX.
CONFERENCE TOPICS: Nonsymmetric linear systems, nonlinear systems, applications on advanced architectures, equivalent preconditioning.
CALL FOR PAPERS: Abstracts deadline: January 1, 1992.
INFORMATION: Send email to cm-info@copper.denver.colorado.edu.

*10–12. **Structure and Representation Theory of Lie Algebras**, Yale University, New Haven, CT.

ORGANIZERS: B. Allison (Univ. of Alberta), W. Feit (Yale), B. Parshall (Univ. of Virginia), R. Wilson (Rutgers).
INVITED SPEAKERS: (Univ. of California, Riverside), E. Friedlander (Northwestern), J. Humphreys (Univ. of Massachusetts), N. Jacobson (Yale), J. Lepowsky (Rutgers), O. Mathieu (Rutgers), L. Scott (Univ. of Virginia), H. Strade (Hamburg).
INFORMATION: W. Feit, Department of Math., Yale Univ., New Haven, CT 06520; email: feit@lom1.math.yale.edu.

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

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

*12–16. **Diophantine Approximation and Abelian Varieties**, Soesterberg, The Netherlands.

INFORMATION: F. Oort, Math. Inst., P.O. Box 80010, NL-3508 TA Utrecht.

12–18. **Mathematische Logik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

13–17. **Workshop on Lie Groups, Ergodic Theory, and Geometry**, Mathematical Sciences Research Institute (MSRI), Berkeley, CA. (May/Jun. 1991, p. 476)

*13–17. **Titre a Préciser**, Marseille, France.

CHAIRMAN: E. Pardoux, Marseille.
INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

*18. **Sixth New England Statistics Symposium**, Bentley College, Waltham, MA.

PRINCIPLE LECTURERS AND TOPICS: R. Devaney: Chaos, fractals, and dynamics; A. Gelfand: Model assessment and model choice: a Bayesian point of view.
INFORMATION: D. Haughton, Math. Sciences Dept., Bentley College, 175 Forest St., Waltham, MA 02154-4705; 617-891-2822; FAX: 617-891-3410.

19–25. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

26–28. **Conference on Applied Statistics in Agriculture**, Kansas State University, Manhattan, KS. (Nov. 1991, p. 1167)

*26–29. **Scalable High Performance Computing Conference "SHPCC '92"**, Williamsburg, VA.

PROGRAM: SHPCC is the successor to the Distributed Memory Computing Conference series. A scalable high performance architecture is defined as an architecture that is likely to be capable of delivering a teraflop sustained performance in the relatively near future. SHPCC will focus on software being developed to make it possible to effectively exploit the coming generations of these architectures and on applications that require teraflop computational rates. Particular emphasis will be placed on two application areas: fluid dynamics and its uses in problems that arise in the design of aircraft, spacecraft, and automobiles; and molecular dynamics and its uses in the pharmaceutical and chemi-

cal industries. The conference will begin with one day of tutorials followed by a two and one half day technical program that will consist of four invited talks, two parallel tracts of half hour talks, and a small poster session.
INFORMATION: E. Todd, ICASE, Mail Stop 132-C, NASA Langley Res. Ctr., Hampton, VA 23665; emily@icase.edu.

26–May 2. **Gruppentheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

* 27–31. **Titre a Préciser**, Marseille, France.

CHAIRMAN: M. Giusti, Palaiseau.
INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

30–May 1. **Twenty-third Annual Pittsburgh Conference on Modeling and Simulation**, University of Pittsburgh, PA. (Jul./Aug. 1991, p. 644)

May 1992

* 1–5. **Topology and its Connections to Geometry and Modular Representation Theory**, Northwestern University, Evanston, IL.

PROGRAM: The conference will be supported by a grant from the NSF and by Northwestern Univ. The program will consist of invited addresses and contributed papers.
INFORMATION: E. Friedlander, Math. Dept., Northwestern Univ., Evanston, IL 60208-2730.

May 1992. **Conference on Classification of Algebraic Varieties**, L'Aquila, Italy. (Apr. 1991, p. 366)

3–9. **Wavelett (Signalverarbeitung)**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

* 3–14. **Evolutionary Stochastic Systems: Theory and Applications to Physics and Biology**, Katsively, Crimea, Ukraine (USSR).

PROGRAM: This conference will broadly cover the field of theory of random evolutions as well as the related problems in probability theory, mathematical statistics and their applications.
ORGANIZING COMMITTEE: V.S. Korolyuk, A.V. Skorokhod, D. Ya. Petrina, A.V. Swishchuk.
INFORMATION: A. Swishchuk, Inst. Math. Ukrain. Acad. Sci., Repin Str. 3, Kiev 4 252601 Ukraine (USSR); V. Zayats, Centre de Recerca Matematica, Inst. d'Estudis Catalans, Apartat 50-08193 Bellaterra (Spain).

4–6. **1992 ACM Symposium on the Theory of Computing**, Victoria, British Columbia, Canada. (Oct. 1991, p. 1009)

4–6. **1992 IEEE Symposium on Research in Security and Privacy**, Oakland, CA. (Nov. 1991, p. 1168)

10–16. **Geschichte der Mathematik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

11–13. **Fourth SIAM Conference on Optimization**, Chicago, IL. (Feb. 1991, p. 146)

11–15. **IUTAM Symposium on Inverse Problems in Engineering Mechanics**, Tokyo, Japan. (Sep. 1991, p. 837)

* 11–15. **Rencontre Franco-Russe de Géometrie**, Marseille, France.

CHAIRMEN: P. Iglesias, V. Ovsienko, Marseille.
INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

17–23. **Quadratische Formen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

18–22. **Eighth International Conference on the Numerical Analysis of Semiconductor Devices and Integrated Circuits: NASECODE VIII**, City Club, Vienna, Austria. (Nov. 1991, p. 1168)

* 18–22. **Algebren en Théorie des Nombres**, Marseille, France.

CHAIRMAN: M. Cohen, Martinet, Bordeaux.
INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

18–23. **Second European Conference on Computer Vision**, Santa Margherita Ligure, Italy. (Jul./Aug. 1991, p. 645)

18–23. **Low-Dimensional Topology**, Knoxville, TN. (Oct. 1991, p. 1009)

20–June 5. **Workshop on Automorphic Forms and L-functions**, Institute for Advanced Studies, Hebrew Univ. of Jerusalem, Israel. (Nov. 1991, p. 1168)

24–30. **Kommutative Algebra und Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 146)

25–28. **NATO Advanced Research Workshop: Asymptotic-Induced Numerical Methods for PDE's, Critical Parameters, and Domain Decomposition**, Beaune, France. (Sep. 1991, p. 837)

* 25–29. **Endoscopie Automorphe**, Marseille, France.

CHAIRMEN: L. Clozel, Paris; J.-P. Labesse, Paris.
INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

28–30. **ICCI '92–Fourth International Conference on Computing and Information**, Toronto, Canada. (Oct. 1991, p. 1009)

29–31. **Twenty-first International Symposium on Multi-Valued Logic**, Sendai 980, Japan. (Jan. 1990, p. 62)

31–June 6. **Singularitaten**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

31–June 6. **Free Resolutions in Algebraic Geometry and Representation Theory**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

* 31–June 14. **Summer Workshop: Calculus, Computers, Concepts, and Cooperative Learning**, Purdue University, West Lafayette, IN.

PROGRAM: This two week, intensive, total-immersion program will focus on the use of computers, research into learning theory, and a cooperative learning environment to help students learn calculus concepts. A three day pre-workshop tutorial on the basic use of the necessary computer systems will be offered as an option. Participants are expected to return the following summer for two days to discuss their teaching experiences based on the workshop. The workshop provides hands-on experience with computer software, class materials, and seminars on learning theory, including viewing and discussing videos of Purdue classroom and laboratory experiences in cooperative learning. Applications must be submitted by February 21, 1992.
INFORMATION: Ed Dubinsky, Dept. of Math., Purdue Univ., West Lafayette, IN 47907; email: bbf@j.cc.purdue.edu; 317-494-1982; FAX: 317-494-6318.

June 1992

June 1992. **IMACS Symposium on Numerical Computing and Mathematical Modelling**, Bangalore, India. (Oct. 1990, p. 1141)

June 1992. **Continuum Models for the Microstructure of Crystals**, International Centre for Mathematical Sciences, Edinburgh, Scotland. (Oct. 1991, p. 1009)

1–5. **Seventh International Conference on Graph Theory, Combinatorics, Algorithms, and Applications**, Western Michigan University, Kalamazoo, MI. (May/Jun. 1991, p. 476)

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

* 1–5. **Third International Conference on Mathematical Population Dynamics**, University of Pau, France.

PROGRAM: The conference will be an interdisciplinary meeting of mathematicians and biologists concerned with populations of biomolecules, genes, cells, as well as other topics of mathematical population biology and epidemiology. The program will include general mathematical pop-

ulation theory, analysis of models, and quantitative data from cell and molecular biology, epidemiology, and cancer research.

ORGANIZING COMMITTEE: O. Arino (Pau), D. Axelrod (Rutgers), K. Hadeler (Tübingen), H. Heesterbeek (Amsterdam), M. Kimmel (Houston), M. Langlais (Bordeaux), A. Swierniak (Gliwice), B. Ycart (Pau).

CONFERENCE TOPICS: Structured population, stochastic models, molecular biology, cell biology, biomedicine, other topics.

INFORMATION: O. Arino, Univ. de Pau et des Pays de L'Adour, Lab. de Math. Appliquees, Av. de l'Univ. 64000 Pau, France; Tel: (33) 59.92.30.47.

*7–11. **International Joint Conference on Neural Networks "IJCNN '92"**, Baltimore, MD.

CHAIRMEN: C. Lau (General), B. Widrow (Honorary), J.J. Shynk (Program).

CONFERENCE TOPICS: Applications, artificially intelligent neural networks, associative memory, electronic neurocomputers, fuzzy neural networks, image processing, invertebrate neural networks, machine vision, neurocognition, neurodynamics, optical neurocomputers, optimization, pattern recognition, robotics and control, sensation and perception, sensorimotor control systems, speech processing, supervised learning, unsupervised learning.

CALL FOR PAPERS: Deadline for papers is January 15, 1992. Six copies of the paper must be submitted, six page maximum.

INFORMATION: Meeting Management, IJCNN '92 Conference Coordinator, 5665 Oberlin Dr., Suite #110, San Diego, CA 92121; 619-453-6222; FAX: 619-535-3880.

7–13. **Computational Group Theory**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

8–11. **Sixth SIAM Conference on Discrete Mathematics**, University of British Columbia, Vancouver, Canada. (May/Jun. 1991, p. 476)

8–13. **Zero-dimensional Schemes**, Ravello, Italy. (Sep. 1991, p. 837)

*8–19. **Dirichlet Forms**, Villa Monastero, Varenna, Italy.

DIRECTORS: G. Dell'Antonio and U. Mosco (Univ. di Roma "La Sapienza).

LECTURERS: E. Fabes (Univ. of Minnesota), M. Fukushima (Osaka Univ.), L. Gross (Cornell Univ.), C. Kenig (Univ. of Chicago), M. Röckner (Univ. Bonn), D. Stroock (MIT).

INFORMATION: P. Zecca, Secretary, CIME, Dipartimento di Matematica, U.Dini, Viale Morgagni 67/A, 50134 Firenze, Italy; email: cime@ifiidg.bitnet; tel: +39-55-434975.

10–16. **Geometric Topology Workshop**, Technion, Haifa, Israel. (Nov. 1991, p. 1168)

12–14. **Canadian Mathematical Society Summer Meeting**, York University, North York, Ontario, Canada. (Nov. 1990, p. 1289)

*12–20. **D-moduli and Representation Theory**, Ca' Foscari, Venezia, Italy.

DIRECTORS: G. Zampieri, A. D'Agnolo (Univ. di Padova).

LECTURERS: J.M. Bismut (Univ. Paris XI), J.E. Björk (Stockholm Univ.), L. Boutet de Monvel (Univ. Paris VI), C. De Concini (SNS, Pisa), C. Procesi (Univ. di Roma "La Sapienza"), P. Schapira (Univ. Paris Nord), M. Vergne (ENS, Paris).

INFORMATION: P. Zecca, Secretary, CIME, Dipt. di Matematica, U. Dini, Viale Morgagni 67/A, 50134 Firenze, Italy; email: cime@ifiidg.bitnet; tel: +39-55-434975.

13–16. **Conference in Geometric Group Theory**, Ohio State University, Columbus, OH. (Nov. 1991, p. 1168)

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

14–20. **Freiformkurven und Freiformflachen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

15–18. **Wave Phenomena II: Modern Theory and Applications**, Edmonton, Alberta, Canada. (Nov. 1991, p. 1169)

*15–18. **Computer Vision and Pattern Recognition**, Champaign, IL.

PROGRAM: The program will consist of high quality contributed papers on all aspects of computer vision and pattern recognition including applications.

CHAIRMEN: A. Rosenfeld (General), Univ. of Maryland; N. Ahuja and T.S. Huang (Program co-chairs), Univ. of Illinois.

CALL FOR PAPERS: Four copies of complete manuscripts should be received no later than November 1, 1991 at the address below.

INFORMATION: S. Collins, Univ. of Illinois, Beckman Institute, 405 N. Mathews, Urbana, IL 61801.

15–19. **Twenty-first International Conference on Stochastic Processes and their Applications**, Toronto, Canada. (May/Jun. 1990, p. 613)

15–19. **Fourth Conference on Formal Power Series and Algebraic Combinatorics**, Université du Quebec a Montréal. (Sep. 1991, p. 837)

15–19. **Sixth International Conference on Domain Decomposition Methods in Science and Engineering**, Como, Italy. (Nov. 1991, p. 1169)

*15–27. **Nonequilibrium problems in many-particle systems**, Montecatini Terme, Italy.

DIRECTORS: C. Cercignani, M. Pulvirenti (Polit. di Milano).

LECTURERS: L. Arkeryd (Chalmers Univ. of Tech., and Univ. of Göteborg), P.L. Lions (Univ. Paris-Dauphine), P. Markowich (Univ. Berlin), S.R.S. Varadhan (Courant Inst., NY).

INFORMATION: P. Zecca, Secretary, CIME, Dipt. di Matematica, U. Dini, Viale Morgagni 67/A, 50134 Firenze, Italy; email: cime@ifiidg.bitnet; tel: +39-55-434975.

17–20. **Fourth International Conference on Computers and Learning, ICCAL '92**, Acadia University, Nova Scotia, Canada. (Feb. 1991, p. 147)

21–27. **Porous Media**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

21–July 10. **Summer Geometry Institute**, Park City, Utah. (Nov. 1991, p. 1169)

*22–24. **Seventh IMACS International Conference on Computer Methods for Partial Differential Equations**, Rutgers University, New Brunswick, NJ.

PROGRAM: Manuscripts, proposals to organize sessions, and suggestions for keynote speakers are solicited on all aspects of the numerical solution of partial differential equations. While special emphasis will be placed on those aspects that are related to applications of new computing architectures, and those related to computational wave propagation and fluid dynamics, contributions to other areas will also be welcome.

CALL FOR PAPERS: Deadline for submission of manuscripts (full texts or one page comprehensive abstracts) and proposals to organize: As soon as possible.

INFORMATION: K. Hahn, IMACS PDE-7 Conference Secretary, Rutgers Univ., Dept. of Comp. Sci., New Brunswick, NJ 08903; FAX: 908-932-5530; email: imacs@cs.rutgers.edu.

22–25. **Seventh Annual IEEE Symposium on Logic in Computer Science**, Santa Cruz, CA. (Sep. 1991, p. 838)

22–25. **Seventh Annual Conference on Structure in Complexity Theory**, Boston University, Boston, MA. (Nov. 1991, p. 1169)

22–26. **Fifth International Meeting on Statistical Climatology (5IMSC)**, Toronto, Canada. (Nov. 1991, p. 1169)

22–26. **Twelfth Conference on Probability and Statistics in the Atmospheric Sciences**, Toronto, Canada. (Nov. 1991, p. 1169)

22–26. **The Twelfth Dundee Conference on Ordinary and Partial Differential Equa-**

tions, Dundee, Scotland. (Nov. 1991, p. 1170)

23–26. **Homotopy Theory**, Sorrento, Italy. (Jul./Aug. 1991, p. 645)

*23–27. **Workshop on Computational Geometry**, Turin, Italy.

ORGANIZERS: A. Conte, V. Demichelis, F. Fontanella, I. Galligani.
CONFERENCE THEME: Mathematical methods for the design of curves and surfaces.
INVITED SPEAKERS: C.K. Chui, N. Dyn, L. Guibas, C.M. Hoffman, T. Lyche, P. Sablonniere, L.L. Schumaker, F.I. Utreras.
INFORMATION: V. Demichelis, Dipt. di Matematica, Univ. di Torino, Via Carlo Alberto 10, 10123 Torino, Italy; FAX: +3911-534497; email: u156@itocisvm or demichelis@unimat.to.cnr.it.

28–July 4. **Hyperbolic Systems of Conservation Laws**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

29–30. **International Conference on the Development of Mathematics from 1900 to 1950**, Luxembourg. (Sep. 1991, p. 838)

29–July 1. **Joint Meeting with the London Mathematical Society**, Cambridge, England.

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

*29–July 3. **International Conference on K-Theory**, Strasbourg, France.

ORGANIZERS: C. Kassel, J.-L. Loday, N. Schappacher.
CONFERENCE THEMES: **Geometrie algebrique, arithmetique**: motifs, fonctions, dzeta, conjectures de Lichtenbaum-Quillen, conjectures de Beilinson, polylogarithmes, K-theorie des schemes; **Topologie algebrique, algebre homologique**: K-theorie des espaces, cohomologie S1-equivariante, homologie cyclique, homologie du groupe lineaire, K-theorie algebrique, algebres de Lie; **Geometrie differentielle**: pseudo-isotopie, conjectures de Novikov, geometrie differentielle noncommutative.
INFORMATION: Inst. de Recherche Math. Avancee, Univ. Louis Pasteur et CNRS, 7 rue Rene-Descartes, 67084 Strasbourg, France; Secretariat: Mme Moreau, tel: [33] 88 41 63 05; FAX: [33] 88 61 90 69; email: irma@frccsc21.bitnet.

29–July 5. **Nineteenth International Colloquium on "Group Theoretical Methods in Physics"**, Salamance, Spain. (May/Jun. 1991, p. 476)

July 1992

1–10. **Stochastic Analysis Workshop of Guadeloupe-Silivri**, Pointe-à-Pitre, France. (Jul./Aug. 1991, p. 645)

5–11. **Mathematische Modellierung und Simulation Elektrischer Schaltungen**, Oberwolfach, Germany. (Jul./Aug. 1991, p. 645)

5–August 1. **NSF Regional Geometry Institute: Computational Algebraic Geometry**, Amherst College, Amherst, MA. (Oct. 1991, p. 1010)

6–10. **European Congress of Mathematics**, Paris, France. (May/Jun. 1991, p. 476)

6–10. **Mathematical Conferences in Perth**, University of Western Australia. (Sep. 1991, p. 838)

6–10. **Eighteenth Australasian Conference on Combinatorial Mathematics and Combinatorial Computing**, Perth, Western Australia. (Nov. 1991, p. 1170)

6–10. **Thirty-Sixth Annual Meeting of the Australian Mathematical Society**, Perth, Western Australia. (Nov. 1991, p. 1170)

6–31. **IMA Summer Program on Environmental Studies: Mathematical, Computational, and Statistical Analysis**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 838)

6–August 14. **Summer Program in Mathematical Physiology**, Mathematical Sciences Research Institute, Berkeley, CA. (Sep. 1991, p. 838)

11–18. **St. Andrews Colloquium**, University of St. Andrews, Scotland. (Jul./Aug. 1991, p. 645)

12–17. **International Colloquium on Automata, Languages and Programming**, Vienna, Austria. (Jul./Aug. 1991, p. 645)

12–18. **Arithmetic Algebraic Geometry**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

*13–24. **SMS-NATO ASI: Bifurcations and Periodic Orbits of Vector Fields**, Univ. de Montréal, Montréal, Canada.

