Calendar of AMS Meetings

This calendar lists all meetings which have been approved by the Council prior to the date this issue of Notices was sent to the press. The summer and annual meetings are joint meetings of the Mathematical Association of American 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.

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Other Sponsored Events

January 5-6, 1988: Short Course: Computational Complexity Theory, Atlanta, Georgia
February 13-14, 1988: Symposium on American Mathematics Entering its Second Century, Boston, Massachusetts
May 1988: Symposium on Some Mathematical Questions in Biology: The Dynamics of Excitable Media, Las Vegas, Nevada
June 4–August 11, 1988: Joint Summer Research Conferences in the Mathematical Sciences, Bowdoin College, Brunswick, Maine
July 18–29, 1988: Summer Seminar on Computational Solution of Nonlinear Systems Equations, Colorado State University, Fort Collins, Colorado

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

As you can see Notices has a new look. This is the first major change in the publication since its introduction in 1954 as a vehicle for providing information about meetings and other items as directed by the AMS Council. The journal has evolved over the years to contain articles on mathematics and to report on items of current interest to mathematicians. There have been changes in typefaces and the color of the cover was changed from brown to gold in 1979. However little change has occurred in format and, with the increase in content, it has become difficult to locate particular articles or items of interest.

In addition to changing the format, the frequency of the journal has changed. There will now be ten issues annually, one each month except for bimonthly issues May/June and July/August. They will be mailed on a regular schedule to arrive approximately the second week of each month for the monthly issues and during the first month of the bimonthly issues. This schedule will allow for more timely reporting of information to the mathematical community. Regular features of Notices, such as the NSF Budget and the AMS-MAA Survey, will be published at the same time as in the past, but they will appear in an issue which provides for the earliest reporting of the information. One noticeable change will be that the program for the January Joint Mathematics Meetings will be published in the December issue. Yes, the December issue will be a regular issue with articles, columns and news. The Assistantships and Fellowships Information will be in a separate publication. However, Notices will continue to carry the information on Grants and Fellowships that appears in the rear of the current December issue.

As you look through this issue, you will notice that items have been grouped into different sections: feature articles, feature columns, news articles, AMS meetings and conferences, and reports on Society activities. The style for items within these sections was designed to make the material easily recognizable. For example, the news sections; News and Announcements, and the name of the section appears at the top of each page for easy reference. And, since information about AMS Meetings and Conferences is an important part of Notices, all the material pertaining to these events has been collected together, with its own contents page. In addition to changing the style, the name of the section Special Meetings has been changed to Mathematical Sciences Meetings and Conferences to better reflect the content of this section.

The new 8½ by 11 inch size makes it possible to use the different page layouts of one, two, or three columns and gives the individual sections some identity. This larger page also means that the amount of material on a page will increase, while at the same time enlarging the type size for better readability.

The appearance of Notices is only one aspect of the effort to make this publication a primary source for information in the mathematical sciences. As the content of Notices has evolved in recent years to provide better coverage, this effort will continue in the future to meet the changing needs of our readership. If you wish to contribute news items, letters to the editor, or simply have comments or suggestions on anything in Notices, please send them to the Managing Editor.

I would like to take this opportunity to thank the mathematical community for supporting the Society and Notices. A special thank you goes to the staff in the Providence office for their efforts in the redesign of this publication.

Managing Editor
JOIN US...
AND SEE WHAT'S NEW AT THE AMS

Joint Mathematics Meetings
Atlanta, Georgia

- A number of newly published titles will be on display at the AMS booth, including a different kind of publication for the AMS -- I Have A Photographic Memory by Paul R. Halmos. This book contains about 600 candid photographs taken by Halmos over the years and shows mathematicians just being themselves. It is a delightful collection of mathematical memorabilia as well as a valuable historical record.

- Also available at the AMS booth will be a new five volume set, Reviews in Numerical Analysis, 1980-86, as well as new titles in most of the AMS publication series.

- Information about the AMS Centennial Celebration in Providence August 8-12, 1988 will be available at the AMS booth.

- Complimentary coffee/tea will be available at the AMS Membership booth, which is part of the AMS exhibit.

- Individual members of the AMS will receive a 50% discount on most AMS titles purchased or ordered at the book sale. VISA and MasterCard will be accepted for purchases.

- The AMS Book Sale and Exhibit will be located in booths #1-5 in Ivy Hall A at the Hyatt Regency Atlanta. Exhibits will be open Wednesday through Saturday, January 6-9.

- The MatSci booth (# 6-7) will feature demonstrations of \TeX\ software products available from the \TeX\ library of the AMS as well as demonstrations of how to use MathSci, the AMS' online database.

Letters
to the Editor

Comments On

“A Very Special Year”

The latest Washington Outlook (These Notices, 34, no. 6, p. 898) on 1988, “A Very Special Year,” goes back as far as 1983 but misses some relevant items before that time. Under 1983 there is listed the fortunate establishment of the JPCBM (the Joint Policy Board for Mathematics), representing AMS, MAA, and SIAM. This misses the fact that there had been a prior joint representation of the same three organizations, called the Joint Policy Committee, and established about 1975 with Richard DiPrima, Hirsh Cohen, Saunders Mac Lane, and others as members. This JPC established a Science Fellow for Mathematics in Washington and arranged for the publication of the book Mathematics Today (edited by Lynn Steen). For my part, I welcome the expansion of JPC to JPBM.

A much earlier and extensive joint group is the Conference Board of the Mathematical Sciences (CBMS), especially encouraged by G. Baley Price. It deserves more notice than the present simple footnote on p. 899.

Page 900 top describes the National Research Council (NRC) as the “public policy arm” of the NAS and the NAE. This is not quite right: the NRC is normally called the “operating arm” of the National Academy of Science (NAS), the National Academy of Engineering (NAE), and the Institute of Medicine (IOM). It deals not just with “public policy” but with a very wide variety of questions, indeed with any request from the government to the Academies for advice on questions of science and art. This requirement is made in the charter of the NAS, written in 1863 (at that time, “art” in this context meant essentially engineering).

Later on that page it is remarked that 1988 “is the first year the American Mathematics Community has had an opportunity to...increase...public understanding...of mathematics.” Good for 1988, but it may not be the first; there were earlier attempts. In the late 1930s the AMS established a publicity committee; G. Baley Price and Saunders Mac Lane were members; I wish better success to the present efforts. But I also wonder when page 898 says (of 1988) that “this special year provides us with the biggest public education opportunity...for many years to come.” This strikes me as a bit of hyperbole. For me the Washington Outlook is clouded by the sad fact that, for the first time in 30 years, there is no mathematician among the 25 members at the National Science Board. But I am more optimistic about the future progress of research. After all, that is the prime business of the AMS; we might well hope that continued striking new advances in research will provide us with many other opportunities for public education.

Saunders Mac Lane
University of Chicago
(Received October 26, 1987)
This year the American Mathematical Society is celebrating its 100th Anniversary. It is a time to look back with pride to our historic past and to look forward to a future of growth and increased service to the mathematical community.
The game is simple and apparently paradoxical: Prove you know something—an ID number, an access code—without revealing even a single bit of the information itself. The importance is obvious: from credit card numbers to computer passwords, we are increasingly reliant on the secure electronic transmission of what are known as signatures. Yet how can one transmit a signature without potentially revealing to an eavesdropper—or an unethical vendor—all the information he needs in order to masquerade as the sender?

Three Israeli computer scientists—Uriel Feige, Amos Fiat and Adi Shamir, of the Weizmann Institute—figured out how to play the game, called “zero knowledge proofs of identity”. They publicized their result at conferences, and they applied for U.S. patent protection. Ironically the United States said disclosure was “detrimental to the national security,” and imposed a secrecy order. The three Israelis sought relief, and, with intervention from powerful sources, they got it. Though no one will say for certain, it appears that the National Security Agency (NSA), the government decrypter of secrets, stepped in to help. What the research is, and why the NSA had reason to involve itself, is the story we present here.

The technical part has its genesis in the work of Stephen Cook and Richard Karp of the early seventies. Our model of a computer is a RAM, a Random Access Machine. At issue is complexity: on a problem of input size \( m \), how many steps does it take as a function of \( m \) to solve the problem? Certain problems are “easy”; by the obvious method, two \( m \times m \) matrices can be multiplied in \( O(m^3) \) steps (although there are considerably more sophisticated algorithms which require only \( O(m^{2.376}) \) steps). Other problems are less obvious. The crucial distinction comes between those problems with polynomial time solutions (the class \( P \)), and those which require more than polynomial time. The latter are considered infeasible.

What Cook did was to show that the question “Is a boolean expression satisfiable?” occupies a special place in the hierarchy of problems. It is solvable in polynomial time by a nondeterministic RAM\(^1\) (it is in NP, Nondeterministic Polynomial time), and it is as hard as any other problem in NP (it is complete). If satisfiability has a polynomial time solution, so will any other problem in NP. Karp then showed that a number of combinatorial problems shared that characteristic, called NP-completeness, including \( k \)-colorability (can the vertices of a given undirected graph be colored with \( k \) colors so that no two adjacent vertices have the same color?), knapsack (given a finite set of integers \( n_i \), is there a subset which sums to an integer \( K \)?)

---

\(^1\) A nondeterministic RAM can choose which of two instructions to perform at certain times. For example, by choosing 0 or 1 \( n \) times, it can “guess” a boolean assignment and then check if that assignment makes a given boolean expression true.
S. Landau

and Hamiltonian circuit (does a given undirected graph have a Hamiltonian circuit?). Most theoretical computer scientists believe that the NP-complete problems require exponential time, but despite fifteen years of concentrated attack, the question "Does P = NP?" remains open.

Where number theoretic questions fit into this hierarchy is unknown. In 1974, using the Extended Riemann Hypothesis (ERH), Gary Miller showed how to test the primality of an m digit integer in $O(m^5)$ steps. Robert Solovay and Volker Strassen gave a probabilistic algorithm which avoids the use of ERH and takes only $O(m^4)$ steps. Meanwhile, the present best algorithm for factoring an m digit integer requires $O(e^{c\sqrt{m \log m}})$ steps. The apparent discrepancy between the complexities of these two problems led to the first public key cryptosystem.

This is a system in which the method of encryption is publicly known, but decryption is infeasible because of contrasts in complexity. It was developed as a way to ensure secure communication between two parties while allowing changes of code (by publicly publishing it). The first public key cryptosystem was RSA, named after its inventors, Ron Rivest, Adi Shamir and Len Adleman. Although no one has proved it secure, Michael Rabin has shown that a variation of it is, provided that factoring remains infeasible.

Because RSA forms the basis for much of the following work, we briefly describe it. Each participant in the system finds two large ($\sim 10^{50}$) primes, p and q, and publishes two integers: n (= pq) and a, where a is less than n and relatively prime to $\phi(n) = (p - 1)(q - 1)$, the Euler phi-function of n.

Suppose the Federal Reserve wants to communicate with the Bank of England. The Fed would proceed as follows:

1. Translate the message into integers, say A=01, B=02, etc.
2. Break the message into blocks of a convenient length.
4. Send each block as $(\text{block})^a \pmod{n}$.

Decryption is easy for the Bank of England because it knows the factorization of n. Since a and $\phi(n)$ are relatively prime, there are x and y—polynomially time computable from a and $\phi(n)$—such that $ax + \phi(n)y = 1$. By Euler's theorem $(\text{block})^\phi(n) \equiv \text{block} \pmod{n}$, so that the decrypted message can be determined in polynomial time. No one else knows n's factorization, and determining $\text{block} \pmod{n}$ any other way appears to be computationally difficult.

A particularly useful aspect of the RSA scheme is that one can "sign" a message. For example, by encoding first using the Federal Reserve's secret decryption algorithm, and then the Bank of England's publicly available encryption method, the Federal Reserve can sign its message. Since the Federal Reserve Bank's encryption scheme is public information, the Bank of England decodes the Fed's message by employing first its own (private) decryption method, and then the publicly available Federal Reserve encryption scheme.

As long as factoring remains difficult, the method appears secure. Yet, sending the encrypted message, the Federal Reserve has, of course, informed the Bank of England what its encoded form of the message is. If the message was simply a credit card number, then an unscrupulous recipient now has all the information he needs in order to later misrepresent himself as the Fed. But how can you prove that you are who you say you are without revealing any information?

In 1985, Shafi Goldwasser, Silvio Micali and Charles Rackoff [GMR] suggested the concept of zero knowledge interactive proofs. In such a proof, the "prover" has infinite computational power, while the "verifier" is a
probabilistic polynomial time machine. The prover "proves" a fact to the verifier; if the "fact" is true, the probability that the verifier accepts it is high 

\(1 - 1/2^n\) for an \(n\)-bit statement, if it is false, the probability of rejection is correspondingly high. The entire interactive proof is limited to polynomial time.

The zero knowledge part of the proof is that no other information is given. More precisely, an interactive proof is zero knowledge if the verifier cannot gain any information from the prover that he could not himself derive in expected polynomial time. [GMR] showed that certain sets in \(\text{NP} \cap \text{co-NP}\) (sets whose complement are in \(\text{NP}\)) have zero knowledge interactive proofs.

We begin with some notation:

\(\mathcal{P}\) (straight \(\mathcal{P}\)) represents the real prover who follows the designated protocol.

\(\mathcal{P}\) (crooked \(\mathcal{P}\)) represents a cheater who can deviate from the protocol in an arbitrary way.

\(\mathcal{P}\) represents either \(\mathcal{P}\) or \(\tilde{\mathcal{P}}\).

\(\mathcal{V}\) (straight \(\mathcal{V}\)) represent the real verifier who follows the designated protocol.

\(\mathcal{V}\) (crooked \(\mathcal{V}\)) represents an arbitrary program which tries to extract additional information from \(\tilde{\mathcal{P}}\).

\(\mathcal{V}\) represents either \(\mathcal{V}\) or \(\tilde{\mathcal{V}}\).

In an example given by [GMR], the language that \(\mathcal{P}\) can recognize is \(Q_n = \{y \in (\mathbb{Z}/n\mathbb{Z})^* \mid \text{the Jacobi symbol of } y \text{ on } n \text{ is } 1, \text{ but } y \text{ is not a square } \mod n\}\), where \(n\) is an odd composite integer. \(\mathcal{V}\) generates a sequence of integers \(x_1, x_2, \ldots, x_m\) (for \(m = \log n\)), where each \(x_i\) is of the form: \(r_i^2 \mod n\) or \(x = yr_i^2 \mod n\), with each \(r_i\) chosen randomly. \(\mathcal{V}\) quizzes his adversary about the sequence.

If \(y\) is in \(Q_n\), \(\mathcal{P}\) distinguishes between the two cases. The tricky part of the protocol is that \(\mathcal{P}\) communicates that information without revealing anything else to \(\mathcal{V}\). That is, \(\mathcal{P}\) responds only to those queries about which \(\mathcal{V}\) has convinced \(\mathcal{P}\) that \(\mathcal{V}\) has the answer. With high probability, \(\tilde{\mathcal{V}}\) is not able to falsely convince \(\mathcal{P}\) that \(\tilde{\mathcal{V}}\) has that information. However the name "zero knowledge" is somewhat misleading since \(\mathcal{P}\) does reveal to \(\mathcal{V}\)—and any eavesdropper—when \(y\) does belong to \(Q_n\). The protocol is rather complicated, and so we do not go into further detail here.

The importance of zero knowledge interactive proofs is in making cryptographic schemes secure. Normally it is a very hard problem. Zero knowledge gives a way to break up the components of a protocol, and prove that no information is transferred between the pieces.

Shortly afterwards, Oded Goldreich, Micali and Avi Wigderson showed if there is any secure probabilistic encryption scheme, then there are zero knowledge proofs for the colorability problem, and thus for any other \(\text{NP}\) problem. One can show that a graph is 3-colorable without revealing any other information about the graph, including such facts as whether vertex 1 and vertex 3 are colored the same. The proof is simple, and we provide a sketch.

Suppose \(\mathcal{P}\) wants to show that a certain graph can be 3-colored. \(\mathcal{P}\) transmits the adjacency matrix of the graph. He also transmits an encrypted version of the coloring, for example by sending for each vertex \(v\) the RSA encryption of the string \(r_v c_v\), which consists of a 75 bit random integer \(r_v\), followed by a 2 bit integer for the color \(c_v\). The reason for including \(r_v\) in the communication is to make it computationally infeasible for \(\mathcal{V}\) to determine the coloring.

\(\mathcal{V}\) picks an edge and asks what the colors of its two vertices are. \(\mathcal{P}\)'s encryption function is known to \(\mathcal{V}\), so what \(\mathcal{P}\) reveals to \(\mathcal{V}\) is the "decrypted"
coloring of the two vertices. V encrypts and checks that they match the information P had originally sent.

Now P changes the coloring (say red vertices are changed to yellow, yellow vertices to blue, and blue to red), and invites a new query. The proof repeats. The point is that after polynomially many tries, if V hasn't found an edge connecting two vertices of the same color, he believes that P has a 3-coloring of the graph. However the constant changing of the coloring scheme sufficiently conceals the information so that V has not learned anything about the coloring that he himself could not have computed in probabilistic polynomial time.

Meanwhile Zvi Galil, Stuart Haber and Moti Yung proposed an alternate model: result indistinguishable protocols. In their model, either P proves that an element belongs to a language, or P proves that the element does not belong to the language. V knows which claim is being shown, but the eavesdropper, who cannot query either V or P, is unable to determine from the computation which result is being proved. They used a number theoretic language for the protocol.

Feige, Fiat and Shamir [FFS] modified the rules. They wanted zero knowledge interactive proofs to be truly zero knowledge. The proof should not give away to anyone even the single bit of information about membership. They achieved this goal by changing the notion of zero knowledge proofs of membership to zero knowledge proofs of knowledge. They showed that any set in \( NP \cap \text{co-NP} \) has a zero knowledge interactive proof under the new definition.

Current identification schemes, whether ID cards, computer passwords, or PIN numbers, have the prover P identify himself by presenting a predetermined fixed secret code. This gives no protection against an eavesdropper or dishonest verifier. Ideally, an identification scheme should be a protocol in which P proves his identity to V without enabling a corrupt V to later misrepresent himself as P. [FFS] invented such a secure scheme: they gave a protocol which was zero knowledge under the new definition, secure as long as factoring was difficult, and which is fast—two orders of magnitude faster than RSA-based schemes. It is practical—eminently so. We present it.

As is frequently the case, the scheme relies on the intractability of a number theory problem. If \( a \) and \( b \) are two integers less than \( n \), with \( a^2 \equiv b^2 \pmod{n} \), but \( a \not\equiv \pm b \pmod{n} \), then both \( a + b \) and \( a - b \) share a nontrivial gcd with \( n \). This is the basis for a number of factoring algorithms. It also shows that computing "square roots" \( \pmod{n} \) is computationally as difficult as factoring.

In this situation both the prover and the verifier have probabilistic polynomial time machines at their disposal. Let \( p, q \) be two distinct, large (\( \sim 10^{75} \)) primes, both of which are congruent to 3 (mod 4), and let \( n = pq \). Integers of this form, known as Blum integers, are useful because \(-1\) is a quadratic nonresidue \( \pmod{n} \) whose Jacobi symbol is \( +1 \). The integer \( n \) is public information. Everyone uses the same \( n \) (whose factorization is unknown).

The prover, P, chooses \( k \) integers \( s_j \), relatively prime to \( n \), which he keeps secret. Let the notation \( c \equiv \pm d \pmod{n} \) mean that \( c \) is randomly chosen to be congruent to either \( d \) or \(-d \pmod{n} \). P publishes \( i_j \equiv \pm s_j^{-2} \), for \( j = 1, \ldots, k \). (The reason for the inverses is to speed the transaction; the protocol would work as well, though less quickly, with \( i_j \equiv \pm s_j^2 \).) Then, if no cheating is detected, steps (1) - (4) are repeated \( t \) times:

1. P picks a random \( r \) in \( \mathbb{Z}/n\mathbb{Z} \) and sends \( x \equiv \pm r^2 \pmod{n} \).
2. V sends a random boolean vector \( \vec{e} = (e_1, \ldots, e_k) \) of 0's and 1's to P.
3. P sends \( y \equiv r \Pi_{e_i = 1} s_j \pmod{n} \) to V.
(4) \( V \) checks that \( x \equiv \pm y^2 \prod_{j=1}^{n} i_j \pmod{n} \).

Feige, Fiat and Shamir showed that the protocol proves that \( P \) knows the \( s_j \)'s without giving away any information when \( k = O(\log \log n) \) and \( t = O(\log n) \).

Note that if \( P \) follows the protocol, then

\[
y^2 \prod_{j=1}^{n} i_j = (r \prod_{j=1}^{n} s_j)^2 \prod_{j=1}^{n} i_j \equiv \pm x^2 \prod_{j=1}^{n} (s_j^2 i_j) \equiv \pm x^2 \equiv x \pmod{n}.
\]

Thus \( V \) will verify the computation in step (4). It is not hard to show—although we will not—that there is a RAM \( M \) such that if \( \hat{P} \) can cheat \( V \) with a non-negligible probability (say \( \geq 1/n^c \), for some constant \( c \)), then \( M \) can produce \( s_1, \ldots, s_k \), in probabilistic polynomial time. That is, \( M \), with \( \hat{P} \)'s aid, could factor in probabilistic polynomial time.

Eavesdropping on a \( V-V \) interaction gives no more information than first generating a set of vectors \( \{\vec{v}\} \) and then simulating an identical interaction, since those two probability distributions are identical. Hence the proof is zero knowledge.

Furthermore, even a crooked verifier gains no information from the interaction. \( \hat{V} \) cannot hope to use the same interaction in a proof of identity, since he cannot anticipate the vectors \( \{\vec{v}\} \) about which he would be queried during a proof. Even if he chooses a special set of vectors \( \{\vec{v}\} \) (say \( \vec{v}_1 = (1, 0, \ldots, 0), \vec{v}_2 = (0, 1, 0, \ldots, 0), \ldots, \vec{v}_k = (0, \ldots, 0, 1) \)), the choice of \( r \) in each round is sufficient to mask any information that the cheater is hoping to glean.

The result is striking. "Smart" cards which contain a computer chip can be programmed to conduct the protocol. Essentially they prove: "This is a valid card. My name is A** S*****." A public national registry stores the value of "\( n \)". At the time you sign the card, you enter the \( k \) integers \( s_j \), and publish the \( k \) integers \( i_j \). From then on, anyone who witnesses you using the card gains no information. Assuming factoring is hard, one can make unforgeable ID cards. Theft, of course, remains a problem.

The work clearly has commercial applications. On July 9, 1986 the three authors submitted a U.S. patent application. The Patent Office had six months to respond with a secrecy order. At the request of the U.S. Army, on January 6, 1987—three days before the end of the six-month period—the Patents and Trademarks Office imposed the order, informing Shamir that "... disclosure or publication of the subject matter … would be detrimental to the national security..." Shamir et al were ordered to notify all Americans to whom the research had been disclosed that unauthorized disclosure could lead to two years imprisonment, or a ten thousand dollar fine, or both. Furthermore, Shamir, Feige and Fiat were to inform the Commissioner of Patents and Trademarks of all foreign nationals to whom the information had been disclosed.

The horse had long since fled the barn. Throughout the summer of 1986, Shamir and his coauthors had given talks about the research at universities in Israel, Europe and the United States. They had presented it at the International Congress of Mathematicians in Berkeley, and at the CRYPTO 86 conference at Santa Barbara a week later. They had also submitted a paper to the Association of Computing Machinery (ACM) conference on the Theory of Computing to be held in New York in May 1987.

Shamir wrote the program committee of the ACM conference, informing them of the secrecy order, and their consequent legal obligations (" [Destroy] all copies of the paper made during the refereeing process, and ... [warn] all people involved about the secrecy order ... ") and asking their advice. He mentioned that the Weizmann Institute would likely appeal the order; the
work had been performed in Israel, by Israeli scientists, with Israeli funding, but he wanted to know what to do if it were not removed in time for the publication or the presentation dates.