PROGRAM: The main topics to be discussed in this summer school are: Finiteness for limit cycles, divergent series and holomorphic dynamical systems techniques in the theory of local and nonlocal bifurcations, studies of real and complex polynomial systems, nonlinear oscillators, computational studies of dynamical systems, applications.
INVITED SPEAKERS: C. Camacho, F. Dumortier, J. Ecalle, J. Guckenheimer, P.J. Holmes, Y. Il'Yashenko, N.G. Lloyd, R. Moussu, J.-P. Ramis, R. Roussarie, C. Rousseau, D. Schlomiuk.
CALL FOR PAPERS: Deadline for applications: before March 6, 1992.
INFORMATION: G. David, Dept. de Math. et de Stats., Univ. de Montréal, C.P. 6128-A, Montréal H3C 3J7, Canada.

*19–23. **Sixth ACM International Conference on Supercomputing**, Washington, DC.

CONFERENCE TOPICS: Papers are solicited on significant new research results and experience in the development and use of supercomputing systems. Parallel and high-performance computer architectures, parallelizing compilers and programming environments, operating systems and performance evaluation, large-scale applications and algorithms, technologies, new experimental and commercial systems.
CALL FOR PAPERS: Authors should submit five copies of the full manuscript as follows: **North & South America**: C. Polychronopoulos, Program Chair, CSRD, Univ. of Illinois, 104 S. Wright St., Urbana, IL 61801; cdp@csrd.uiuc.edu; **Europe & Africa**: H. Wijshoff, Region Chair, Dept. of Comp. Sci., Utrecht Univ., Padualaan 14, 3584 CH Utrecht, The Netherlands; harry@cs.ruu.nl; **Japan & Far East**: T. Yuba, Region Chair, Electrotechnical Lab., 1-1-4 Umezono, Tsukuba, Ibaraki 305, Japan; yuba@etl.go.jp. Deadline for submissions is December 10, 1991.

19–24. **SIAM Annual Meeting (SIAM's 40th Anniversary)**, Los Angeles, CA. (Feb. 1991, p. 147)

19–25. **Lower-Dimensional Theories and Domain Decomposition Methods in Mechanics**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

19–25. **Applications of Nonstandard-Analysis to Analysis, Functional Analysis, and Probability Theory**, Heinrich Fabri-Institut der Universität Tübingen, Blaubeuren (Ulm), Federal Republic of Germany. (Jul./Aug. 1991, p. 645)

*19–31. **SERC Numerical Analysis Summer School**, Lancaster University, Lancaster, England.

PROGRAM: The meeting will comprise two one-week modules each of which can "stand alone" though it is hoped that many participants will stay for longer periods. SERC will contribute towards the subsistence costs of a limited number of participants each week. In each week there will be three five-lecture courses given by the invited instructors, additional activities organized by the local expert and a program of current research seminars given by participants.
SPEAKERS AND TOPICS: **Large scale matrix problems** (July 20-24): J. Dongarra, block algorithms for dense matrix computations; P.J. Plemmons (Wake Forest), parallel algorithms; H. Elman (Maryland), iterative methods for linear systems; N. Higham (Manchester), local expert. **Numerical solution of partial differential equations** (July 27-31): R. Bank (San Diego), preconditioners for elliptic PDEs; J. Jerome (Northwestern), semiconductor

device modelling; M. Pandolfi (Politecnico di Torino), hyperbolic systems; A. Wathen (Bristol), local expert.
INFORMATION: J. Gilbert, Dept. of Math., Lancaster Univ., Fylde College, Lancaster LA1 4YF; maa002@cent1.lancs.ac.uk.

20–24. **The Fifth International Conference on Fibonacci Numbers and their Applications**, University of St. Andrews, St. Andrews, Scotland. (May/Jun. 1991, p. 476)

20–24. **Algorithms for Approximation**, Cranfield Institute of Technology, Oxford. (Sep. 1991, p. 839)

*20–24. **Second Symposium on Logical Foundations of Computer Science (SCFS '92)**, Tver University, Tver, USSR.

CONFERENCE TOPICS: Complexity of formal systems, constructive mathematics in computer science, denotational semantics of programs, descriptive complexity, dynamic logic, concurrent and distributed computational models, foundations of logic programming, generalized computability, lamda and combinatory calculi, logical foundations of database theory, logics for knowledge, modal and temporal logics, program verification, teaching computer science and logic, and type theory in programming.
CALL FOR PAPERS: Abstracts of papers (2 copies) by December 2, 1991 with a cover page and a detailed abstract in English (3000 words or less including references).
INFORMATION: I. Kh. Musikaev, LFCS '92, Tver University, 33 Zhelyabova Str. Tver 170013 USSR or V.W. Marek, Dept. of Comp. Sci., Univ. of Kentucky, Lexington, KY 40506; email: marek@ms.uky.edu; FAX: 606-257-4078.

20–26. **International Conference on Algebraic Geometry**, Université Paris-Sud. (Please note date change from Apr. 1991, p. 363)

26–31. **Eighteenth International Symposium on Rarefied Gas Dynamics (RGD18)**, University of British Columbia, Vancouver, Canada. (May/Jun. 1991, p. 477)

26–August 1. **Variationsrechnung**, Oberwolfach, Germany. (Feb. 1991, p. 147)

26–August 1. **AMS-SIAM Summer Seminar on Exploiting Symmetry in Applied and Numerical Analysis**, Colorado State University, Fort Collins, CO.

INFORMATION: D.L. Salter, AMS, P.O. Box 6887, Providence, RI 02940.

*30–August 1. **The State of Matter: Conference on Mathematical Physics, Celebrating the Sixtieth Birthday of E.H. Lieb.**, Copenhagen, Denmark.

ORGANIZING COMMITTEE: M. Aizenman (Chair), G. Dell'Antonio, T.A. Bak, M. Flato, G.K. Pedersen, T. Spencer, and W. Thirring.
INVITED SPEAKERS: *Tentative and Partial*: I. Affleck, F. Almgren, M. Fisher, J. Froehlich, K. Gawedzki, J. Lebowitz, R. Seiler, B. Simon, Ya. Sinai, J.P. Solovej, W. Thirring, H.-T. Yau.
INFORMATION: M. Aizenman, Princeton Univ., Jadwin Hall, P.O. Box 708, Princeton, NJ 08544.

August 1992

August 1992. **The International Conference Lobachevsky and Modern Geometry devoted to the 200th Anniversary of Lobachevsky's birthday**, Kazan, USSR. (Feb. 1991, p. 147)

August 1992. **Kinetics of Phase Transitions**, International Centre for Mathematical Sciences, Edinburgh, Scotland. (Oct. 1991, p. 1010)

2–8. **Algebraische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

3–7. **Sixth Workshop on Lie-Admissible Formulations**, Clearwater, FL. (Mar. 1991, p. 244)

3–7. **Fifth International Meeting of Statistics in the Basque Country**, San Sebastin, Spain. (Jul./Aug. 1991, p. 646)

3–7. **Second Meeting of the International Linear Algebra Society (ILAS)**, University of Lisbon, Portugal. (Sep. 1991, p. 839)

*3–28. **IMA Summer Program for Graduate Students: Mathematical Modeling**, University of Minnesota, Minneapolis, MN.

PURPOSE: To expose 30 graduate students in mathematics and applied mathematics to mathematical modeling of problems which come from industry and engineering sciences, and to impact on them the excitement of solving real-world problems; and to create an environment whereby the students will get to know each other and will develop contacts which will enhance further research.
PROGRAM: Each Monday morning 3 problems will be posed to the whole class by the 3 tutors. The students will then be organized into 3 groups and each will concentrate on one of the problems the rest of the week. The students will develop a mathematical model as independently as possible. There will be 3 new problems weekly. Students are expected to participate in the entire four week program.
TUTORS: M. Brewster (Univ. of Colorado), D.S. Cohen (California Inst. of Tech.), J.D. Cole, D. Drew, A. Kapila (Rennselaer Polytechnic Inst.), P. Hagan (Los Alamos Nat'l Lab.), J.B. Keller (Stanford Univ.), C. Please (Southampton Univ.).
INFORMATION: Institute for Mathematics and Its Applications, University of Minnesota, 514 Vincent Hall, 206 Church St., SE, Minneapolis, MN 55455; FAX: 612-626-7370; 612-624-6066; ima_staff@ima.umn.edu.

9–15. **Jordan-Algebren**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

*9–16. **1992 ASL European Summer Meeting (Logic Colloquium '92)**, Budapest, Hungary.

PROGRAM: The meeting will be held in Veszprem, a small town about 50 miles from Budapest. The conference will consist of 5 sections: Set theory, algebraic and categorical logic, arithmetic, computer science logic, and philosophical logic.
CALL FOR PAPERS: Deadline for submitting abstracts (one page) for 20 minute contributed talks is April 1, 1992.
INFORMATION: Janos Bolyai Mathematical Society, ASL '92 Logic Conference, H-1027 Fö utca 68, Budapest, Hungary; or by email: aslogic@sztaki.hu; from Europe: aslogic@sztaki.uucp or h2499asl@ella.hu.

*10–18. **Canadian Mathematical Society Annual Seminar on Representations of Algebras and Related Topics**, Carleton University, Ottawa, Canada.

PROGRAM: One of the objectives of the seminar is to promote relationships of the representation theory of finite dimensional associative algebras to other areas of mathematics.
INFORMATION: V. Dlab, Dept. of Math. and Stat., Carleton Univ., Ottawa, Ontario K1S 5B6; 613-788-2166 or 788-2155; email: icra@carleton.ca; FAX: 613-788-3536.

13–17. **First Colloquium on Numerical Analysis**, Plovdiv, Bulgaria. (Oct. 1991, p. 1011)

16–22. **Reelle Analysis**, Oberwolfach, Germany. (Jul./Aug. 1991, p. 646)

17–21. **The Sixth International Conference on Boundary and Interior Layers–Computational and Asymptotic Methods (BAIL VI)**, Summit County, Colorado. (Nov. 1991, p. 1170)

17–21. **The Alan Day Conference on Lattices and Algebras**, McMaster University, Hamilton, Ontario, Canada. (Nov. 1991, p. 1171)

17–23. **Seventh International Congress on Mathematical Education (ICME-7)**, Université Laval, Québec, Canada. (Sep. 1991, p. 839)

18–22. **Third Colloquium on Differential Equations**, Plovdiv, Bulgaria. (Oct. 1991, p. 1011)

*19–22. **Sixth International Conference on Representations of Algebras (ICRA VI)**, Carleton University, Ottawa, Canada.

CALL FOR PAPERS: Abstracts due by July 15, 1992.
INFORMATION: Secretary ICRA VI, Dept. of Math. and Stat., Carleton Univ., Ottawa K1S 5B6, Canada.

19–26. **World Congress of Nonlinear Analysts**, Melbourne, FL. (Nov. 1991, p. 1171)

22–28. **Eighteenth International Congress of Theoretical and Applied Mechanics**, Technion–Israel Institute of Technology, Haifa, Israel. (Jan. 1991, p. 52)

23–29. **Mathematical Finance**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

26–28. **IMACS RM2S '92 Kobe**, Kobe University, Kobi, Japan. (May/Jun. 1991, p. 477)

30–September 5. **Komplexe Analysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

September 1992

September 1992. **IMACS 2nd International Conference on System Simulation and Scientific Computing-BICSC '92**, Beijing, China. (May/Jun. 1991, p. 477)

6–12. **Topologie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

8–11. **IMA Tutorial: Introduction to Linear Multivariable Control, Optimal Design, and Parameter Estimation**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 839)

9–11. **Royal Statistical Society Full Conference**, Sheffield, UK. (Nov. 1991, p. 1171)

13–19. **4-Dimensional Manifolds**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

14–18. **Twentieth European Meeting of Statisticians**, Bath, UK. (Nov. 1991, p. 1171)

16–18. **Second SIAM Conference on Control in the 90s**, Minneapolis, MN. (Feb. 1991, p. 148)

17–19. **International Conference on Group Theory**, University of Timisoara, Romania. (Jul./Aug. 1991, p. 646)

20–26. **Funktionalgeichungen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

21–25. **IMA Workshop on Robust Control Theory**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 839)

27–October 3. **Darstellungstheorie Endlicher Gruppen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

October 1992

4–10. **Funktionalanalysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

11–17. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

12–16. **IMA Workshop on Control Systems Design for Advanced Engineering Systems: Complexity, Uncertainty, Information, and Organization**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)

16–19. **Second SIAM Conference on Dynamical Systems**, Salt Lake City, UT. (Jul./Aug. 1991, p. 646)

18–24. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

*19–21. **The Fourth Symposium on the Frontiers of Massively Parallel Computation**, McLean, VA.

PROGRAM: This symposium will focus on research related to, or adaptable for, systems with 1,000 or more processors.

CALL FOR PAPERS: **Papers**: Submissions of original research papers about any aspects of the design, analysis, development, and/or use of massively parallel computers are solicited. Papers relating to high performance computing and communications are of particular interest. Please submit six copies of ten double-spaced pages by March 2, 1992 to: H.J. Siegel, Program Chair, Frontiers '92, School of Elect. Eng., 1285 Electrical Engineering Bldg., Purdue Univ., West Lafayette, IN 47907-1285. **Workshops**: by February 3, 1992 to I.D. Scherson, Workshops Chair, Frontiers '92, Dept. of Info. and Comp. Sci., Univ. of California, Irvine, CA 92717; email: wsf92@ics.uci.edu; FAX: 714-856-4056. **Tutorials**: by February 3, 1992 to J. Devaney, Tutorials Chair, Frontiers '92, NIST, Bldg. 225, Room B-146, Gaithersburg, MD 20899-0001; email: judy@cam.nist.gov; 301-975-2882.

22–30. **Forty-sixth Conference and Congress of the International Federation for Information and Documentation**, Madrid, Spain. (May/Jun. 1991, p. 477)

25–31. **Stochastische Analysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

30–November 1. **Central Section**, Right State University, Dayton, OH.

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

November 1992

*1–6. **The First Pan American Conference on Pre-Columbia Mathematics, Astronomy, and Modes of Thought**, Univ. Francisco Marroquín, Guatamala City and Tikal.

PROGRAM: The program will include plenary conferences, a symposium with guest speakers, informal sessions, poster sessions, and workshops.
CALL FOR PAPERS: Deadline for receipt of abstracts March 30, 1992.
INFORMATION: L. Morales Aldana, FIS-ICC, Univ. Francisco Marroquín, Apartado Postal 632-A, Guatemala, Guatemala; Tel: (502-2) 313890; FAX: (502-2) 346896; email: internet: lmorales@huracan.cr; bitnet: huracan!lmorales@uunet.uu.net.

1–7. **Kombinatorik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

8–14. **Numerische Integration**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

9–13. **IMA Workshop on Control and Optimal Design of Distributed Parameter Systems**, Institute for Mathematics and its Applications, University of Minnesota. (Nov. 1991, p. 1171)

14–16. **The Third Biennial Conference of the Allahabad Mathematical Society**, Allahabad, India. (May/Jun. 1991, p. 477)

15–21. **Komplexitatstheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

16–20. **International Congress on Numerical Methods in Engineering and Applied Sciences**, University of Concepción, Concepción, Chile. (Jul./Aug. 1991, p. 646)

16–20. **IMA Period of Concentration: Flow Control**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)

29–December 5. **Theory of Large Deviations**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

December 1992

6–12. **Theory and Numerical Methods for Initial-Boundary Value Problems**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

7–11. **IMACS Symposium on Scientific Computing and Mathematical Modelling**, Bangalore, India. (May/Jun. 1991, p. 477)

13–19. **Asymptotische Statistik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

27–31. **Holiday Symposium on Lie Group Representations and Combinatorics**, New

Mexico State University, Las Cruces, NM. (Sep. 1991, p. 840)

1993

1992–1993. **Mittag-Leffler Institute's Academic Program for 1992–1993: Special Problems in Mathematical Physics**, Djursholm, Sweden. (Nov. 1991, p. 1171)

The following new announcements will not be repeated until the criteria in the last paragraph in the box at the beginning of this section are met.

August 1993

* 13–17. **Second International Colloquium on Numerical Analysis**, Plovdiv, Bulgaria.

CONFERENCE TOPICS: Numerical methods of algebra, of approximation theory, for ordinary and partial differential equations.
CALL FOR PAPERS: Abstracts for contributed papers should be received by January 1, 1993.
INFORMATION: Secretary S. Zlatev, Mathematical Faculty of the Plovidv Univ., Tsar Assen Str. 24, Plovdiv 4000, Bulgaria; or D. Bainov, P.O. Box 45, 1504 Sofia, Bulgaria.

* 18–22. **Fourth International Colloquium on Differential Equations**, Plovdiv, Bulgaria.

CONFERENCE TOPICS: *Ordinary differential equations*: general, functional, impulsive, stochastic, integro-differential equations, dynamical systems and symplectic geometry, bifurcation theory, invariant manifolds, oscillation theory, difference equations, control theory, numerical analysis; *Partial differential equations*: linear and nonlinear—general, scattering theory and inverse problems, nonlinear hyperbolic equations—lifespan and blow-up of the solutions, global existence and stability, oscillation theory, numerical analysis.
CALL FOR PAPERS: Abstracts for contributed papers should be received by January 1, 1993.
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August 1994

3–11. **The International Congress of Mathematicans 1994**, Zürich, Switzerland. (Mar. 1991, p. 244)

New AMS Publications

TOPOLOGICAL CLASSIFICATION OF INTEGRABLE SYSTEMS
A. T. Fomenko, Editor
(Advances in Soviet Mathematics, Volume 6)

In recent years, researchers have found new topological invariants of integrable Hamiltonian systems of differential equations and have constructed a theory for their topological classification. Each paper in this important collection describes one of the "building blocks" of the theory, and several of the works are devoted to applications to specific physical equations. In particular, this collection covers the new topological invariants of integrable equations, the new topological obstructions to integrability, a new Morse-type theory of Bott integrals, and classification of bifurcations of the Liouville tori in integrable systems.

The papers collected here grew out of the research seminar "Contemporary Geometrical Methods" at Moscow University, under the guidance of A. T. Fomenko, V. V. Trofimov, and A. V. Bolsinov. Bringing together contributions by some of the experts in this area, this collection is the first publication to treat this theory in a comprehensive way.

Contents

1991 *Mathematics Subject Classifications*: 53, 57, 58, 70
ISBN 0-8218-4105-X, LC 91-640741, ISSN 1051-8037
345 pages (hardcover), December 1991
Individual member $108, List price $180,
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ESTIMATES AND ASYMPTOTICS FOR DISCRETE SPECTRA OF INTEGRAL AND DIFFERENTIAL EQUATIONS
M. Sh. Birman, Editor
(Advances in Soviet Mathematics, Volume 7)

The Leningrad Seminar on mathematical physics, begun in 1947 by V. I. Smirnov and now run by O. A. Ladyzhenskaya, is sponsored by Leningrad University and the Leningrad Branch of the Steklov Mathematical Institute of the Academy of Sciences of the USSR. The main topics of the seminar center on the theory of boundary value problems and related questions of analysis and mathematical physics. This volume contains adaptations of lectures presented at the seminar during the academic year 1989-1990.

For the most part, the papers are devoted to investigations of the spectrum of the Schrödinger operator (or its generalizations) perturbed by some relatively compact operator. The book studies the discrete spectrum that emerges in the spectral gaps of the nonperturbed operator, and considers the corresponding estimates and asymptotic formulas for spectrum distribution functions in the large-coupling-constant limit. The starting point here is the opening paper, which is devoted to the important case of a semi-infinite gap. The book also covers the case of inner gaps, related questions in the theory of functions, and an integral equation with difference kernel on a finite interval. The collection concludes with a paper focusing on the classical problem of constructing scattering theory for the Schrödinger operator with potential decreasing faster than the Coulomb potential.

Contents

of semiclassical integral equations; **A. V. Sobolev**, *Weyl asymptotics for the discrete spectrum of the perturbed Hill operator*; **D. R. Yafaev**, *On solutions of the Schrödinger equation with radiation conditions at infinity*.

1991 *Mathematics Subject Classifications*: 34L, 35J, 35P, 35S, 45A, 47B, 47G; 35B, 47A
ISBN 0-8218-4106-8, LC 91-640741, ISSN 1051-8037
204 pages (hardcover), December 1991
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REPRESENTATIONS OF FINITE DIMENSIONAL ALGEBRAS
H. Tachikawa and V. Dlab, Editors

(Conference Proceedings, Canadian Mathematical Society, Volume 11)

This volume contains the proceedings of the Tsukuba International Conference on Representations of Algebras and Related Topics (fifth ICRA), held at the University of Tsukuba, August 13–18, 1990. The conference focused on the rapid development of research on representations of finite-dimensional algebras and group representations. A subset of the fifty-seven lectures are collected here, together with a number of other papers not originally presented at the conference. With contributions by some of the world's leading experts in this area, this book provides a valuable overview of the frontier of research in representations of algebras.