An informal network swung into action. The program committee told colleagues. Several Bell Labs scientists made some well-placed calls. A New York Times reporter was informed, and he prepared a front page story. But the response with the most impact seems to have come from an agency which refuses to acknowledge that it had any role in the affair: the National Security Agency.

The NSA was chartered in 1952. Its mission includes devising codes for the military as well as cryptoanalysis of foreign intelligence. It is possibly the world's largest employer of cryptologists. No one knows for certain; like most information about the agency, the number of employees is classified.

For most of its existence, the agency faced little competition from research published by industry or academia. The introduction of computers into all facets of modern life changed that. Banks, business, industry must be able to transfer securely large amounts of information; hence cryptography flourished in the private sector and in openly published research.

Early on, there were several public squabbles between the NSA and academic researchers. In 1977, Shamir and his two coresearchers at MIT sought to present the RSA scheme at a conference at Cornell. An employee of the NSA—the agency claims that he acted on his own—warned that doing so was in possible violation of a 1954 Munitions Control Act. In 1980, Adleman was denied NSF funding because the NSA feared certain "national security implications".

Both cases were later settled. Bobby Inman, at the time director of the NSA, told the academic community that open publication was harmful to the NSA's mission, and that he sought a dialogue regarding the publication of cryptography research. He warned that if an agreement could not be reached, the agency might seek legislative relief.

On his urgings, the American Council on Education formed the Public Cryptography Study Group (PCSG). In 1981, after a year of meetings, the group proposed guidelines under which members of the academic community would voluntarily submit cryptography papers to the NSA prior to publication. The agency might suggest changes, including deletion. The NSA might even ask that the paper not be published.

George Davida, a member of the panel, and professor of computer science at the University of Wisconsin, disagreed with the guidelines. He felt that the greater risk to national security was the vulnerability of the private sector to electronic espionage. NSA needs were outweighed by the need for secure cryptographic schemes within the private sector. "NSA's efforts to control cryptography [are] unnecessary, divisive, wasteful," said Davida, "It is only by allowing progress in the field... that the NSA will remain effective."

Davida had his own reasons for distrusting governmental secrecy. In 1977, the Wisconsin Alumni Research Foundation, acting on his behalf, had submitted a patent application for an encryption device which would protect computers from unauthorized penetration. Several months later, the Patent and Trademarks Office informed Davida that the device was protected by an Invention Secrecy Order. This came at the request of the NSA.

Davida protested. The chancellor of the University of Wisconsin appealed to the NSF (which had funded the research). The press—local and national—played up the story. Two months later the order was rescinded with the explanation that it was all a "bureaucratic snafu".

Since 1917 the United States has had laws which permit the government to classify private ideas. The reason was to protect the country at war, and the
grounds were whenever "... publication might be detrimental to the public safety or defense ..." In a recent (1979) review of the patent secrecy system, Congress expressed concern, "The invention secrecy enterprise ... conflicts with the principles of the patent system ... Invention secrecy ... is heavily weighted against private inventors who work outside the classified and defense community ... It gives those nonmember inventors the choice of presenting their discoveries to the public without ownership protection, or of trying to obtain a patent and thereby risking Government confiscation of their ideas."

The current Secrecy Act dates from 1951. Under it, secrecy orders are issued by the Commissioner of Patents and Trademarks at the request of a defense agency. Normally the orders must be renewed each year, except in times of national emergency. (The Korean War emergency, declared in 1950, lasted until 1978.) Recently the Patent Office has issued about 350 new secrecy orders annually. From these, the Patent Office typically receives about fifty petitions for some relief—not necessarily total—of the order.

Secrecy orders are subject to little review. The head of a defense agency makes a request, and the Patent Office is compelled to impose it. Despite the potential importance of these actions, the defense agencies have often relegated the decision-making to the ranks.

In the [FFS] case, it really does appear that there was a bureaucratic snafu. The patent application included the phrase "... potential military applications ...". That meant the Patent Office had to send it to all the defense agencies for examination. When the Army requested a secrecy order, the Patent Office was required to comply. Yet if the Army evaluators had known the work was by non-U.S. citizens—the official reason for the removal of the order—or that it had already been publicized, they would not have asked for a secrecy order, according to Department of Defense spokesmen.

The NSA cryptologists did know the relevant facts, but the agency was not informed of the secrecy order before it was imposed. When American computer scientists became aware of the order, several of them made calls to the NSA. So did the New York Times reporter. Within two days the secrecy order was rescinded (although Shamir was not officially informed until a month and a half later, three days before the conference publication date). Shamir and others involved are convinced that the agency pulled strings to have the order removed. The NSA predictably had "no comment".

In one sense, the story is very simple. The Army mistakenly requested a secrecy order. It was removed. Even without NSA involvement, it is likely the order would have been rescinded. The interesting issue is why the agency may have intervened.

The NSA has had a relatively comfortable relationship with the theoretical computer science community since the PCSG report. By 1982, thirty-five papers had been submitted to the NSA, and changes and deletions were requested in two. Now over five hundred papers have been submitted, and although the agency will no longer give precise figures, it does say that changes were asked for in "a small number". On at least one occasion, a researcher did not publish work because of an NSA request.

Some computer scientists find even the voluntary submission of papers to have a chilling effect on research, and others are disturbed by the increasing proportion of funding from military sources. Yet there does not appear to be the tension between the two communities that there was in the late seventies and early eighties. The theoretical computer science community has not found its early fears of suppression of research and loss of civilian funding to be realized. The NSA would prefer to keep things comfortable; after all, it is much easier to find out what the competition is doing if they send you their papers.
Would the cryptography community be better off if only the NSA did patent reviews? Probably not. In this case, it seems that the NSA argued against an Army secrecy order; some other time the situation might be reversed. Many years ago, Dwight Eisenhower argued against concentrating power in a single military command because its uncontested voice would carry an inordinate weight in civilian affairs. It is likely that the research community benefits from the diversity of agencies performing reviews.

Shamir did give his talk on May 26 at the ACM conference. About three hundred computer scientists attended. He thanked anonymous readers (viz the Army) of an early version of the paper for being so counterproductive, said that "... the NSA guys ... were extremely helpful behind the scenes in removing the order . . . ."

References


Jeffrey C. Lagarias is joining Ronald L. Graham as an Associate Editor of Special Articles. The series of Special Articles was created to provide a place for articles on mathematical subjects of interest to the general membership of the Society. The Editorial Committee of the Notices is especially interested in the quality of exposition and intends to maintain the highest standards in order to assure that the Special Articles will be accessible to mathematicians in all fields. The articles must be interesting and mathematically sound. They are first refereed for accuracy and (if approved) accepted or rejected on the basis of the breadth of their appeal to the general mathematical public. Items for this series are solicited and, if accepted, will be paid for at the rate of $250 per page up to a maximum of $750. Manuscripts to be considered for this series should be sent to Ronald L. Graham or Jeffrey C. Lagarias, Associate Editor for Special Articles, Notices of the American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.
After the middle of January there will be a referendum of the membership by mail ballot on five motions, each of which is related to the funding of research in the mathematical sciences by the U.S. government. The text of the resolutions can be found in the Notices for November 1987, p. 1014.

Background information is available in various places, much of it in recent issues of Notices. To assist the member who wishes to review such material upon receiving the text of the motions and the ballot, a listing is provided here.

Articles of Incorporation, Section III, first paragraph, quoted here because it is not readily accessible: The particular business and objects of the Society are the furtherance of the interests of mathematical scholarship and research.

Bylaws, particularly Article IV, Sections 2 and 8. See Notices, November 1987, 1155–1160.

Resolution B. Bulletin, 75 (1969), 736 and 76 (1970), 43, quoted here because it is not readily accessible: Whereas the American Mathematical Society encourages all persons interested in mathematical research to be members of the Society and whereas these members hold a wide variety of political and social views and have been welcomed to membership without regard to these views, resolved that the Society shall not attempt to speak with one voice for the membership on political and social issues not of direct professional concern and shall adhere closely to the purpose stated in its Articles of Incorporation of “furtherance of the interests of mathematical scholarship and research.” Resolution B was approved by a vote of 6731 to 538.

References to the Notices

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News from Washington, p. 325: DARPA Funding.

JUNE 1986

AUGUST 1986
Letter to the Editor, R. S. Strichartz, p. 633.

OCTOBER 1986
The University Research Initiative, Allyn Jackson, p. 738–740.


JANUARY 1987
Letter to the Editor, W. P. Thurston, p. 39–44.

Committee on the Agenda for Business Meetings, p. 52.

Motions at the Business Meeting, p. 76.

FEBRUARY 1987

Challenges to the Mathematics Community, W. R. Graham, p. 245–250.

Letters to the Editor, I. Stakgold, p. 300; P. A. Griffiths, p. 300–301.


APRIL 1987
Science Policy Committee Recommendations, p. 448;
Funding Sources for Mathematicians, Allyn Jackson, p. 449–458.


JUNE 1987

Council Plan for a Referendum, p. 615.


Letters to the Editor, C. Davis, p. 637; R. Gurevic, p. 637; D. M. Weiss, p. 637-638.

The Council Meeting in Newark, p. 699-700.

AUGUST 1987

An Interview with John Polking, p. 731-736, (especially p. 734).

Commentary on Defense Funding: P. D. Lax, p. 737-738; J. Harmse, p. 738; M. M. Dediu, p. 738.


OCTOBER 1987


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Commentary on Defense Funding: Jair Koiller, p. 895; Pankaj Topiwala, p. 895; Mikhail Katz, p. 895-896; Keith Ramsay, p. 896-897; Patricia Clark Kenschaft, p. 897.

Letter to the Editor: Steven H. Cullinane, p. 924.

The Council Meeting in Salt Lake City, p. 1013-1014; The Business Meeting in Salt Lake City, p. 1014-1015.

NOVEMBER 1987

National Science Foundation, News & Reports, Open Letter from the New DMS Director, Judith S. Sunley, p. 1115-1116.

University Support for Mathematical Research, Frank Gilfeather, p. 1067-1070.

Commentary on Defense Funding: Chandler Davis, p. 1103-1104; Mischa Cotlar, p. 1105; Arlene Sbardella, p. 1105-1106.

JANUARY 1988

Calculus Reform and Research Centers: The 1987 Chairmen's Colloquium, Allyn Jackson, (this issue).

Commentary on Defense Funding: (this issue); James Glimm; Linda Keen; Thomas R. Love; Saunders Mac Lane; Mina Rees; Michael Shub; Cory B. Smith; Daniel B. Szyld; Jean E. Taylor; William P. Thurston.

Replacement Ballots for the Referendum

By the middle of January, a ballot for a referendum on 5 motions will be mailed to the membership. The deadline for receipt of the ballots in Providence is March 18, 1988.

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

To help alleviate this problem the following replacement procedure has been devised: A member who has not received a ballot by February 11, 1988, or who has received a ballot but has accidentally spoiled it, may write after that date to the Secretary of the AMS, Post Office Box 6248, Providence, RI 02940, asking for a second ballot. The request should include the individual's member code and the address to which the replacement ballot should be sent. Immediately upon receipt of the request in the Providence office, a second ballot, which will be indistinguishable from the original, will be sent by first class or air mail. It must be returned in an inner envelope, which will be supplied, on the outside of which is the following statement to be signed by the member:

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

Signature

Although a second ballot will be supplied on request and will be sent by first class or air mail, the deadline for receipt of ballots will not be extended to accommodate these special cases.
This year the AMS will celebrate its 100th anniversary. The last hundred years have witnessed an unprecedented growth in mathematical research and will surely be known as one of the golden ages of mathematical history. Throughout the past century, the Society has pursued through many diverse activities its aim of furthering mathematical scholarship and research.

The Society cordially invites its members to participate in the Centennial of the AMS. The following article focuses on two aspects of the Centennial. The first part presents a historical perspective on the Society's activities and accomplishments. The second part describes the festivities connected with the AMS Centennial Celebration, which will be held August 8-12, 1988 in Providence, Rhode Island, home of the Society's headquarters.

A Historical Perspective

Through meetings, publications, information dissemination, and other services, the AMS has continued over the years to find ways to serve the mathematical community. In order to fully understand the role of the AMS in the support of mathematical research in the United States over the past 100 years and to provide a basis for looking to the future, it is necessary to have a perspective on the Society's past activities and accomplishments.

The Beginnings

In 1887, Thomas Scott Fiske was in his second year of graduate study at Columbia College. On the suggestion of Professor J. H. Van Amringe, Fiske spent six months at Cambridge University, where a colleague, J. W. L. Glaisher, took him to meetings of the London Mathematical Society. Fiske later reminisced, "On my return to New York, I was filled with the thought that there should be a stronger feeling of comradeship among those interested in mathematics." By the end of 1888, Fiske and a number of his colleagues had organized the New York Mathematical Society, as it was then called, and Van Amringe was named the first president. As the fledgling society grew, Fiske served at various times as secretary, treasurer, and president, and in many ways the Society's continued existence was due to his efforts.

Meetings

From the start, one of the principal activities of the Society has been its meetings. Because the Society was based at Columbia University, most of the early meetings were held there. There were monthly meetings, except during the summer, at which the members conducted Society business, presented one or more papers, and discussed mathematics. At the fourth annual meeting in 1892, with 10 members in attendance, a mathematical paper was presented as a feature of the annual meeting, thereby inaugurating the scientific program which has developed into the chief attraction for the general membership.

In 1894, the Society changed its name to the American Mathematical Society, and broadened its activities to include summer meetings. Sectional meetings began around the turn of the century, and eventually became regular meetings of the Society. Today, eight or nine sectional meetings are held each year. In addition to the scientific program, the annual winter and summer meetings now encompass a wide range of presentations and activities on such topics as education, science policy, and government affairs. The AMS also sponsors smaller institutes, seminars, and symposia which are organized by members of the mathematical community. The AMS sponsorship includes the assistance of the Meetings Department at the Society's Providence office, the securing of government grants to support the expenses, and in most cases, publication of the conference proceedings.

Two of the most prestigious events at the annual and summer meetings are the Josiah Willard Gibbs Lecture and the Colloquium Lectures. The first Gibbs lecture, entitled "Coordination," was presented in 1924 by Michael I. Pupin. In 1934, Albert Einstein presented the Gibbs lecture on "An elementary proof of the theorem concerning the equivalence of mass and energy." In 1896, the Colloquium Lectures commenced with James Pierpont speaking on "Galois theory of equations" and Maxime
Böcher on "Linear differential equations and their applications." The lists of Gibbs and Colloquium lectures contains some of the most brilliant mathematicians of the past century and attests to the Society's high standards of excellence and its commitment to furthering the communication of mathematical ideas.

During the summer meeting in 1938, the AMS celebrated its Semicentennial at Columbia University. At that time, the Society's founder, Thomas Scott Fiske, was 73 years old, and was the center of attention at several of the Semicentennial activities. At a gala dinner, the Society presented Fiske with his portrait, which now hangs in the Providence office of the AMS. In addition, Fiske received felicitations from President Franklin Delano Roosevelt and the prime minister of Canada. The main feature of the meeting was a series of ten invited addresses by such distinguished mathematicians as George D. Birkhoff, Eric Temple Bell, Griffith C. Evans, E. J. McShane, and Norbert Wiener. Other activities included several mathematical exhibits, cultural excursions in New York City, and a trip on a steamer to West Point Academy.

Publications

In addition to meetings, the Society promotes mathematical communication through its extensive publication program. Mathematical publishing is one of the Society's principal activities and accounts for about three-quarters of its budget.

The first publication was the Bulletin of the New York Mathematical Society, published in three volumes in 1891-94. When the name of the Society changed to the AMS, the name of the Bulletin changed accordingly. At the time, the Bulletin was the official organ of the Society, and contained research papers, notices of official acts of the Society, meetings information and other news of interest to the mathematical community.

As the Society grew in number of members and in the diversity of its activities, new publications were created. Their histories have become intertwined because some of the new publications grew out of existing ones. In 1950, shorter papers that had been appearing in the Bulletin were moved to a new publication, the Proceedings of the American Mathematical Society. Memoirs of the American Mathematical Society, also created in that year, is a paperback serial publication containing longer papers or sets of cognate papers. In 1954, the Notices of the American Mathematical Society was established to accommodate the meetings information and news announcements that had been appearing in the Bulletin. In 1958, abstracts of papers presented at AMS meetings were shifted from the Bulletin to Notices, and then, in 1980, to a separate publication, Abstracts of Papers Presented to the American Mathematical Society. In 1977, Notices was made the journal of record of the Society, and from that time on, only scientific material appeared in the Bulletin.

Today, the AMS is one of the world's largest mathematical publishers, producing five primary research journals, seven Russian translations journals, twelve book series, and three translation series. In addition, the AMS has contributed, financially or otherwise, to the publication of various journals such as the American Journal of Mathematics, the Duke Mathematical Journal, and the Annals of Mathematics.

In 1985 the AMS Committee on the Publication Program decided to recommend that "a new journal be instituted, having significantly higher standards of acceptance than Transactions or Proceedings." This recommendation has evolved into a new quarterly journal, Journal of the American Mathematical Society, containing research articles of the highest quality in all areas of pure and applied mathematics. The first issue will appear in January 1988, to celebrate the Centennial year.

Information Services

One of the most important accomplishments of the Society is the establishment of Mathematical Reviews (MR) in 1940. The need for such a publication had been evident for some time—indeed, at the second summer meeting of the AMS, held in 1895 at a high school in Springfield, Massachusetts, one of the topics discussed was "a general subject catalogue or index of mathematical literature."

Until MR began, Zentralblatt für Mathematik und ihre Grenzgebiete was the only abstracting and reviewing journal for mathematics. In fact, one of the founding editors of MR, Otto E. Neugebauer, was also a founding editor of Zentralblatt. Neugebauer left Germany in the mid-1930s when the Nazis had decided that no article written by a Jew could be published. One of the other founding editors of MR, Jacob D. Tamarkin, also fled his native Russia in 1925 for political reasons. The third founding editor was Oswald Veblen, President of the Society, 1923-24. Because both Neugebauer and Tamarkin were at Brown University, as were the Society's secretary, R. G. D. Richardson, and librarian, R. C. Archibald, and because of the growth of MR, the Society moved to Providence, Rhode Island in 1945. In 1965, MR moved to Ann Arbor, Michigan.

From the start MR enjoyed an excellent reputation. The volume of reviews has increased with the volume of mathematical literature: the first issue contained 2120 reviews, and today there are about 45,000. Utilizing about 12,000 reviewers worldwide, it covers almost all the published mathematical literature in the world, and remains one of the most widely used of all mathematical publications. In addition to MR, the AMS also publishes various other indexes and reviewing journals.
The advent of computers and database techniques for manipulating information have made the production of \( MR \) much more efficient and has allowed for the automatic production of numerous subfiles and indexes. \TeX, the computer typesetting system developed by Donald Knuth, is particularly suited to handling the difficult problems connected with typesetting mathematics. Over the past several years, the Society has been gradually converting all of its publishing, including \( MR \), to the \TeX system, and this project was recently completed. In the process, the AMS has developed extensive equipment and expertise in electronic publishing and is recognized as one of the leaders in the utilization of this technology. Because \TeX can be used on personal computers, the AMS has made available \TeX software packages and manuals.

The power and versatility of \TeX has influenced many aspects of AMS publication and information services, including MathSci, the online service that provides computer access to the \( MR \) database. MathSci originally began as MATHFILE in 1982, and \TeX has lent to MathSci an important capability that MATHFILE did not possess. MathSci citations are now encoded in the \TeX language, so that the user can now view, on a graphics screen or in print, a print-quality copy of the citation just as it appears in \( MR \).

MATHFILE contained bibliographic and subject classification information about entries that occurred in \( MR \) since 1973 and the text of reviews themselves going back to July 1979. Beginning in 1985, bibliographic entries in MATHFILE were extended back to 1959, and statistical indexes and \emph{Current Mathematical Publications} have been added. To reflect this broadened scope, the name was changed in 1986 to MathSci. MathSci is very timely: new \( MR \) entries are available online about one month before they appear in print.

The Society provides many other information services. Two of the most important are the Annual Survey and the AMS employment services. The Annual Survey began in 1957 as a survey of the number of teachers in 61 mathematics departments in the U. S. and their salaries. By 1975, the survey had expanded to include 912 departments, salaries of mathematicians in nonacademic organizations, and information on the race, citizenship, and gender of new doctorates. In that same year, the survey increased its scope to include a second report which provided information on employment of new PhDs, faculty flow, and enrollments. The second report in the annual survey was added in response to growing concern over the poor employment opportunities during the 1970s for new PhDs in mathematics. The two reports have continued to this day and have expanded from time to time to include data of current interest.

The Society's employment services have two major components: the Mathematical Sciences Employment Register and the publication \emph{Employment Information in the Mathematical Sciences}. By 1959, the AMS meetings had grown so large that it seemed no longer feasible to leave the contact between employers and job seekers up to the individuals involved, so the Employment Register was established to match them for interviews to be held during the winter meeting. It is interesting to note that in 1973, when job prospects for new PhDs in mathematics were quite bleak, the Employment Register arranged interviews between 60 employers and 535 applicants; in 1987, there were 178 employers and 270 applicants. Since about 1962 the AMS has used a computer program to match employers and applicants, and the program has been updated and refined over the years. \emph{Employment Information in the Mathematical Sciences} provides listings of open positions for mathematicians. Since 1984 this journal has been supplemented by a special issue containing the résumés of each applicant who preregistered for the Employment Register.

A significant influence on the information services provided by the Society has been the Committee to Monitor Problems in Communication. The committee was established in 1967 to make recommendations for facilitating the dissemination of mathematical information, for not only was that information increasing in volume and complexity, but the mathematical community was growing as well. Two of the many ingenious recommendations of this committee are still in use today in the Notices: the Queries section, a mathematical question-and-answer column; and the Special Meetings section, which began in 1969 and which provides information about mathematical meetings all over the world.

As the primary means of communicating nonscientific information to the AMS membership, \emph{Notices} provides a host of other information services, including information about AMS meetings, information on assistantships and fellowships in mathematics, a yearly analysis of the budget of the National Science Foundation, lists of unpublished lecture notes, and descriptions of new AMS publications. In addition, \emph{Notices} keeps the mathematical community informed through news and articles on a wide variety of scientific and policy topics.

In recent years one of the Society's most important initiatives has been the development of a "Washington presence" for mathematics. The main component of this presence is the Joint Policy Board for Mathematics (JPBM), a 9-member executive action arm sponsored jointly by the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. The JPBM was formally created in 1984, but its precursor, the Joint Projects Committee for Mathematics, was created in 1974.

1984 also marked the release of the David Report, which described the flourishing of U.S. mathematics...
since World War II and pointed to the serious short-
age in mathematicians and the inequity between federal
support for mathematics and that for other fields. The
David Report was instrumental in persuading officials at
the National Science Foundation and other government
agencies to enhance support of mathematics. Part of the
JPBM's function has been to implement the recommend-
dations of the David Report. The JPBM has orchestrated
increased media coverage of mathematics through consist-
ent development of contacts with reporters and editors.
In addition, the JPBM's cultivation of congressional
contact has elevated governmental understanding of the
contributions of mathematics and the importance of fed-
eral support of the field. In 1986 the JPBM established
a permanent Office for Governmental and Public Affairs
in Washington in part to provide a permanent, long-
term, coordinated effort to increase public awareness of
mathematics.

Two important boards of the National Research
Council (NRC) form part of the “Washington pres-
ence” but are not directly sponsored by the Society: the
Board on Mathematical Sciences (BMS), established in
1984, and the Mathematical Sciences Education Board
(MSEB), established in 1985. The BMS is designed to un-
dertake surveys and studies of the field, and to advise the
NRC and government agencies having an interest in the
mathematical sciences. The Board consists of 12 leading
mathematical scientists representing a variety of math-
ematical areas. The MSEB provides national leadership
in assessing and reformulating mathematics education
from kindergarten to college. This 34-member board rep-
resents all the various sectors that would be affected by
extensive reforms in mathematics education—classroom
teachers, research mathematicians, administrators, mem-
ers of school boards and parent organizations, and
representatives of business and industry.

AMS Prizes

The Society recognizes mathematical talent through
several prizes, awarded for outstanding mathematical
research.

Böcher Memorial Prize, founded in memory of
Maxime Böcher, President of the Society, 1909-1910.
Awarded every five years for a notable research memo-
ir in analysis. First award in 1923 to G. D. Birkhoff
for his memoir, “Dynamical Systems with Two Degrees
of Freedom,” published in Transactions of the AMS in
1917.

Frank Nelson Cole Prizes in Algebra and in Number
Theory, founded in honor of Cole, secretary of the
Each awarded every five years. First algebra award in
1928 to L. E. Dickson for his book Algebra und ihre

Oswald Veblen Prize in Geometry, established with
contributions by former students and colleagues in honor
of Veblen, President of the Society, 1923-24. Awarded
every five years. First award in 1964 to C. D. Papaky-
aiakopoulos for his papers “On solid tori” and “On
Dehn’s lemma and the asphericity of knots.”

G. D. Birkhoff Prize in Applied Mathematics, in
honor of Birkhoff, President of the Society from 1925-26.
Awarded every five years for outstanding contributions to
applied mathematics and presented jointly by the AMS
and the Society for Industrial and Applied Mathematics.
First award in 1968 to Jürgen K. Moser for contribu-
tions to the theory of Hamiltonian dynamical systems.

Norbert Wiener Prize in Applied Mathematics, end-
dowed by Massachusetts Institute of Technology. First
award in 1970 to Richard E. Bellman for work in dy-
namic programming, control, stability, and differential-
delay equations.

Leroy P. Steele Prizes, in honor of George David
Birkhoff, William Fogg Osgood, and William Caspar
Graustein, by a bequest from Leroy P. Steele. Three
prizes are now given each year. First award to Solomon
Lefschetz in 1970 for “A page of mathematical biogra-

In commemoration of the AMS Centennial, the Na-
tional Academy of Sciences has established a major
new prize in mathematics. Entitled the NAS Award in
Mathematics, the prize will be given every four years
for excellence of published research in the mathematical
sciences within the past ten years. The prize is made
possible by generous gifts from two longtime Society
members and will be sponsored by the AMS. The first
award will be made in 1988.

Centennial Activities

The AMS Centennial Celebration

The AMS Centennial Celebration will be the event of
the century for the American mathematical community.
The meeting features a rich scientific program exemplify-
ing the brilliant and diverse range of mathematical talent
in this country. In addition, the festive social agenda
will bring the community together to celebrate the ac-
complishments of the past 100 years and to inaugurate
the next century. The Celebration will be held August
8-12, 1988, in Providence, Rhode Island, the home of
the Society’s headquarters.

Throughout this past century, in which the United
States has established itself as a world leader in mathe-
matics, AMS meetings have facilitated the commuica-
tion vital to mathematical research. It is therefore fitting
that, at this very special Centennial meeting, the AMS provide its members with the opportunity to benefit from the insight and perspective of some of the country's leading mathematicians. The Centennial program contains a range of lectures exceptional in the diversity of their topics and unsurpassed in the distinction of their speakers.

At the Centennial, the AMS-MAA Joint Invited Addresses will continue the tradition of excellence in expository talks. These addresses not only reflect the highest standards of scholarship, but also represent a tribute to the spirit of cooperation that has developed between the AMS and the MAA as the two organizations pursued their complementary activities since the founding of the MAA in 1915. The lectures will be presented by three outstanding mathematicians whose work has profoundly influenced mathematical research in the United States and the world. Their names, affiliations, and lecture titles follow.

RAOUL H. BOTT, Harvard University; Topology of Lie groups and differential geometry (lecture title unavailable)

PETER D. LAX, New York University-Courant Institute for Mathematical Sciences; Applied Mathematics

SAUNDERS MAC LANE, Emeritus, University of Chicago; Some Major American Mathematical Centers, 1892-1960

The Centennial Celebration provides a natural backdrop for a look to the future of mathematical research. "Mathematics into the Twentieth Century," a series of AMS Invited Addresses, constitutes the main part of the scientific program and brings together 18 of the country's stellar young mathematicians who are likely research leaders of the next 25 years. Representing the principal areas of active mathematical research, the symposium will direct attention to the fact that mathematical research may take under the guidance of these brilliant young minds. The invited speakers, their affiliations, and their principal areas of interest are:

MICHAEL ASCHBACHER, California Institute of Technology; The theory of finite simple groups

LUIS CAFFARELLI, Institute for Advanced Study, Princeton; Nonlinear elliptic partial differential equations

PERSI DIACONIS, Harvard University; Probability and mathematical statistics

CHARLES L. FEFFERMAN, Princeton University; Analysis and mathematical physics

MICHAEL H. FREEDMAN, University of California, San Diego; Low dimensional topology and mathematics, physics

HARVEY M. FRIEDMAN, Ohio State University; Mathematical logic

BENEDICT H. GROSS, Harvard University; Algebraic number theory

JOSEPH HARRIS, Brown University; Algebraic geometry

ROGER E. HOWE, Yale University; Representation theory of p-adic groups

VAUGHN F. R. JONES, University of California, Berkeley; von Neumann algebras and knot theory

VICTOR KAC, Massachusetts Institute of Technology

ANDREW MAJDA, Princeton University; Nonlinear hyperbolic equations and computation

CHARLES S. PESKIN, New York University-Courant Institute of Mathematical Sciences; Mathematical biology

DENNIS P. SULLIVAN, City University of New York Graduate School and University Center; Dynamical systems and Kleinian groups

ROBERT E. TARJAN, AT&T Bell Laboratories, Murray Hill, NJ; Theoretical computer science and combinatorics

WILLIAM P. THURSTON, Princeton University; Low dimensional topology and iteration

KAREN UHLENBECK, University of Chicago; Calculus of variations and mathematical physics

EDWARD WITTEN, Princeton University; Mathematical physics

On Monday morning, August 8, the Opening Ceremonies will kick off the Celebration with pomp and flair by putting the Centennial into its public, international and historical contexts. Representatives from government and industry will extend their greetings to the mathematical community together with felicitations from sister mathematical organizations from all over the world. Everett Pitcher, secretary of the AMS for the past 20 years, will provide a historical perspective, and AMS President George Daniel Mostow will comment on mathematics as an intellectual discipline. Edward E. David, Jr., chairman of the committee that produced the influential David Report, will speak on where mathematicians stand as a scientific community.

The day ends on a festive note, with a gala reception at the Rhode Island State House, a setting of architectural, aesthetic, and historical appeal. Chamber music, hors d'oeuvres, and a special AMS birthday cake will enliven this elegant soirée.

The participation of the MAA is an important and integral part of the Centennial. In addition to the AMS-MAA Joint Invited Addresses, the MAA is sponsoring several scientific sessions and minicourses. The MAA has graciously scheduled these activities on the weekend before the Celebration and has abbreviated its own program in order to allow more time for the Centennial activities. As a further expression of friendship, the MAA will present the AMS with a sculpture by Helamon Ferguson. The sculpture will be installed near the entrance to the Society headquarters building.

Other special events include three mathematical exhibits at Brown University. The John D. Rockefeller Library at Brown will present an exhibit of archives
and historical material pertaining to the Society. Rare mathematical books and manuscripts will be on display at the John Hay Library. The David Winton Bell Gallery at Brown’s List Art Center will present the Royal Vale Heath Collection of mathematical puzzles, which Heath called “mathemagic.”

The AMS headquarters will be open to visits by conference participants during the entire week of the Celebration. These visits will enable the membership to better understand the magnitude and sophistication of the AMS enterprise and to meet the dedicated staff that makes it all happen. For a convivial finale, the Celebration ends with a traditional Rhode Island clambake in a lovely outdoor setting.

Every member is encouraged to attend this very special celebration and to take part in the festivities. Full details on the program, including information on registration deadlines and housing, will appear in the April issue of Notices.

100 Years of American Mathematics

The founding of the Society coincides with the beginning of the American mathematical enterprise, now one of the most prolific, vibrant, and creative of any nation in the world. It is only appropriate, then, that the Centennial Celebration should extend beyond the Society’s summer meeting. “100 Years of American Mathematics,” an expansion of the AMS Centennial, is a yearlong series of events designed to focus national attention on celebrating the accomplishments of the American mathematical community, reexamining the many roles of mathematics, and renewing a commitment to excellence. “100 Years” will involve the entire mathematical community, from school teachers to research mathematicians, and the various publics the community serves—government, industry, academia, etc. The kickoff for “100 Years” will be a special banquet at the Joint Mathematics Meetings, to be held January 6–9, 1988 in Atlanta, Georgia. (Full details and the meeting program appear in this issue of Notices.)

One of the upcoming events in “100 Years” is a special symposium entitled “American Mathematics Entering its Second Century.” This symposium will be held February 11–15, 1988 in Boston, Massachusetts, during the annual meeting of the American Association for the Advancement of Science. The rejuvenation of bonds between mathematics and the natural sciences and the emergence of the modern computer represent major trends in mathematics during the past century. The symposium will illustrate these trends by focusing on four themes important in current mathematical research: computer aided mathematical modeling; the concept of symmetry; revolutionary developments in low-dimensional geometry; and the close alliance between mathematics and physics in such areas as fluid dynamics, dynamical systems, and string theory. Here are the names of the speakers, their affiliations, and the titles of their talks.

George F. Carrier, Harvard University; The modeling of fire spread

John Conway, Princeton University; Packing spheres

Persi Diaconis, Stanford University; The mathematics of mixing things up

James G. Glimm, Courant Institute of Mathematical Sciences; Higher dimensional mixing and diffusion

David A. Hoffman, University of Massachusetts, Amherst; Soap films and soap bubbles: Surface interfaces in nature

Robion C. Kirby, University of California, Berkeley; Dimension 4: Not the place to do your calculus homework

John Morgan, Harvard University and Columbia University; A guide to the baffling fauna and flora of low dimensional topology

George Daniel Mostow, Yale University; Groups and symmetry

David Mumford, Harvard University; Mathematical models in the cognitive sciences

Charles S. Peskin, Courant Institute of Mathematical Sciences; A mathematical model of the heart and the computer-assisted design of prosthetic heart valves

Daniel G. Quillen, Oxford University; Title to be announced

William P. Thurston, Princeton University; Topology’s quintessential problem, elusive as ever

James A. Yorke, University of Maryland; Obstructions to predictability in dynamical processes

The Society is its Members

The Centennial of the AMS and “100 Years of American Mathematics” are both celebrations of the importance, beauty, and challenge of mathematics. Moreover, the Centennial Celebration, with its emphasis on strengthening the sense of community among mathematicians, harks back to the idea of the Society’s founder, Thomas Scott Fiske, who wished to develop a “feeling of comradeship among those interested in mathematics.” The Society is making every effort to insure that the Centennial Celebration will be a scientifically stimulating and personally rewarding event for each participant. But the Society is its members, and only through the active involvement of the entire mathematical community will this tribute to mathematics have the vitality and excitement that this noble science deserves.

Allyn Jackson
Staff Writer
SALARY SURVEY FOR NEW RECIPIENTS OF DOCTORATES

Editor’s note: Unfortunately, the tabular information that appeared in the November 1987 issue of Notices in the section “Salary Survey for New Recipients of Doctorates” was reported incorrectly. Due to an error in inputting the information for Notices, certain columns of statistical data were not placed under the proper headings. Therefore, the introductory material and the tables for this section are given in this issue of Notices in corrected form. The graphical data is not reproduced since it was correct in the original publication. The Managing Editor of the Notices apologizes for this error and for any inconvenience it may cause. Reprints of the entire First Report of the 1987 Annual AMS-MAA Survey, with the corrections incorporated, are available from the Managing Editor.

Errors also occurred: 1) in tabulating the number of faculty members used to determine the statistical information in the “Faculty Salaries, Tenure, Women” portion of the survey. The number of professors with doctorates listed under Women with tenure on page 1073 should be 226 (1986-1987), 211 (1987-1988); 2) in presenting the year headings on pages 1074-1076. The headings 1985-1986 and 1986-1987 should be 1986-1987 and 1987-1988, respectively.

The figures for 1987 in this article were compiled from questionnaires sent to individuals who received a doctorate in the mathematical sciences during the 1986-1987 academic year from universities in the United States and Canada. Questionnaires requesting information on salaries and professional experience were distributed to 695 recipients of degrees using addresses provided by the departments which granted the degrees. Of these, 10 were returned by the postal service as undeliverable and could not be forwarded. There were 307 individuals who returned forms between late June and early September. The tables below are based on the responses from 284 of these individuals (232 men and 52 women). Data from 23 responses were not used in the compilation of the tables below; forms with insufficient data, or from individuals who had indicated they had part-time employment, were not yet employed, or were not seeking employment were considered unusable.

Readers should be warned that the data in this report are obtained from a self-selected sample and inferences from them may not be representative of the population. More comprehensive information on the number, the sex—minority group status—citizenship, and the employment status of the recipients of new doctorates granted last year in the mathematical sciences in the U.S. and Canada may be found in the following article of this report on the 1987 Survey.

Key to Tables. Salaries are listed in hundreds of dollars. Years listed refer to the academic year ending in the listed year. M and F are Male and Female respectively. One year experience means that the persons had experience limited to one year or less in the same position or a position similar to the one reported; some persons receiving a doctorate had been employed in their present position for several years. (X + Y) means there are X men and Y women in the 1987 sample. Quartile figures are given only in cases where the number of responses is large enough to make them meaningful.

Note that throughout the graphs, salaries have yet to appear as boxes along the vertical lines. (Because the deflator is not yet available for this year, the 1987 figures do not appear on the graphs.)

The horizontal line represents the median salary for 1986 in hundreds of dollars. The points plotted are the relevant data for each year converted to 1986 dollars using the implicit price deflator prepared annually by the Bureau of Economic Analysis, U.S. Department of Commerce. Where available, first and third quartiles appear as boxes along the vertical lines. (Because the deflator is not yet available for this year, the 1987 figures do not appear on the graphs.)

Note that throughout the graphs, salaries have yet to return to their high point of 1970, although steady progress has been made since 1980. (For a more detailed analysis of academic salaries see Donald Rung’s article, “A Fifteen Year Retrospective on Academic Salaries of U.S. Doctorate Holding Faculty,” in the November 1985 issue of Notices, pp. 772-773.)
## Nine-Month Salaries

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One Year Experience (121 + 25)

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## Twelve-Month Salaries

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One Year Experience (20 + 7)

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One Year Experience (12 + 1)

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Fair or unfair, mathematics has the reputation of being isolated from other disciplines. Mathematicians are often criticized for not communicating effectively with nonmathematicians and for not interacting with other scientists in the realms of research and education. But the 1987 Chairman’s Colloquium, held October 9-10, 1987, in Washington, DC, demonstrated that key leaders in the mathematical community are working to change this reputation and are calling for the cooperation of the entire community.

The meeting focused on two major issues facing the mathematical community: calculus reform and the role of centers in mathematics research and education. These issues are related in the sense that, if the mathematical community is to participate fully in calculus reform and research centers, it must actively seek out and cooperate with the various groups involved—students, teachers, administrators, scientists in other disciplines and in industry—and be responsive to their needs and concerns.

Calculus Reform

In education, one difficulty in increasing such cooperation relates to the discrepancy between what mathematicians value in mathematics and what society values in it. Ronald G. Douglas, Dean of Mathematical and Physical Sciences at the State University of New York at Stony Brook, opened the session on calculus and
curriculum on the first day of the colloquium. He remarked that mathematicians value mathematics because of its beauty, challenge, and depth, and, often as a secondary consideration, because of its utility. "Society supports mathematicians to teach mathematics and to solve society's mathematical problems," Douglas noted, but mathematicians often consider educational issues unimportant. He pointed out that while many mathematicians consider precalculus and calculus to be the realm of 2- or 4-year colleges, if these courses were to disappear, many mathematicians would be out of work.

Neglecting education has important implications that extend beyond the classroom. "Teaching is our principal influence on society," Douglas said, noting that generally about 80% of college students enroll in a mathematics class. The only other college course that competes with that enrollment figure is freshman English. Therefore, mathematics, more than most other subjects, has an opportunity—as well as a responsibility—to increase society's awareness and understanding of mathematics and to attract the best students to the field.

One of the greatest opportunities to influence society's view of mathematics is through calculus. For most college-educated people, calculus is the last mathematics class they take, and the course conveys to them an impression about the entire field. It was in this vein that colloquium speaker Lynn Arthur Steen of St. Olaf College quoted a paper by Gail S. Young: "Calculus is our most important course, and the future of our subject ... depends on improving it." Unfortunately, calculus often convinces bright students not to pursue further study in mathematics. With over 600,000 students enrolling in calculus each year, it is sobering to realize that only 15,000 bachelor's degrees were awarded in mathematics in 1985.

High calculus enrollments may seem to imply that the course is effective, but Steen maintains that students are not learning what they need in order to function mathematically in the workplace. The calculus course has changed neither in response to the changing needs of students and society, nor in response to the computer and the variety of ways that mathematics is currently being utilized in all areas of science. One of the participants at the meeting remarked that, in teaching, mathematicians are much more "conservative" than other scientists, who are often "amazed" to find that mathematics departments are teaching a 20-year-old calculus curriculum.

Disagreement on Problems, Solutions

During the discussion period, everyone seemed to agree that calculus has problems, but disagreed on what the problems were and how they should be solved. Some complained that large classes prohibited effective teaching; others maintained that reducing class size is pointless unless teaching methods change. Some called for higher standards and a more sophisticated, conceptual approach to calculus; others maintained that their students were too poorly prepared for anything more challenging. Some argued that, as a single course, calculus tries to do too much and that several courses may be needed; others noted that often students have to choose one introductory course from among offerings in mathematics, statistics, and computer science, with inadequate information about how they all fit together.

Such discussion is necessary to establish a consensus about the essential features of a new calculus curriculum. For example, Douglas remarked that, in his view, certain topics need to be trimmed from the calculus curriculum, and that choices about what to leave out may become sensitive political issues. A national consensus on the basic elements of the calculus curriculum would prevent such issues from dominating.

National Efforts Have Begun

Douglas also noted that proposals for ways to improve the teaching of mathematics would be more persuasive if made in concert with the national reform efforts which have begun. Two examples of such efforts are the initiative of the National Science Foundation (NSF) in calculus curriculum reform, and the symposium "Calculus for a New Century" (held October 28 in Washington, DC).

The NSF initiative is one indication of the Foundation's renewed interest in undergraduate education. In July 1987, the NSF established a new Office of Undergraduate Science, Engineering, and Mathematics Education (USEME) in the Science and Engineering Education (SEE) directorate. USEME will manage those undergraduate programs budgeted within SEE, coordinate the undergraduate programs across the NSF, and stimulate the involvement of faculty, colleges, and other agencies in improving undergraduate education. In addition to coordinating projects in calculus and engineering curricula, USEME has four other programs: Instrumentation and Laboratory Improvement, Research Experiences for Undergraduates, Undergraduate Faculty Enhancement, and Career Access Opportunities for Women, Minorities, and the Disabled. The three latter programs are new, while the first is an expanded version of SEE's College Science Instrumentation Program; the main difference is that universities and two-year colleges are now eligible for the program.

The acting head of USEME is Robert F. Watson, a chemist and former head of SEE's Office of College Science Instrumentation. William Lucas, Professor of Mathematics at Claremont Graduate School, served part time as a program officer through the fall of 1987; at the time of this writing, USEME had found no replacement. Research Experiences for Undergraduates is coordinated through USEME but implemented by the
research divisions. Within the Division of Mathematical Sciences (DMS), the coordinator of that program is William Adams, Program Director for Algebra and Number Theory. Also, the calculus curriculum reform project is being handled through the DMS by Louise Raphael, former Program Director for SEE's Teacher Enhancement Program. (For information on the calculus reform program and upcoming deadlines, see NSF News and Reports in this issue of Notices.)

In speaking about the DMS's goals for the calculus reform project, Division Director Judith Sunley said that there are limits to the changes that can be made at the local level. She pointed out that the NSF is designed to implement the kind of long-range, national effort that is needed. Reform efforts must be coordinated not only with other disciplines that rely on calculus, but also with activities at the state and local levels. Sunley remarked that information dissemination is important in order “to create an environment of acceptance to reform.”

MS2000

Another important component in mathematics education reform is a project of the National Research Council, “Mathematical Sciences for the Year 2000: Assessment for Renewal,” known as MS2000. MS2000 is a joint project of the Board on Mathematical Sciences and the Mathematical Sciences Education Board (MSEB). Bernard Madison, Director of MS2000, spoke at the colloquium about the goals of the project. Its main purpose is to assess the U.S. mathematics enterprise, as it now stands, in the broad areas of national needs and potential, curriculum and instruction, and resources. Madison is focusing his attention on assessing these areas at the undergraduate, graduate, professional, and research levels, while the MSEB portion of the study concentrates on mathematics education from kindergarten through high school. Such a broad assessment is crucial to the success of any reform effort in mathematics education. Says Madison, “We want students to see mathematics education as a single system, not as a collection of separate pieces.”

Indeed, one of the difficulties of calculus reform is that calculus is not an isolated course. Any changes will affect the high school curriculum that prepares students for calculus and collegiate courses taken after calculus. The NSF's reform programs don't address these other areas of mathematics education, but Madison pointed out that the ideas and philosophy developed in the calculus reform movement will be useful in evaluating and reforming other courses as well.

Science and Technology Centers

During the colloquium, the discussion of calculus reform was generally livelier and more active than the discussion of the NSF's Science and Technology Centers (STCs) initiative. The STCs, which will be established in 1988, are intended to combine basic research in universities with knowledge transfer and education in order to strengthen the nation's economic competitiveness. The idea of the STCs has been politically popular and has played a key role in the NSF's drive to double its budget by 1992. The background of the STC initiative is sketched in an article entitled “Science and Technology Centers: New Opportunities for Research Support in the Mathematical Sciences,” (Notices, October 1987, page 879). In addition, the article explains the NSF's plans and describes some current examples of collaborative and interdisciplinary research involving mathematics.

Some of the speakers pointed to important reasons for the centers approach that go beyond its political appeal. Opening the session on centers, Philip Griffiths, Provost of Duke University, noted that the trend toward interdisciplinary and collaborative mathematical research indicates the scientific impetus for the centers. Sunley said that a “mix or balance of different research modes is healthier.” Little is known about how technology transfer works, she maintained, and focused efforts are needed to speed up the process.

The STC Initiative has generated considerable controversy among mathematicians, many of whom feel that such large-scale operations may not be suitable to mathematical research and that the centers may drain funds from the individual research grants that form the bulk of federal support of mathematical research. But the NSF has appeared sensitive to these concerns and vows that the centers will not encroach on traditional modes of support. Judging from the reaction at the colloquium, the mathematical community has accepted the inevitability of the centers initiative and has adopted a “wait and see” attitude. Fewer questions were asked and there was less discussion of sensitive policy issues—such as the impact on individual grants—than might have been expected. It appeared that most of those at the colloquium considered themselves observers of, not participants in, the STCs, despite a succession of speakers encouraging them to become involved.