Contents

1991 *Mathematics Subject Classifications*: 16; 20
ISBN 0-8218-6016-X, LC 91-24244, ISSN 0731-1036
322 pages (softcover), December 1991
Individual member $55, List price $92,
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SPINOR CONSTRUCTION OF VERTEX OPERATOR ALGEBRAS, TRIALITY, AND $E_8^{(1)}$
Alex J. Feingold, Igor B. Frenkel, and John F. X. Ries

(Contemporary Mathematics, Volume 121)

The theory of vertex operator algebras is a remarkably rich new mathematical field which captures the algebraic content of conformal field theory in physics. Ideas leading up to this theory appeared in physics as part of statistical mechanics and string theory. In mathematics, the axiomatic definitions crystallized in the work of Borcherds and in *Vertex Operator Algebras and the Monster*, by Frenkel, Lepowsky, and Meurman. The structure of monodromies of intertwining operators for modules of vertex operator algebras yields braid group representations and leads to natural generalizations of vertex operator algebras, such as superalgebras and para-algebras. Many examples of vertex operator algebras and their generalizations are related to constructions in classical representation theory and shed new light on the classical theory.

This book accomplishes several goals. The authors provide an explicit spinor construction, using only Clifford algebras, of a vertex operator superalgebra structure on the direct sum of the basic and vector modules for the affine Kac-Moody algebra $D_n^{(1)}$. They also review and extend Chevalley's spinor construction of the 24-dimensional commutative nonassociative algebraic structure and triality on the direct sum of the three 8-dimensional D_4-modules. Vertex operator para-algebras, introduced and developed independently in this book and by Dong and Lepowsky, are related to one-dimensional representations of the braid group. The authors also provide a unified approach to the Chevalley, Griess, and E_8 algebras and explain some of their similarities. A third goal is to provide a purely spinor construction of the exceptional affine Lie algebra $E_8^{(1)}$, a natural continuation of previous work on spinor and oscillator constructions of the classical affine Lie algebras. These constructions should easily extend to include the rest of the exceptional affine Lie algebras. The final objective is to develop an inductive technique of construction which could be applied to the Monster vertex operator algebra.

Directed at mathematicians and physicists, this book should be accessible to graduate students with some background in finite-dimensional Lie algebras and their representations. Although some experience with affine Kac-Moody algebras would be useful, a summary of the relevant parts of that theory is included. This book shows how the concepts and techniques of Lie theory can be generalized to yield the algebraic structures associated with conformal field theory. The careful reader will also gain a detailed knowledge of how the spinor construction of classical triality lifts to the affine algebras and plays an important role in a spinor construction of vertex operator algebras, modules, and intertwining operators with nontrivial monodromies.

Contents

a vertex operator para-algebra for $D_4^{(1)}$; Spinor construction of E_8; Spinor construction of vertex operator algebras for $E_8^{(1)}$.

1991 *Mathematics Subject Classifications*: 17, 81
ISBN 0-8218-5128-4, LC 91-24409, ISSN 0271-4132
146 pages (softcover), September 1991
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ENUMERATIVE ALGEBRAIC GEOMETRY
Steven L. Kleiman and Anders Thorup, Editors

(Contemporary Mathematics, Volume 123)

1989 marked the 150th anniversary of the birth of the great Danish mathematician Hieronymus Georg Zeuthen. Zeuthen's name is known to every algebraic geometer because of his discovery of a basic invariant of surfaces. However, he also did fundamental research in intersection theory, enumerative geometry, and the projective geometry of curves and surfaces. Zeuthen's extraordinary devotion to his subject, his characteristic depth, thoroughness, and clarity of thought, and his precise and succinct writing style are truly inspiring.

During the past ten years or so, algebraic geometers have reexamined Zeuthen's work, drawing from it inspiration and new directions for development in the field. The 1989 Zeuthen Symposium, held in the summer of 1989 at the Mathematical Institute of the University of Copenhagen, provided a historic opportunity for mathematicians to gather and examine those areas in contemporary mathematical research which have evolved from Zeuthen's fruitful ideas. This volume, containing papers presented during the symposium, as well as others inspired by it, illuminates some currently active areas of research in enumerative algebraic geometry.

Contents

1991 *Mathematics Subject Classifications*: 14-06, 14N10, 14N05, 14C17
ISBN 0-8218-5131-4, LC 91-37558, ISSN 0271-4132
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DISCRETE AND COMPUTATIONAL GEOMETRY: PAPERS FROM THE DIMACS SPECIAL YEAR
Jacob E. Goodman, Richard Pollack, and William Steiger, Editors

(DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 6)

The first DIMACS special year, held during 1989-1990, was devoted to discrete and computational geometry. More than 200 scientists, both long- and short-term visitors, came to DIMACS to participate in the special year activities. Among the highlights were six workshops at Rutgers and Princeton Universities that defined the focus for much of the special year. The workshops addressed the following topics: geometric complexity, probabilistic methods in discrete and computational geometry, polytopes and convex sets, arrangements, and algebraic and practical issues in geometric computation.

This volume presents some of the results growing out of the workshops and the special year activities. Containing both survey articles and research papers, this collection presents an excellent overview of significant recent progress in discrete and computational geometry. The diversity of these papers demonstrate how geometry continues to provide a vital source of ideas in theoretical computer science and discrete mathematics as well as fertile ground for interaction and stimulation between the two disciplines.

Contents

1991 *Mathematics Subject Classifications*: 03, 05, 12, 13, 14, 15, 32, 51, 52, 57, 68
ISBN 0-8218-6595-1, LC 91-36806, ISSN 1052-1798
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VORTEX DYNAMICS AND VORTEX METHODS
Christopher R. Anderson and Claude Greengard, Editors

(Lectures in Applied Mathematics, Volume 28)

Understanding vortex dynamics is the key to understanding much of fluid dynamics. For this reason, many researchers, using a great variety of different approaches—analytical, computational, and experimental—have studied the dynamics of vorticity. The AMS-SIAM Summer Seminar on Vortex Dynamics and Vortex Methods, held in June 1990 at the University of Washington in Seattle, brought together experts with a broad range of viewpoints and areas of specialization. This volume contains the proceedings from that seminar.

The focus here is on the numerical computation of high Reynolds number incompressible flows. Also included is a smaller selection of important experimental results and analytic treatments. Many of the articles contain valuable introductory and survey material as well as open problems. Readers will appreciate this volume for its coverage of a wide variety of numerical, analytical, and experimental tools and for its treatment of interesting important discoveries made with these tools.

Contents

1991 *Mathematics Subject Classifications*: 76MXX, 76D05, 76D25, 65MXX, 76-05
ISBN 0-8218-1135-9, LC 91-29692, ISSN 0075-8485
751 pages (softcover), December 1991
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FIXED POINTS
Yu. A. Shashkin

(AMS-MAA Mathematical World Series, Volume 2)

The theory of fixed points finds its roots in the work of Poincaré, Brouwer, and Sperner and makes extensive use of such topological notions as continuity, compactness, homotopy, and the degree of a mapping. Fixed point theorems have numerous applications in mathematics; most of the theorems ensuring the existence of solutions for differential, integral, operator, or other equations can be reduced to fixed point theorems. In addition, these theorems are used in such areas as mathematical economics and game theory.

This book presents a readable exposition of fixed point theory. The author focuses on the problem of whether a closed interval, square, disk, or sphere has the fixed point property. Another aim of the book is to show how fixed point theory uses combinatorial ideas related to decomposition (triangulation) of figures into distinct parts called faces (simplexes), which adjoin each other in a regular fashion. All necessary background concepts—such as continuity, compactness, degree of a map, and so on—are explained, making the book accessible even to students at the high school level. In addition, the book contains exercises and descriptions of applications. Readers will appreciate this book for its lucid presentation of this fundamental mathematical topic.

Contents

1991 *Mathematics Subject Classifications*: 01-01, 54-01, 54H25; 54C15
ISBN 0-8218-9000-X, LC 91-28994, ISSN 1055-9426
77 pages (softcover), December 1991
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PROBABILISTIC COMBINATORICS AND ITS APPLICATIONS
Béla Bollobás, Editor

(Proceedings of Symposia in Applied Mathematics, Volume 44)

Probabilistic methods have become a vital tool in the arsenal of every combinatorialist. The theory of random graphs is still a prime area for the use of probabilistic methods, and, over the years, these methods have also proved of paramount importance in many associated areas such as the design and analysis of computer algorithms. In recent years, probabilistic combinatorics has undergone revolutionary changes as the result of the appearance of some exciting new techniques such as martingale inequalities, discrete isoperimetric inequalities, Fourier analysis on groups, eigenvalue techniques, branching processes, and rapidly mixing Markov chains. The aim of this volume is to review briefly the classical results in the theory of random graphs and to present several of the important recent developments in probabilistic combinatorics, together with some applications.

The first paper contains a brief introduction to the theory of random graphs. The second paper reviews explicit constructions of random-like graphs and discusses graphs having a variety of useful properties. Isoperimetric inequalities, of paramount importance in probabilistic combinatorics, are covered in the third paper. The chromatic number of random graphs is presented in the fourth paper, together with a beautiful inequality due to Janson and the important and powerful Stein-Chen method for Poisson approximation. The aim of the fifth paper is to present a number of powerful new methods for proving that a Markov chain is "rapidly mixing" and to survey various related questions, while the sixth paper looks at the same topic in a very different context. For the random walk on the cube, the convergence to the stable distribution is best analyzed through Fourier analysis; the final paper examines this topic and proceeds to several more sophisticated applications. Open problems can be found throughout each paper.

Contents

1991 *Mathematics Subject Classifications*: 68Q25, 60C05, 05C80; 52A20, 60J15
ISBN 0-8218-5500-X, LC 91-33123, ISSN 0160-7634
196 pages (hardcover), December 1991
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COMPLEX GEOMETRY AND LIE THEORY
James A. Carlson, C. Herbert Clemens, and David R. Morrison, Editors

(Proceedings of Symposia in Pure Mathematics, Volume 53)

In the late 1960s and early 1970s, Phillip Griffiths and his collaborators undertook a study of period mappings and variation of Hodge structure. The motivating problems, which centered on the understanding of algebraic varieties and the algebraic cycles on them, came from algebraic geometry. However, the techniques used were transcendental in nature, drawing heavily on both Lie theory and hermitian differential geometry. Promising approaches were formulated to fundamental questions in the theory of algebraic curves, moduli theory, and the deep interaction between Hodge theory and algebraic cycles. Rapid progress on many fronts was made in the 1970s and 1980s, including the discovery of important connections to other fields, including Nevanlinna theory, integrable systems, rational homotopy theory, harmonic mappings, intersection cohomology, and superstring theory.

This volume contains thirteen papers presented during the Symposium on Complex Geometry and Lie Theory held in Sundance, Utah in May 1989. The symposium was designed to review twenty years of interaction between these two fields, concentrating on their links with Hodge theory. The organizers felt that the time was right to examine once again the larger issue of understanding the moduli and cycle theory of higher-dimensional varieties, which was the starting point of these developments. The breadth of this collection of papers indicates the continuing growth and vitality of this area of research. Several survey papers are included, which should make the book a valuable resource for graduate students and other researchers who wish to learn about the field. With contributions from some of the field's top researchers, this volume testifies to the breadth and vitality of this area of research.

Contents

1991 *Mathematics Subject Classifications*: 32, 14, 22, 58A
ISBN 0-8218-1492-3, LC 91-25148, ISSN 0082-0717
348 pages (hardcover), December 1991
Individual member $44, List price $73,
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THIRTEEN PAPERS IN ALGEBRA, FUNCTIONAL ANALYSIS, TOPOLOGY, AND PROBABILITY TRANSLATED FROM THE RUSSIAN

(American Mathematical Society Translations, Series 2, Volume 149)

This collection of papers ranges over several areas of research, including matrix theory, group theory, functional analysis, Morse theory, global analysis, and probability theory.

Contents

B. I. Zil'ber, *Groups and rings whose theory is categorical*; **V. P. Shchedrik**, *On the separation of a real linear monic factor from a matrix polynomial*; **Ya. G. Berkovich**, *Subgroups of symmetric and alternating groups*; **Ya. G. Berkovich**, *A generalization of Burnside's second theorem on $\{p, q\}$-groups*; **Ya. G. Berkovich and B. M. Pogrebinskiĭ**, *Finite groups of large degree*; **N. A. Vavilov**, *Maximal subgroups of Chevalley groups containing a maximal split torus*; **V. A. Tolokonnikov**, *The corona theorem in algebras of bounded analytic functions*; **L. G. Khanin**, *The structure of closed ideals in some algebras of smooth functions*; **V. V. Sharko**, *K-theory and Morse theory.* I; **V. V. Sharko**, *K-theory and Morse theory.* II; **V. Z. Grines**, *Diffeomorphisms of two-dimensional manifolds with transitive foliations*; **V. S. Afraĭmovich and L. P. Shil'nikov**, *Invariant two-dimensional tori, their breakdown and stochasticity*; **I. Ya. Novikov and O. P. Skachkova**, *Stable random variables and convexity of Banach function spaces.*

1991 *Mathematics Subject Classifications*: 15A, 20B, 20D, 20E, 30C, 30H, 46J, 57R, 58F; 18G, 19R, 57Q, 46A, 46B
ISBN 0-8218-3137-2, LC 91-24552, ISSN 0065-9290
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Collection of Papers from the All-Union School on Function Theory

S.B. Stechkin, Editor

Proceedings of the Steklov Institute, Volume 189

This collection consists of ten papers presented at the All-Union School on Function Theory, held in Dunshanbe in August 1986, under the editor's guidance. The book encompasses a wide range of current directions in the metric theory of functions, the theory of approximation of functions, and related parts of mathematical analysis. The papers concern the following topics: extremal properties of functions, representation of functions by series, convergence of multiple Fourier series, approximation of functions by trigonometric polynomials in L_p-metrics, widths of classes of functions, approximation of functions by Fourier sums in systems of characters of zero-dimensional compact commutative groups, bilinear approximations of functions, the study of Tchebycheff sets in normed linear spaces, and spline approximation of functions of several variables.

Among the results obtained are: new criteria for convexity of Tchebycheff sets in terms of continuity properties of the metric projection operator; conditions on the character of integrability of a periodic function of several variables under which its Fourier series converges to it in measure; a characterization of representation systems for symmetric spaces in which there are no nonzero continuous functionals.

1980 *Mathematics Subject Classifications*: 11, 41, 42, 43, 46; 22, 35, 54
ISBN 0-8218-3136-4, LC 91-218, ISSN 0081-5438
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Miscellaneous

Personals

The Department of Mathematics and Statistics of the University of Massachusetts, Amherst announces the following promotions: **David R. Hayes** to Department Head, **George S. Avrunin** to Professor, and **Lorraine D. Lavallee** to Professor.

Kazuyuki Hatada, of Gifu University, was named Man of the Year 1990 by the American Biographical Institute, and was honored with the International Order of Merit by the International Biographical Centre for his services to pure mathematics, especially to the theory of modular forms and varieties.

Deaths

Y. Lehrer-Ilamed, of Tel Aviv, Israel, died on August 12, 1991, at the age of 72. He was a member of the Society for 36 years.

Demetre John Mangeron, Consultant Professor Emeritus of the Institutul Politehnic Gheorghe Asachi, Iasi, died on February 26, 1991, at the age of 84. He was a member of the Society for 23 years.

Morris Marden, Professor Emeritus of the University of Wisconsin-Milwaukee, died on October 20, 1991, at the age of 86. He was a member of the Society for 66 years.

Fred D. Rigby, Professor Emeritus of Texas Tech University, died on July 20, 1991, at the age of 76. He was a member of the Society for 53 years.

Erik A. Schreiner, of Western Michigan University, died on September 8, 1991, at the age 55. He was a member of the Society for 30 years.

Visiting Mathematicians

Supplementary List

Andras Bezdek (Hungary), Auburn University, Geometry, 9/91-6/92.

Stephen J. Gardiner (Ireland), McGill University, Potential Theory and Function Theory, 1/92-12/92.

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The Mathematics Department will also have several visiting positions for next year.

We encourage early application. Deadline date will be December 15, 1991 or whenever positions are filled. *Women and minority applicants are especially welcome.* Send application, which should include a letter of interest, curriculum vitae with a list of publications, and a minimum of three (3) letters of recommendation (enclose or arrange to be sent), to:

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Graduate Fellowships
in the Mathematical Sciences

Up to 12 fellowships for outstanding new graduate students in the mathematical sciences may be available in 1992-93. Fellowship applicants should be seeking the Ph.D. and planning careers in teaching and/or fundamental research. Anticipated stipends are $12,000 or more for 12 months with both in-state and non-resident tuition waived.

These fellowships are restricted to citizens, permanent residents, or individuals who have established intent to become citizens or permanent residents of the United States. Applications from U.S. women and students belonging to U.S. minority groups are particularly invited. Currently one-fourth of the U.S. graduate students in pure and applied mathematics at Arizona are women.

The University of Arizona has excellent programs in traditional pure and applied mathematics, and is a leading institution in interdisciplinary applied mathematics. This presents a wealth of opportunities for graduate study encompassing such areas as dynamical systems, number theory, computational science, geometry, nonlinear partial differential equations, mathematical physics, probability, and applications of mathematics in the physical, biological, social, and engineering sciences. In addition, outstanding computational facilities for graduate study and research are available to the over 170 graduate students in the mathematical sciences at the University of Arizona.

Fellowship applicants of superior quality will be among the students invited to the Sixth Annual Workshop for Advanced Undergraduates on Current Ideas in Nonlinear Science, February 29-March 3, 1992. Limited support is available for attendees. (The deadline for Workshop applications is February 1, 1992.) The workshop is designed to communicate topics in current active research is three areas: (i) Geometrical and Computational Aspects of Analysis and Number Theory, (ii) Analytical Approaches to Applied Problems, and (iii) Numerical Modeling.

For information and application materials contact:
W. M. Greenlec or T. W. Secomb
Department of Mathematics/Program in Applied Mathematics
University of Arizona
Tucson, AZ 85721
(602)621-2068

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

CALIFORNIA

CALIFORNIA STATE POLYTECHNIC UNIVERSITY

The Department of Mathematics in the College of Science invites applications and nominations for the position of Chair of the Mathematics Department. Doctorate in Mathematics, Statistics, Math Education or equivalent degree. Record of successful administrative, teaching and scholarly research required. Evidence of commitment to promoting teaching, research, and other scholarly activities. Application, resume, transcripts and three current letters of reference to be received by 1/15/92. For additional information or to apply contact: Search Committee, Mathematics Department, California State Polytechnic University, 3801 W. Temple Ave., Pomona, CA 91788-4033. (714)869-3467.

MILLS COLLEGE
Department of Mathematics and Computer Science
Oakland, California 94613

Mills College is seeking outstanding candidates for two tenure-track positions, commencing Fall 1992. The first is Assistant Professor of Computer Science. A Ph.D. in Computer Science is required. The second is Assistant Professor of Computer Science and Director of the Interdisciplinary Computer Science Master's Degree Program. A strong computer science background, a Ph.D. in a related field, and the ability to guide students, with quite diverse backgrounds, in a master's degree program are required. Candidates for both positions must submit evidence of superior teaching and research abilities. Salary will depend on experience and qualifications. The initial contract will be for three years, subject to final administrative approval. Please send vita, and direct three letters of reference, to:

Chair, Computer Science Search Committee
Mills College
Oakland, California 94613

The deadline for applications is January 10, 1992. Mills College is an Equal Opportunity Employer.

STANFORD UNIVERSITY
Department of Mathematics

Assistant Professorships in honor of Gabor Szegö.

The Department of Mathematics expects to make one or more appointments in 1992-1993 for these special two-year positions. Applicants are expected to show outstanding promise in research and clear evidence of achievement. They should have received the Ph.D. prior to the start of the appointment but not before 1990. Stanford is committed to excellence in teaching, and applicants should count this as one of their goals. Candidates should send a letter of application with a curriculum vitae, a list of publications and information concerning teaching experience, and should arrange to have three letters of recommendation sent to Prof. Solomon Feferman, Chairman, Dept. of Mathematics, Stanford University, Stanford, CA 94305-2125, by January 1, 1992. Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

STANFORD UNIVERSITY
Department of Mathematics

The department expects to make at least one tenure-track or tenured appointment beginning September 1992, among the following fields: (1) analysis, (2) geometry or topology, (3) algebra, number theory, or logic, (4) applied mathematics or probability; in the last case there are also possibilities for joint appointments with other departments. At the tenured level, preference would go to individuals in the early years of their ranks, though a more senior appointment may be possible for an extremely well-qualified individual. Candidates should send a letter of application and a curriculum vitae with a list of publications, and arrange to have three letters of recommendation and some evidence of commitment to teaching sent to Prof. Solomon Feferman, Department of Mathematics, Stanford University, Stanford, CA, 94305–2125 by January 1, 1992. Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Bereley, CA 94720
Tenured Position

We invite applications for one or more positions effecttive July 1, 1992 at tenure level (Associate or full Professor), subject to bugetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Demonstrated leadership in research is expected of applicants. Applicants should send a curriculum vitae, list of publications, a few selected reprints or preprints, and the names of three references to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1992. The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Assistant Professorships

We invite applications for one or more positions effective July 1, 1992, at the tenure-track Assistant Professor level, subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Applicants are expected to have demonstrated outstanding research potential, normally including major contributions beyond the doctoral dissertation. Applicants should send a resume, and reprint or preprints, and/or dissertation abstract, and ask three people to send letters of recommendation to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1992. The University of California is an Equal Opportunity Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Charles B. Morrey, Jr.
Assistant Professorships

We invite applications for these special two-year (nontenure-track) positions effective July 1, 1992. Applicants should have a recent Ph.D. in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology, and should have demonstrated superior research potential. Applicants should send a resume, reprints, preprints and/or dissertation abstract, and ask three people to send letters of recommendation to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1992. The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Temporary Postdoctoral Positions

Several temporary positions beginning in Fall 1992 are anticipated for new and recent Ph.D.s of any age. In the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. The terms of these appointments may range from one to three years. Applicants for NSF or other postdoctoral fellowships are encouraged to apply for these positions; combined teaching/research appointments may be made for up to three years. Mathematicians whose research interests are close to those of regular department members will be given some preference. Applicants should send a resume, and reprints, preprints, and/or dissertation abstract, and ask three people to send letters of recommendation to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1992. The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA, IRVINE
Department of Mathematics
Irvine, CA 92717

Applications are invited for up to five positions effective July 1, 1992 at the tenure-track level in the areas of algebra, analysis, applied mathematics, foundations, geometry, probability, sta-

tistics, or topology. Demonstrated leadership in research is expected of applicants at the tenure (Associate or Full Professor) levels. Applicants at these levels should send a curriculum vitae, list of publications, a few selected reprints or preprints, and the names of three references to Peter Li, Chair of the Recruitment Committee, at the above address. Applicants at the tenure-track level are expected to have demonstrated outstanding research potential, and should send a resume, reprints, preprints and dissertation abstract, and ask three people to send letters of recommendation to Peter Li. We should receive all these materials no later than March 1, 1992. The University of California is an Equal Opportunity/Affirmative Action employer. The Department of Mathematics welcomes applications from women and minority candidates.

UNIVERSITY OF CALIFORNIA, SANTA BARBARA
Department of Mathematics

Applications are invited for the KY FAN ASSISTANT PROFESSORSHIP. The Ky Fan assistant professorship is a special two-year nonrenewable position which carries a research stipend. Appointment is effective July 1, 1992. Candidates must possess a Ph.D by September 1992. Selection will be based primarily on demonstrated research achievement. Teaching experience is desirable. Teaching load will consist of four quarter courses per year. To apply send vita and publication list, and arrange to have 3 letters of recommendation sent to: Ky Fan Faculty Search Committee, Department of Mathematics, University of California, Santa Barbara, CA 93106. All applications received by January 10, 1992 will be given thorough consideration. UCSB is an Equal Opportunity/Affirmative Action employer. Proof of U.S. citizenship or eligibility for U.S. employment will be required prior to employment (Immigration Reform and Control Act of 1986).

UNIVERSITY OF CALIFORNIA, SANTA CRUZ
Department of Mathematics

The Mathematics Department at the University of California, Santa Cruz, expects to have J. W. T. Youngs Assistant Professorships in Mathematics beginning Fall 1992. These recently established Assistant Professorships in Mathematics are named in honor of our founding chairman, J. W. T. Youngs. Appointees will be expected to teach, pursue their research, and perform some department or university service. These positions are available for a two-year period with the possibility of an extension for a third year. Minimum Qualifications: Ph.D. in Mathematics and a demonstrated excellence in research and teaching or potential for excellence. Salary Range: $35,900–$37,400 commensurate with qualifications and experience. Available: Fall 1992. Application Deadline: December 15, 1991. Please refer to position #T91-04. Applicants should send vitae, three letters of reference, and information about their teaching and research experience to: Recruitment Committee, Mathematics Department, University of California, Santa Cruz, CA 95064. UCSC is an affirmative action/equal opportunity employer.

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES

The Department of Mathematics has available several tenure-track or tenured positions at the Assistant and/or Associate Professor level. Applicants must show strong research promise and possess excellent communications skills for teaching undergraduate mathematics courses. Visiting positions (at all levels) and postdoctoral appointments will also be available.

The Department of Mathematics also seeks to fill at least one tenured position at the senior level. Successful applicants will have an outstanding record of mathematical research and scholarship, and proven administrative skills for academic leadership. Applications should be mailed to: Chair of Appointments Committee, Department of Mathematics, DRB 155, University of Southern California, Los Angeles, CA 90089-1113. USC is an Equal Opportunity/Affirmative Action employer. Women and minorities are especially encouraged to apply.

COLORADO

UNIVERSITY OF NORTHERN COLORADO
Greeley, Colorado

The Department of Mathematical Sciences at UNC is inviting applications for a one- or two-year temporary position beginning August 1992. A Ph.D. in Mathematics is required along with a strong commitment to excellent teaching. In addition to a 12-hour teaching load at the undergraduate level, advising or committee work or continuing scholarly activities are expected. Send letter of application, resume, three letters of recommendation (and the names, addresses and phone numbers of the three references) and position number 21341 to:

Professor Richard Grassl
Chair, Department of Mathematical Sciences
University of Northern Colorado
Greeley, CO 80639

Applications received by January 15, 1992 will be given full consideration. AAEO

DISTRICT OF COLUMBIA

TRINITY COLLEGE
Division of Mathematics and Natural Science
Washington, D.C. 20017

Tenure-track position at the Assistant Professor level beginning Fall 1992 (subject to funding appropriations). Qualifications include a Ph.D., with specialization in analysis or statistics preferred. Strong interest in teaching necessary. Send letter of application with vita, transcripts and three letters of recommendation to Dr. Marlene Lawson, Division of Mathematics and Natural Science, Trinity College, Washington, D.C. 20017.

Trinity College is a liberal arts college for women under Catholic auspices. Applications from women and minorities are strongly encouraged. AA/EOE.

FLORIDA

ROLLINS COLLEGE
Department of Mathematical Sciences
Winter Park, FL 32789

One tenure track position, involving both mathematics and computer science, preferably at the Assistant Professor level, is available for September 1992, pending approval. The Department offers majors in mathematics and computer science, and seeks a versatile, broadly educated mathematician who is willing to teach and participate in both programs. In addition to the usual range of undergraduate mathematics courses for majors and non-majors, the applicant must also be able to teach at least two upper-level ACM computer science courses; for example, database management systems, operating systems, or compiler construction. The area of mathematical specialization is open, but a Doctorate (or ABD with degree nearing completion), strong commitment to innovative teaching and continued professional development in a liberal arts environment is required. The teaching load is 8-10 hours per week. Winter Park, a delightful city of 40,000, is located in the greater Orlando area. To ensure full consideration, applications must be complete by 15 Feb 1992. Send resume, transcripts and three letters of recommendation (at least one of which must comment on teaching) to: David Kurtz, Chair. Rollins College assures equal employment opportunity through a continuing and effective affirmative action program.

UNIVERSITY OF FLORIDA
Graduate Studies in Mathematics

The University of Florida's Department of Mathematics invites qualified individuals to apply for graduate study beginning in fall 1992. New opportunities exist for students to participate in the mathematics program of a department which has been growing vigorously for five years in both size and breadth. In addition, the University and its environs offer superb opportunities for intellectual, cultural, and recreational activities.

A distinguished faculty directs research in virtually all areas of modern mathematics leading to the M.A., M.S., and Ph.D. degrees. Outstanding groups of researchers work in the following fields: differential geometry and mathematical physics, numerical analysis, combinatorics and finite geometries, probability, dynamical systems and topology, group theory, differential equations, number theory, and logic.

Full fellowships and assistantships are available to qualified applicants. Applications for fellowships should be received by January 1, 1992. Teaching assistants receive $9000 in the 1991-1992 academic year, and nearly

all tuition is waived. Outstanding applicants may also be awarded a $3000 supplemental fellowship. Supplemental summer teaching assistantships are also available. Applications for teaching assistantships should be complete by March 1, 1992. For additional information and applications, write to: Graduate Selection Committee, Department of Mathematics, University of Florida, Gainesville, Florida 32611.

GEORGIA

GEORGIA INSTITUTE OF TECHNOLOGY

The School of Mathematics expects to have some visiting and tenure-track positions in several areas, including probability and statistics, at various levels beginning in Fall 1992. Candidates with strong research and teaching records or potential should send a resume, at least three letters of reference, and a summary of future research plans to the Hiring Committee, School of Mathematics, Georgia Institute of Technology, Atlanta, Georgia 30332-0160. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

GEORGIA INSTITUTE OF TECHNOLOGY

The Center for Dynamical Systems and Nonlinear Studies expects to have some long and short-term visiting positions beginning Fall 1992. These positions are in nonlinear differential equations, dynamical systems, computational methods and related areas. In addition to a resume and at least three letters of reference, candidates should send a summary of future research plans to Professor Jack K. Hale, Director, CDSNS, Georgia Institute of Technology, Atlanta, GA 30332-0190. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

HAWAII

UNIVERSITY OF HAWAII
Department of Mathematics

One or more tenure-track professorships possible in Fall 1992, pending clearance. Rank open. Duties include math research and teaching six credit hours per semester. Minimum qualifications include a Math. Ph.D., commitment to research and teaching, achievement appropriate to rank, and research interest complementing those of the Department. E-mail ramsey@kahuna.math.hawaii.edu for list of faculty, their research interests, and information about Honolulu. Normal salary range: $34,644–$51,264 (asst), $43,824–$64,872 (assoc), $53,316–$78,924 (full). To apply, write to Prof. L. T. Ramsey. Have 3 references send confidential letters directly to the chairman. Letters of references must be postmarked by 12/24/91 to guarantee full consideration. DEADLINE FOR APPLICATION: postmarked by 12/24/91. EOE/AA Employer.

ILLINOIS

EASTERN ILLINOIS UNIVERSITY
Department of Mathematics
Charleston, IL 61920

We anticipate one or more tenure-track positions to start in Fall 1992. Duties include teaching a wide spectrum of computer science courses and some supervision of student interns. Excellence in teaching is expected. A Ph.D either in Computer Science or Mathematics is required, and experience in both is preferred. Applications from minorities and women are encouraged.

Send application letter, transcript, and three letters of recommendation to Ira Rosenholtz, Chairperson, by Jan. 1, 1992.

ELMHURST COLLEGE

Tenure-track position beginning fall 1992 (pending approval of the Board of Trustees). Qualifications desired: Ph.D. in mathematics, interest in continued scholarship, and a strong commitment to undergraduate teaching in a liberal arts college. Teaching load: 6 courses per year. Elmhurst College is a four-year private institution located in the western suburbs of Chicago. Applications should include a curriculum vitae and three letters of reference. Please send to Dr. Jon L. Johnson, Dept. of Mathematics, Elmhurst College, Elmhurst, IL 60126. Elmhurst College is an Equal Opportunity Employer.

ILLINOIS STATE UNIVERSITY
Chairperson
Department of Mathematics

The Department of Mathematics at Illinois State University invites applications for the position of Chairperson at the rank of Professor. Qualifications: Applicants must have a doctorate in Mathematics or Mathematics Education and a solid record of achievement in research, teaching, and leadership. They must have demonstrated effective administrative skills. Experience with undergraduate and graduate programs is desirable. The salary is competitive. Duties begin on or about August 1, 1992.

The Department: The ISU Department of Mathematics has 44 full-time faculty positions and offers undergraduate, master's, doctoral programs (Doctor of Arts in Mathematics and Ph.D. in Mathematics Education). Current faculty research interests include various areas of mathematics, applied mathematics, statistics, and mathematics education. The department serves over 4000 students each semester.

Application Procedures: To ensure consideration applicants should send a letter of application, a complete vita, graduate transcript(s), and names and addresses of at least 3 references to Dr. Robert Corbett, Secretary, Mathematics Chair Search Committee, Department of Geography-Geology, Illinois State University, Normal, IL 61761, before February 14, 1992. Illinois State University is an Equal Opportunity/Affirmative Action Employer.

LOYOLA UNIVERSITY OF CHICAGO

The Department of Mathematical Sciences anticipates at least one tenure track position and some visiting positions beginning in August 1992. Requirements are the Ph.D., an active research program in any area, and a commitment to quality teaching. The department offers courses in mathematics, computer science, and statistics at the undergraduate and masters level. Interviews will begin in January and continue until all positions are filled. Send detailed C.V. and three letters of recommendation to Professor S.R. Doty, Department of Mathematical Sciences, Loyola University, Chicago, IL 60626. Loyola University of Chicago is an Equal Opportunity/Affirmative Action Employer.

NORTHERN ILLINOIS UNIVERSITY
Department of Mathematical Sciences

Anticipated assistant professorship with a specialization in Group Theory. Ph.D. or equivalent and strong potential in research and teaching required. Application (vita) plus three letters of reference and description of research program should be sent to: Group Theory Position, c/o Professor William D. Blair, Chair, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL 60115 by February 1, 1992. EO/AAE

NORTHERN ILLINOIS UNIVERSITY
Department of Mathematical Sciences

Anticipated assistant professorship with a specialization in Ordinary Differential Equations. Ph.D. or equivalent and strong potential in research and teaching required. Application (vita) plus three letters of reference and description of research program should be sent to: ODE Position, c/o Professor William D. Blair, Chair, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL 60115 by February 1, 1992. EO/AAE

NORTHERN ILLINOIS UNIVERSITY
Department of Mathematical Sciences

Anticipated assistant professorship with a specialization in Classical Complex Analysis. Ph.D. or equivalent and strong potential in research and teaching required. Application (vita) plus three letters of reference and description of research program should be sent to: Complex Analysis Position, c/o Professor William D. Blair, Chair, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL 60115 by February 1, 1992. EO/AAE

NORTHERN ILLINOIS UNIVERSITY
Department of Mathematical Sciences

Anticipated assistant professorship with a specialization in Ring Theory. Ph.D. or equivalent and strong potential in research and teaching required. Application (vita) plus three letters of reference and description of research program should be sent to: Ring Theory Position, c/o Professor William D. Blair, Chair, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL 60115 by February 1, 1992. EO/AAE

NORTHWESTERN UNIVERSITY
Mathematics Department
Evanston, Illinois 60208–2730

Applications are invited for one or more anticipated tenure-track positions starting September 1992. Priority will be given to young, exceptional research mathematicians (no more than several years after the Ph.D.). However, more senior candidates with very exceptional credentials may be considered for a tenured position. Fields of interest within the department include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty, so women and minority candidates are especially encouraged to apply. Candidates should arrange that at least three letters of recommendation be sent to Prof. D. G. Saari, Chair, Personnel Committee, Department of Mathematics, Northwestern University, Evanston, Illinois 60208–2730. Alternatively, applications and supporting documentation can be sent via email to "hiring@math.nwu.edu." In order to receive full consideration, applications should be received by February 15, 1992. Hiring is contingent upon eligibility to work in the United States.

NORTHWESTERN UNIVERSITY
Mathematics Department
2033 Sheridan Road,
Evanston, Illinois 60208-2730

The Mathematics Department will sponsor an Emphasis Year in partial differential equations. This program will include 2-year Assistant Professorship positions starting September 1992, and possible visiting positions for more senior mathematicians for part or all of the academic year.

Applications should be sent to Professor Neil S. Trudinger at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, an application must be received by February 15, 1992.

Northwestern University is an affirmative action, equal opportunity employer committed to fostering a diverse faculty, so women and minority candidates are especially encouraged to apply. Hiring is contingent upon eligibility to work in the United States.

IOWA

IOWA STATE UNIVERSITY
Department of Mathematics

Subject to the availability of funds, the Department of Mathematics of Iowa State University expects to fill one tenure track position at the assistant professor level in applied partial differential equations for the 1991-92 academic year. Start up funds will be available for the successful applicant. The successful candidate is expected to have a strong interest in teaching at both the graduate and undergraduate level and maintain an active research program.

Iowa State is the closest member institution to the NSF Institute for Mathematics and its Applications in Minneapolis. The Department strongly encourages its faculty and graduate students to participate in the Institute's programs and provides direct and indirect support for them to do so.

We will begin screening applications January 15, 1992. However we shall continue to accept applications until the positions are filled.

A number of visiting positions in diverse areas of mathematics and applied mathematics are expected to be available and applications for them are also encouraged. Preference will be given to those applicants whose interests are similar to those of the current faculty.

Iowa State University is an Affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.

Applications and three letters of recommendation should be sent to Howard A. Levine, Chair, Department of Mathematics, Iowa State University, Ames, Iowa 50011.

THE UNIVERSITY OF IOWA

Actuarial Science faculty position in Dept. of Statistics & Actuarial Science beginning August 1992. Specialties in either life or casualty welcome. Authorization is for one position: either tenure-track Asst. Prof., or visitor at any rank for a period of 1 or 2 years. Ph.D. required for tenure-track appointment. Commitment to excellence in teaching & research. Minorities and women are especially encouraged to apply. Selection process will begin Feb. 1 and continue until position is filled. Send current C.V. and have 3 letters of reference sent to: Prof. Broffitt, Stat. & Act. Sci., Univ. of Iowa, Iowa City, IA 52242. EO/AAE

KANSAS

EMPORIA STATE UNIVERSITY
Division of Mathematics
and Computer Sciences

Applications are invited for two tenure track Assistant Professor positions beginning August 18, 1992. For one of the positions a degree in computer science or a significant background in computer science is desirable. The other one is open to candidates from any area of mathematics. A Ph.D. is expected for either position. While ESU has an emphasis on teaching, the successful candidate should also have an interest in continuing scholarly activity. The Division of Mathematics and Computer Science offers undergraduate and graduate degrees in mathematics. Salary is commensurate with qualifications. Screening will begin on January 31 and continue until the positions are filled. Send letter of application, resume, transcripts, and three letters of recommendation to: Joe Yanik, Search Committee Chair, Emporia State University, Emporia, KS 66801-5087. ESU is an Affirmative Action/Equal Opportunity Employer. We encourage applications from members of protected classes.

KANSAS STATE UNIVERSITY
Department of Mathematics

Subject to budetary approval, applications are invited for several tenure-track and visiting positions commencing August 18, 1992; rank and salary commensurate with qualifications. All fields will be considered, but for some of the tenure-track positions, preference will be given to candidates in Numerical Analysis, Differential Equations, and Global Analysis. Applicants must have strong research credentials and a commitment to excellence in teaching. A Ph.D. in mathematics or a Ph.D. dissertation accepted with only formalities to be completed is required. Letter of application, current vita, description of research and three letters of recommendation should be sent to:

Louis Pigno
Department of Mathematics
Cardwell Hall 137
Kansas State University
Manhattan, KS 66506

Deadline: February 1, 1992

THE WICHITA STATE UNIVERSITY

The Department of Mathematics and Statistics invites applications for a tenure-eligible Assistant or Associate Professor position starting August 1992. Special consideration will be given to persons having expertise in the following areas of research: probability and statistics, geometric analysis, or numerical analysis. We seek someone whose research interests are consonant with those of our faculty. Candidates are expected to have excellent research potential. All candidates should also have a strong commitment to excellence in teaching and ability to participate in and contribute to our doctoral program in Applied Mathematics. Salary and rank negotiable. Ph.D. in Mathematics or Statistics is required. Deadline for completed application is January 20, 1992 and then monthly until position is filled. Send application letter, detailed resume, and arrange to have three reference letters sent to:

The Wichita State University
Professor Stephen W. Brady, Search Committee Chair
Department of Mathematics and Statistics
Wichita, Kansas 67208–1595

UNIVERSITY OF KANSAS
Department of Mathematics

Applications are invited for tenure-track positions at the assistant or associate professor level and for visiting positions at the assistant professor level (pending on funding), beginning August 17, 1992 or as negotiated. Field is unrestricted but preference will be given to candidates whose specialties mesh well with those already represented in the department. Candidates must have a Ph.D. or its requirements completed by August 15, 1992. Postdoctoral experience for tenure-track positions is preferred but optional.