Initiating Outreach

There is a variety of forms this involvement could take. “You don't need a full, completed proposal to make a contribution in this first year,” Sunley said. Besides a full proposal, one can submit a planning grant proposal, or simply begin developing a research group in preparation for later STC competitions. She suggested finding out about collaborative or interdisciplinary efforts that may be going on in other departments at one's own institution, at other mathematics departments in nearby institutions, in industry, or through state agencies. Making such contacts is not easy, conceded Sunley, noting that even developing a proposal within one's own
department presents the difficult question of who should and should not be included.

John Polking, former DMS Director, pointed out that mathematicians can participate in the centers initiative either by leading a center, or by getting involved in a center in another discipline. Polking encouraged mathematicians to submit, if at all possible, a full proposal rather than a planning grant proposal. He maintained that the feedback one would get from the review process would be more useful than the money from a planning grant. Andre Manitius, Deputy Director of the DMS, added that even if few mathematically-oriented centers are funded in this first year, a strong showing of mathematics in the 1988 competition would help in subsequent competitions.

Advice for Proposals

Some of the speakers gave their views on the features of potentially successful proposals. D. J. Lewis was on a National Academy of Sciences panel that developed guidelines for the centers initiative (the panel’s report, “Science and Technology Centers: Principles and Guidelines,” was reprinted in Notices, October 1987, page 887). According to Lewis, one of the most important components of a successful proposal will be the leadership of its director. In addition, Lewis noted that STC proposals must demonstrate a plan for knowledge transfer, but that the transfer might be indirect. For example, the center might include an engineer who would utilize the research in an industrial laboratory, but the center itself may have no ties to the laboratory.

The coherence and integration of STC proposals was frequently mentioned as an important feature. Griffiths summarized the sentiments of several of the speakers when he cautioned against “throwing together a bunch of separate proposals.” Manitius said that the proposals must show that the impact of the research goes beyond mathematics, that it would be slower or impossible without collaboration, and that there would be advantages of scale.

Manitius also pointed out that “mathematics will have to make its case and compete for the centers against other disciplines” in order to show why the mathematical research is better or more important than that in other sciences. The lengthy, four-phase review will include mail review, review by interdisciplinary panels, and site visits. Manitius says the NSF anticipates receiving 300–500 proposals and is likely to fund 10–20 centers.

The STC initiative may be rather bewildering because it asks the mathematical community to rethink its traditional role in scientific research. Even for the NSF, the program presents a formidable challenge. Manitius, an STC Coordinator, called the STC program “a learning experience for the NSF.” The NSF is divided into disciplinary divisions which almost exclusively handle proposals originating in their own disciplines. However, the review mechanism for the STCs will necessarily be interdisciplinary. “All the organizational support is in the divisions,” says Manitius, “but the STC program must cut across these boundaries. This is a large-scale operation, and the NSF must develop the organizational structure to handle it.”

Experience with Collaborative Research

Two of the speakers at this session offered views based on their experience with centers: James Crowley, Acting Director of Mathematical and Information Sciences at the Air Force Office of Scientific Research (AFOSR), and Nancy Kopell, Director of the Center for the Study of Rhythmic Processes. Crowley has seen the development of the Defense Department’s University Research Initiative (URI), begun two years ago. The main goals of the URI are to promote basic, interdisciplinary research and to increase interactions between researchers in universities and in defense laboratories.

Crowley said that, unlike the NSF’s STC initiative, the topics for the URI program in mathematics were preselected. Five URIs were established in mathematics through the AFOSR. Crowley said that, among these, the typical grant had a 5-year budget of $480,000, included 4–8 senior investigators with 1–3 months of summer support, 4–6 graduate students, and 2 postdoctoral researchers. According to Crowley, there may be another round of URIs in 1988, and, if there is, the selections will probably be made on a tight schedule by the summer of 1988.

Kopell’s center, which began with a URI grant, receives more that half of its funds from the Life Sciences directorate at AFOSR and the remainder from the Mathematical and Information Sciences directorate. The establishment of the center increased the visibility of the group’s research, thereby encouraging other experimentalists to become involved in the research. According to Kopell, the formal ties of the center facilitated increased communication between the mathematicians and the biologists. In addition, a flexible budget structure allowed the group to bring in new people and to trade students and postdoctoral associates.

Conclusion

The colloquium ended with a question and answer session with representatives from the various funding agencies, but it was clear by that time that calculus and centers had stolen the show. Between those two topics, calculus seemed to generate more interest, but perhaps that impression is misleading. As Bernard Madison put it, “The response you get to an issue is proportional to the number of people who know enough about the subject to be critics of it.” While everyone at the colloquium
had extensive experience teaching calculus, few had experience with centers or interdisciplinary research.

In addition, it became clear from individual conversations that many from smaller institutions felt that they could not compete effectively for center funds. And in certain areas of mathematics, a center simply does not appear to be a feasible mode of research. Some of the participants preferred to speak individually to NSF program officers about their ideas for centers, rather than present their ideas publicly at the colloquium. Such reticence is understandable, since the program is still in the formulative stage. Mathematicians are interested in the centers issue, but may not yet be clear about where they fit in.

The Chairman's Colloquium is sponsored every year by the Board on Mathematical Sciences of the National Academy of Sciences. Next year's colloquium will be held October 14–15, 1988, in Washington, DC. The Board invites comments on possible topics of interest for next year and on any organizational matters which may make the colloquium more productive or comfortable. Lawrence Cox, Staff Director of the Board, can be contacted at Board on Mathematical Sciences, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, DC 20418; 202-334-2421.

Allyn Jackson
Staff Writer
At the Council Meeting in Salt Lake City, it was decided to place five motions on a mail referendum which would be sent to the AMS membership following the January 1988 Annual Meeting. (See the reports of the Council Meeting and the Business Meeting in the AMS Reports and Communications section, October 1987 Notices, page 1013.) On page 13 of this issue of Notices is a bibliography of material pertaining to this referendum. This is the last issue of Notices in which this section will appear. Any further commentary on the defense funding issue should be directed to the Notices as a letter to the editor and will be considered for publication by the Editorial Committee according to the policy stated in the Letters to the Editor section of this issue of Notices.

James Glimm  
New York University  
Courant Institute of Mathematical Sciences

The debate over the San Antonio motions 1 and 2 could be epitomized by the question “Why do we want to shoot ourselves in the foot?” asked by one writer to these Notices.

The motions 1' and 2' are political, divisive, negative, backward looking, and contain technical errors. They should be rejected. The motions contain some useful ideas, which should be reformulated in constructive terms and considered for action by appropriate AMS committees. Some of the useful ideas are captured in motions 3', 4', and 5' and others will be alluded to below.

POLITICAL refers to the promulgation by the AMS of policy statements that are not based on mathematical expertise or on information known principally to mathematicians. The mathematical community has had at most a marginal participation in the SDI program. For example it would not be possible to assemble a blue ribbon AMS panel with the technical credentials to evaluate SDI.

DIVISIVE refers to AMS resolutions which displease a significant block of mathematicians. The letters published in these Notices demonstrate the divisive character of motions 1 and 2. The council of the AMS has just established a policy directive to emphasize the importance of applied mathematics. That this policy coincides with a vote which has irritated many applied mathematicians indicates that there is still some distance for the AMS to move on the applications learning curve.

There are four reasons which have been used successfully to advance governmental support of science over the past four decades. These are (a) the support of science for its own sake, (b) defense and national security, (c) productivity and economic well-being and (d) health. These arguments do not compete with each other. They cooperate, both politically and intellectually. A success in one area will re-enforce our performance in all of the others. We would all prefer the support of mathematics for its own sake. Washington understands this and also the fact that our sister disciplines feel the same way about their own subjects. Politically effective plans must be built around opportunities in areas (b), (c), and (d) and we can argue that (a) must keep pace as well.

Applied mathematical thinking, whether done by engineers, applied physicists, or mathematicians, has a potentially enormous impact on society. Society has a stake in the outcome and will certainly play a large role in selecting the broader goals of science and applied mathematics. The economy of several U.S. cities will prosper or falter according to the ability of engineers and mathematicians to devise, use, and understand computer design codes which model the flow of air around a wing or engine inlet. The health of at least our young urban minorities and possibly of all of us has been jeopardized in the AIDS epidemic by a failure to act on the first principle of mathematical
epidemiology: early is the best and easiest time to confine an epidemic.

Defense and national security are also legitimate governmental functions. Defense has been employed by all governments throughout history, by democracies and dictatorships, by socialist and communist governments, and even by neutralist governments. Defense has been supported by all presidents and congresses in our own history.

It is not reasonable for the mathematics community to ask for a larger and more responsible role in the scientific life of our nation while pulling back from the defense area. If the thrust of the motions 1' and 2' is rather to broaden the base of applied mathematics problems by seeking opportunities in areas (c) and (d): productivity and health, then the sponsors should state this clearly. Such a thrust is a good idea. To achieve success will require more than voting on resolutions. Some mathematicians will have to put their careers and their talent on the line.

NEGATIVE politics is the listing of dislikes, while a positive policy consists of a practical plan for achieving desired goals. To illustrate the difference, I list some topics in the health area where mathematical thinking is being used and where the future prospects appear bright. Models of heart valves have been successful. More generally methods of fluid and continuum science can be applied to computational models of body tissues and organs. Biology at the molecular level requires a three dimensional reconstruction of known protein or gene sequences. Prominent success was achieved recently with the cold virus. Knot theory is relevant to genetics and the effective comparison of genetic sequences was proposed and first solved by mathematicians. The epidemiology of AIDS was mentioned above. The brain, as well as models for neurons and groups of neurons have been investigated by mathematicians.

BACKWARD LOOKING contrasts to (my estimate of) current and future political trends. After a period of increasing defense budgets, and with a large trade deficit, budget imbalance, and a possible runaway health problem, the major focus of political thought will shift to new areas. Those areas for which technology is amenable will present to the scientific community, and to mathematicians in particular, their best and most constructive opportunities.

TECHNICAL ERRORS are contained in the SDI motion. If SDI is infeasible, some research should continue, both to evaluate the ongoing Russian program in this area and to assess changes in the relevant technologies. It is a technical error to argue from infeasibility to oppose all SDI research. SDI comes in many flavors. The version studied and criticized by the American Physical Society has received only limited funding for several years. The technical error in the motion consists in using arguments against this version of SDI and applying them out of context to other or all versions of SDI.

CONCLUSION. A vote against motions 1' and 2' is not a vote for SDI. It is a vote in favor of good judgement and common sense by the mathematical community.

Saunders Mac Lane
The University of Chicago

In these Notices for October, 1987, pp. 895-896, Mikhail Katz holds that the shallowness of the current debate on military funding in mathematics stems from the lack of a historical perspective. At the end of his article, he asked that older mathematicians "step up and tell us all" on the subject of pre-Vietnam funding. I venture to respond, though I can't possibly tell "all" and my response necessarily rests in part on personal recollections.

Before World War II there was no federal government funding of research in mathematics. One possible exception is the National Research Council postdoctoral fellowships in the sciences, chiefly funded, I believe, by the Rockefeller Foundation; they were a major help to a number of young mathematicians in the 1930s.

During WWII, very many American scientists were enthusiastically engaged in war research of various types. J. von Neumann and S. Ulam were at Los Alamos, F. Burton Jones and others at the Radiation Laboratory (for radar, at MIT), many were at Aberdeen for ballistics research and others worked for the Applied Mathematics Panel (AMP), directed by Warren Weaver (at that time, Vice President of the Rockefeller Foundation and a trustee of the AMS). I was active in the group at Columbia University, 1943-1945. The Applied Statistics Group at Columbia made some notable contributions—for example, Abraham Wald's discovery of sequential analysis.

After WWII, there was a general agreement that science (including mathematics) could make major contributions not just to military matters, but also to the general welfare. This idea was formulated by Vannevar Bush in his influential book Science: The Endless Frontier. One result was a congressional

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In 1957, the U.S.S.R. lofted Sputnik. The general concern that the USA was falling behind soon led to a drastic increase in funding for science—for example, the funding for the "new math" under the School Mathematics Study Group. All the federal agencies mentioned above took part. In the mathematical community, it was the general opinion that funding by a variety of agencies was much better than having just one big agency; if a grant application was rejected by one agency, there would be alternative possibilities. With the more extensive support, it became possible in many sciences to use government funds to pay part of the academic year salaries (an idea evidently appealing to deans and university administrators). In this and other regards, practice in mathematics was modeled on that in the other sciences. (Physicists, having achievements and needing big apparatus, knew their way around Washington much better than we mathematicians.)

Government funding for summer salaries for scientists began at the ONR in 1947 and developed slowly—first usually for 1/3 of annual salary; later at the NSF, 2/9ths. In 1960, Arthur Grad came from the ONR to be Program Director for the Mathematical Sciences at the NSF. He travelled around the country to gather information, to encourage grant applications and to encourage summer salaries and support for graduate students on grants. He is reported (incorrectly!) to have said that he wanted a Cadillac in front of every mathematician's house, so that students could see that the subject prospered (I never counted the Cadillacs, but I did observe a general upgrading of mathematicians' houses and a rapid increase in the NSF budget for mathematics). The various defense agencies (ONR, AFOSR, OOR) supported much applied mathematics and also much mathematics with no relation to the agencies' "mission."

This liberal support of science began to slow down about 1965. Subsequently, the Congress adopted the so-called Mansfield Amendment (in the Armed Forces Military Procurement Act for 1971). This amendment required that the various defense agencies support only that scientific research which was relevant to the agency's mission. There was then an attempt to transfer some defense agency money previously used for the support of pure sciences to the NSF, but substantial portions of the money were dissipated in the transfer. The subsequent development of the funding of mathematics is summarized in the David report (Notices, 3 (1984) p. 435).

After this (hopefully) objective summary, I will try to comment on the more subtle question: To what extent did this government and defense funding...
help or distort mathematics? In this, it is not easy to separate the effects of NSF funding from that by defense agencies.

First: It certainly encouraged the vigorous growth of American mathematical research in the period 1950–1970. It improved the financial situation of scientists, and it encouraged them to devote more time to research activities. (In many universities there was a real reduction of teaching loads for mathematicians.) The fact that grants were made to individuals or to small groups of mathematicians tended to strengthen their positions vis-a-vis university administrators. The number of research mathematicians was substantially increased by a liberal program of postdoctoral fellowships and the provision to fund research assistants under grants. Travel funds and grants for visitors sharply increased the rapid exchange of ideas.

Second: The defense agency support was a major source for the renewal of applied mathematics in this country. In the early part of this century, there had been an effective “native” school of applied mathematics. However, at several major institutions (for example, Yale, Chicago, Harvard, Wisconsin) leading applied mathematicians retired or left for administrative positions without training or finding talented replacements. I have not succeeded in understanding why this happened (in the 1930s). However, R. G. D. Richardson (at Brown University), Richard Courant (at NYU), Solomon Lefschetz (at Princeton), and others set about to build centers of applied mathematics. It is my observation that the support of the various defense agencies played a vital role in their success, notably at the Courant Institute. This did not happen at the cost of grants in pure mathematics.

Third: Did the defense agencies support pure mathematics across the board in this period 1950–1970? For 1950–1965, I think the answer is “yes”; though I have only sketchy evidence. For example, during this period I had several grants from the AFOSR for research on algebraic topology and homological algebra; I was never under any pressure to produce practical applications; only once, in 1967, was I asked to attend an AFOSR scientific seminar—where I gave a lecture on the origins of category theory.

Fourth: Peer review was not then the method of choice for the defense agencies, since they depended more on professional staff and on advisory committees. Did this lead to misjudgements? I do not know, and I do not think it possible to find an objective answer. I.M. Singer, for the National Academy of Sciences, once directed an empirical study of peer review at the NSF: What would happen with different reviewers? The answer was: It would be somewhat different—but we don’t know if it would be better or worse.

Fifth: Quality? Occasionally research funded by defense agencies was largely nonsense; I know a couple of dandy examples from WWII. I also think I know examples of such NSF-funded research.

Sixth: Does funding by a defense agency constrain research or the activities of the recipient? For the period 1950–1970 in question here, I did not hear of any such constraints, and I personally noticed no such constraints. I think there was an unspoken understanding that government support of scientists meant that the scientists would be willing to help the government in a time of clear national emergency. The understanding was real. I recall one occasion when the chairman of the AFOSR advisory board notified several grantees that an international crisis was brewing; would we please start out to get a security clearance so we could be ready to help? I and others did so start.

I hope that this summary of the earlier aspects of government funding may be a useful background in the present inevitably changed situation.

I would like to thank Arthur Grad, Walter Leighton, Everett Pitcher, Mina Rees, and Barkley Rosser for knowledgeable and helpful comments on a first draft of this article—but they bear no responsibility for its final form.

Thomas R. Love
Daemen College

I am writing to support all five of the motions at the Salt Lake Meeting.

I was not going to comment on the motions until I heard of Dr. James Glimm speak in opposition to them. I could not let his statements go unchallenged. Dr. Glimm said that the members of the AMS are not technically competent to judge the merits of the Star Wars program. The American Physical Society recently released a study of the program which showed it is not viable. We are competent enough to read that report and agree with it.

Dr. Glimm and others gave us the standard patriotic rhetoric, saying in effect that we are talking about the defense of the country. We are talking about the Department of Defense, which until the late thirties was known as the War Department. Changing the name of the agency did not change its mission, but it did make it harder to fight: no one wants war, but who can argue against defense? If the program were purely defensive and technically viable, it would be
hard to argue against. But this program is neither: particle ray-guns are not purely defensive, they can easily be turned into offensive weapons; the APS study concluded that at least ten years of study would be required to determine if the program is viable.

Dr. Glimm listed several areas where mathematics could be used to help improve life on this planet: models of the spread of disease, food distribution, etc. I agree with him, these are areas which need to be studied. But there are limited funds available for research and limited numbers of mathematicians to work on them. If the Star Wars program draws the funds and the mathematicians, these other programs will not receive the funds or attention they should.

There are no moral issues in pure mathematics research (other than justifying the time spent by some of the best minds in the country on such esoteric questions when there are important questions facing humanity). But there are tremendous moral questions one must face when working on weapons systems. Will the next century see a modern version of Nuremberg trials where, after the destruction of most of the civilized world by a new generation of weapons, the scientist’s only defense for their creation of the weapons is “Those were the only research funds available?”

It is time we realized that the only defense against nuclear weapons is peace.

Michael Shub
IBM Research
T.J. Watson Research Center

After consultation with other makers and cosigners of Motions 1 and 2 at Salt Lake City, I moved to table these motions at the Business Meeting with the following statement.

“It was our intention in putting these motions before the business meeting to expand the debate within the AMS on two important public policy issues of professional concern, and to allow the broadest possible base of the society to set the framework for those policies. The council has responded to the initiative of the Business meeting in San Antonio and has decided to bring the motions, slightly amended in a friendly way, to a mail ballot of the membership, and to have an open debate in the Notices. Moreover, they have decided to seek the guidance of the membership on three additional questions which arose in connection with the discussion of the San Antonio motions. I applaud this tendency to involve the membership in active debate and to rely on its judgement in setting overall policy and I see it as a success of the process set in motion in San Antonio.

The council has deferred to the outcome of the mail ballot and I think it would be appropriate for the Business meeting to do the same. The President has assured me that even if we table these motions, he still will allow discussions on their substance here today. So I move that Motions 1 and 2 before us be tabled in deference to the results of the mail ballot to be conducted by the Council.”

The recommendation of the Committee of the Whole at the Business Meeting in San Antonio that Motions 1 and 2 be passed, obviously extends to the mail ballot.

Daniel B. Szpyld
Duke University

It appears that the discussion about the motions concerning military funding of mathematics has taken an unusual twist. Some people now believe that only pure mathematicians favor the approval of the motions while applied scientists are all adamantly opposed to it. Nothing can be further from the truth. First of all, as is becoming more evident every day, there is little distinction between pure and applied mathematics. More important, among those traditionally called applied mathematicians there are many of us opposed to having our names and our brains used in a seemingly uncontrollable military buildup. Some even signed a pledge circulated by physicists not to solicit nor accept funding for Strategic Defense Initiative (SDI or Star Wars) research.

The single event which most contributed to this misperception seems to have been the publication in SIAM News (March 1987, p. 6) of Ettore Infante’s Commentary “Is DOD Research Support Good for the Math Sciences?” which was similar to his position paper at the AMS meeting in San Antonio in January, and published in the Notices (February 1987, pp. 239-240).

In the commentary he essentially says that we, as scientists, should do science and accept support from military-related projects and agencies the same way we do from, say, NSF, and if we are concerned about the policies carried out by the agencies or the implications of the projects we should address those concerns as citizens and not as mathematicians. This concept oversimplifies and misdirects attention from the concern of the many members who cosponsored the two motions being considered for adoption. These motions generated a necessary and important discus-
One of the motions deals with SDI or Star Wars. It is President Reagan’s fantasy of shielding us from incoming nuclear missiles. It has repeatedly been said that if the shield existed, the Soviet Union would be forced to a “launch on warning” strategy and thus we would have made the world much more unstable. Moreover, Star Wars can be thought of as another step towards a first strike capability, with similar destabilizing effects. But leaving these two important points aside, Star Wars does not appear technically feasible in the eyes of many scientists. In fact, a great number of them, particularly physicists, have pledged not to collaborate with Star Wars development in any way, and thus the Administration has been having a hard time selling the idea to taxpayers and to Congress, which has drastically cut all SDI requests. In this context, the issue of credibility is a very political one. If scientists work for SDI, they are allowing their names or that of their institutions to be mentioned by the funding agencies as “proof” that Star Wars is workable. Such scientists are used in the political arena to justify a program of dubious technological feasibility and dubious security advantages.

In this context, the separation of our concerns as scientists and citizens or taxpayers becomes impossible. One does not have to be an expert in particle beam weapons, say, to understand that our professional goals are being distorted.

Another motion to be considered expresses concern about increased military funding of mathematics research. I strongly support this motion for several reasons.

First, the goals of military funding for science are very clearly military-oriented. If a project does not advance military capabilities in the long run, it will not be funded. Scientists who feel that “well, it is the same proposal I would send to NSF,” miss the point that collectively the projects serve military interests and reorient the focus of science in this country. Moreover, as with Star Wars projects, scientists doing research for the military are used to add credibility to arguments presented for funding multi-billion-dollar projects, which politicians cannot fully understand due to lack of expertise. Actually, the military funding for mathematics research is about 2/100 of 1% of the military budget, and can be seen as a small budget to advertise military projects.

Second, scientists do become dependent on military funding for their research. John Kenneth Galbraith calls such researchers “subsidized scientists.” In addition to reorienting their research they also may become politically and culturally dependent, reinforcing a militaristic and isolationist society. For example, I know of a U.S. professor who wanted to invite an Eastern European collaborator to come to his university for a short visit, but decided against the idea for fear of losing some of his funding in the future. This brings to mind the statement by then Undersecretary of Defense Donald Hicks, who said he would like to see funds cut off from scientists receiving DOD support who speak out and “bite the hand that feeds them.” So much for the separation between citizen and scientist.

Finally, I wish to express my concern regarding the level of rhetoric expressed in some positions, which has gotten to the point of members threatening to leave the Society if the original motions are adopted. It is an attitude which distracts from the real issues being discussed. It adds a flavor of divisiveness to what should be conducted as a fully democratic process. In contrast, the motions do not call for casting out our colleagues who solicit or accept military support, but rather calls for the AMS not to help them secure those funds. It also calls for the AMS to state unequivocally that science is much broader than “shock, blast and penetration,” and that efforts should concentrate on funding a broader and more universal concept of scientific inquiry.

Linda Keen
Lehman College, CUNY

Mathematics is underfunded. Support for basic research in pure and applied mathematics is in the national interest and the government should support such research at universities. Very specific military research, for example for SDI (Starwars), does not belong on campuses. The motions before the Society address the fact that we must distinguish between what is and is not appropriate. Much of the discussion on these motions is about where the line should be drawn and it is healthy.