Application, detailed resume with description of research, and three recommendation letters should be sent to C. J. Himmelberg, Chairman, Department of Mathematics, 405 Snow Hall, University of Kansas, Lawrence, KS 66045-2142.

Deadlines: December 1, 1991 for first consideration, then monthly until August 1, 1992.

The University of Kansas is an equal opportunity/affirmative action employer.

KENTUCKY

BELLARMINE COLLEGE
Department of Mathematics

Tenure-track position in Analysis beginning Fall 1992. Ph.D. required. Should possess a dedication to quality teaching at a liberal arts college. Consideration will begin Feb. 1, 1992. Send letter of application, transcript and letter of recommendation along with vita to: Dr. Muzaffar Ali, Department of Math and Computer Science, Bellarmine College, 2001 Newburg Road, Louisville, KY 40205–0671. AA/EOE

LOUISIANA

SOUTHEASTERN LOUISIANA UNIVERSITY
Department of Mathematics

The department expects to make one or more tenure-track appointments, at the Assistant Professor level, to begin in the Fall of 1992. Strong research potential and a commitment to excellence in teaching are required. Applicants in all areas of mathematics will be considered; however, preference will be given to applied mathematics and algebra. Applications will be accepted until positions are filled. Send vitae and three letters of recommendation to: Professor Steve Ligh, Head, Department of Mathematics, Box 687 SLU, Hammond, LA 70402. Email: Ligh@slu.bitnet. SLU is an Affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.

MARYLAND

THE JOHNS HOPKINS UNIVERSITY
Department of Mathematical Sciences

Applications are invited for a faculty position in OPERATIONS RESEARCH or OPTIMIZATION to begin in Fall 1992. Within these areas, either a stochastic or a deterministic emphasis is of interest. Applicants at all levels will be considered.

Selection is based on demonstration and promise of excellence in research, teaching, and innovative application. AA/EOE.

Applicants are asked to furnish a curriculum vitae, transcripts (junior applicants only), reprints (if available), a letter describing professional interests and aspirations, and to arrange for three letters of recommendation to be sent to:

John C. Wierman, Chair
Department of Mathematical Sciences
220 Maryland Hall
The Johns Hopkins University
Baltimore, MD 21218-2689

THE JOHNS HOPKINS UNIVERSITY
Department of Mathematics

Applications are invited for a position beginning Fall 1992 at the Associate or Assistant Professor level in partial differential equations or related areas. Outstanding research accomplishments and commitment to teaching are required. Applications will be considered from candidates who have received a Ph.D. in mathematics prior to 12/89.

Minority and women candidates are strongly encouraged to apply. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer.

Applications and recommendation letters should be sent to: PDE Search Committee, Department of Mathematics, The Johns Hopkins University, Baltimore, MD 21218.

UNIVERSITY OF MARYLAND
UNIVERSITY COLLEGE

The University of Maryland University College seeks excellent teachers for openings on U.S. military bases overseas. Appointments begin August 1992. Requirements include M.A. or Ph.D., recent college teaching experience, and U.S. citizenship. Competence to teach in another discipline desirable. Benefits include transportation and military base privileges (PX, commissary, etc.). Frequent travel and the cost of schooling make these positions difficult for those with children. Send resume to: Dr. Ralph E. Millis, Assistant to the President, Overseas Programs, The University of Maryland University College, College Park, MD 20742-1642. AA/EEO.

MICHIGAN

GMI ENGINEERING & MANAGEMENT INSTITUTE
Department of Science and Mathematics

GMI Engineering & Management Institute invites applications for one or more tenure-track positions in Mathematics at the level of Assistant Professor or higher. At least one position will be filled by September 15, 1992.

GMI operates on a five-year fully cooperative plan of education. The Science and Mathematics Department offers a Bachelor of Science degree in Applied Mathematics, as well as courses at all levels as an active participant in the Engineering and Management bachelors and masters degree programs.

The successful candidates must demonstrate outstanding teaching and research capability. They must also show interest in using the computer in both teaching and research. A Ph.D. in Mathematics or related area is required. We are especially interested in applicants with a background in applied mathematics, computer science, statistics, or actuarial science. Please send resume, statement of research interests and at least three letters of recommendation to: Dr. S. Chakravarthy, Chair, Mathematics Search Committee, Department of Science and Mathematics, GMI Engineering & Management Institute, Flint, Michigan 48504–4898. Applications will be accepted until February 15, 1992.

GMI is an Affirmative Action/Equal Opportunity Employer. Women and minorities are particularly encouraged to apply.

HILLSDALE COLLEGE
Department of Mathematics
Hillsdale, MI 49242

An independent, coeducational, liberal arts college of 1200 students, seeks two Computer Scientist/Mathematicians for tenure-track positions. Both positions will be joint appointments as Assistant Professor of Mathematics and Computer Science to begin August 1992. For each position, preference will be given to candidates holding a Ph.D. in computer science or a Ph.D. in mathematics or a related area with a strong or developing expertise in computer science. In addition to a 12 hour teaching load per semester, duties will include academic advising and college service. A commitment to quality liberal arts education and experience in undergraduate teaching will be important. Salary will be competitive and commensurate with qualifications. Send letter of application, resume, a statement about your teaching philosophy, and three letters of reference to: Prof. Mark J. Watson, Chair, at the above address by January 31, 1992. EOE.

HILLSDALE COLLEGE
Department of Mathematics
Hillsdale, MI 49242

An independent, coeducational, liberal arts college of 1200 students, seeks a Mathematician

for a tenure-track position as Assistant Professor of Mathematics to begin August 1992. A candidate should hold the Ph.D. in mathematics, and should expect to teach all levels of undergraduate mathematics. In addition to a 12 hour teaching load per semester, duties will include academic advising and college service. A commitment to quality liberal arts education and experience in undegraduate teaching of mathematics will be important. Salary will be competitive and commensurate with qualifications. Send letter of application, resume, a statement about your teaching philosophy, and three letters of reference to: Prof. Mark J. Watson, Chair, at the above address by January 31, 1992. EOE.

MINNESOTA

GUSTAVUS ADOLPHUS COLLEGE

Tenure-track position beginning Sept. 1992. Ph.D. in math stat., stat expected. Ability to build stat. track in math/cs program, commitment to excellence in teaching, continuing research interests in stats, operations research or modeling, some c.s. preferred. Women and minority candidates urged to apply. Send c.v., transcripts, 3 letters of reference by 31 January 1992 to: Dr. T. J. Morrison, Chair Math/C.S., Gustavus Adolphus College, St. Peter, MN 56082. Telephone: (507)933-7483 or 933-7009. Email: TJ@GACVAX2.BITNET or TJM@BANACH.GAC.EDU.

MISSISSIPPI

UNIVERSITY OF SOUTHERN MISSISSIPPI
Department of Mathematics

Applications are invited for a tenure-track position at the assistant professor level. Candidates must have the Ph.D. in mathematics, the ability to establish a serious research program, and a sincere dedication to teaching.

The successful candidate will be based at Gulf Park, the branch campus which fronts the scenic Gulf of Mexico in Long Beach, Mississippi. This campus is 75 miles south of the Hattiesburg main campus. As the sole full-time mathematician based at Gulf Park, the successful applicant will select and schedule mathematics courses on the Coast, and will be actively involved in advising students pursuing the baccalaureate degree and M. Ed. in mathematics. Ideally the candidate should possess a people-oriented personality, for an important part of the position is to sustain and nourish the mathematics program on the Coast. At present there are 25 majors working on degrees there. The teaching load is 9 credit hours per semester, including both undergraduate and graduate courses, with the possibility of a course release for research.

Those candidates whose research interests complement those of the current faculty are especially urged to apply. These interests include algebra, combinatorics, differential equations, graph theory, mathematics education, matrix theory, linear algebra, mathematical physics, numerical analysis, and probability. In addition, the Department participates with Computer Science and Physics in a multidisciplinary Ph.D. program in Scientific Computing. It is expected that the successful applicant will interact with the Hattiesburg mathematics faculty through colloquia and faculty interchanges. The successful candidate may seek both promotion and tenure through the Mathematics Department in Hattiesburg or the Division of Arts and Sciences at USM Gulf Coast.

The salary is negotiable and competitive, dependent upon qualifications. The starting date will be fall, 1992–93. While the application deadline is open, selection may begin as early as February 1st.

Send resume and three letters of recommendation to: Chair, Search Committee, Department of Mathematics, University of Southern Mississippi, Hattiesburg, MS 39406–5045. The University of Southern Mississippi is an affirmative action, equal opportunity employer. Applications from women and minority group members are encouraged.

MISSOURI

SAINT LOUIS UNIVERSITY
Department of Mathematics and Computer Science
Saint Louis, MO 63103

One or more tenure-track appointments, to begin in the Fall of 1992. Candidates should have a Ph.D. in mathematics and be committed to teaching and research. Preference given to researchers in analysis, especially harmonic analysis, Lie group representations, and functional analysis. If more than one appointment is made, researchers in the area of group theory will also be given preference. The Department currently has 13 members, all of whom are active in research. Representatives of the Department will be present at the joint mathematics meetings in Baltimore. Deadline for full consideration is 2/1/92. Send vita (with email address if available) and three letters of reference to Bradley Currey, Chair, Faculty Search Committee, (email: curreybn@sluvca.slu.edu). Saint Louis University is an equal opportunity employer; minorities and women are encouraged to apply.

UNIVERSITY OF MISSOURI-ROLLA
Department of Mathematics and Statistics
Rolla, MO 65401

Possible tenure-track position available for the fall of 1992. Rank and salary are open and depend on qualifications, but applicant must have completed the Ph.D. by August 15, 1992. There is also a possibility that a visiting position will be available. Preference will be given to those whose research area complements departmental research or fills a need. Training, research potential and teaching ability of the candidate will be considered in the selection. Submit curriculum vitae, summary of research, transcripts and three letters of reference to W. T. Ingram, Chairman. Applicant review will begin in January 1992. In order to receive full consideration, please have all materials in by January 15. AA/EOE.

NEVADA

UNIVERSITY OF NEVADA, LAS VEGAS

The Department of Mathematical Sciences has two tenure-track or tenured positions for Associate/Full Professor, starting Fall 1992. Applicants from all areas of mathematics will be considered. Preference will be given to applicants with research interests compatible with those of our current faculty, and in one of the two positions, preference may be given to applicants in Math Education. Both a Ph.D. in Mathematics, Applied Mathematics, or Math Education, and a record of successful research and teaching are required. Rank and salary will be commensurate with experience and qualifications.

UNLV, a growing urban university with an enrollment of over 19,500 students, houses a National Supercomputing Center for Energy and the Environment funded by the DOE.

Submit a letter of application, a current resume, and at least three letters of reference to the Department of Mathematical Sciences, University of Nevada, Las Vegas, Las Vegas, Nevada 89154-4020. The processing of applications for senior level positions will begin immediately. Applications for unfilled positions will be accepted until March 31, 1992. Proof of Eligibility for U.S. Employment (under the Immigration Reform and Control Act of 1986) will be required prior to employment. The University of Nevada, Las Vegas is an equal opportunity/affirmative action employer.

UNIVERSITY OF NEVADA, RENO
Department of Mathematics
Chair Wanted

Do you have what it takes to lead a Math Department boldly into the future? Would you welcome the opportunity to make an impact on an entire state? If you answered "yes" to these questions, then UNR invites your application!

The Department of Mathematics is seeking a dynamic, well-rounded individual to be its Chair. Currently the department has 15 faculty. Among these are three recipients of distinguished teaching awards and one outstanding researcher award. More faculty members will be added in the near future, and the chair will play a key role in making those hires.

We offer B.A., M.S., and M.A.T.M. degrees in mathematics. We are committed to excellence in teaching at all levels, especially in the university wide core curriculum math courses. We are also working to increase the quantity and quality of our research output.

We intend that this position be filled by someone with the qualifications of a full professor, so an applicant must have a substantial and continuing record of scholarly achievement, research, and demonstrated interest in teaching.

Salary will be competitive and commensurate with qualifications of the applicant.

Applications should include biographical information and names, addresses (including email, if appropriate), and telephone numbers of five references. Please send to Don Pfaff, Department of Mathematics, University of Nevada, Reno, Reno, NV 89557, [(702) 784-6775; email address: don@cs.unr.edu; FAX: 702-784-1478]. Review of applications will begin November 15, 1991; the search will continue until the position is filled.

The University of Nevada, Reno is an Equal Opportunity, Affirmative Action employer and does not discriminate on the basis of race, creed, color, sex, age, national origin, veteran status or handicap in any program or activity it operates. The University of Nevada employs only United States citizens or aliens lawfully authorized to work in the United States.

NEW HAMPSHIRE

DARTMOUTH COLLEGE

John Wesley Young Research Instructorship in Mathematics. The John Wesley Young Research Instructorship is a two year postdoctoral appointment for promising new or recent Ph.D.s whose research interests overlap a department member's. Current departmental interests include areas in algebra, analysis, algebraic geometry, combinatorics, computer science, differential geometry, logic and set theory, number theory, probability and topology. Teaching duties of four ten-week courses spread over two or three quarters typically include at least one course in the instructor's specialty and include elementary, advanced and (at instructor's option) graduate courses. Nine-month salary of $34,000 supplemented by summer (resident) research stipend of $7,556 (two-ninths). Send letter of application, résumé, graduate transcript, thesis abstract, description of other research activities and interests if appropriate, and 3 or preferably 4 letters of recommendation (at least one should discuss teaching) to Phyllis A. Bellmore, Mathematics and Computer Science, 6188 Bradley Hall, Hanover, NH, 03755-3551. Applications received by Jan. 15 receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to affirmative action and strongly encourages applications from minorities and women.

DARTMOUTH COLLEGE

The Department of Mathematics and Computer Science has an opening for a tenure-track Assistant Professor in Mathematics, with initial appointment in the 1992-1993 academic year. A candidate for the position must be committed to outstanding teaching at all levels of the undergraduate and graduate curriculum and must give evidence of a well-regarded research program that shows real promise for the future. Candidates with several years of experience should in addition be ready to direct Ph.D. theses.

To create an atmosphere supportive of research, Dartmouth offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence and flexible scheduling of teaching responsibilities. The teaching responsibility in mathematics is four courses spread over two or three quarters. The department encourages good teaching with a combination of committed colleagues and bright, responsive, students.

Applications are welcome in all fields of mathematics and statistics; the department expects to be able to give applicants more information about departmental priorities after completion of an application, curriculum vitae, and a brief statement of research results and interests. Also arrange for four letters of reference to be sent, at least one of which addresses teaching, and, if the applicant's native language is not English, the applicant's ability to use English in a classroom. All application materials should be addressed to Phyllis Bellmore, Recruiting Secretary, Mathematics and Computer Science, 6188 Bradley Hall, Dartmouth College, Hanover, NH 03755–3551. Applications completed by February 1 will receive first consideration. Dartmouth is committed to Affirmative Action and encourages applications from African Americans, Asian Americans, Hispanics, Native Americans and women. Specific questions on the selection process can be directed to C. Dwight Lahr, Recruiting Chair.

KEENE STATE COLLEGE

Mathematics, Assistant/Associate, tenure-track position beginning Fall 1992. Teach introductory and advanced undergraduate courses in Mathematics (12 credits per semester), serve on committees, review and plan curriculum, advise students. Qualifications: Doctorate in mathematics or related field, full-time college teaching experience; record of scholarly activity; excellent oral communication skills and strong commitment to teaching required; people with experience in mathematics education encouraged to apply. Rank and salary dependent upon qualifications; minimum for Assistant, $28,200, Associate, $33,450. Send letter of application, resume, and three letters of recommendation documenting teaching excellence to Gaynelle Pratt, Office of Human Resource Management, Keene State College, Keene, NH 03431. Non-US citizens include current visa status. Review of applications begin January 20, 1992. Keene State College will be represented at the January 1992 AMS/MAA meeting in Baltimore. AA/EOE.

NEW JERSEY

NEW JERSEY INSTITUTE OF TECHNOLOGY
Chairperson: Mathematics

Significant strides have been made in developing a first-class, research-level, applied mathematics program at NJIT. Further growth is anticipated and desired. Areas of departmental expertise include acoustics, dynamical systems, electromagnetics, fluid mechanics, asymptotic and perturbation methods, numerical analysis and scientific computing, and statistical analysis.

The Department of Mathematics offers B.S. degrees in applied mathematics and in statistics and actuarial science, and an M.S. degree in applied mathematics. A Ph.D. program in mathematical sciences is currently under review. The department also offers core mathematics courses in support of other university curricula.

A chairman is sought with a Ph.D. in applied mathematics or statistics, with a strong commitment to research and teaching, with the desire to develop and strengthen cooperative relationships with industry, and with a record of effective administration and leadership.

NJIT is New Jersey's technological university with approximately 7,500 students enrolled in baccalaureate, master's and doctoral programs within Newark College of Engineering, the School of Architecture, the College of Science and Liberal Arts, and the School of Industrial Management.

NJIT does not discriminate on the basis of sex, race, color, handicap, religion, national or ethnic origin or age in employment.

For further information please contact Professor Gregory A. Kriegsmann, chairman of the search committee, Department of Mathematics.

Send resume: Personnel Box MATH-C
New Jersey
Institute of Technology
University Heights
Newark, New Jersey 07102

NEW YORK

BARUCH COLLEGE-CUNY
Department of Mathematics

Tenure-track position at asst/assoc rank beginning 8/31/92. A Ph.D. in mathematics is required. Quality teaching, student support and curricular development are primary concerns while scholarly publications are expected for all future promotion and tenure decisions. A proven record of excellence in teaching, curriculum development, and scholarly publication is preferable and past successful grant funding is very desirable. Applications must be received by 2/3/92. Salary ranges from $28,630 to $55,179. Send resumé, and three letters of recommendation to: Baruch College, Dept. of Mathematics-Search Committee, Box 509, 17 Lexington Ave, New York, NY 10010. Baruch is an EOE/AA employer; women and minorities are encouraged to apply.

COLLEGE OF STATEN ISLAND (CUNY)
Department of Mathematics

A tenure-track position in mathematics is available for Fall 1992. Requirements: Ph.D., strong commitment to undergraduate teaching and to a productive research program. All mathematics research areas will be considered with special preference given to areas of strength within the

department. These areas include probability, group theory and applied mathematics. The position is budgeted at the assistant professor level. The College of Staten Island is a senior college in CUNY. Send resume and three letters of reference to Dr. Jane Coffee, Chairperson, Mathematics Department, College of Staten Island, 130 Stuyvesant Place, Staten Island, N. Y. 10301, by January 15, 1992. AA/EOE Employer.

CUNY GRADUATE SCHOOL
Ph.D. Program in Mathematics

The Ph.D. Program in Mathematics of The Graduate School and University Center of The City University of New York, located in midtown Manhattan, anticipates a vacancy for a full professor, at $49,395 to $66,310. Candidates should exhibit very high-level scientific achievement and the ability to teach graduate students successfully. Another extremely important requirement is long-range potential for scientific growth.

The program currently has several active areas of research, and candidates should be broadly based and able to interact with other faculty in several of these areas, which include differential geometry, Riemann surfaces, automorphic forms, Lie groups and algebraic groups and their representation theory, number theory, ergodic theory and dynamical systems, combinatorial group theory, topology, and logic.

Candidates should send a curriculum vitae and the names and addresses of three references to: Professor Martin Moskowitz, Executive Officer, Ph.D. Program in Mathematics, CUNY Graduate Center, 33 West 42 Street, New York, NY 10036. Review of applications will begin January 1, 1992. CUNY is an Affirmative Action/Equal Opportunity Employer.