I urge you to join the over 400 supporters of the original motions and vote for all the motions on the ballot.
Mina Rees  
*CUNY Graduate School*

This letter is written in partial response to the last sentence in the letter from Mikhail Katz of SUNY-Stony Brook, published in the October issue of the *Notices*: “Would these (older) mathematicians please step up and tell us all?”

As some readers of this letter will know, I was the first head of the Mathematics Branch of ONR and largely responsible, in consultation with my colleagues, for establishing the policies that would govern the operation of the mathematics program. In particular, I was very happy, early in the program, to secure approval from the Captain who headed the Research Division, for the support of research in pure mathematics.

Though I find it impossible “to tell all,” I call attention to a paper I gave at the San Antonio mathematics meeting in 1976, “Mathematics and the Government: The Post-War Years as Augury of the Future.” This was published in *The Bicentennial Tribute to American Mathematics, 1776-1976*, Dalton Tarwater, Editor, The Mathematical Association of America, 1977. I believe this paper will provide some, but by no means all of the answers to questions now under discussion.

Probably most important is the fact that the situation now is very different from the situation that determined our planning immediately after World War II. Then the total number of research mathematicians was small enough so that it was possible for us to know most of those who attended meetings of the Society by name. Moreover, we were extremely lucky that many of those mathematicians who came to Washington fairly often stopped to talk with me and other members of the ONR staff often enough so that we found it relatively easy to keep in touch with their work with a relatively small number of visits to their campuses. In particular, John von Neumann, who is specifically mentioned by Professor Katz in his letter, had frequent occasions to visit Washington, and I was able to discuss with him many questions that troubled me. Of course, his work with computers was seminal. Not only did he participate with a splendid staff in the construction of the Institute for Advanced Study computer, but, in collaboration with Arthur W. Burks and Herman Goldstine, he produced a series of papers dealing with aspects of the overall logical considerations arising in connection with the von Neumann machine which was basic in the development of computers.

But when I was on the National Science Board from 1964 to 1970, it was clear to me that the considerable increase in the number of research mathematicians and in the number of universities involved, as well as the growing size of the NSF budget, made the ONR experience largely irrelevant. ONR had no peer review except for advice from a National Research Council Committee that reviewed our competitive program which provided small one year contracts to selected new Ph.D.s. In all other instances proposals were discussed by members of our staff with qualified mathematicians. This would be an impossible task in NSF today. I find that I have considerably sympathy with the opinion expressed by Peter Lax and other mathematicians that DOD has provided much diversification, and that this can be their distinctive contribution.

On the other hand there are some distinct advantages to an association with one of the military services. In my paper in the Bicentennial Tribute volume to which I have referred, I quote A.W. Tucker of Princeton who commented on one occasion that, though most mathematicians supported by ONR continued to work on their own research, there were some mathematicians who “felt an obligation to reach out beyond customary courses, seminars and research, to make two-way contact with industrial labs and government undertakings.” Partly as a result of such visits, Solomon Lefschetz set up at Princeton a broadly based program in differential analysis that provided a home for the work of a number of vigorous young mathematicians who, in their subsequent careers became leaders in new developments in such areas as stability theory of differential equations, mathematical theory of control processes, and dynamic programming. And the project in the ONR Logistics Project under Tucker produced several of the leading figures in fields related to the Project. As George Dantzig observed in a book published in 1963, “Tucker’s interest in game theory and linear programming began in 1948. Since that time, Tucker and his former students (notably David Gale and Harold W. Kuhn) have been active in developing and systematizing the underlying mathematical theories of mathematical inequalities. Their main efforts … have been in the field of Game Theory.” Though none of the people I have mentioned was under pressure to work on problems of interest to the navy, their interest in these problems was most welcome.

I hope that my response to the plea for information has some usefulness but I doubt that it will solve any of our present problems.
Jean E. Taylor  
Rutgers University

I was one of the authors of motions 1 and 2, which will shortly appear in your mailboxes (along with motions 3, 4, and 5 which I also, more reluctantly, helped draft as a member of the Executive Committee of the Council of the AMS). Although I agree with much of what those urging you to vote against motions 1 and 2 say, I do not agree with their conclusions. Rather, I find many of their arguments tangential to the actual motions. I urge you to read the motions to see what they in fact say, and then to vote FOR them.

Motion 1 says roughly (read it) that the AMS should not act as a marketing agent for SDI. One effect of the passage of this motion would be to prevent the AMS from running a show like that at the National Academy over a year ago. There the backers of SDI were given a forum to sell their wares to prominent mathematicians—without rebuttal by experts who believe that participation in such SDI research is unwise. The basic reason I support Motion 1 is that I think SDI, as sold to the American people, is a fraud. I do not think that the AMS should lend its support to something fraudulent. But you don’t have to believe that SDI has been mathematically demonstrated to be a fraud to vote for Motion 1; you just have to agree that the AMS should adopt a neutral position and “lend no support” to SDI.

Motion 2 says roughly (again, read it yourself) that there are some inherent problems in military funding for research, and that the AMS should, in its efforts to increase funding for mathematics, work to have the proportion of non-military funding increase. If the motion called for a complete and immediate end to military funding for mathematics, I would not support it, since I appreciate the diversity-of-funding arguments. In fact, I really bought those arguments until I realized that a diversity of funding was turning out to mean a diversity of defense department agencies involved in funding! I’d like to see us go after a truly diverse set of funding sources. Meanwhile, we can and should say that we feel it would be better for mathematics if more of its funding came from non-military sources.

I was disappointed to see that two members of the AMS have threatened to resign if these motions are passed. The AMS exists to further mathematics research and the interests of mathematicians, and I personally believe that both are advanced by these two motions. The AMS is already actively involved in soliciting defense department support, and it might be the target of publicity efforts by SDI proponents. It is reasonable and right to find out how the membership views this. If the plurality of those who vote against my opinions, I certainly will not resign. My efforts to strengthen the AMS and the communication between its members and its leadership will continue.

William P. Thurston  
Princeton University

Near the end of January, AMS members will have the chance to vote in a referendum on five questions. I urge you to vote.

Whether you work at a major university, a small college, in industry, or in government, whether you are a U.S., or a foreign citizen, this is your Society. The actions of the AMS on these questions affect the climate in which all of us work. I have been struck by the differences between prevailing opinions expressed by ordinary mathematicians, and opinions prevailing in the circles of power within the AMS. The growing breath of democracy in the AMS over the last year has been most refreshing. We have a rare chance to exercise democracy: please do.

I recommend a vote of YES on all five questions. In the January 1987 Notices I wrote a comprehensive letter explaining why the large presence of the military in academic departments is unhealthy. In a nutshell, a military force, by the very nature of its mission, needs to be and is organized in a hierarchical line of command so that it can act in concert. The function of a University is to nurture diverse ideas so that they have a chance to grow to maturity, and reach a stage where some of them can be transplanted and bear fruit in society at large. This calls for an entirely different, pluralistic organization. This letter evoked a large, mostly sympathetic private reaction as well as the public reaction in the Notices forum. I will not attempt to reiterate the points made in that letter. It still reads well, and I think it still answers many of the comments which have appeared since.

However, I would like to clear up a couple of misconceptions I have heard arising from the letter of a year ago. First and most important, I want to emphasize that I do not blame people who accept funding from the military, and I am not trying to stop them from receiving military funding. Motions 1 and 2 do not bar anyone from or blame anyone for accepting money from the military or SDI. There are many people, both students and faculty, who whether or not they like the idea of military funding, have no other recourse. I have heard more than once that “Thurston has the luxury of not having to take
Commentary on Defense Funding

I have heard of many mathematicians who are under pressure from their deans to bring in grants, at the pain of being fired, having their teaching loads raised, or not getting raises (let alone not having resources for research). This is why we need to address the issues as a group: alone we are powerless. Motion 2 of the referendum proposes that the AMS direct its efforts toward increasing the proportion of civilian funding for mathematics—this does not mean cutting people off from military funding, but giving them more of an option of civilian funding.

Second, there have been statements in the Notices that the motions are divisive and against applied mathematics. Some people have interpreted what I wrote, or things they have read about me, to mean that I won't care about applications or applied mathematics—or that I think mathematicians should be left to do what they please, with no accountability in terms of real-world applications. This is off the mark. My background is not in applied mathematics, but I think those who know me know that I delight in applications of mathematics. Lately, I have been heavily involved in computer graphics, where I encounter many of the same circumstances and difficulties as applied mathematicians.

In my letter of a year ago, I emphasized the need for finding alternate funding for applied mathematicians if military funding is reduced. This point has been made repeatedly by the sponsors of resolution 2 (on military funding). To oppose increased military funding does not at all mean to oppose applied mathematics. In fact, mathematicians are spread very thin among the many important civilian areas where mathematics could be beneficially applied. I believe that a shift of applied mathematics toward greater civilian funding could be very beneficial.

A number of people have claimed that despite appearances, there is nothing much to get excited about: that the proportion of military funding in mathematics is about 40%, where it has hovered for a number of years. Numbers of this sort are tricky: it all depends on what is included in the tabulation, and which of the many possible statistics you quote. One issue is that the categories of computer science vs. statistics vs. mathematics are not clear cut, and the grouping in official figures has shifted over the years. This makes a significant difference.

On page 39 of the April 1987 Notices there is a pie chart giving the breakdown of sources of funding for academic mathematics: according to it, the military-civilian split is close to 50-50. Note that this does not include government operations such as the DOE

weapons labs or the National Security Agency, which claims with several hundred mathematicians to be the largest single employer in the field.

Even the 40% level is much too high as a presence of the military in our academic departments. But perhaps more important, the nature of military funding has been shifting, away from the traditional modes into much more intrusive "initiatives."

Iz Singer, p. 503 in the April Notices, specifically addressed my letter. He gave a (simplistic) summary in five points, and discussed them one by one. On both of these points, he is not expressing real disagreement: I will focus on the two where our differences are strongest.

Point II(1) of his summary is that "he who pays the piper calls the tune," thereby distorting our discipline when their aims are not in accord with ours. Singer agrees that this happens, but says we should fight specific DOD abuses, rather than the broad trend: he points to Serge Lang as a good example of someone who has led worthwhile fights.

But few people have the energy, prominence, and the willingness to devote time to issues as Serge Lang. The ill effects of the trends in science funding are to be seen in lots of small changes everywhere: the problems are not concentrated in scandals where an obvious abuse can be isolated and surgically removed by a Serge Lang. Furthermore, the fights and the circumstances which necessitate them take away a great deal from time which we could preferably devote to mathematics.

Singer's strongest point is probably the final one, II(4), where he paraphrases me as saying that "accepting DOD funding lends support to the military establishment." Singer says "Yes it does. The added statement that that's bad is a political or moral judgment. One that I don't agree with. And I don't particularly care to have someone else's political position dictate where I and other scientists should seek support."

We are not proposing to dictate to Singer or to anyone else where they should seek support. Motion 1 proposes that the Society as an organization have no official involvement with SDI. We don't want the AMS to engage in official actions which would express support, on our behalf, for SDI.

Motion 2, regarding military funding, is quite mild. It proposes that the AMS advocate a decreasing proportion of military funding, together with increased total funding. There is no mention of AMS official involvement with the military (there is an ongoing relationship, in the form of military grants for some AMS-sponsored conferences.) The AMS is involved
Commentary on Defense Funding

(spending hundreds of thousands of dollars per year) in efforts to influence government policy and public opinion. It is entirely proper that members of the AMS have a say in what we advocate.

Cory B. Smith
Bellevue Community College

I am writing to support Motions 1' and 2' as someone who has participated in SDI research (Boeing's AOA project) and who regrets having been party to same. Although many math and technical people have been lured into SDI by megabucks and hype concerning prospects for an effective defense against nuclear missiles the reality falls far short. At best only limited point defenses might be achieved, leading to the standard problems of ABM systems and subsequent offensive escalation to overcome same. SBKKV is as big a fraud as the Star Wars beam and laser systems which were oversold by the Edward Teller-Lowell Wood clique at Lawrence Livermore Labs. (See William Broad's book The Star Warriors for background; also note the growing internal dissent from experts such as Roy Woodruff and Chris Cunningham who were overridden and ignored prior to the APS report.)

Aside from the pork-barrel and outright sleaze considerations, SDI is another layer of superfluous DOD budgeting which has already led the western world to the brink of economic collapse (and perhaps over the brink as the events of Oct. 19, 1987, may indicate). It is not an accident that the annual national deficit is about equal to the DOD budget at present; deploying a flawed SDI system in the early 1990s will most likely bring down the whole house of economic debt cards as expenditures reach into the $100 billion range and all existing strategic arms agreements fall by the wayside.

AMS members can help the nation to step back from this abyss and redevote its attention to other pressing problems, e.g., environmental threats from acid rain, \( CO_2 \), ozone depletion, water pollution, smog; inadequate health care and delivery; languishing math and science education needs to face a competitive international, multilateral world; world hunger and poverty due to diversion of national resources to a dead-end arms race. Instead of militarizing our last frontier we should be considering efforts to monitor world problems from space and join with other emerging spacefaring nations to explore the solar system. There are plenty of precedents for space cooperation rather than confrontation, ranging from Intelsat communications and SARSAT-KOSPAS search and rescue satellites to the recent success of the coordinated Halley's Comet missions and possibilities for joint Mars exploration. These issues and opportunities would give the next few generations some hope to start answering the real questions our species faces rather than the contrived technical dilemmas of overcoming first-strike offensive systems that we are currently developing and deploying. A vote for Motions 1' and 2' is a vote in the best traditions of intellectual honesty and the better uses of mathematical talent. You will also sleep better than I have since my experience with nuclear doublethink.
The Sound of Mathematics

There are two New Year’s resolutions which you as a mathematician should make as 1988 is about to begin. One is to take an active part in the events of ‘100 Years of American Mathematics’, the year-long expansion of the AMS Centennial. The second is related to one of the basic topics which will be under active discussion during the coming year, namely, bridging the gap between the college-university-industry mathematics community and the school mathematics community. You should resolve to become involved in the many efforts under way to help mathematics teachers bring the excitement of mathematics and its uses to young people in the schools of the nation.

Most opportunities for you to carry the real message of mathematics to elementary, middle or secondary school students appropriately occur at the local level, working directly with a school in your neighborhood or through a local or regional organization that will help couple you to a school. Committees and projects of our professional organizations provide other means of contributing. The work of the Mathematical Sciences Education Board (MSEB) has opened up an unusual opportunity for you to contribute to efforts at the national level to enhance school mathematics—and input from you is needed now.

The initiative required of you is purely mental, and should be right up your alley, since it has to do with no less a question than what mathematics is all about, and how the teaching of it should be organized. The form of it will take a bit of explaining, which can rather easily be done through a series of questions about the general situation in which school mathematics—and mathematics more broadly—now finds itself. Let’s speculate about a related field of human endeavor: music.

If music were a required subject throughout school, would it be in the fix mathematics is in today? Would most members of the public fear and dislike music? Would each of them have been subjected to a school regimen consisting of three years of sand blocks and recorder, followed by five years of practice piano, with pupils and teachers evaluated almost entirely on the basis of results from computer-graded examination tapes, recording proficiency at scales and rhythm? Would musicians still be feeling the sting of the backlash from the school music reform effort of the sixties, in which an attempt was made to expose students earlier to the structure of music? Would resentful parents, now grandparents, still be denouncing the “new music” and asserting with gusto that if the old music was good enough for them it is good enough for their progeny—and besides, the discipline of doing the scales is good for the young? Would these and other members of the public be oblivious to the fact that music changes, that it is alive, that it is an essentially human endeavor?

Such outcomes would not seem likely, even though music has a few problems similar to the hypothetical ones just described and is just as dependent as is mathematics on the development of basic skills. Furthermore, the two primary reasons the outcomes would be unlikely are rather apparent: (i) Composers, conductors, performers, and teachers of music see themselves as engaged in a common enterprise, that of bringing music to the world; (ii) they hold firmly in mind that, whatever techniques one is trying to impart to the young, it should always be in the context of the wonderful sound of music.

We in mathematics, on the other hand, fragment our profession and our subject. We present it to the young as a seemingly endless stream of techniques, failing almost entirely to expose students to the sound of mathematics, the look, the feel, the power of it. In his book “Math! Encounters With High School Students”, Serge Lang described mathematics texts this way, “They pile up one little thing on another, with-
out rhyme or reason. They accumulate technical details endlessly, without showing the great lines of thought in which technique can be inserted, so that it becomes both appealing and meaningful. They don’t show the great mathematical lines, similar to musical lines in a great piece of music. And it’s a great pity, because to do mathematics is a lively and beautiful activity.” For most people, learning mathematics is the ultimate exercise in delayed gratification—the message seems to be: prepare thoroughly each year for the next year’s course, and when you get to be 20 we’ll let you see what it really sounds like.

Here is the question for you, based on your perspective on what mathematics is or ought to be. Starting from kindergarten and continuing right up to the frontiers of research, what are the great lines of mathematics, in all its ramifications? What are the great themes, the strands around which you would organize a curriculum which showed that mathematics is all one system, from our earliest exposures to today’s research? Please send any and all thoughts you have to:

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because early in 1988 MSEB will select a set of such strands for concentrated work over the next year, work to show explicitly how each theme could be developed up through the grade levels. The themes do not have to be from pure mathematics; indeed, each will need to be developed in the context of the many uses of mathematics. Nor should one think of any part of this exercise as school-, textbook-, or teacher-bashing. Its aims are entirely constructive as they relate to people at the front lines of school mathematics. They are timely because very real possibilities for increasing emphasis on the themes of mathematics will exist over the next decade or so, in part because of changes in learning environments made possible by computers.

In connection with the last point, it is important to note that thinking similar in spirit to MSEB’s concern with ‘strands’ has been actively going on this year in the NRC’s Board on Mathematical Sciences (BMS), in the Mathematical Sciences Advisory Panel at the National Science Foundation and in the national dialogue concerning the teaching of calculus, which took another step forward at the BMS-MSEB-MAA October 28-29 symposium, “Calculus for a New Century”. It seems an important time to see whether pure and applied mathematicians, statisticians, mathematics educators, and the many “attentive publics” of mathematics education might come to some general understandings about the central themes of mathematics, and how to do what we all do. It will take us a few years to find out.

But please don’t wait that long. Send your thoughts to the MSEB right away. It’s a good note on which to start 1988. During the remainder of the year, join in the events of the ‘100 Years’ celebration, which has public understanding of mathematics as a major focus. This, too, deals with exposing more people to the sound of mathematics.
Call for Russian Translators

The AMS maintains a sizable program of translation from the Soviet mathematical literature. We translate six of the premier Soviet journals cover to cover and will soon add to our list the new Journal of Theoretical and Applied Mathematics, to be published by the Leningrad branch of the Steklov Mathematical Institute. We also publish selected journal articles from a wide variety of Soviet journals not otherwise translated at all, as well as five or more monographs each year. We provide careful editing of our translations to be sure they are correct and idiomatic, an expensive step not taken by every translation house. Furthermore, we have recently enlisted the assistance of four outstanding Soviet mathematicians to aid in selecting the very best of the new or forthcoming monographs, and have appointed Dr. Smilka Zdravkovska as Acquisition Editor for Soviet books. In short, we are endeavoring to assist the mathematics community to more easily keep abreast of developments in the Soviet Union without having to learn Russian.

We have a problem. The program is self-defeating, in a way: by making it less necessary to learn Russian, we are further decreasing the number of graduate students who do so. We are beginning to have real difficulty in finding mathematicians who are fluent in both English and Russian. The scarcity has been ameliorated in the past by the influx of Soviet emigrés, but their number has been curtailed in recent years, and their command of English is not always of the quality to produce first-rate translations—just as some Western mathematicians' command of Russian does not always suffice for our purposes.

I am writing to ask help from those readers or members who read Russian reasonably fluently. I invite you to get in touch with Mr. Ben Silver, the head of the translation department in the Providence office. He will send a short article for translation; if the results are satisfactory, he will continue to send material, at a frequency to be determined by you. We presently pay $17 per Russian page for acceptable translations; mathematical formulas need not be copied over but will be read from the original by our keyboarders.

For the well-being of the entire mathematics community, both in this country and in the Soviet Union, as well as of your graduate students and the AMS, I urge faculty members to urge their graduate students to study Russian. It will give them earlier access to the Soviet literature than they can gain through translations, it will give them a way to earn money while studying (and translating) papers they are interested in anyway, and it will give them an entree into the Soviet mathematics community that could be extremely valuable to them in later life.

Thank you for your help.

G. D. Mostow
President
Andrei Nikolaevich Kolmogorov 1903–1987

Andrei Nikolaevich Kolmogorov, the founder of modern probability theory and one of the century’s most brilliant mathematicians, died on October 20, 1987 at the age of 84. Kolmogorov’s life work ranged over a vast array of topics in mathematics and had profound implications for other fields, such as physics, computer science, linguistics, biology, and geology.

Born in Tambov, Russia on April 25, 1903, Kolmogorov enrolled in the University of Moscow in 1920. At a meeting of the Moscow Mathematical Society in 1922, he delivered his first paper, “An example of an almost everywhere divergent Fourier-Lebesgue series,” which immediately identified him as an outstanding mathematician. He graduated in 1925, and in 1928 became a professor at the University of Moscow, which remained the center of his research activities for the rest of his life.

In 1924, Kolmogorov became interested in probability theory, the area in which his influence has been greatest. He put forth an axiom system for probability theory based on measure theory and the theory of functions of a real variable. His classic 1933 monograph, “Fundamental concepts of probability,” not only launched a new era in the development of probability theory as a branch of mathematics, but also set the stage for the creation of the theory of random processes.

The modern theory of Markov random processes can be traced to Kolmogorov’s 1931 paper, “Analytical methods in probability theory.” This new branch of mathematics, replete with potential applications, was immediately utilized by physicists, biologists, chemists, and engineers, and has become one of the most powerful mathematical tools used today.

During the 1930s, Kolmogorov investigated a wide range of topics, including projective geometry, mathematical statistics, approximation theory, mathematical biology, philosophy, and the history of mathematics. It was also during this period that Kolmogorov and the American topologist Alexander simultaneously and independently arrived at the notion of cohomology and founded the theory of cohomology operations.

Toward the end of the 1930s, Kolmogorov’s interest turned toward the mechanics of turbulence. Through the work of Kolmogorov and his pupils, turbulence theory received its first accurate mathematical treatment as an application of the measure theory in function spaces. His main work in 1941 on the mechanics of turbulence demonstrated his penetrating physical intuition which led to fundamental quantitative relations.

After World War II, Kolmogorov continued to pursue such topics as functions of a real variable (with his student Arnol’d, he solved Hilbert’s 13th problem) and logic and the foundations of mathematics. At the same time, the scope of his research broadened to include classical mechanics, ergodic theory, function theory, information theory, and algorithm theory. In each of these areas he made fundamental contributions that have had a lasting impact.

During the 1950s, Kolmogorov worked in the area of dynamical systems and formulated a general theory of Hamiltonian systems. The method he used was later improved by Kolmogorov’s student Arnol’d and by Moser, and is now known as Kolmogorov-Arnol’d-Moser, or KAM, theory. KAM theory has been crucial in the study of stability of physical processes. His application of ideas of information theory to dynamical systems paved the way for the development of the ergodic theory of dynamical systems. In the 1960s, Kolmogorov reconstructed information theory on an algorithmic basis, thereby creating the field of algorithmic information theory.

In addition to his wide-ranging scientific interests, Kolmogorov possessed a profound sense of responsibility for the future of scientific research and was deeply involved in pedagogical activities. His many students went on to distinguish themselves in a diversity of fields, including probability theory, logic, function theory, mechanics, atmospheric physics, oceanology, and cybernetics.

In his last 25 years, Kolmogorov devoted a great deal of effort to secondary school mathematics. During the 1960s, he was chairman of the Soviet Academy of Sciences’ committee on mathematics education and...
played a central role in reforming the teaching of mathematics. He took an active part in writing textbooks and lectured on mathematics, music, the arts, and literature.

Kolmogorov was director of the Institute of Mathematical Research (1933-39) and the Institute of Mathematics and Mechanics (1951-53) at Moscow State University. At the University of Moscow, he held chairs in probability theory, mathematical statistics, and mathematical logic, and was head of the interdepartmental laboratory of statistical methods from 1966 to 1976. The international recognition of his genius brought him many prizes and awards.

Jagiellonian University in Krakow. Mathematical Sciences in 1955. He received the Doctorate of his death he was an editor of the journal "Mathematica." Jan Mikusinski was Director of the Polish Academy of Sciences, died on July 27, 1987, at his summer home in Malinka, Poland. He was the author of many mathematical works, including over one hundred mathematical papers, and numerous books. Professor Mikusinski was Director of the Mathematical Center, Polish Academy of Sciences, in Katowice, Poland, from its founding in the early 1960s until his retirement in 1984. He served on the councils of the Polish Academy of Sciences for Mathematics and for Physics, and from 1951 until his death he was an editor of the journal "Studia Mathematica."

He was born in Stanislawow, Poland, in 1913. He had obtained his M.S. degree in 1937 from the University of Poznan when his studies were interrupted by the Second World War. During the war, he continued to teach and to do research even though such activities were forbidden by the occupying authorities, and he was arrested at that time for teaching. The Polish universities reopened after the war and he received his Ph.D. degree in 1945 from the Jagiellonian University in Krakow. He received the Doctorate of Mathematical Sciences in 1955. Since 1965,

he had been a corresponding member of the Polish Academy of Sciences. His earliest mathematical work was in the theory of differential equations and the theory of moments. His interest in simplifying the theory of the solution of linear differential equations, and mathematically justifying it, led him to a direct operational approach which he called "the operational calculus." This approach allows one to solve differential equations by the use of operators without invoking the restrictions on growth introduced by integral transforms. The Mikusinski operators include a class of generalized functions which overlap, but are not contained in the class of Schwartzian distributions; they include all distributions with left bounded support, but include other generalized functions as well. The Mikusinski operational calculus was presented in his book, "Operational Calculus," in Polish (1953), and in English translation (1959). A second English edition has recently appeared in two volumes, Vol. I (1983), Vol. II (1987). Volume II is with T. Boehme. A striking feature that persists in all of Mikusinski's creative work is an effort to simplify and extend. He insisted on his works being self-contained, and that they draw on the fewest possible facts and hypotheses essential to the job at hand.

20th Interface Symposium

As reported in the November 1987 Notices, the Twentieth Symposium on the Interface of Computing Science and Statistics will be held at the Sheraton International Conference Center in Reston, Virginia, on April 21-23, 1988.

The American Mathematical Society has recently agreed to cosponsor the Symposium. AMS members are therefore eligible for discounted registration.


In addition, planned invited sessions which support computationally intensive methods include: Computational Geometry, Parallel Architectures, Visualizing High Dimensional Spaces, Object Oriented Programming, Computational Discrete Mathematics, Communication Networks, Symbolic Computing, Numerical Methods, and Neural Networks.

Sessions will include invited talks, contributed papers, and exhibits. An opening night reception is planned as well as a banquet. An extensive exhibit area is also planned. Contributed presentations will be selected by the Program Committee and last for twenty minutes. Authors who wish to contribute a paper should submit a written abstract no later than January 15, 1988. The abstract should be no longer than one page. Abstracts of invited and contributed papers will be available at the Symposium. Abstract and inquiries should be sent to Edward J. Wegman, Interface Symposium, P.O. Box 7460, Fairfax Station, VA 22039-7460. Telephone: 703-323-2723. Bitnet: EWEGMAN @ GMUVAX.

Conference Proceedings will be published. Camera-ready copy of the contributed and invited papers will be due on June 1, 1988. The Proceedings will include both invited and contributed papers.

The Conference will be held in April, an extremely attractive time in Washington coinciding with the blooming of the famous cherry blossoms. Free shuttle service is provided by the Sheraton to and from nearby Dulles Airport. A commercial airport
bus service is available from Washington National Airport. Hotel rates are quite reasonable for the peak of the tourist season ($79 for a single on Wednesday and Thursday and $45 for a single on Friday and Saturday). A block of rooms has been reserved and attendees are expected to make their own reservations. Because this is a peak tourist season, early reservations are strongly encouraged. Reservations can be made by calling 800-325-3535, or 703-620-9000. Make sure to identify yourself as being associated with the Interface Symposium. Registration and welcoming reception will take place on Wednesday, April 22.

The regular registration fee for members of the cooperating societies (AMS, ASA, IMS, SIAM, and ORSA) is $105 and for nonmembers is $130. A preregistration discount is being offered to those who register early. For registrations received before January 15, 1988 the registration fee will be $95 for members of cooperating societies and $120 for nonmembers. The registration fee will include a copy of the proceedings of the opening night reception. For further information, to be put on the INFA mailing list and/or to register, please contact Ed Wegman at the above address.

Travel Support for Foreign Graduate Students

The Society is pleased to announce that travel support for foreign graduate students attending 1988 AMS conferences is expected to be available again this year through a grant from the STEP program of the Institute of International Education. An application has been filed by the Society for foreign students attending the International Symposium on the Legacy of John von Neumann to be held May 29–June 4 at Hofstra University, Hempstead, New York; the Summer Seminar on Computational Solution of Nonlinear Systems of Equations to be held July 18–29 at Colorado State University, Fort Collins, Colorado; the Joint Summer Research Conferences to be held June 11–August 5 at Bowdoin College, Brunswick, Maine; and the AMS Centennial Symposium to be held August 8–12 in Providence, Rhode Island.

To be eligible for these grants the foreign student must be enrolled in full-time graduate studies at a U.S. institution of higher education. Students are ineligible if they are receiving any U.S. government funds for academic support or if they are on refugee, immigrant, or tourist visa status. Previous recipients of STEP awards are ineligible for a second grant.

To apply, send a letter stating your name, home country, student status, the name of the institution at which you are enrolled, the name of an official at the institution who can verify your status and financial situation, and the name of the AMS conference you plan to attend to: Dr. James W. Maxwell, Associate Executive Director, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.

New Associate Editor for Special Articles

The Managing Editor and the Notices Editorial Committee are pleased to announce that Jeffrey C. Lagarias, of AT&T Bell Laboratories, has been appointed as a second associate editor for the series of Special Articles appearing in Notices. The series of Special Articles was started in 1981 with the appointment of Ronald L. Graham, of AT&T Bell Laboratories, as associate editor. Since then Graham has been instrumental in acquiring 17 high quality expository articles. Lagarias, who coincidentally was the author of the first special article (Notices, February 1982), will join Graham in acquiring future articles for this series.

Individuals who have written expository articles that will appeal to a broad spectrum of the mathematical community are encouraged to send their manuscripts to either Dr. Graham or Dr. Lagarias; for further information see the box accompanying the Special Article in this issue of Notices that describes this series.

AMS Trustees Honor Twenty-year Employees

In the past, Notices has announced the resolutions adopted by the AMS Board of Trustees concerning twenty-year employees of the Society. At their November 1985 and November 1986 meetings, the Trustees passed such resolutions but, through an oversight, these were not reported in Notices. The following resolutions honor seven AMS employees who completed twenty years of service in 1985 and 1986 respectively. This brings to twenty-one the number of employees who have devoted twenty or more years to the Society.

At its meeting in November 1985, the Board of Trustees adopted the following resolution:

This year the Board of Trustees takes special note of the fact that four more employees of the Society have completed twenty years of service. The Board expresses its profound gratitude to Armando Armendariz, Sandra Barth, Carol-Ann Blackwood, and Janet Pecorelli, who bring to eighteen the number of employees of the Society, past and present, who have devoted more than twenty years as members of the AMS staff. The Trustees offer their special thanks and their best wishes to these four long-term employees, wish them well in the future, and hope that they will continue to serve the Society for many years to come.

Sandra Barth was first hired shortly after the opening of the Ann Arbor office of Mathematical Reviews in 1965. For several years she worked...
as a technical typist and she was promoted to the position of principal secretary for Ray Goucher, the former Administrative Manager of the Ann Arbor office, in 1971. In 1975, she took a leave of absence for a year and went to live in Woodburn, Oregon, a community of Russian emigrés (Old Believers), where she worked in the local elementary school. She learned Russian there and also had the opportunity to travel extensively on the West coast. She returned to her previous position for a year and then became involved in the early stages of MR’s computerization, holding positions as data entry supervisor (1977), production assistant (1980), co-production manager (1982) and then her current position of production manager (1984). Sandy has seen the computerized production process evolve through several different systems and says she has always enjoyed the new challenges her job has provided.

Carol-Ann Blackwood started working at the AMS in 1962 as a Varitypist. From then until 1974 (except for a two-year period spent in California), she held various positions in the Editorial Department and Computer Services Division. Since 1974, she has been working in the Membership and Sales department. In 1984 Carol-Ann was promoted to Assistant Head of the Membership and Sales Department. In February 1987 Carol-Ann was again promoted to Head of the Membership and Sales Department. For the past ten years, she has been a familiar sight at the AMS Exhibit Booth and, more recently, the Members Information Booth at Annual Meetings.

Janet Pecorelli was hired in 1964 to type journals and to learn how to use the photon machine. She started out on an old “klunky” typewriter and worked her way through the “green machine” and the IBM compositor, the key punch and finally the terminal. Janet has certainly seen many changes during the past years. The way in which the books and journals are prepared and typed is certainly much different than when she was hired in 1964! Presently Janet is working towards becoming a plain TeX specialist.

At their meeting in November 1986, the Board of Trustees adopted the following resolution:

This year the Board of Trustees takes special note of the fact that three more employees of the Society have completed twenty years of service. The Board expresses its profound gratitude to Christine Lefian, Wahlenne Siconio and Ralph Sizer, who bring to twenty-one the number of employees of the Society, past and present, who have devoted more than twenty years as members of the AMS staff. The Trustees offer their special thanks and their best wishes to these three long-term employees and wish them well in the future.

Christine Lefian was hired in 1966 to work in the Mailing List section of the Special Projects Department. For three months she worked on the addressograph machine, fondly known as “Agatha”. The late Dr. Sidney Gould, then Head of the Translations Department and Ellen Swanson, then Head of the Editorial Department, heard of her linguistic talents (she is fluent in Armenian and Russian) and moved her to the Editorial Department. Chris has had experience in all phases of work within the Editorial Department since that time. She is currently Production Editor of Matematicheskii Sbornik, Mathematics of Computation and Pacific Journal of Mathematics.

Ralph Sizer came to work at the AMS in 1966. Two years prior to his employment at the AMS, Ralph graduated from Brown University with a major in mathematics. He has been a technical editor since that time. Almost all of his work at the AMS has been with the Russian translations program. Ralph’s contribution to the Society is invaluable.

Wahlene Siconio was hired in 1966 to work in the Composition Department. In 1971 she was promoted to Assistant Supervisor of the department and then in 1977 promoted to Supervisor of that same department. She has been involved in many different types of positions since her employment began more than 20 years ago. Wally is known to be more than willing to help out wherever she is needed. Her present position is Translations Secretary and she is the Coordinator for the Russian-English Dictionary. For a number of years, Wally assisted in the production of Notices by serving as the Advertising Coordinator.

Mathematical Sciences Research Institute Berkeley

MSRI has nearly completed its program decisions through 1990–1991.

1989–1990: A program in Logic is already in place, with the following committee: L. Harrington, A. Macintyre, D. A. Martin (chairman), R. Shore.


During the current year the programs in Classical Analysis and Representations of Lie Groups are complemented by the following events in 1988.

February 8–12 Representations of p-adic groups with applications to automorphic forms
March 29–April 1 Harmonic analysis and its applications
May 16–20 Harmonic maps and minimal surfaces
June 27–July 15 The structure of Banach spaces
The year 1988-1989 will feature Combinatorial Group Theory and Symplectic Geometry. The planning of these two programs is now in its final stages.

In 1986-1987, MSRI experimented with special awards for midcareer mathematicians. It is planned to resume the program on a regular basis, beginning in 1989-1990. The awards have been named Research Professorships. See the full page advertisement in this issue of Notices for details.

Suggestions for future programs are always welcome. In particular, a half-year program still needs to be selected for 1990-1991.

News from the Institute for Mathematics and its Applications
University of Minnesota

During the summer of 1988 the IMA will run a six-week program on Signal Processing (June 27 to August 5). The organizers are T. Kailath, L. Auslander, A. Grunbaum, W. Helton, P. Khargonekar, and S. Mitter. The program will be an integrated approach to one-dimensional and multi-dimensional problems in Signal Processing. Thus, the first two weeks will be devoted to a broad range of problems and methods. An effort will also be made to promote new interaction between people working within the framework of one-dimensional techniques (such as linear control and nonlinear control areas) and within the multi-dimensional issues (such as radar, sonar, and medical imaging). The remaining four weeks will be somewhat less structured and will include periods of concentration in both one and multi-dimensional topics. In addition to invited speakers and discussants there will be some support for other people who would like to attend the program. For application and more details, please contact the Director.

Meanwhile, the year on Applied Combinatorics is continuing with periods of concentration on Applied Graph Theory (coordinated by Daniel Kleitman) and Interactions between Combinatorics and other parts of Mathematics (coordinated by G. C. Rota and D. Stanton). During January 18–22, there will be a workshop on Applications of Combinatorics and Graph Theory to Biological and Social Sciences, organized by Joel Cohen and Fred Roberts. A workshop on Invariant Theory and Tableaux will be conducted March 21–25 by G. C. Rota and D. Stanton.

The preparations for the year in Nonlinear Waves 1988–1989 are proceeding. The Fall program will deal with Nearly Integrable Systems and Applications and will include Applications of Solitary Waves to Nonlinear Optics. The Winter period of 1989 will be devoted to Hyperbolicity, Change of Type, and Wave Propagation in Non-Newtonian Fluids and Multiphase Flows. The topic for Spring of 1989 will be Nonlinear Hyperbolic Systems. For more details, see News from IMA in the October issue of Notices.

News from the Mathematical Sciences Institute
Cornell University


Information concerning these workshops may be obtained from Mathematical Sciences Institute, 201 Caldwell Hall, Ithaca, NY 14853. Telephone 607-255-8005.

Geissinger Receives Award for Instructional Mathematics Software

Seven instructional computer programs for higher education have been selected as winners in a new effort to identify exemplary software and reward its developers. The software, in subjects ranging from mathematics to history, was chosen by a panel of researchers and educators. The contest was run by EDUCOM Software Initiative, a project to promote development and dissemination of instructional software for higher education. The winners were chosen from 159 programs submitted for review to the National Center for Research to Improve Postsecondary Teaching and Learning at the University of Michigan.

Ladnor D. Geissinger, University of North Carolina, was cited for the best mathematics software and best tool. Geissinger’s program is titled “Exploring Small Groups” and is written for IBM PCs and compatibles. It allows students to investigate binary operations defined on small sets, especially small groups. Says the citation: “The software’s purpose is clear, and that purpose is well served neither by other software nor by non-computer methods. Its conception also is clear and reflects a careful review of useful strategies for teaching the mathematics. Finally, the conception is executed elegantly, producing an engaging, simple-to-use, attractive, responsive user environment.”
Mathematical History

The AMS Centennial Celebration in 1988 provides an opportunity for the Society to highlight the role mathematics has played in the development of science and technology. One activity planned in this connection is the publishing of books and articles of a historical nature. The publication of such manuscripts is a departure from the Society's traditional involvement with research-oriented material and, therefore, assistance from the mathematical community is requested in acquiring historical works. The Society is also interested in locating existing manuscripts about twentieth-century mathematicians and historical accounts, which could be incorporated into a collection of reprints. A committee has been appointed for this project: Peter Duren, University of Michigan, Chairman; Richard Askey, University of Wisconsin; Bruno Harris, Brown University; and Uta Merzbach, Smithsonian Institution.

If you are planning to write or are currently writing a manuscript on the history of mathematics, or if you have information about existing manuscripts, you are invited to contact Ms. Mary C. Lane, Director of Publication, P.O. Box 6248, Providence, RI 02940, for further details about this activity. Information and manuscripts may also be forwarded directly to the committee members.

ICME-86 Travel Grants

Mathematics educators, including pre-college classroom teachers, may qualify for travel grants for the Sixth International Congress on Mathematics Education. The Congress takes place from July 27–August 3, 1988, in Budapest, Hungary. Information and applications for travel grants can be obtained by writing to Dept. E, National Council of Teachers of Mathematics, 1906 Association Drive, Reston, VA 22091.

Applications must be received by March 1, 1988.

Fulbright Grants Awarded

Following are the name of U.S. graduate students in the Mathematical Sciences who have received Fulbright awards for 1987–88, with their U.S. institutions and the countries in which they will study. The awards are sponsored by the United States Information Agency and administered by the Institute of International Education. Grants were awarded to Peter Dolan, State University of New York at Stony Brook; Hungary; Laura Silber, Boston University; West Germany; Emil Volcheck, University of Delaware; West Germany.

LMS 1987 Prizes

The Polya prize is awarded to J. H. Conway for his distinguished contributions to coding theory, combinatorics, knot theory, number theory, and the theory of finite groups.

The Senior Whitehead Prize is awarded to R. A. Rankin for his important contributions to number theory and the theory of modular forms.

The Junior Berwick Prize is awarded to P. A. Linnell for his paper entitled “Decomposition of augmentation ideals and relation groups.”

Junior Whitehead Prizes are awarded to A. H. Schofield for his work in ring theory, and to C. M. Series for her work on dynamical systems.

Geometry Prizes Awarded

The Geometry Prize was newly established in 1987 to be awarded annually to a maximum of two geometers in recognition of major fundamental research in geometry. The fund was donated to the Mathematical Society of Japan by several senior geometers, who are members of the Society.

The Geometry Prizes in the year 1987 were awarded to Shoshichi Kobayashi, of University of California, Berkeley, and Akio Kawauchi, of Osaka City University. The award to S. Kobayashi was made in recognition of his research work of fundamental and lasting importance and also his several influential books which have inspired many young mathematicians. The award to A. Kawauchi was for his outstanding research papers on the knot theory and the low dimensional manifold theory.

Television Program on Mathematics

“For All Practical Purposes,” a 26-part television course on mathematics, will be aired on public television stations beginning in January 1988.

This series of half-hour programs addresses the increased need for knowledge of mathematics by focusing on the importance and usefulness of the subject. “For All Practical Purposes” uses graphics, animated sequences, and location shooting in order to introduce concepts and quantitative methods in familiar settings.

Request for Photos

In conjunction with the Centennial of the American Mathematical Society, which is to be celebrated in Providence in 1988, the AMS would like to set up an exhibit of group photos from meetings and similar items of interest. If anyone has memorabilia of this kind which they would like to give or loan to the AMS, please write to William J. LeVeque, Executive Director, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.
National Science Foundation
News & Reports

NSF Budget Update

In the proposed NSF budget for fiscal 1988, submitted to Congress in January 1987, President Reagan requested a 17% increase for the Foundation. The increase was part of a plan to double the NSF budget by 1992. At the time of this writing, Congress had still not come to an agreement on the federal budget. In the current atmosphere of concern over cutting government spending and reducing the federal deficit, any increases for the NSF are uncertain. Indeed, at this point, the NSF budget could drop as much as 8% below the fiscal 1987 level or could increase as much as 15%.

The President’s request for the NSF totaled $1893 million, with $1635 million for research and $115 million for science education. On September 22, 1987, the House of Representatives passed an appropriations bill containing the NSF budget. The bill reduced the President’s request by $100 million and shifted $30 million from research to education. The Senate appropriations bill, passed October 15, 1987, contained amounts for research and education equal to the President’s request. However, that bill cut $26 million from the request for the U.S. Antarctic Program for a total budget of $1867 million, 15% over the fiscal 1987 level.

The NSF budget is under the jurisdiction of the House and Senate Subcommittees on Housing and Urban Development and Independent Agencies. Representatives from these two subcommittees are scheduled to meet with the President to work out a compromise spending bill. At this point, two things could happen. First, if no agreement is reached, the NSF budget may be frozen at last year’s level. Gramm-Rudman automatic deficit reduction cuts may then reduce the budget by as much as 8%. Second, a compromise may be worked out, in which case the NSF budget is supposed to fall between the $1867 million passed by the Senate and the $1793 million passed by the House. However, Gramm-Rudman cuts may still apply, or selective cuts may be made in the compromise bill.

New Calculus Program at DMS

The Division of Mathematical Sciences (DMS), in cooperation with the Office of Undergraduate Science, Engineering, and Mathematics Education, announces a program of support for projects concerned with curriculum and instruction in calculus. The program will emphasize coordination with other disciplines in science and engineering and interactions between different sectors of the mathematical sciences community in the development of model curricula and prototypical instructional materials. During this first year of the program, emphasis will be on the generation of ideas and formulation of a national context within which significant changes can be accomplished.

There are three major categories of support:

Conferences and workshops should be aimed at generating ideas, fostering interactions, and providing a context within which curriculum development can take place with enhanced probability of success. There are no submission deadlines, proposals will receive ad hoc merit review, and the project duration is 6 to 12 months.

Planning projects will provide the time frame to allow fully formed, well-designed curriculum projects to materialize. The result of an award in this category would be development of a well-formulated plan for a project of the scope described in the next category below. Proposals must describe clearly an underlying philosophy for change and a well-defined structure for the planning activities. The submission deadline is March 15, 1988. The projects will begin after August 1, 1988 and will last one year. Proposals will be reviewed by a panel.

Curriculum development projects must have a well-formulated underlying philosophy and a well-defined plan for development. Proposals should contain complete information on which to base a multi-year award. The project description should cover planning, development, testing, implementation, evaluation, and dissemination. It is requested that all applicants consider submitting a preliminary proposal which may be in the form of a comparatively brief and informal letter of inquiry. The
deadline for preliminary proposals is February 1, 1988, and March 15, 1988 for formal proposals. The projects will begin after August 15, 1988 and will continue for up to five years. Proposals will be reviewed by a panel.

Awards made in this last category must show clear potential to contribute to renewal of calculus instruction on a national basis. Without addressing the issue of national impact, no proposal, however sound, can expect to compete effectively for a multi-year award.

In all categories, proposals will be reviewed according to the general NSF evaluation criteria, in addition to other criteria developed specifically for this program.

Those interested are encouraged to contact the program director, Louise Raphael, who will be happy to answer questions and provide program announcements. She can be contacted at Special Projects/Calculus, Division of Mathematical Sciences, Room 339, National Science Foundation, 1800 G Street, N.W., Washington, DC 20550; 202-357-3453.

**NSF Advisory Committee**

Announcement is made of the new and continuing membership of the Advisory Committee to the Directorate for Science and Engineering Education of the National Science Foundation (NSF) for 1987-1988. Among those appointed to new three-year terms, eight members join the Committee for the first time, while two, Dr. Joe Crosswhite and Dr. George Pimentel, were reappointed.

Dr. Gerald Holton (Harvard University) and Dr. Margaret MacVicar (Massachusetts Institute of Technology) will lead the Committee as Chair and Vice Chair, respectively, for the second year in a row. The members of the Advisory Committee are distinguished leaders from the scientific, educational, and policy making communities.

The National Science Foundation is charged by statute with the responsibility for strengthening science, mathematics, and engineering education at all levels. The Advisory Committee to the Directorate provides advice, recommendations, and oversight concerning the Foundation’s education policies and programs.

**NSF Announces Minority Research Centers of Excellence**

The NSF recently announced two grants to establish its first research centers to enhance the participation of leading minority institutions and researchers in areas of vital scientific and engineering importance.