POTSDAM COLLEGE

Mathematics: Potsdam College of the State University of New York invites applications for one possible tenure track position in Mathematics commencing September 1, 1992. Responsibilities: Teach, at most, 12 hours/semester of undergraduate and beginning graduate mathematics. Qualifications: Ph.D. in Mathematics (any area). Near completion of A.B.D. will be considered. Salary: Commensurate. Send letter of application, resume, graduate transcripts (copies are acceptable) and letters of reference to: Dr. K. Chapman, Search Committee Chair, Department of Mathematics, Potsdam College, Potsdam, NY 13676. Application review will commence February 1, 1992 and continue until the position is filled. Potsdam College is an equal opportunity affirmative action employer committed to excellence through diversity.

SAINT BONAVENTURE UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for an anticipated tenure track position to begin Fall 1992. A Ph.D. in mathematics is required. Applicants should possess a strong commitment to undergraduate teaching in a liberal arts environment. The teaching load is 12 hours a semester and continued scholarly activity is expected. Saint Bonaventure University is located in the scenic hills of western New York State, 70 miles south of Buffalo. Candidates should send a letter of application, vita, and three letters of recommendation to: Mathematics Search Committee, c/o Fr. Richard Mucowski, OFM, St. Bonaventure University, St. Bonaventure, NY 14778. The closing date for applications is January 4, or until the position is filled. Saint Bonaventure is an Equal Opportunity Employer; women and minorities are encouraged to apply.

SUNY AT CORTLAND

Two Assistant Professors (Mathematics). These are tenure-track positions. These positions entail teaching a variety of mathematics courses each semester, from the elementary to the upper-division level, as well as taking part in departmental governance and student advisement. A doctorate in mathematics and evidence of strength in, and commitment to, undergraduate education is required. An interest in the preparation of secondary mathematics teachers will be valued, as well as research potential in mathematics or mathematics education. All areas of specialization in mathematics or mathematics education are encouraged to apply. Applications for the positions will be accepted untill January 31, 1992. AA/EEO Employer.

Applicants should submit a letter of application, vita, three letters of recommendation and all transcripts to:

Dr. Jalal Alemzadeh
Chair, Search Committee of
Mathematics Department
State University of New York
College at Cortland
P.O. Box 2000
Cortland, NY 13045

YESHIVA UNIVERSITY
Department of Mathematics

The small, selective liberal arts colleges of Yeshiva University invite applications for a tenure-track position starting in Fall 1992 at the rank of assistant/associate professor. Responsibilities include teaching 12 hrs/sem and active scholarship at a level consistent with the teaching load. Rank and salary commensurate with background and experience. Qualifications: Ph.D., postdoctoral college teaching experience with a record of excellence, and a commitment to undergraduate teaching and productive scholarship. Send letter, vita and have three letters of reference sent to Dean Norman S. Rosenfeld, Yeshiva College, New York, NY 10033. (EOE).

NORTH CAROLINA

DUKE UNIVERSITY
Department of Mathematics

Applications are invited for a tenure track Assistant Professorship in Mathematics, salary open, all fields, starting September 1, 1992. Applicants should send a curriculum vitae, a research plan, and should arrange for three letters of recommendation to be sent. A teaching recommendation is also strongly suggested. Complete applications received by January 15, 1992 will be guaranteed full consideration. Address correspondence to: Faculty Search Committee, Department of Mathematics, Duke University, Durham, NC 27706. Duke University is an affirmative action/equal opportunity employer.

NORTH CAROLINA STATE UNIVERSITY
Biomathematics Graduate Program
Department of Statistics

Assistant/Associate Professor of Biomathematics (tenure-track). Research strength expected in mathematical biology, either in mathematical theory or in applications. Duties include research, teaching, and graduate student direction. Special attention will be given to candidates whose appointment would increase the diversity of faculty research in the Biomathematics program. The successful candidate will be expected to establish a significant, externally funded, research program. Letter of application, CV (including transcript or list of graduate courses for recent graduates), and 3 letters of reference should be sent by February 1, 1992 to Faculty Search Committee, Biomathematics Graduate Program, North Carolina State University, Campus Box 8203, Raleigh, NC 27695-8203. EOE/AA.

UNIVERSITY OF NORTH CAROLINA
AT CHAPEL HILL
Department of Mathematics
Chapel Hill, NC 27599-3250

Applications are invited for one faculty appointment effective Fall 1992. Rank and salary depend on qualifications and budget considerations. Ph.D. in mathematics highly preferred, exceptionally strong research program and commitment to excellent teaching required. Send curriculum vitae, abstract of current research program and four letters of recommendation to Search Committee Chairman, Math. Dept., CB #3250 Phillips Hall, UNC at Chapel Hill, Chapel Hill, NC 27599-3250. EO/AA Employer. Women and minorities are encouraged to identify themselves voluntarily. Completed applications received by February 15, 1992 are assured of full consideration.

WESTERN CAROLINA UNIVERSITY
Department of Mathematics and Computer Science

Tenure-track position at the rank of assistant/associate professor, starting Fall 1992. Ph.D. in mathematics required. Duties include teaching undergraduate courses in mathematics and graduate courses in a master's program in applied mathematics. Excellence in teaching and continued scholarly activity are expected. Applicant should possess the ability to teach in English effectively. Send resume, copies of transcripts, and three letters of reference to:

E. L. Morton
Search Committee
Department of Mathematics and Computer Science
Western Carolina University
Cullowhee, NC 28723

Application deadline January 31, 1992; however, applications will be accepted until the position is filled. EO/AAE.

OHIO

BOWLING GREEN STATE UNIVERSITY
Department of Mathematics and Statistics

The department anticipates a position in either (1) Applied Analysis, (2) Computational Mathematics, or (3) Functional Analysis. We have a growing doctoral program (thirteen Ph.D.s awarded in the last three years; eight anticipated in 1992) and seek to strengthen these areas. The selected candidate will be expected to pursue research, teach two courses per semester, work with doctoral students, and eventually direct Ph.D. dissertations. Qualifications: Ph.D. in Mathematics. Preference will be given to candidates who already hold a Post-Doctoral Fellowship (or equivalent), have a strong research record, and whose research is compatible with current faculty. Salary competitive. Please provide a vita, publication list, official transcript, and have 3 letters of recommendation sent by 2/1/92 to:

Andrew Glass, Chair
Mathematics & Statistics Dept.
Bowling Green State University
Bowling Green, OH 43403-0221
EOE Employer. Females & minorities encouraged to apply.

CASE WESTERN RESERVE UNIVERSITY
Visiting Positions in Mathematics and Statistics

The Department of Mathematics and Statistics anticipates at least two one-year visiting appointments in Mathematics and Statistics, beginning July 1, 1992. Applications in all areas of mathematics are invited. Preferred areas include probability and statistics, global analysis and geometry, dynamical systems, control theory, functional analysis, partial differential equations, and numerical analysis. Women and minority group applicants are especially encouraged to apply. Send vita plus three letters of recommendation to Professor David Singer, Chairman, Department of Mathematics and Statistics, Case Western Reserve University, Cleveland, OH 44106–7058. CWRU is an Affirmative Action/Equal Opportunity employer.

KENT STATE UNIVERSITY
Department of Mathematics and Computer Science

The Department invites applications for the Fall Semester, 1992, for two tenure-track positions (funding pending) for entry-level assistant professors in the areas of algebra, analysis (including algebraic or analytic number theory), applied mathematics, or mathematical statistics. Applicants must have completed the requirements for a Ph.D. by August 1992. Salary is competitive and negotiable.

The Department of Mathematics and Computer Science at Kent State University houses pure and applied mathematics, statistics, computer science, and the Institute for Computational Mathematics. Strengths in mathematical research in the Department include several areas of analysis and algebra. Active areas of computer science research include theoretical computer science, computer algebra, and scientific computing.

The Department operates a computer network including a significant number of workstations, plus Encore, Sequent, WARP, and WaveTracer parallel-processing computers, and a variety of periphials. The University maintains an IBM 3090 mainframe and a high-performance link to the Cray Y-MP/864 at the Ohio Super Computer Center, on which computing time is readily available.

Application deadline is February 1, 1992. However, if the positions are not filled by this date, the deadline will be extended until the positions are filled. Applicants should submit a curriculum vitae, and arrange to have three letters of recommendations sent to Per Enflo, Head of Search Committee, Department of Mathematics and Computer Science, Kent State University, Kent, OH 44242. Kent State University is an Affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.

OHIO UNIVERSITY
Department of Mathematics

The Department of Mathematics anticipates the appointment of one tenure-track assistant, associate or full professor beginning September 1, 1992. Salary (at least $30,000 per year) and rank dependent on candidate's qualification and experience. The appointment of associate full professor rank may be contingent on budgetary constraint. Applicants must have a Ph.D. in Mathematics before September 1, 1992 and have research interests in general topology or set theory with possible applications to topology. Only exceptionally well-qualified individuals will be considered for the associate or full professor rank. Send resume and have three letters of recommendation sent to Shih-liang Wen, Chairman, Department of Mathematics, Ohio University, Athens, Ohio 45701. The deadline for applications is January 1, 1992. Ohio University is an Equal Opportunity/Affirmative Action Employer.

THE OHIO STATE UNIVERSITY
Department of Mathematics

The Department of Mathematics of The Ohio State University hopes to have available several positions, both visiting and permanent, effective Autumn Quarter 1992. Candidates in all areas of applied and pure mathematics, including those with demonstrated interest in pedagogical matters, are invited to apply. Significant mathematical research accomplishments or exceptional promise, and evidence of good teaching ability, will be expected of successful applicants.

Please send credentials and have letters of recommendation sent to Professor Dijen Ray-Chaudhuri, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. Review of résumés will begin immediately.

The Ohio State University is an Equal Opportunity/Affirmative Action employer. Qualified women and minority candidates are encouraged to apply.

THE OHIO STATE UNIVERSITY
Department of Mathematics
Research Instructorships in Mathematics

The Department of Mathematics of The Ohio State University hopes to have available a few research instructor positions for the academic year 1992–93. Candidates should hold a Ph.D. (or equivalent) in mathematics and show strong research promise.

Please send credentials and have letters of recommendation sent to Professor Dijen Ray-Chaudhuri, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. The Ohio State University is an Equal Opportunity/Affirmative Action employer.

UNIVERSITY OF TOLEDO
Department of Mathematics
Toledo, OH 43606

Applications are invited for a tenure-track assistant professor position beginning in September 1992. Applicants should have a Ph.D. (or have completed all requirements for the Ph.D. by Fall 1992) and be committed to excellence in both teaching and research. We are particularly interested in applicants with research interests in statistics. Minority and women candidates are encouraged to apply. Applicants should send a resume and arrange for three letters of reference to be sent to Harvey Wolff, Chairman, Department of Mathematics, The University of Toledo, Toledo, OH 43606. The University

of Toledo is an Equal Opportunity/Affirmative Action Employer.

OREGON

PORTLAND STATE UNIVERSITY
Portland, Oregon

Possible tenure track position at the assistant professor rank starting September 1992. Applicants sought whose research is in one of the areas of current interest in the department such as control theory and numerical methods, Lie Groups and Ergodic Theory, Differential Geometry, and low dimension topology. Candidates must have a PhD or equivalent, show an ability to conduct a strong research program including refereed publications, and have a record of excellent teaching. Send a c.v. and have at least three letters of reference sent directly to Search Committee, Department of Mathematical Sciences, PO Box 751, Portland State University, Portland, OR, 97207–0751. Consideration of applications will begin on February 1, 1992. Portland State is an Affirmative Action/Equal Opportunity Employer. Minorities and women are especially urged to apply.

UNIVERSITY OF OREGON
Department of Mathematics
Eugene, Oregon 97403
Frank W. Anderson, Head

Two Assistant Professor tenure track positions in the areas of probability/statistics or analysis beginning September 1992. Preference given to person with research interests related to ones currently represented. Competitive salary with excellent fringe benefits. Send complete resume and three letters. Closing date: January 24, 1992. Women and minorities are specially encouraged to apply. An EO/AA institution committed to cultural diversity.

PENNSYLVANIA

CARNEGIE MELLON UNIVERSITY
Department of Mathematics
Center for Nonlinear Analysis

The Department expects to make four to five Post-doctoral appointments for 1992–1993 in the area of applied analysis. This is a one-year (twelve month) joint appointment by the Center and Department of Mathematics. Recipients will teach at most one course per semester. Applicants should send a vita, list of publications, a statement describing current and planned research, a statement of teaching experience, and arrange to have at least three letters of recommendation sent to the committee. The deadline for application is January 15, 1992; late applications may be considered on a space-available basis. All communications should be addressed to: Post-doctoral Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

CARNEGIE MELLON UNIVERSITY
Department of Mathematics

The Department invites applications for a senior level appointment in Computational Mathematics/Numerical Analysis. We are particularly interested in candidates who will enhance existing computational and analytical programs which involve continuum models in fluid dynamics, mechanics of solids including microstructure, phase transitions as well as other aspects of materials science. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to: Chairman, Computational Mathematics Search Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

CARNEGIE MELLON UNIVERSITY
Department of Mathematics

The Department expects to make two tenure-track appointments, to begin in the Fall of 1992, at the Assistant Professor level. We seek candidates in areas of research which strongly intersect those of the current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to the committee. All communications should be addressed to: Tenure-track Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

LAFAYETTE COLLEGE
Department of Mathematics
Easton, PA 18042

Tenure track position at the rank of Assistant Professor (contingent upon final approval) beginning in late August 1992. Requirements include Ph.D. and strong commitment to undergraduate teaching and continuing professional development. Teaching load of 5 courses per year. Lafayette offers liberal arts and engineering in a small (2000 students) highly selective private college.

Send vitae, 3 letters of reference, and telephone numbers (office and home) to Chair, Mathematics Search Committee. Review of applications will begin January 20, 1992, and will continue until the position is filled. Lafayette College is an Equal Opportunity Employer and particularly encourages applications from women and minority candidates.

LEHIGH UNIVERSITY
Department of Mathematics

The Department of Mathematics at Lehigh University invites applications and nominations for two tenure-track positions beginning with the Fall Semester 1992. Both positions are at the level of Assistant Professor. Preference will be given to researchers in the continuum from algebraic topology through differential geometry to global analysis and in algebra, specifically in an area overlapping combinatorics, discrete mathematics, and computational algebra.

Candidates for the positions must have an earned doctorate in mathematics and an excellent record in teaching and research. Applicants should send a curriculum vita, reprints of published papers (or accepted for publication), and at least three letters of recommendation to Search Committee, Department of Mathematics (Bldg 14), Lehigh University, Bethlehem, PA 18015. Applications from minorities and women are strongly encouraged. The selection process will begin in January 1992, and continue until the positions are filled.

Lehigh University is an equal opportunity and affirmative action employer.

MILLERSVILLE UNIVERSITY
Department of Mathematics

Full-time tenure-track assistant professorship to begin August 1992, in a department of 20 faculty and over 225 math majors. Primary duties: leadership in developmental mathematics, diagnostic techniques, remediation delivery packages, teaching and placement, teaching through calculus, advisement curriculum development, committees, and scholarly growth. Twelve-hour load per semester. Doctoral degree (or expected completion within one year) in mathematics, math education, or curriculum and instruction with a mathematics background at least through the master's level. Must exhibit evidence of strong commitment to excellence in teaching developmental mathematics, relate well with developmental students and the wider university community, and be an effective teacher of math through calculus. Experience in pre-university or urban teaching preferred. Excellent salary-benefits. Full consideration will be given to applications received by 2/1/92. Send letter of application, vita, copies of transcripts, and three letters of reference (at least two which attest to your teaching effectiveness) to: Prof. Marshall Anderson, Staff Search Committee Chair, Department of Mathematics AMS192, MILLERSVILLE UNIVERSITY, Millersville, PA 17551. AA/EOE.

SAINT JOSEPH'S UNIVERSITY
Department of Mathematics
and Computer Science

The department of Mathematics and Computer Science will have one or two tenure track positions beginning Fall 1992. Candidates should have a serious commitment to excellence in undergraduate teaching, and a Ph.D. by the time the appointment begins. Applicants in all

areas of mathematics will be considered; ability to teach some (undergraduate or Master's level) computer science is a plus. Send curriculum vitae, and arrange for three letters of recommendation to: Professor Jonathan Hodgson, Department of Mathematics and Computer Science, Saint Joseph's University, 5600 City Avenue, Philadelphia, PA 19131. Letters of recommendation should speak to teaching as well as research capabilities.

Saint Joseph's is an equal opportunity/affirmative action employer. Minorities and women are encouraged to apply.

SWARTHMORE COLLEGE
Department of Mathematics
Swarthmore, PA 19081

Applications are invited for 2 one year leave replacement positions for the 92–93 academic year. There is some possibility that one of these positions could be renewable for a second year. A Ph.D. is expected. Applicants should have excellent potential for teaching and a clear commitment to research. Of primary importance is the ability to teach a variety of introductory and advanced undergraduate courses well. Applicants should send a resume, statement of interest, and 3 references to Search Committee, Department of Mathematics, by February 15, 1992. Women and minorities are encouraged to apply.

TEMPLE UNIVERSITY
Department of Mathematics
Faculty Position

The Mathematics Department anticipates a tenure-track position opening at the junior level beginning Fall 1992. Preferred fields are Several Complex Variables and Geometry/Topology. Vita and three letters of reference should be sent by **December 31, 1991** to **Search Committee, Department of Mathematics, Temple University, Philadelphia, PA 19122.**

Women and Minorities are especially encouraged to apply. Temple University is an **Affirmative Action and Equal Opportunity Employer.**

UNIVERSITY OF PITTSBURGH
Department of Mathematics and Statistics

The department invites applications for the following positions, which will be available for September 1992 if funding permits.

1. Assistant Professor in pure mathematics. We have a significant interest in someone in algebra, topology, or geometry.

2. Visiting Assistant Professor in mathematical biology. Here we have a preference for an individual with a strong computational aspect to their research. There is a possibility that the person appointed to this position will be considered for a tenure-track position for the following year.

Requirements include outstanding research accomplishment and potential commensurate with experience, and ability and interest in excellent teaching.

Applicants should send resume and arrange to have at least three letters of recommendation sent to: S. Hastings, Chairman, Department of Mathematics and Statistics, University of Pittsburgh, Pittsburgh, PA 15260.

The University of Pittsburgh is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

THE UNIVERSITY OF SCRANTON
Mathematics Department

The University of Scranton, a Jesuit university with over 3,500 undergraduates, anticipates an opening in the academic year 1992-1993 for an entry level assistant professor of mathematics, tenure-track. Applications are invited from qualified candidates interested in a teaching environment where research is encouraged and supported. Applicants are required to have a Ph.D. in Mathematics or near completion. Individuals with expertise in any area of mathematics will be considered; however, preferred areas include Probability/Statistics, Actuarial Mathematics, Applied Mathematics, Algebra, and Analysis.

Submit a vita, copies of transcripts, and three letters of recommendation attesting to teaching and research ability to Mathematics Faculty Search Committee, University of Scranton, Scranton, PA 18510-4666 or phone (717) 941-6113. Interviews will be conducted at the Baltimore meeting Employment Register in January. The University of Scranton is an Affirmative Action/Equal Opportunity Employer.

RHODE ISLAND

BROWN UNIVERSITY
Division of Applied Mathematics

The Division of Applied Mathematics seeks a distinguished senior Professor to lead research in areas of applied mathematics related to physical applications such as wave propagation and random media. Candidates should have achieved eminence in all three of the following: mathematical analysis, modelling of physical phenomena and computational aspects. The starting date for this appointment is negotiable. Applications should be sent to: Prof. Wendell H. Fleming, Chairman, Division of Applied Mathematics, 182 George St., Box F, Providence, RI 02912. The closing date for applications is January 15, 1992.

Brown University is an equal opportunity employer.