Howard University in Washington, DC, and Meharry Medical College in Nashville, Tennessee, will each receive $5 million over five years through NSF’s Minority Research Centers of Excellence (MRCE) program. MRCE was initiated last year to address the continuing shortage of minority scientists and engineers needed to maintain U.S. pre-eminence in fundamental research.

In addition to supporting qualified scientists, the MRCE program seeks to attract talented minority students to careers in science and engineering through center outreach efforts, scholarships, and opportunities to participate in research.

In funding the first MRCEs, NSF continues its support of center-based research in rapidly advancing areas of critical national interest. NSF plans to establish a total of six MRCEs, with as many as four additional MRCE awards to be made during the 1988 fiscal year.

-NSF News Release

**Undergraduate Faculty Enhancement Program**

The NSF has recently made available an announcement entitled “Undergraduate Faculty Enhancement Program.” The Undergraduate Faculty Seminars and Conferences activity makes grants to conduct regional or national seminars, short courses, workshops, or similar activities for groups of faculty members. Grants will be made for the development and implementation of ways to assist large numbers of faculty to learn new ideas and techniques in their fields, and to use the knowledge and experience to improve their undergraduate teaching abilities.

Projects must be regional or national in scope, and may include seminars, short courses, workshops, and conferences, or a series of such activities, but are not limited to these. Actual sessions may vary considerably in length, normally from a few days to a few weeks.

The kinds of activities which are encouraged include projects which allow participants to gain experience with recent developments in the field; enable participants to work with innovative technologies relevant to their academic responsibilities and which allow them to evaluate the technology; permit participants to work with experts who have had a part in originating the ideas which are the subject of the project or who have worked extensively with the ideas or techniques; allow participants to work with industrial scientists, mathematicians, and engineers and to learn new industrial applications in the field; permit participants to obtain personal experience working with new ideas and techniques, rather than just hearing about them; encourage participants to develop instructional materials that include new ideas and techniques; explore new methods of delivery of information, such as the use of computers or teleconferencing, either in work with other participants during the project or in participants’ activities after the project; encourage sustained interaction among the participants following the project and continued opportunities for learning about the topics of the project; encourage the increased participation.
of underrepresented groups in science, mathematics, and engineering.

Although the kinds of projects and activities described here are expected to include the majority of those supported through the Undergraduate Faculty Enhancement Program, proposals envisioning additional mechanisms for enhancing the vitality of the undergraduate faculty will be considered by NSF.

Proposals for projects which are planned to begin during the summer of 1988 should be received in the Foundation no later than December 11, 1987 in order to allow time for review and evaluation. Proposals for projects to begin after the summer of 1988 which are to be funded in fiscal year 1988 should be received in the Foundation by March 4, 1988. Proposals received in March 1988 may be for projects which begin during the academic year 1988-1989 or during the summer of 1989; submission at this time may allow greater opportunity for planning after the announcement of an award. Proposals received after these target dates will be reviewed, but decisions may be delayed by their late arrival.

For further information, contact the Undergraduate Faculty Enhancement Program, Office of Undergraduate Science, Engineering, and Mathematics Education, Directorate for Science and Engineering Education, National Science Foundation, Washington, DC 20550. Telephone: 202-357-7051.
News from Washington

Travel Support for AMS Centennial

It is anticipated that the Society will receive funds from one or more federal agencies for travel and subsistence support for senior graduate students and young Ph.D.'s to attend the AMS Centennial Celebration to be held in Providence, Rhode Island from August 8, 1988 through August 12, 1988. The Centennial program, built around 21 Invited Addresses by an extraordinarily influential group of U.S. mathematicians, is likely to influence the direction of mathematics research internationally for the next ten to fifteen years. Such a program will be particularly valuable to this new generation of mathematicians. Watch the February Notices for details on awards and criteria for application.

Calculus Symposium

"Calculus is big, calculus is important, calculus is in trouble," said Ronald G. Douglas, Dean of Physical Sciences and Mathematics at the State University of New York at Stony Brook, at a recent national symposium on calculus reform. Douglas' remark summarized the basic message of the symposium, entitled "Calculus for a New Century." Skyrocketing enrollments, the advent of computer technology, and a dilated curriculum were among the key issues discussed at the meeting, which brought together research mathematicians, users of calculus from science and industry, and university administrators to discuss the problems and potential of the calculus course. The symposium was held October 28-29, 1987 at the National Academy of Science in Washington, DC.

According to Douglas, the purpose of the symposium was not to discuss the details of the forms that a new calculus curriculum might take. Before that can be done, many must be convinced that there are in fact problems with the course, and, perhaps more importantly, that change is possible. Many believe that although the calculus curriculum has problems, it has stood the test of time. Besides, they say, the magnitude of the calculus teaching enterprise and its inertia make widespread change impossible. "No one complains about calculus because it's respected and it's too big to change," said Thomas W. Tucker of Colgate University.

If the list of calculus ills presented at the symposium is any indication, change must come soon. A succession of speakers told of textbooks bloated with "plug and chug" exercises and "template" word problems, unenthusiastic teachers, and a lack of emphasis on conceptual understanding. As an example, Michael Reed of Duke University pointed to an examination problem asking for the derivative of $x^x \sin x$. "That's what's wrong with calculus," he said. "The teaching of calculus has developed into a series of technical hurdles." Indeed, calculus is often used as a filter rather than an enabler. Lynn Arthur Steen of St. Olaf College pointed out that 50-60% of calculus students either withdraw or fail the course.

Many of the participants noted that the calculus curriculum has not responded to the ability of computers to handle many of the calculus problems that students typically spend hours working out. While wading through the technical details of such problems may be necessary, many question the strong emphasis on repetition. According to Anthony Ralston of the State University of New York at Buffalo, most mathematicians believe that "knowing is doing." "But perhaps we need to revise our idea of what 'doing' is," he said. "Don't use traditional methods if newer methods are better."

The symposium brought together various users of calculus to hear their views on what they expect from the course and how it might be improved. Such input is crucial because calculus enrollments have grown largely in response to the increasing number of science majors requiring calculus. In addition, calculus textbooks have increased in size partly because of pressures from client disciplines to include examples and applications from their areas. The representatives from the client disciplines called for more sophisticated and substantive applications from their areas, but agreed that the most valuable contribution calculus can make is the development of logical thinking and a conceptual understanding of mathematics.
A solid mathematical background is more important than ever before because of the increased ‘mathematization’ of all areas of science. Several speakers warned that unless more students are successful in calculus, the scientific and technological capacity of the nation as a whole will suffer. ‘Calculus must become a pump and not a filter,’ said Robert M. White, President of the National Academy of Engineering.

The high calculus enrollments naturally raise the question of whether calculus should be viewed as a core course. S. Frederick Starr, President of Oberlin College, noted that college and university faculty and administrators who are outside mathematically based fields do not necessarily understand why calculus is sufficiently fundamental and important to be considered a core course. He suggested that mathematics departments offer a calculus course to colleagues in other departments. Reed of Duke University commented that he has offered such courses at his institution and found them very successful and rewarding.

This kind of active outreach on the part of mathematicians may be necessary. Reed called mathematicians ‘too timid’ when it comes to dealing with the administrations at their schools. ‘We as a group are terrible entrepreneurs,’ he said, noting that other sciences such as physics and chemistry are constantly badgering their administrations for money for their projects. He exhorted the mathematicians in the audience to go to the deans, presidents, and provosts of their institutions and say, ‘Now is your chance to contribute to a national effort in calculus reform.’ Linda B. Salamon, Dean of the College of Arts and Sciences at Washington University, suggested that mathematics departments build ‘allegiances’ with client disciplines. She pointed out that university administrations would be more responsive to such a ‘chorus to speak for the needs of mathematics.’

The importance of the reform issue is reflected in the appearance at the symposium of White, President of the National Academy of Engineering, and of Frank Press, President of the National Academy of Sciences. Two representatives from the National Science Foundation also spoke at the symposium, Judith S. Sunley, Director of the Division of Mathematical Sciences, and Robert F. Watson, acting head of the newly formed Office of Undergraduate Science, Engineering, and Mathematics Education. They described the goals of the Foundation’s new $2 million initiative in calculus reform (this program is described in NSF News and Reports in this issue of Notices). In addition, the symposium was limited to 700 participants and was fully registered weeks before the deadline.

It appears that the symposium has generated the high-level, national exposure needed before the nuts and bolts of calculus reform can be addressed. In the words of Starr of Oberlin College, ‘Now the key is the attention span of the reformers.’

Chairman Named for MS2000 Committee

J. Fred Bucy has been named chairman of the committee to oversee the project ‘Mathematical Sciences in the Year 2000,’ known as MS2000. With a background in semiconductors and geophysics, Bucy has worked in a number of industrial research capacities. In 1984, Bucy retired from his position as Chief Executive Officer of Texas Instruments Incorporated.

Sponsored by the National Research Council, MS2000 is aimed at assessing the state of the mathematical sciences from the undergraduate to the research level. The committee that Bucy will head will guide the project and eventually issue recommendations. The remainder of the committee membership will be selected soon.

New Staff Director at BMS

Lawrence Cox has been appointed Staff Director of the Board on Mathematical Sciences (BMS) of the National Academy of Sciences.

Cox received his Ph.D. in mathematics from Brown University in 1973. After a brief period at the University of Maryland, he moved to the Bureau of the Census, where he initiated a successful research and development program in applying mathematical theory to statistical problems. He has held several administrative and scientific positions at the Bureau, most recently as Senior Mathematical Statistician.

A founding member of the graphics community in statistics, Cox has lectured and published extensively and has organized several conferences. In addition, he is on the Board of Directors of the American Statistical Association.

In his new position at the BMS, Cox succeeds Frank Gilfeather, who has returned to an academic position at the University of Nebraska, Lincoln. Cox can be reached at the BMS offices at 202-334-2421.

NAS Scientific Exchange Program

The National Academy of Sciences (NAS) invites applications from American scientists who wish to make visits beginning during the period January 1, 1989, through December 31, 1989, to the U.S.S.R., Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, Poland, Romania, and Yugoslavia. Long-term research visits of three to twelve months duration are encouraged, particularly if contact with colleagues in the other country has already been established. The minimum length of visits is one month in one country.

Applicants must be U.S. citizens and have a doctoral degree or its equivalent by June 1988 in physics; chemistry; mathematics and computer sciences; earth, atmospheric, and oceanographic sciences; agricul-
cultural, forestry, fishery, and plant sciences; biological sciences; environmental sciences; engineering; archaeology and anthropology; geography; or psychology. Also included are science and technology policy and those aspects of the economic and social sciences that involve quantitative analysis as a primary consideration. Other scientific disciplines not explicitly mentioned will be considered on a case-by-case basis. Necessary expenses will be met by the NAS and the foreign academy, including reimbursement for long-term visitors for salary lost up to a predetermined maximum and expenses for accompanying family members for visits exceeding five months.


SOME MATHEMATICAL QUESTIONS IN BIOLOGY—CIRCADIAN RHYTHMS
Gail A. Carpenter, Editor

The articles in this collection are based on lectures given at the 20th Annual Symposium on Some Mathematical Questions in Biology, held in May 1986, and sponsored jointly by the AMS, the Society for Industrial and Applied Mathematics and Section A of the American Association for the Advancement of Science. For the past thirty years, due particularly to the fundamental work of Pittendrigh, Aschoff, and Wever, theoretical analysis of circadian rhythms and sleep have gone hand in hand with experimental and clinical studies. Circadian rhythms have been investigated at levels ranging from cell fragments to humans, from biochemistry to behavior. This experimental diversity is reflected in a diversity of modeling approaches, several of which are represented in this collection. One class of models focuses on the circadian sleep and activity cycles of humans, for which some investigators postulate pacemaker systems with two coupled oscillators, while others propose single oscillator models. Other analyses focus upon the activity patterns of small vertebrates or upon anatomical data and physiological recordings. The mathematical formulations and analyses utilize nonlinear dynamical systems, stochastic models, and computer simulations. The articles in this volume discuss, analyze, and compare these various experimental, theoretical, and mathematical approaches.

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# Meetings and Conferences

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Coming Events

1988 will be a unique year in mathematics. Not only will the Society celebrate its Centennial, but a year-long celebration of mathematics called "100 Years of American Mathematics" thematically and visually links the Centennial to ten major events in 1988.

Two of these events are special symposia:

- "American Mathematics Entering its Second Century" (February 13-14)
- "The Legacy of John von Neumann" (May 29–June 4)

AAAS has responded by setting aside time on the program of its annual meeting for the former, and the Society for Industrial and Applied Mathematics and Hofstra University are joining AMS in sponsoring the latter. Further details on both of these special symposia can be found on the following pages.

The Centennial Celebration itself will be held in Providence, Rhode Island, August 8–12. Although the First Announcement of this meeting will not appear until the April issue, an article on this special event can be found on page 15.
Program

The January 1988 Joint Mathematics Meetings, including the 94th Annual Meeting of the AMS, the 71st Annual Meeting of the Mathematical Association of America, and the 1988 annual meetings of the Association for Women in Mathematics and the National Association for Mathematicians will be held January 6 – 9 (Wednesday – Saturday), 1988, in Atlanta, Georgia. Sessions will take place in the Hyatt Regency Atlanta and the Atlanta Marriott Marquis.


AMS-MAA Invited Addresses

By invitation of the AMS-MAA Joint Program Committee (H. W. Lenstra, Jr., Carl Pomerance, Paul H. Rabinowitz, and James W. Vick, chairman), four speakers will address the AMS and MAA on the history and development of mathematics. The names of the speakers, their affiliations, the titles, dates, and times of their talks follow:

LIPMAN BERS, Columbia University, The European mathematicians' migration to America, 11:10 a.m. Friday.
JOSEPH W. DAUBEN, Herbert H. Lehman College, CUNY and the Graduate Center, City University of New York, Georg Cantor: The battle for transfinite set theory, 11:10 a.m. Saturday.
JOHN G. KEMENY, Dartmouth College, How computers have changed the way I teach, 11:10 a.m. Wednesday.
DAVID MUMFORD, Harvard University, Oscar Zariski and his work, 11:10 a.m. Thursday.

IMPORTANT DEADLINES

AMS Abstracts
For consideration for special sessions Expired
Of contributed papers Expired

MAA Abstracts
Of contributed papers Expired

Employment Register
(Applicants & Employers) Expired

EARLY Preregistration and Housing Expired
Preregistration and Housing Expired

MAA Minicourse Preregistration Expired

Motions for AMS Business Meeting December 7
Preregistration cancellations (50% refund) December 23
Meetings

94th Annual Meeting of the AMS
January 6 – 9, 1988

Sixty-First Josiah Willard Gibbs Lecture
The 1988 Gibbs lecture will be presented at 8:30 p.m. on Wednesday, January 6, by David P. Ruelle of Institut des Hautes Etudes Scientifiques. The title of his lecture is How natural is our mathematics? The example of equilibrium statistical mechanics.

Colloquium Lectures
There will be a series of four Colloquium Lectures presented by Victor W. Guillemin of the Massachusetts Institute of Technology. The title of this lecture series is Spectral properties of Riemannian manifolds. The lectures will be given at 1:00 p.m. daily, Wednesday through Saturday, January 6–9.

Prizes
The 1988 George David Birkhoff Prize in Applied Mathematics will be awarded at 4:25 p.m. on Thursday, January 7.

Invited Addresses
By invitation of the Program Committee, there will be eight fifty-minute invited addresses. The names of the speakers, their affiliations, the dates and times of their talks, and some of the titles follow:
Constantine M. Dafermos, Brown University, Hyperbolic conservation laws in classical physics: recent results and open problems, 2:15 p.m. Thursday;
Mark Goresky, Northeastern University, Topology and combinatorics of affine subspaces of Euclidean space, 3:20 p.m. Thursday;
Philip J. Hanlon, University of Michigan, The MacDonald root system conjectures and their significance, 10:05 a.m. Wednesday;
H. W. Lenstra, Jr., University of California, Berkeley, Applied number theory, 3:20 p.m. Saturday;
Dusa McDuff, SUNY at Stony Brook, Symplectic structures on manifolds, 10:05 a.m. Friday;
Roger D. Nussbaum, Rutgers University, Means and their iterates, 9:00 a.m. Wednesday;
Peter Clive Sarnak, Stanford University, Determinants of Laplacians, heights and finiteness, 2:15 p.m. Saturday;
Stephen William Semmes, Rice University, Nonlinear Fourier analysis, 9:00 a.m. Friday.

Special Sessions
By invitation of the same committee, there will be eighteen special sessions of selected twenty-minute papers. The topics of these special sessions, the names and affiliations of the mathematicians arranging them, and the dates and times they will meet, are as follows:
American Mathematical Society Short Course Series

Introductory Survey Lectures on Computational Complexity Theory
Atlanta, Georgia, January 5–6, 1988

The American Mathematical Society, in conjunction with its ninety-fourth Annual Meeting, will present a short course entitled Computational Complexity Theory on Tuesday and Wednesday, January 5–6, 1988, in Atlanta at the Hyatt Regency Atlanta. The program is under the direction of Juris Hartmanis of Cornell University. Six lectures are planned and it is anticipated that proceedings will be published in the series Proceedings of Symposia in Applied Mathematics. Please note that this is not an MAA Minicourse.

The systematic study of computational complexity theory was initiated in the early sixties and during the following twenty-five years it has developed into one of the central and most active research areas of computer science. It has grown into a rich and exciting mathematical theory whose development is motivated and guided by computer science needs and technological advances. At the same time, it is clear that complexity theory, dealing with the quantitative laws of computation and reasoning, is concerned with issues and problems of direct interest to many other disciplines as well. In particular, complexity theory is of considerable interest to mathematics and some of the key open problems in complexity theory are basic questions about the quantitative nature of mathematics.

This course is intended to provide a quick introduction to computational complexity theory followed by five lectures on related, current research topics in complexity theory. Titles, speakers and schedule for the talks follow.

January 5, morning:
8:00 a.m.–2:30 p.m. Registration
9:00 a.m.–10:15 a.m. Overview of Computational Complexity Theory, Juris Hartmanis, Cornell University.
10:45 a.m.–noon The Isomorphism Conjecture and Sparse Sets, Stephen R. Mahaney, AT&T Bell Laboratories.

January 5, afternoon:
1:45 p.m.–3:00 p.m. Restricted Relativizations of Complexity Classes, Ronald V. Book, University of California, Santa Barbara.
3:15 p.m.–4:30 p.m. Descriptive and Computational Complexity, Neil Immerman, Yale University.
4:30 p.m.–5:00 p.m. Discussion period

January 6, morning:
8:00 a.m.–9:15 a.m. Complexity Issues in Cryptography, Alan L. Selman, Northeastern University.
9:30 a.m.–10:55 a.m. Interactive Proof Systems, Shafi Goldwasser, Massachusetts Institute of Technology.

While no specialized background is required of participants, a familiarity with basic notions about Turing machines and computability will generally be assumed. Those who wish to get the most benefit from the course should consult M. Garey and D. S. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979, Chapters 1 and 2; J. E. Hopcroft and J. D. Ullman, Introduction to Automata Theory, Languages, and Computation, Addison-Wesley, 1979, Chapters 7, 12 and 13. Synopses of the talks and accompanying reading lists appeared in the October and November issues of the Notices. Complete lecture notes will be mailed to those who preregister for the course, and will be available at the Short Course registration desk for those registering for the course on site.

Those who also plan to register for the Joint Mathematics Meetings should take note of an AMS special session entitled Structural Complexity Theory, organized by Stephen R. Mahaney of AT&T Bell Laboratories. For more information, see the Special Session section of the Atlanta meeting announcement in this issue of the Notices.

All who wish to participate in the Short Course may do so upon payment of a $35 advance registration fee ($45 on site). There are reduced fees for students and unemployed individuals. Please refer to the sections titled Registration at the Meetings for details.

The Short Course was recommended by the AMS-MAA Committee on Employment and Educational Policy (CEEP), whose members are Morton Brown, Stefan A. Burr, Edward A. Connors (chair), Philip C. Curtis, Jr., David J. Lutzer, Donald C. Rung, and Audrey A. Terras. The Short Course series is under the direction of the CEEP Short Course Subcommittee, whose members are Stefan A. Burr (chair), Lisl Novak Gaal, Robert P. Kurshan, Barbara L. Osofsky, and Marjorie L. Stein.
Ordered algebraic systems, Marlow Anderson, The Colorado College, and Todd Feil, Denison University. Friday 1:00 p.m., Saturday 8:00 a.m.

Banach space theory, Alfred D. Andrew, and John H. Elton, Georgia Institute of Technology. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Modern trends in matrix analysis and applications, Jean Bevis, George Davis, Frank Hall, Fred A. Massey and Valerie Miller, Georgia State University. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Measure theory and descriptive set theory, Jack B. Brown, Auburn University, and R. Daniel Mauldin, North Texas State University. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Nonlinear differential delay equations, Shui-Nee Chow, Michigan State University, and Roger D. Nussbaum, Rutgers University. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Toeplitz operators and geometry, Lewis A. Coburn, SUNY at Buffalo. Friday 1:00 p.m., Saturday 8:00 a.m.

Algebraic number theory and algorithms, Gary Cornell, University of Connecticut, Storrs, and H. W. Lenstra, Jr., University of California, Berkeley. Friday 1:00 p.m., Saturday 9:00 a.m.

Stability of differential and integro-differential equations, Saber Elaydi, University of Colorado at Colorado Springs. Friday 1:00 p.m., Saturday 8:00 a.m.

Applications of differential equations to population ecology, Herbert Freedman, University of Alberta, and Paul Waltman, Emory University. Friday 12:30 p.m., Saturday 8:00 a.m.

Geometry of nonlinear control systems, Robert B. Gardner, University of North Carolina at Chapel Hill, and Clyde Martin, Texas Tech University. Friday 1:00 p.m., Saturday 8:00 a.m.

Graph theory, Ronald Gould, Emory University, and Michael S. Jacobson, University of Louisville. Friday 1:00 p.m., Saturday 8:00 a.m.

Total positivity and applications, Johnny Henderson and R. A. Zalik, Auburn University. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Abelian groups, Paul Hill, Baylor University. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Discrete-time optimal stopping theory, Theodore P. Hill and Robert Kertz, Georgia Institute of Technology. Friday 1:00 p.m., Saturday 7:30 a.m.

Structural complexity theory, Stephen R. Mahaney, AT&T Bell Laboratories, Murray Hill. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Optimization, Lynn McLinden, University of Illinois, and Jay S. Treiman, Western Michigan University. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Multidimensional inverse problems, related problems in analysis and applications, A. G. Ramm, Kansas State University. Friday 1:00 p.m., Saturday 9:00 a.m.

Combinatorics and group representations, Dennis Stanton, University of Minnesota. Wednesday 2:15 p.m., Thursday 8:00 a.m.

Contributed Papers

There will be sessions for contributed papers Wednesday afternoon, Thursday morning, Friday afternoon, and Saturday morning.

Late papers will not be accepted.

Other AMS Sessions

AMS Committee on Science Policy

Special Presentation

The Committee on Science Policy is sponsoring a Special Presentation on Why the SDI software could never be trusted, given by David L. Parnas, Queens University. This presentation will take place on Wednesday, January 6, at 2:15 p.m.

Council Meeting

The Council of the Society will meet at 5:00 p.m. on Tuesday, January 5.

Business Meeting

The Business Meeting of the Society will take place immediately following the award of the Birkhoff Prize at 4:25 p.m. on Thursday, January 7. The secretary notes the following resolution of the Council: Each person who attends a Business Meeting of the Society shall be willing and able to identify himself as a member of the Society.