SOUTH CAROLINA

CLEMSON UNIVERSITY
Clemson, SC

Applicants are invited for a tenure-track position at the assistant professor level. The department encompasses the areas of algebra/combinatorics, analysis, computational math, operations research and statistics. Preference will be given to candidates having a strong background in algebra with some research interest in combinatorics. Desirable attributes for candidates include an interdisciplinary research orientation in the mathematical sciences and an interest in innovative applications. Candidates should have strong potential or demonstrated capability for effective research and teaching. All of the above areas of the mathematical sciences are integrated into degree programs at the BS, MS, PhD levels. In addition, the department jointly administers a PhD program in Management Science with the Department of Management. Applications received by February 15, 1991, will be given highest priority, but others will be considered until position is filled. Applicants should indicate in the cover letter their research specialities. Vita and names of three references should be sent to address below. Reference letters will be requested when necessary. AA/EOE

Professor R. D. Ringeisen, Head
File A
Department of Mathematical Sciences
Clemson University
Clemson, SC 29634-1907

COLLEGE OF CHARLESTON
Department of Mathematics

Applications are invited for at least one tenure-track position at the Assistant Professor level beginning August 1992. Candidates must have a Ph.D. in one of the mathematical sciences, a commitment to undergraduate teaching, and potential for continuing research. The normal teaching load is 9 hrs/wk, with possibilities for reductions through internal grants. The salary is competitive. Applicants should send a vita and have three letters of recommendation sent to William L. Golightly, Chairman, Department of Mathematics, College of Charleston, Charleston, SC 29424. The process of evaluating applications will begin on January 13, 1992, but applications will be considered until the positions are filled. The College of Charleston is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF SOUTH CAROLINA
Department of Mathematics

The Department of Mathematics invites applications for expected tenure-track faculty positions for Fall 1992, at all ranks. Applications in all areas of mathematics will be considered. Research is supported by excellent inhouse library and computing facilities. The Ph.D. degree or its equivalent is required. Appointments will be consistent with the Department's commitment

to excellence in research and in teaching at the undergraduate and graduate levels. A detailed resumé, containing a summary of research accomplishments and goals, and four letters of recommendation should be sent to:

Dr. George F. McNulty, Chairman
Department of Mathematics
University of South Carolina
Columbia, SC 29208

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

TENNESSEE

MEMPHIS STATE UNIVERSITY
Department of Mathematical Sciences

The Department of Mathematical Sciences invites applications for anticipated tenure-track and visiting positions in Mathematics, Statistics and Computer Science for 1992. Preference will be given to those applicants whose research areas complement the research interests of our faculty. The Department offers degrees at all levels including the Ph.D. and provides a very favorable research environment in terms of library and computing facilities, teaching load, travel opportunities, etc. Applicants must have a Ph.D. by September 1, 1992, and a strong potential for excellence in teaching and research.

Selection will begin on February 14, 1992. Applications will continue to be accepted until all positions are filled. Women and Minorities are strongly urged to apply. Successful candidates must meet Immigration Reform Act criteria. Applicants should submit a resume and direct three letters of reference to:

Ralph Faudree, Chair
Department of Mathematical Sciences
Memphis State University
Memphis, TN 38152

An Equal Opportunity/Affirmative Action Employer.

TEXAS

RICE UNIVERSITY
Department of Mathematics

Applications are invited for a tenure-track assistant professorship. There is a possibility of an upgrade to associate or full professorship for an exceptional senior candidate. Candidates must have an extremely strong research background and good teaching skills. Preference will be given to applicants in geometric topology, geometric analysis, partial differential equations, and algebraic geometry. Duties will include research and classroom teaching.

Please send a curriculum vitae and at least 3 letters of recommendation to: Appointments Committee, Department of Mathematics, Rice University, P.O. Box 1892, Houston, TX 77251.

Applications received by December 31, 1991 will be assured full consideration.

Rice University is an Equal Opportunity/Affirmative Action Employer.

RICE UNIVERSITY
Griffith Conrad Evans Instructorships

Postdoctoral appointments for two to three years for promising research mathematicians with research interests in common with the active research areas at Rice, particularly geometric topology, geometric analysis, differential geometry, mathematical physics and ergodic theory. Duties will include research and classroom teaching. Applications received by December 31, 1991 will receive full consideration. Rice University is an Equal Opportunity/Affirmative Action Employer and strongly encourages applications from women and minority group members. Inquiries and applications should be addressed to Chair, Evans Committee, Department of Mathematics, Rice University, PO Box 1892, Houston, TX 77251-1892.

TEXAS TECH UNIVERSITY
Department of Mathematics
P.O. Box 41042
Lubbock, TX 79409-1042

The Department of Mathematics at Texas Tech University anticipates openings for at least two tenure-track Assistant Professorships beginning in the fall semester of 1992. In at least one of these positions, special consideration will be given to applicants in applied and computational mathematics. To qualify, the applicants must:

1. have a Ph.D. from a recognized university;
2. have a strong dedication to both teaching and research;
3. exhibit research interests that are compatible with ongoing programs in the department; and
4. be willing and able to work with students at both the undergraduate and graduate level.

To apply, please send a resume and have three letters of recommendation sent to Harold Bennett, Chairman of Hiring Committee, Department of Mathematics, Texas Tech University, P.O. Box 41042, Lubbock, TX 79409-1042 EOE/AA.

THE UNIVERSITY OF TEXAS AT AUSTIN
Department of Mathematics
Austin, Texas 78712

Openings are expected for Fall 1992 at all levels, including Instructor, Assistant Professor, Associate Professor and Professor. Candidates should have outstanding research ability and concern for teaching. Duties include teaching undergraduate and graduate courses and conducting independent research. Applicants at all levels are expected to have completed the Ph.D. by August 31, 1992. Salaries are competitive. If you have access to email, request a form from **recruit@math.utexas.edu**. Otherwise please send vita, detailed summary of research interests and three recommendation letters to address above, directed as follows:

Instructor and Assistant Professor: c/o Recruiting Committee; **Associate Professor and Professor:** c/o Efraim P. Armendariz, Chairman

The University of Texas at Austin is an equal opportunity employer. Minorities and women are encouraged to apply.

THE UNIVERSITY OF TEXAS AT SAN ANTONIO

The Division of Mathematics, Computer Science, and Statistics will have one tenure-track position at the assistant professor level in Mathematics, beginning August 1992. Although applicants in all areas of mathematics will be considered, preference will be given to those candidates whose research areas are in applied or applicable analysis. Applicants should have a Ph.D. degree in Mathematics by August 1992, and should demonstrate strong potential for excellence in research and teaching. Responsibilities include research, teaching, direction of graduate students, and contributing to program development.

San Antonio, Texas is a scenic, dynamic and fast growing city of rich cultural diversity. UTSA is the only public university in the city of San Antonio, and serves a metropolitan community of approximately one million people. The university is viewed by the community as an important asset in the economic development of the area.

Applicants should submit a resume and arrange to have at least three letters of recommendation sent to

Professor Shair Ahmad, Director
Division of Mathematics, Computer Science and Statistics
The University of Texas at San Antonio
San Antonio, TX 78285–0664
Email: math@ringer.cs.utsa.edu

The closing date for receipt of applications for this position is January 31, 1992. UTSA is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

UNIVERSITY OF TEXAS OF THE PERMIAN BASIN

One or more tenure track position(s) in the Department of Mathematics and Computer Science at the rank of Assistant/Associate Professor, starting September 1, 1992. Candidates should have the Ph.D. in mathematics or computer science and be able to contribute to both the teaching and research missions of the department. Primary teaching responsibility will be in mathematics, but preference will be given to candidates who can share in the teaching of computer science. After almost twenty years as an upper division and graduate institution, UT Permian Basin admitted its first freshman class in the fall of 1991. The State of Texas requires all faculty in higher education to be proficient in both written and spoken English. Candidates whose first language is not English

will be expected to provide evidence of such proficiency. EEO/AA

Interested candidates should send a resume and three letters of reference by February 1, 1992 to:

Dr. J. A. Nickel
Division of Science and Engineering
The University of Texas of the Permian Basin
Box 8385
Odessa, Texas 79762–0001

UTAH

BRIGHAM YOUNG UNIVERSITY
Department of Mathematics

Applications are invited for two positions, one in each of two specialties: PDE/computational mathematics, and geometric topology/geometric combinatorial group theory.

Selection will be based upon a proven record of research and teaching ability. Applications will be accepted until 1 February 1992. Please send a curriculum vitae and have three letters of reference sent to:

Donald W. Robinson
292 TMCB
Brigham Young University
Provo, UT 84602

BYU is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF UTAH
Department of Mathematics

Invites applications for the following positions:

1. At least two **full time tenure track appointments** on the professorial levels. The Department is primarily interested in applicants who work in the research areas represented in the Department and who received their Ph.D. degrees prior to 1991. Selection will be based on research and teaching ability.

2. Two or more nonrenewable **three-year Instructorships.** Persons of any age receiving Ph.D. degrees in 1991 or 1992 are eligible. Applicants will be selected on the basis of ability and potential in teaching and research. Starting salary will be $32,000; future cost of living increases are contingent on action by the State Legislature. Duties consist of teaching five courses during the three quarter academic year.

3. One **C. R. Wylie Instructorship.** The term of this instructorship is one year, but it may be renewed for up to three years. It will be awarded either to an incoming Instructor or to one of the Instructors already in residence on the basis of ability and potential in teaching and research. The stipend in $36,200. Duties consist of teaching four courses during the three quarter academic year.

4. One or more **visiting faculty positions** of one year or less in any of the professorial ranks. Selection will be based on potential contributions to the department's research program, and on teaching ability.

It is expected that offers of Instructorships will begin on January 1, 1992, but applications for all positions will be accepted until January 31, 1992, or until all positions are filled.

Applications for any of these positions should include curriculum vitae, bibliography and three letters of reference. (Instructorship applications should also include an abstract of the thesis and either a list of graduate courses completed or a transcript of graduate work.) Visiting faculty applications should indicate the portion of the three-quarter academic year during which the applicant wishes to visit. Please send your application to Committee on Staffing, Department of Mathematics, University of Utah, Salt Lake City, Utah 84112. The University of Utah is an Equal Opportunity, Affirmative Action Employer and encourages nominations and applications from women and minorities.

WEST VIRGINIA

WEST VIRGINIA UNIVERSITY
Department of Mathematics

The Department of Mathematics intends to make two faculty appointments at the Assistant Professor rank that will commence August 1992. Candidates are expected to have a Ph.D. in mathematics or equivalent with a strong record or demonstrated potential in both research and teaching. Preference will be given to applicants whose research interests complement those currently in the Department. One appointment will be in analysis, applied analysis, or numerical analysis. The other, pending funding, will be in algebra or discrete mathematics. Normal responsibilities include research and a two course teaching assignment per semester at the graduate or undergraduate level. Applications and inquiries should be directed to Michael Mays, Department of Mathematics, West Virginia University, Morgantown, WV 26506. Applicants should submit a vita and have three letters of reference sent. To insure consideration, application materials must be received by January 15, 1992. WVU is an affirmative action/equal opportunity employer. Qualified women and minorities are especially encouraged to apply.

WISCONSIN

CARTHAGE COLLEGE
Kenosha, Wisconsin

Applications are invited for two tenure-track Assistant Professor positions, to begin Fall 1992. A strong general mathematical background, including a Ph.D. is expected. One of the positions requires an interest in probability and/or statistics. Commitment to excellence in undergraduate instruction, continued mathematical scholarship and development of independent student mathematical work is required. Carthage College is a liberal arts college located on Lake Michigan between Chicago and Milwaukee, with a growing enrollment and an expanding Mathematics Department. The College seeks candidates who wish to participate in the building of a strong mathematics program and who would also look forward to developing interdisciplinary ties in a college-wide setting.

Applications, consisting of transcripts and three letters of reference, should be submitted to: Dr. Thomas A. Brawner, Chairperson of the Division of Natural Sciences, Carthage College, Kenosha, WI 53140. Review of applications will begin on December 1, 1991. A representative from the department will attend the joint AMS-MAA January 1992 meetings in Baltimore and meet with interested candidates. Strong candidates not able to attend the meetings will also be considered.

Carthage College is an equal opportunity employer and specifically invites and encourages applications from women and minorities.

WYOMING

THE UNIVERSITY OF WYOMING
Department of Mathematics
Position in Mathematics

Applications are invited for a tenure-track position in Applied Mathematics or Analysis at the rank of assistant professor. Strong consideration will be given to, but not limited to, the following areas: partial differential equations, numerical linear algebra, applied functional analysis, and numerical analysis. Salary is competitive and commensurate with experience and qualifications. Candidates should demonstrate accomplishment and potential in research and teaching.

Applicants should send vita, three letters of recommendation, and brief description of his/her research plans to: Dr. John George, Chairman, Department of Mathematics, University of Wyoming, Laramie, Wyoming 82071. Email inquiries should be sent to *gauss*@CORRAL.UWYO.EDU. Applications completed by January 15, 1992 will receive first consideration. The University of Wyoming is an AA/EOE.

AUSTRALIA

MACQUARIE UNIVERSITY
Sydney, Australia
Research Fellow in Mathematics

The Fellow will conduct research with Professor Alan McIntosh in harmonic analysis and partial differential equations. Applicants should have a Ph.D. in a relevant field of mathematics. The position is available for two years from 1 February 1992.

Salary: A$27,060-$33,620 per annum.

Applications should be sent to Professor Alan McIntosh, School of Mathematics, Physics, Computing and Electronics, Macquarie University, New South Wales 2109, Australia, by 13 January, 1992.

Applicants should submit a C.V., a publication list, and some relevant publications. They should ask at least two referees to forward reports to the same address.

Air-fares to Sydney, and a contribution to removal expenses may be provided. Further

information can be obtained from Alan McIntosh at

(02) 805 8926 (work telephone)
(02) 805 8983 (fax)
alan@macadam.mpce.mq.edu.au
(email)

CANADA

McMASTER UNIVERSITY
Department of Mathematics & Statistics

Applications are invited for the **Britton Post-Doctoral Fellowship in Mathematics**. Named after Dr. Ronald Britton, the Britton Fellowship is intended for talented, young research mathematicians who have recently completed the Ph.D. degree. The Britton Fellowship is open to candidates of any nationality and selection will be based upon the candidate's research potential. Preference will be given to candidates working in partial differential equations or harmonic analysis. The Britton Fellowship is tenable for a period of two years with effect from July 1, 1992 at a salary of $34,000 per year plus a research grant of $5,000. Applications, including three letters of reference, should be completed by January 31, 1992 and sent to: **Dr. I. Hambleton, Chairman or V. P. Snaith, Sc.D., F.R.S.C., Britton Professor of Mathematics, Dr. P. Guan, Dr. E. Sawyer, Department of Mathematics & Statistics, McMaster University, Hamilton, Ontario, Canada, L8S 4K1.**

MEMORIAL UNIVERSITY OF NEWFOUNDLAND
St. John's, Newfoundland, Canada A1C 5S7
Locum Positions in Mathematics and Statistics

Applications are invited for two or more one-year term positions, at the Assistant Professor level, as sabbatical replacements commencing 1 September 1992. A Ph.D. and proven ability for research and effective teaching are required. Duties will include teaching two courses for each of two semesters.

Applications, marked REF: MS/LOC/92, with complete curriculum vitae and the names of at least three referees should be sent to:

Dr. Edgar G. Goodaire, Head
Department of Mathematics and Statistics
Memorial University of Newfoundland
St. John's, Newfoundland, Canada A1C 5S7

The closing date for receipt of applications is 15 January, 1992 or until the positions are filled.

Memorial University is committed to the principle of equity in employment. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

MEMORIAL UNIVERSITY OF NEWFOUNDLAND
St. John's, Newfoundland, Canada A1C 5S7
Tenure Track Positions in Mathematics

Applications are invited for two tenure track positions in Mathematics at the assistant professor level commencing 1 September 1992. While applications are sought from candidates with varied research interests, at least one position requires expertise in Applied Mathematics. Above all, a Ph.D. and proven ability for excellent research and teaching are required.

Applications, marked REF: MS/MA/92, with complete curriculum vitae and the names of at least three referees should be sent to:

Dr. Edgar G. Goodaire, Head
Department of Mathematics and Statistics
Memorial University of Newfoundland
St. John's, Newfoundland, Canada A1C 5S7

The closing date for receipt of applications is 15 January, 1992 or until the positions are filled.

Memorial University is committed to the principle of equity in employment. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

THE UNIVERSITY OF CALGARY
Assistant Professor in Pure Mathematics

The University of Calgary Department of Mathematics and Statistics invites applications for an Assistant Professor (tenure-track) in Pure Mathematics, effective July 1, 1992. Well-qualified individuals from all areas of pure mathematics will be considered. The applicant must have a Ph.D. (or equivalent) and demonstrated excellence in research. Skill in teaching and the potential to interact with the activities of research groups in the Department are important.

In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. The University of Calgary has an Employment Equity Program and encourages applications from all qualified candidates, including women, aboriginal people, visible minorities and people with disabilities. The University offers a Dual Career Assistance Program for spouses.

Applications, including a curriculum vitae, list of publications, and three letters of reference, should be submitted by January 10, 1992. However, applications will be received until the appointment process is terminated.

Dr. R. Woodrow, Chair
PMAT Division
Department of Mathematics and Statistics
The University of Calgary
Calgary, Alberta, Canada T2N 1N4

UNIVERSITY OF TORONTO
Department of Mathematics

The Department solicits applications for a tenure-stream position in Analysis at the downtown (St. George) campus to begin on July 1, 1992. Preference will be given to researchers working in Harmonic Analysis, or Ordinary or Partial Differential Equations.

Duties include teaching and research, and candidates are expected to demonstrate excellence at each.

Applicants should send their complete C. V. together with a list of publications, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chairman, Department of Mathematics, University of Toronto, Toronto, Canada, M5S 1A1. At least one letter should deal with the candidate's teaching. To insure full consideration, this information should be received by January 31, 1992.

The University of Toronto encourages both women and men to apply.

UNIVERSITY OF TORONTO
Department of Mathematics

The Department solicits applications for a tenure-stream appointment in Analysis. Preference will be given to researchers in the areas of harmonic analysis, geometric analysis and differential equations.

The appointment is at the downtown (St. George) campus at the level of Assistant Professor, to begin July 1, 1992. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics.

Applicants should send their complete C. V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada, M5S 1A1. At least one letter should deal with the candidate's teaching. To insure full consideration, this information should be received by January 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

UNIVERSITY OF TORONTO
Department of Mathematics

The Department solicits applications for up to three limited term Assistant professorships at the Erindale campus, each for the three-year period from July 1, 1992 to June 30, 1995. Duties consist of teaching and research, and

candidates must demonstrate clear strength in both.

Applicants should send their complete C. V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada, M5S 1A1. At least one letter should deal with the candidate's teaching. To insure full consideration, this information should be received by January 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

UNIVERSITY OF TORONTO
Department of Mathematics

The Department solicits applications for two limited term Assistant professorships at the downtown (St. George) campus, each for the three-year period from July 1, 1992 to June 30, 1995. Duties consist of teaching and research, and candidates must demonstrate clear strength in both.

Applicants should send their complete C. V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should deal with the candidate's teaching. To insure full consideration, this information should be received by January 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

UNIVERSITY OF TORONTO
Department of Mathematics
Scarborough Campus

Applications are invited for a limited term Assistant Professorship from July 1, 1992 to June 30, 1994. Ph.D. or equivalent required. Duties consist of teaching and research, and candidates must demonstrate real strength in both.

Applicants should arrange for at least three letters of reference to be sent directly to the Chair; at least one of these should deal with teaching.

Applications, including a complete curriculum vitae, should be sent to:

Professor John Perz
Chair of Physical Sciences Division
Scarborough Campus
University of Toronto
1265 Military Trail
Scarborough, Ontario
M1C 1A4

The selection process will begin on January 2, 1992, so that applications and letters of reference should be received by that date.

In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. The University of Toronto encourages both women and men to apply for positions.

FRANCE

UNIVERSITY OF BORDEAUX II
Professor of Statistics

A brand new research group in Stochastic Mathematics is currently being set up at the University of Bordeaux II (Life, Human and Social Sciences). In order to complete the team, the University is now seeking candidates for a newly-created post of Professor of Statistics to commence work on October 1, 1992. During the selection process, the candidates' scientific work will be assessed according to the usual criteria, taking particular note of their publications record, ability and experience in taking on students at Master's level and beyond, record of interdisciplinary collaboration. The review of applicants will begin in January 1992, and will continue until the position is filled.

Potential candidates are strongly encouraged to make contact as soon as possible with:

Jean-Marc Deshouillers
Mathématiques Stochastiques
Université Bordeaux II
146, rue Léo Saignat
33076 Bordeaux Cedex (France)
Tel.: (33) 57 57 10.64
Fax: (33) 56 99 03 80
email: dezou@frbdx11.bitnet

GERMANY

SPRINGER-VERLAG
Mathematics Editor

Mathematics editor required to join Springer-Verlag's mathematics editorial in Heidelberg. Applicants should be under 30 years of age and native English-speaking. Preference will be given to applicants who possess a Ph.D. in mathematics or expect to receive such a degree soon. Applications should be addressed to:

Ms. Christa Voss
Personnel Dept.
Springer-Verlag
Tiergartenstr. 17
D-6900 Heidelberg

SWITZERLAND

UNIVERSITE DE GENEVE

La Faculté des sciences ouvre une inscription pour un poste de

PROFESSEUR ORDINAIRE DE MATHEMATIQUES, direction analyse et géométrie.

La préférence sera donnée à un candidat spécialiste des méthodes modernes qui sont en rapport avec l'analyse globale, la théorie des groupes et la combinatoire.

Charge: il s'agit d'un poste à charge complète, comprenant 6 heures hebdomadaires de cours, séminaires et direction de recherches.

Titre exigé: docteur ès sciences ou titre jugé équivalent.

Entrée en fonction: ler octobre 1993 ou date à convenir.

Les dossiers de candidature (avec curriculum vitae, liste des publications, tirés-à-part des 5 publications les plus significatives, projets de recherche et références) doivent être adressés avant le 15 février 1992 au secrétariat de la Faculté des Sciences, quai Ernest-Ansermet 30, CH-1211 Genève 4, auprès duquel peuvent être obtenus des renseignements complémentaires sur le cahier des charges et les conditions.

UNITED KINGDOM

UNIVERSITY OF CAMBRIDGE
Isaac Newton Institute
for Mathematical Sciences
Rosenbaum Visiting Fellowships

Applications are invited for Rosenbaum Visiting Fellowships at the Isaac Newton Institute for Mathematical Sciences. Four Fellowships of six-months duration will be awarded annually out of funds generously provided by the Paul and Gabriella Rosenbaum Foundation. There will be one Fellowship associated with each of the four scientific programmes run by the Institute. The programmes planned for 1992-93 are:

Low-dimensional Topology and Quantum Field Theory (July to December 1992), Dynamo Theory (July to December 1992), L-functions and Arithmetic (January to June 1993), Epidemic Models (January to June 1993).

The stipend of a Fellow will be $17,500 for the six-month tenure and travel expenses may be provided. To be eligible, candidates must have a Ph.D. and be U.S. citizens or permanent residents or have resided in the U.S. for a minimum of four years.

Applications, including a *curriculum vitae*, list of publications and the names of two referees, should be sent by 31 December 1991 (in the case of the July to December 1992

programmes) or 31 March 1992 (in the case of the January to June 1993 programmes) to the Deputy Director, Dr. Peter Goddard, Isaac Newton Institute for Mathematical Sciences, c/o Department of Applied Mathematics and Theoretical Physics, Cambridge CB3 9EW, U.K., from whom further details of the programmes can be obtained.

PUBLICATIONS FOR SALE

American Math. Monthly, Bulletin of AMS, from 1961, bound volumes. An invaluable resource for scholars and libraries. Send request for detailed information to Dr. Bert Ross, Univ. of New Haven, West Haven, CT 06516.

MATH SCI PRESS, 53 Jordan Rd., Brookline, MA 02146, 617-738-0307. **GEOMETRIC STRUCTURES AND NONLINEAR PHYSICS**, $95. **GEOMETRIC COMPUTING SCIENCE**, $85, both by R. Hermann. Under development: **DEFORMATION THEORY IN PHYSICS AND COMPUTING SCIENCE**. Lecturing and Consulting available.

Zentralblatt für Mathematik Band 1 (1931) through Band 23 (1941) plus Index (Band 24 and Band 25). *Mathematical Reviews* (1940–1991). Mint condition. Call 800-321-4267, ext. 4084, refer to code #1408.

PUBLICATIONS WANTED

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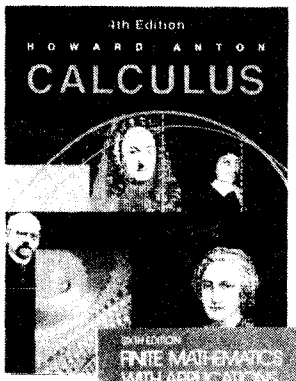

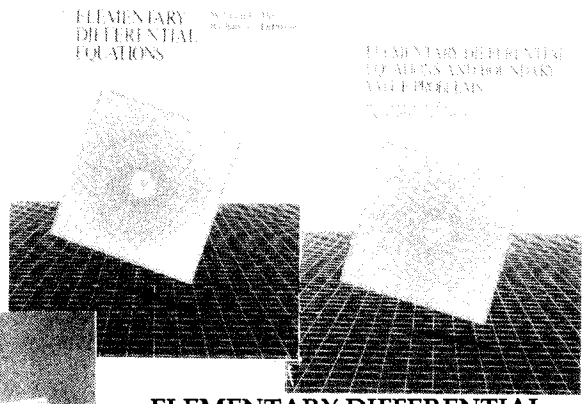

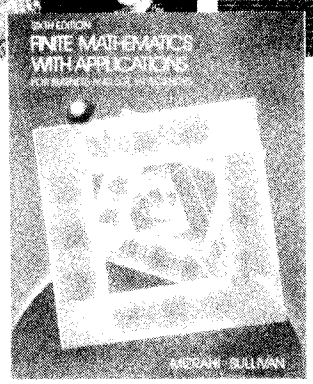

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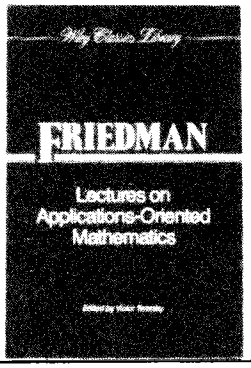

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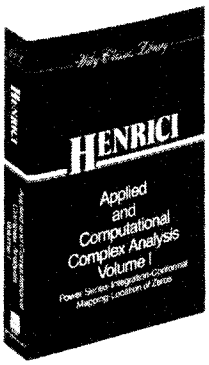

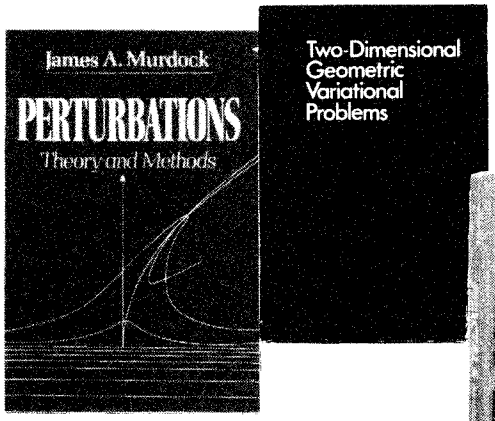

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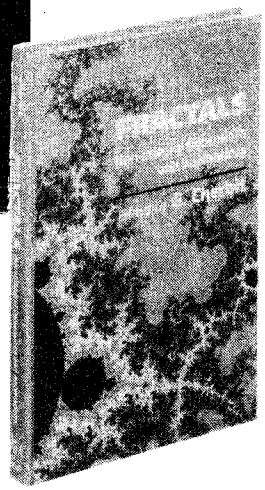

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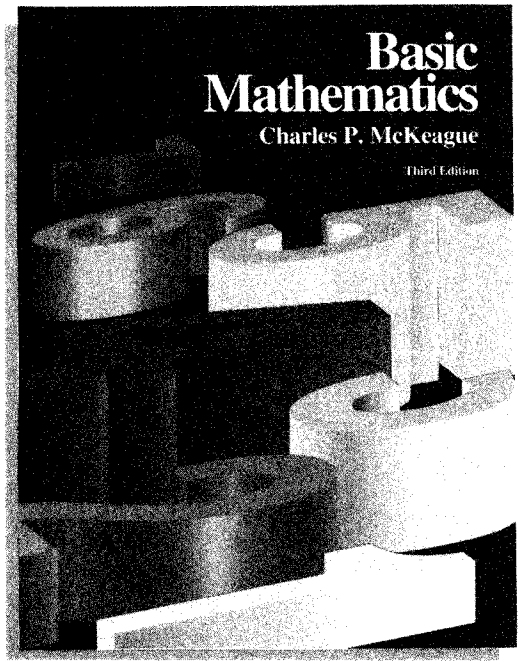

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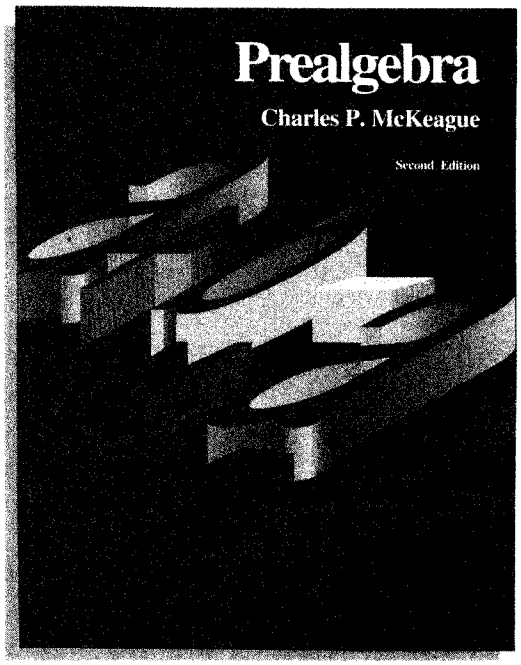

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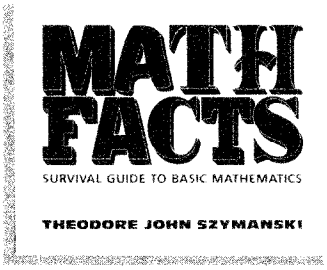

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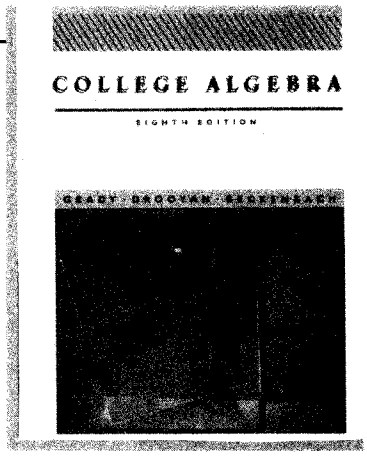

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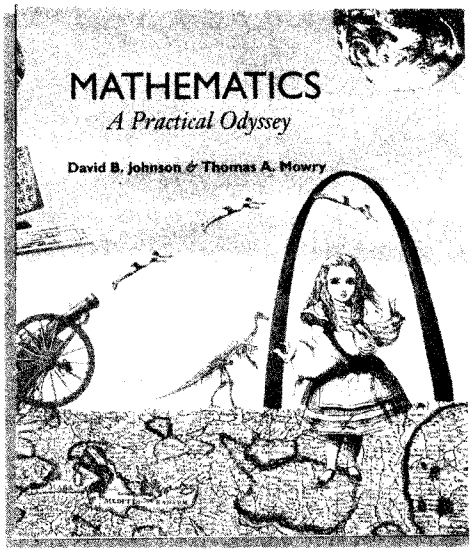

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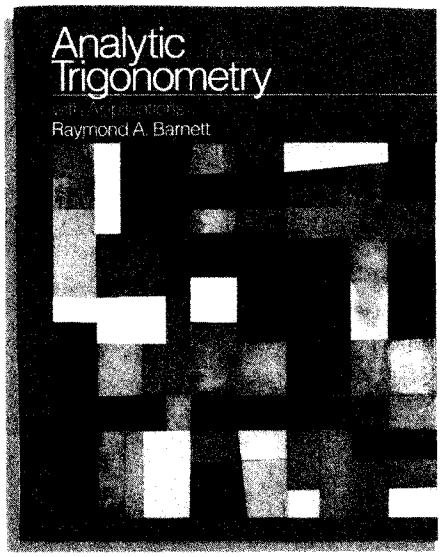

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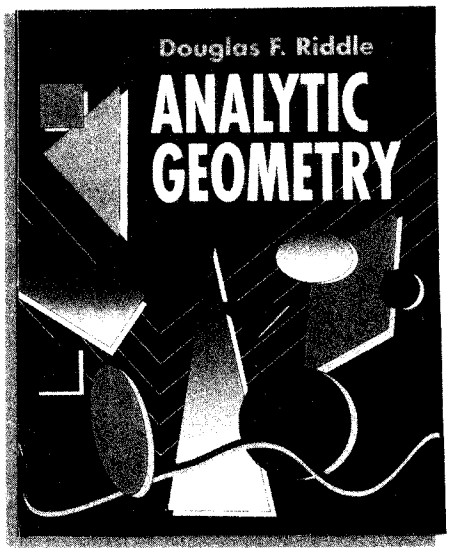

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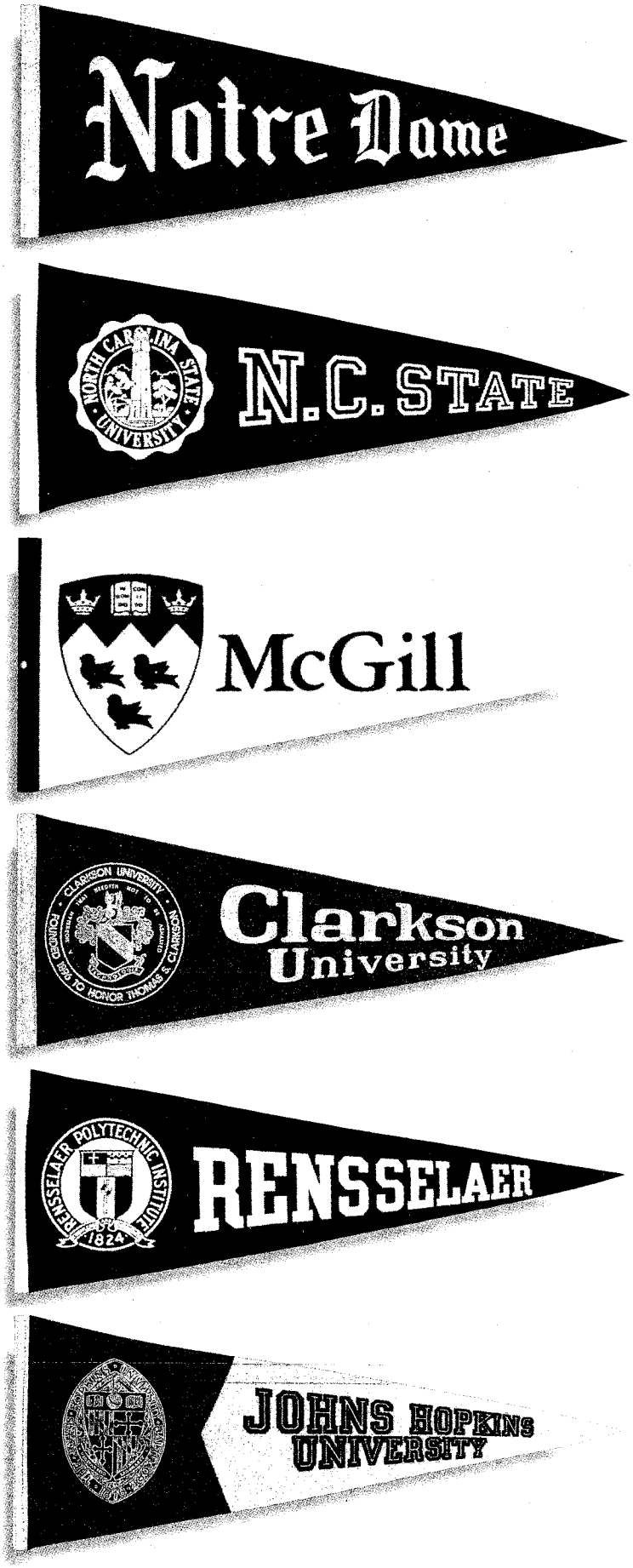

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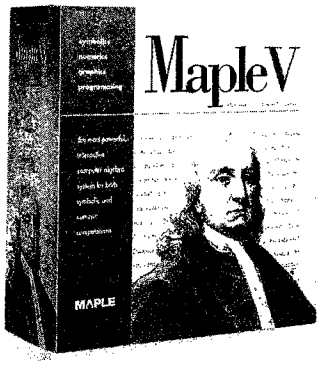

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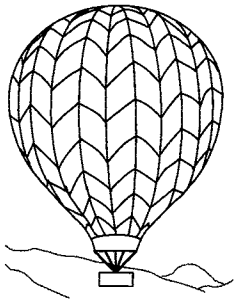

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The conference will explore some of the topics of current interest and importance in combinatorics and its applications. The emphasis will be on finite sets, the combinatorial theory of ordered sets with applications to the classical posets (Boolean posets, partition posets, posets of a multiset, posets of a vector space, and the poset of Ferrers diagram in a given frame), combinatorial designs, codes and interconnections between these topics. The conference will provide a more thorough and deeper understanding of topics taught or directly related to those taught in undergraduate courses on combinatorics or discrete mathematics. The conference could also serve as an introduction to topics not available in all graduate programs. Participants should leave with many new ideas for exploration.

Prerequisites: A familiarity with combinatorics at the undergraduate level (perhaps through self study) and elementary linear algebra.

Speakers: Richard Brualdi, University of Wisconsin, Madison and Vera Pless, University of Illinois at Chicago.

Admission and Scholarships: Entry into the conference is restricted, but is without charge to those who are qualified and are admitted. National Science Foundation funding which consists of living costs and a few stipends is available for selected faculty. A limited number of scholarships, covering living costs, are available for qualified graduate students. For further information and application forms, please write to:

Professor A. Duane Porter, Mathematics Department
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(January–December)

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12 Field theory and polynomials
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17 Nonassociative rings and algebras
18 Category theory, homological algebra
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Index

The numbered pages of the ten issues of *Notices* for 1991 are:

January: 1–96	July/August: 537–696
February: 97–176	September: 697–880
March: 177–272	October: 881–1080
April: 273–400	November: 1081–1232
May/June: 401–536	December: 1233–1416

MATHEMATICS BOOKS

Topics in Soliton Theory

by **R. Carroll**

North-Holland Mathematics Studies Volume 167

1991 xii + 428 pages
Price: US $ 100.00 / Dfl. 195.00
ISBN 0-444-88869-1

This book concentrates on developing the theme of the tau function. KdV and KP equations are treated extensively, with material on NLS and AKNS systems, and in following the tau function theme one is led to conformal field theory, strings, and other topics in physics. The extensive list of references contains about 1000 entries.

Contents: KdV and KP; Analytic Methods. Systems and Algebraic Methods. Physics.

Lakatos' Philosophy of Mathematics

A Historical Approach

by **T. Koetsier**

Studies in the History and Philosophy of Mathematics Volume 3

1991 xii + 312 pages
Price: US $ 82.00 / Dfl. 160.00
ISBN 0-444-88944-2

In this philosophical and historiographical study, the author investigates the fallibility and the rationality of mathematics by means of rational reconstructions of developments in mathematics. The initial chapters are devoted to a critical discussion of Lakatos' philosophy of mathematics. In the remaining chapters several episodes in the history of mathematics are discussed, such as the appearance of deduction in Greek mathematics and the transition from Eighteenth-Century to Nineteenth-Century analysis.

Pseudo-Differential Operators on Manifolds with Singularities

by **B.-W. Schulze**

Studies in Mathematics and its Applications Volume 24

1991 vi + 410 pages
Price: US $ 133.50 / Dfl. 260.00
ISBN 0-444-88137-9

The present book is devoted to elliptic partial differential equations in the framework of pseudo-differential operators. The first chapter contains the Mellin pseudo-differential calculus on **R**+ and the functional analysis of weighted Sobolev spaces with discrete and continuous asymptotics. Chapter 2 is devoted to the analogous theory on manifolds with conical singularities, Chapter 3 to manifolds with edges.

Geometry of Riemann Surfaces and Teichmüller Spaces

by **M. Seppälä** *and* **T. Sorvali**

North-Holland Mathematics Studies Volume 169

1992 iv + 264 pages
Price: US $ 97.50 / Dfl. 190.00
ISBN 0-444-88846-2

The aim of this monograph is to present information about the structure of the moduli space using as concrete and elementary methods as possible. This simple approach leads to a rich theory and opens a new way of treating the moduli problem, putting new life into classical methods that were used in the study of moduli problems in the 1920s.

Combinatorics and Theoretical Computer Science

Proceedings of the Capital City Conference

edited by **R. Simion**

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