Committee on the Agenda for Business Meetings

The Society has a Committee on the Agenda for Business Meetings. The purpose is to make Business Meetings orderly and effective. The committee does not have legal or administrative power. It is intended that the committee consider what may be called "quasi-political" motions. The committee has several possible courses of action on a proposed motion, including but not restricted to:

(a) doing nothing;
(b) conferring with supporters and opponents to arrive at a mutually accepted amended version to be circulated in advance of the meeting;
(c) recommending and planning a format for debate to suggest to a Business Meeting;
(d) recommending referral to a committee;
(e) recommending debate followed by referral to a committee.

There is no mechanism that requires automatic submission of a motion to the committee. However, if a motion has not been submitted through the committee, it may be thought reasonable by a Business Meeting to refer it rather than to act on it without benefit of the advice of the committee.

The committee consists of M. Salah Baouendi, Everett Pitcher (chairman), and Carol L. Walker.

In order that a motion for the Business Meeting of January 7, 1987, receive the service offered by the committee in the most effective manner, it should be in the hands of the secretary by December 7, 1987.

Everett Pitcher, Secretary
In further explanation, it is noted that each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society. For additional information on the Business Meeting, please refer to the box titled Committee on the Agenda for Business Meetings.

Other Joint AMS–MAA Sessions

100 Years of American Mathematics

In Atlanta, Thursday evening, January 7, will be devoted to a Special Banquet, co-hosted by the Presidents of AMS and MAA, launching 100 Years of American Mathematics, a year-long expansion of the Society’s Centennial linking ten major events in 1988. A letter of invitation from President Mostow and further details on the banquet appear elsewhere in this announcement.

On Friday evening, January 8, the AMS and MAA, in cooperation with the Society for Industrial and Applied Mathematics, the Board of Mathematical Sciences, and the Mathematical Sciences Education Board, have organized a Special Program on Forces for Change in Mathematics Education. This program begins at 6:15 p.m. with an exhibitor-hosted open reception and light supper, followed at 7:30 p.m. by three concurrent sessions to help launch The Mathematical Sciences in the Year 2000 (MS 2000), a joint BMS/MSEB project for the revitalization of collegiate mathematics, undertaken at the request of AMS, MAA, and SIAM. Again, further details on this Special Program appear elsewhere in this announcement.

Ethno-mathematics Panel Discussion

The AAAS-AMS-MAA Committee on Opportunities in Mathematics for Disadvantaged Groups is sponsoring a panel discussion on How does ethno-mathematics make sense at the college level? This panel is scheduled from 1:00 p.m. to 3:00 p.m. on Saturday, January 9. The organizer is GLORIA GILMER, Math-Tech, Inc. The participants are the organizer; UBIRATAN D’AMBRÓSIO, Universidade Estadual de Campinas (Brazil); SOLOMON A. GARFUNKEL, COMAP; MARCIA ASCHER, Ithaca College; and ARTHUR B. POWELL, JR., Rutgers University.

AMS-MAA-TUG Workshop

This workshop is being cosponsored by the AMS and MAA and will be presented by the \TeX\ Users Group.

\TeX\ is a series of programs for preparation of scientific papers for publication. It was developed by DONALD KNUTH, Stanford University, Computer Science Department. This workshop is designed to familiarize the participant with \TeX\ and also give basic instruction in how to use \TeX. An opportunity for hands-on experimentation using the IBM PC will be available.

The AMS-\TeX\ macro package, which was written by Michael Spivak to simplify using \TeX\ for inputting mathematical material, will be discussed also.

This workshop will be presented in three two-hour sessions on Tuesday, January 5: 9:00 a.m. to 11:00 a.m.; 2:00 p.m. to 4:00 p.m.; and 7:00 p.m. to 9:00 p.m. A fee of $60 will be charged through preregistration. The fee at the meeting is $80.

71st Annual Meeting of the MAA
January 6–9, 1988

Retiring Presidential Address

The Retiring Presidential Address will be given by LYNN A. STEEN, St. Olaf College, at 3:50 p.m. on Friday, January 8. The title of his address is Celebrating mathematics.

Invited Addresses

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

- LAWRENCE COUVILLON, Southern University, What does it mean to understand the function concept?, 9:00 a.m. Thursday;
- RONALD G. DOUGLAS, SUNY at Stony Brook, Calculus: Past, present, and future, 2:45 p.m. Friday;
- DONALD L. KREIDER, Dartmouth College, Mathematics and computing—25 years of collaboration, 10:05 a.m. Saturday;
- JEFFREY C. LAGARIAS, AT&T Bell Laboratories, Karmarkar’s linear programming algorithm and nonlinear programming, 10:05 a.m. Thursday;
- CHARLES C. LINDNER, Auburn University, Perpendicular arrays and graph decompositions, 3:20 p.m. Wednesday;
- VERA S. PLESS, University of Illinois at Chicago, Codes and designs—existence and uniqueness, 9:00 a.m. Saturday;
- JANE CRONIN SCANLON, Rutgers University, Singularly perturbed equations: theory vs. applications, 2:15 p.m. Wednesday.

Minicourses

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

Minicourse #1: Using computer graphing to enhance the teaching and learning of calculus and precalculus mathematics is being organized by FRANKLIN D. DEMPANA and BERT K. WAITS of Ohio State University. Part
Dear AMS Member:

1988 is the centennial year of the American Mathematical Society. I want to tell you about some of the events we have planned and urge you to catch the centennial spirit.

Since the early planning stages it has been my concern, and the concern of our Centennial Committee, that the festivities we undertake involve the broader mathematics community, not just AMS, and that they incorporate serious discussion looking toward the future.

To these ends, we have joined with the Mathematical Association of America and the Society for Industrial and Applied Mathematics to create a year-long celebration and dialogue called '100 Years of American Mathematics'. This has been done by linking the AMS Centennial Celebration next August to nine other special events taking place throughout 1988, to create a future-oriented 'centennial of American mathematics'.

I want to extend to you a personal invitation to participate in these events, especially to attend the January 7 banquet at the upcoming Joint Mathematics Meetings in Atlanta. This banquet, together with a unique session the following evening called 'Forces for Change in Mathematics Education', will launch the year-long '100 Years of American Mathematics'.

By attending the banquet you can be a part of the kick-off of our special year, and you can take advantage of a once in a lifetime offer made by Hewlett-Packard to acquire for $60 the $235 HP 28C calculator. It will be a specially-inscribed, enhanced model of this state-of-the-art machine which Hewlett-Packard is producing for the occasion. Our purposes in making this offer available are to help heighten your interest in coming to the banquet and put into your hands one of the forces for change in mathematics education which we all need to think about.

Please join us at Atlanta, and in the other Centennial events.

Sincerely,

George Daniel Mostow
President
100 Years of American Mathematics

Special Banquet, Thursday, January 7, 7:00 p.m.

Presidents Leonard Gillman (MAA) and G. D. Mostow (AMS) will co-host a festive Thursday evening banquet to launch 100 Years of American Mathematics, a year-long expansion of the AMS Centennial linking ten major events in 1988. A description of 100 Years and a special banquet invitation from G. D. Mostow are found on the facing page.

The Banquet (cost to you $30) will feature the Dollar-a-Year Centennial Package for all registrants who attend. This package includes a banquet ticket for $30, and for an additional $60 a specially-inscribed HP 28C calculator (list price $235), plus an optional $10 contribution to the support of 100 Years of American Mathematics. The HP 28C offered to you will be an enhanced model of this state-of-the-art machine produced by Hewlett-Packard solely for 100 Years and will be available for $60 only on this banquet occasion.

Brief ceremonies to launch 100 Years and entertainment will follow dinner. Emcee for the evening will be A. B. "AI" Willcox, MAA Executive Director.

Don't Miss This Special Evening!

Although ticket purchases through preregistration have far exceeded expectations, it is possible that there will be a limited number of banquet tickets available at the meeting. Please check at the Transparencies section of the registration desk.

AMS-MAA Special Program:
Forces for Change in Mathematics Education
Friday, January 8, 7:30 p.m.

The American Mathematical Society and the Mathematical Association of America—in cooperation with the Society for Industrial and Applied Mathematics, the Board of Mathematical Sciences and the Mathematical Sciences Education Board—have organized a program of three concurrent sessions involving national leaders in education in dialogue about impending major changes of which all mathematicians should be aware.

The proceedings of the October 1987 symposium at the National Academy of Sciences on the reform of the teaching of calculus, the rapidly changing picture of where the talent must come from in mathematics, and the new patterns of educating and certifying mathematics teachers which are developing will form the basis for informative presentations, brief prepared responses and general discussions.

The program will be preceded by a 6:15 p.m. Reception hosted by the exhibitors, free to registrants at the Joint Mathematics Meetings. The following sessions will run concurrently from 7:30 p.m. to 9:00 p.m.:

**CALCULUS FOR A NEW CENTURY**
The views of a perceptive and witty mathematician turned provost on the current reform movement in the teaching of calculus.

Speaker: TIMOTHY O'MEARA, Provost, University of Notre Dame
Respondent: RONALD G. DOUGLAS, SUNY at Stony Brook
Moderator: LYNN A. STEEN, St. Olaf College

**THE BEAUTY OF FRACTALS: A FORCE FOR REACHING THE PUBLIC**
A compelling lecture to illustrate the effectiveness of fractals in creating understanding in a nonmathematical audience.

Speaker: HEINZ-OTTO PEITGEN, University of California, Santa Cruz, and University of Bremen
Moderator: HYMAN BASS, Columbia University

**WHO WILL TEACH MATHEMATICS?**
A compelling description of the issues involved in attracting, educating and certifying tomorrow's teachers.

Speaker: MARC TUCKER, Executive Director, Carnegie Forum on Education and the Economy
Respondent: F. JOE CROSSWHITE, Northern Arizona University and Chairman, Conference Board of the Mathematical Sciences
Moderator: JOHN A. DOSSEY, Chairman, Mathematics Department, Illinois State University, and President, National Council of Teachers of Mathematics
A Year-long Celebration of a Century of Mathematical Achievement
A Year-long Preview of the Future with Mathematics

1988 Events

January  Banquet: *100 Years of American Mathematics*
AMS-MAA Special Program: *Forces for Change in Mathematics Education* – Joint Mathematics Meetings, Atlanta, GA

February  *American Mathematics Entering its Second Century* –
American Association for the Advancement of Science
Annual Meeting, Boston, MA

April  National Mathematics Awareness Week – JPBM Annual Event
April  *A Century of American Mathematics* – National Academy of Sciences
Annual Meeting, Washington, DC
April  *The Impact of Mathematics* – Board on Mathematical Sciences Event
Washington, DC

May  *Mathematics Education: Wellspring of U.S. Industrial Strength* –
Mathematical Sciences Education Board Symposium, Irvine, CA

June  *The Legacy of John von Neumann* – Hofstra-AMS-SIAM International
Symposium, Hempstead, NY

July  *Applied Mathematics: Foundations for Science & Technology* –
SIAM Annual Meeting, Minneapolis, MN

August  *Mathematics into the 21st Century* – AMS Centennial Celebration,
Providence, RI

October  *The Future of Mathematics Education in the U.S.* – MSEB-BMS
Report to the Nation

For a detailed calendar of events, write: JPBM – *100 Years*, 1529 18th Street,
NW, Washington, DC 20036, and watch for details in upcoming mathematics’
society publications or call Kirsten Sampson at the JPBM office: (202) 387-5200.

**Sponsored by the Joint Policy Board for Mathematics:**

American Mathematical Society, Mathematical Association of America, So-
ciety for Industrial and Applied Mathematics

**In cooperation with:**

Board on Mathematical Sciences, Mathematical Sciences Education Board of
the National Research Council
A is scheduled from 7:00 p.m. to 9:00 p.m. on Tuesday, January 5, and Part B from 4:30 p.m. to 6:30 p.m. on Wednesday, January 6. Enrollment is limited to 30.

Technology can dramatically change the way we teach mathematics and the way students learn mathematics. Participants will learn how to use "state of the art" computer graphing software with features such as zoom out and zoom in to enhance the understanding of important topics from Calculus and Precalculus mathematics. Computer graphing is a powerful tool that permits the user to make and test generalizations by looking at a large number of examples in a short period of time, to easily solve difficult problems, and to deal with problems and applications that are not contrived. Mathematical topics will include inequalities, theory of equations, two dimensional and three dimensional analytic geometry, polar and parametric equations, general conics, maximum and minimum problems, systems of equations (limits of integration for area between two curves), and numerical analysis. Software will be available to participants for the Macintosh, IBM and Apple II (e, c or GS) computers.

Minicourse #2: Computer software for differential equations is being organized by HOWARD LEWIS PENN and JAMES BUCHANAN of the U.S. Naval Academy. Part A is scheduled from 9:00 a.m. to 10:55 a.m. on Wednesday, January 6, and Part B from 2:15 p.m. to 4:15 p.m. on Thursday, January 7. Enrollment is limited to 30.

In this Minicourse, the participants will have a chance to see demonstrations of and use several computer packages which are useful in the teaching of differential equations. The Minicourse is limited to 30 people so as to allow hands on experience with each participant. There will be available at least 10 IBM PC's for the students to use. The Minicourse will consist of two two-hour sessions with about half of each session devoted to demonstrations by the instructors and the other half devoted to use of the programs by those taking the Minicourse. The programs will cover numerical and graphical uses of the computers as well as applications of differential equations.

Minicourse #3: Teaching mathematical modeling is being organized by FRANK R. GIORDANO, U. S. Military Academy and MAURICE D. WEIR, Naval Postgraduate School. Part A is scheduled from 9:00 a.m. to 10:55 a.m. on Wednesday, January 6, and Part B from 2:15 p.m. to 4:15 p.m. on Thursday, January 7. An optional third session, Part C, will use the microcomputer facility and is scheduled from 7:00 p.m. to 9:00 p.m. on Thursday, January 7. Enrollment is limited to 40.

The MAA Committee on the Undergraduate Program in Mathematics recommended in 1981 that "Students should have an opportunity to undertake 'real world' mathematical modeling projects..." as part of the common core curriculum for all mathematical science majors. This is because many applications of problems in science, industry, and government are best approached using mathematical modeling techniques.

This Minicourse provides an introduction to the modeling process, to several topics underlying the construction of mathematical models and addresses issues related to the design of an undergraduate course in modeling.

The optional third session will consist of demonstrations and "hands-on" running of models on microcomputers.

Minicourse #4: Teaching calculus with an HP-28C symbol manipulating calculator is being organized by JOHN W. KENELLY, Clemson University and THOMAS W. TUCKER, Colgate University. Part A is scheduled from 9:00 a.m. to 10:55 a.m. on Wednesday, January 6 and Part B from 2:15 p.m. to 4:15 p.m. on Thursday, January 7. Enrollment is limited to 30.

After briefly surveying the capabilities of currently available graphic calculators, the Minicourse will introduce participants, hands on, to the HP-28C. Graphing, symbol manipulating, differentiation, equation solving, Taylor polynomials and (time permitting) matrix operations will be viewed.

There will be a discussion of the use of the HP-28C in calculus instruction of how its use will change current topics and will make possible the introduction of new topics in calculus.

Minicourse #5: Logo and problem solving is being organized by CHARLES A. JONES, Grinnell College. Part A is scheduled from 2:15 p.m. to 4:15 p.m. on Wednesday, January 6, and Part B from 9:00 a.m. to 10:55 a.m. on Thursday, January 7. Enrollment is limited to 30.

Logo is a powerful computer language which includes commands for graphics and list processing. Logo has been an excellent language to teach to nonscience oriented undergraduates in the course "Problem Solving and Computing" at Grinnell College. The goal of this Minicourse is to provide an introduction to Logo that illustrates how Logo can be used to teach problem solving concepts and techniques.

This Minicourse will provide a hands-on introduction to a selection of Logo commands and programming techniques. The emphasis will be on the use of procedures, especially recursive procedures, to produce graphical displays and to obtain elegant solutions to list processing problems. The Logo instruction will consist of handouts which provide a wide variety of problems and which describe the particulars of Logo syntax.

Some previous programming experience (using any programming language) is assumed.

Minicourse #6: Coloring and path following algorithms for approximating roots and fixed points is being organized by WILLIAM F. LUCAS, Claremont Graduate
School. Part A is scheduled from 4:30 p.m. to 6:30 p.m. on Wednesday, January 6, and Part B from 7:00 p.m. to 9:00 p.m. on Thursday, January 7. Enrollment is limited to 80.

Cayley (1879) found that Newton’s method for approximating complex roots of a polynomial equation could lead to complications. (See Science News, February 28, 1987, regarding regions with chaotic boundaries.) H. W. Kuhn (1974) has provided an elementary path following algorithm in the plane for finding such roots. The roots are triple points in a simple three coloring of the plane as was already evident in a geometric view provided in Gauss’ thesis (1799).

The fundamental combinatorial lemmas by E. Sperner (1928) and A. W. Tucker (1946) for labeling (or coloring) the vertices of an n-simplex or n-octahedron are the discrete analogues of the Brouwer fixed point theorem and Borsuk-Ulum antipodal points theorems, respectively. These provide the basis for the path following algorithms of Scarf (1967) and others for finding approximate fixed points. Applications include the computing of equilibrium points or prices in game theory and economics.

These topics can be included at various levels in undergraduate courses on discrete mathematics, and do not assume any specialized prerequisites.

Minicourse #7: Computer based discrete mathematics is being organized by Nancy Baxter, Dickinson College and Ed Dubinsky, Purdue University. Part A is scheduled from 9:00 a.m. to 10:55 a.m. on Friday, January 8, and Part B from 3:30 p.m. to 5:30 p.m. on Saturday, January 9. An optional open-ended hands-on lab is scheduled from 11:15 a.m. to 12:45 p.m. on Saturday. Enrollment is limited to 30.

This Minicourse is about a new way of teaching Discrete Mathematics. The content agrees with what is generally recommended. The method is based on contemporary research in learning abstract mathematics and makes use of a very high level programming language ISETL.

ISETL is interactive and its syntax is close to mathematical notation. Participants will learn to understand several mathematical programs that express complicated mathematical ideas and will write their own. The point for teaching is that students learn to use important mathematical constructs (such as set formers, quantifiers, function definitions) in the context of getting their programs to do the right thing. The syntax is sufficiently simple that most of their mental energy is devoted to understanding mathematical processes that become realities for them.

The course includes “hands-on” experience with ISETL and Discrete Mathematics, as well as discussion of what topics can be handled and how. Software and detailed lecture notes will be sent to participants after the course on request (for a nominal handling fee).

Minicourse #8: Laboratory projects for first year calculus is being organized by L. Carl Leinbach, Gettysburg College. Part A is scheduled from 9:00 a.m. to 10:55 a.m. on Friday, January 8, and Part B from 3:30 p.m. to 5:30 p.m. on Saturday, January 9. Enrollment is limited to 80.

The presentation of the First Year Calculus course differs from that of any other course we offer to mathematics majors. Instead of the presentation of theorems and proofs in the standard format, much of our effort is spent on motivation of results and application of technique. The course is more mathematical engineering than it is mathematics.

The format for presenting a Calculus course suggested in this Minicourse is to use the existence of inexpensive software and hardware to create a laboratory component for the standard calculus course. The laboratory is to be conducted in the same way a physics, chemistry, or biology laboratory is conducted. Students run experiments, observe results, write reports, and make conjectures. Some experiments are to motivate results to be presented in lecture. Others are to apply the material of the lecture to a specific situation. In an ideal situation, student conjectures may be used to motivate a lecture presentation.

Minicourse #9: Constructing placement examinations is being organized by John G. Harvey, University of Wisconsin at Madison, and sponsored by the Committee on Placement Examinations. Part A is scheduled from 9:00 a.m. to 10:55 a.m. on Friday, January 8, and Part B from 3:30 p.m. to 5:30 p.m. on Saturday, January 9. Enrollment is limited to 40.

Lectures and workshops will take participants, step-by-step, through the entire process of constructing and implementing placement exams, including: preliminary planning, writing test items, designing a test for establishing cut-off scores, and evaluating the test. Placement testing problems of participants’ own institutions will be discussed during question and answer periods.

Minicourse #10: Computer graphics in elementary statistics is being organized by Florence S. Gordon, New York Institute of Technology and Sheldon P. Gordon, Suffolk County Community College. Part A is scheduled from 1:30 p.m. to 3:30 p.m. on Friday, January 8, and Part B from 9:00 a.m. to 10:55 a.m. on Saturday, January 9. Enrollment is limited to 30.

This Minicourse is intended to provide a hands-on introduction to the use of microcomputer graphics for an elementary, non-calculus-based, statistics course. All participants will have the opportunity to work with a graphics software package developed by the presenters which covers virtually all of the topics normally encountered in elementary statistics including data analysis and


descriptive statistics, probability simulations, the normal and t-distributions, sampling and the Central Limit Theorem, estimation, hypothesis testing, linear regression analysis, etc. The Minicourse is designed for individuals who have taught such an introductory statistics course, though no previous computer experience is assumed.

**Minicourse #11: The use of computing in teaching linear algebra** is being organized by Eugene Herman and Charles Jepsen, Grinnell College. Part A is scheduled from 7:00 p.m. to 9:00 p.m. on Friday, January 8, and Part B from 1:00 p.m. to 3:00 p.m. on Saturday, January 9. Enrollment is limited to 30.

The goal of this course is to discuss the changes that can or should occur in a linear algebra course in which students have access to a powerful matrix computation package. Participants will get hands-on experience in using such a package to better prepare them for the discussion.

A major reason that linear algebra is now taught to so many students so early in their education is that the computer has made linear algebra much more useful to scientists than it was 35 years ago. Yet computing has not had a significant effect on how undergraduate linear algebra is usually taught. This Minicourse explores the possibilities and consequences of putting powerful matrix computation packages in the hands of beginning linear algebra students. Participants will get to use one such package and will get information on others. Topics discussed will include the new kinds of problems that can be assigned to students, the changes that might be warranted in course, the background needed by instructors and students, the effects of the changed course on students, and the mathematical algorithms incorporated into the software. The packages we discuss have at least the following computational capabilities: Finding all the solutions of a consistent system of equations, finding matrix inverses, LU-factoring, QR-factoring, finding complete sets of eigenvectors and associated eigenvalues for arbitrary square matrices, and finding least-squares solutions.

**Minicourse #12: Using computer algebra systems in undergraduate mathematics** is being organized by Paul Zorn, St. Olaf College. Part A is scheduled from 7:00 p.m. to 9:00 p.m. on Friday, January 8, and Part B from 1:00 p.m. to 3:00 p.m. on Saturday, January 9. Enrollment is limited to 80.

Computer algebra system (Macsyma, Maple, SMP, etc.) which handle many standard mathematical operations, are emerging as powerful tools for teaching, learning, and doing mathematics. In freshman calculus, for example, a CAS facilitates combining algebraic, numerical, and graphical viewpoints on limits, derivatives, integrals, antiderivatives, Taylor series, differential equations, and other objects. Because CAS's operate in calculator-like interactive mode, without programming, distraction from mathematical content is minimized.

The course will include a detailed demonstration (on-line or simulated) of an introduction to a particular CAS, description (with examples) of a freshman calculus project using CAS at St. Olaf College, and remarks on use of CAS in other courses. Because CAS hardware and software are changing rapidly and teaching experience is limited, the course will raise questions, not give definitive answers. Discussion time will be reserved.

**Minicourse #13: Learning mathematics through discrete dynamical systems** is being organized by James T. Sandefur, Georgetown University. Part A is scheduled from 7:00 p.m. to 9:00 p.m. on Friday, January 8, and Part B from 1:00 p.m. to 3:00 p.m. on Saturday, January 9. Enrollment is limited to 60.

This course will consider difference equations as a dynamical process. Difference equations, which only require an algebra background to study, give students an appreciation of the beauty and applicability of mathematics. There is also a unifying effect in that they can be combined with linear algebra and probability to study interesting models including the Markov processes and predator-prey relationships. Linearization of nonlinear difference equations, which arise in population models and Newton's method, uses differentiation, the product rule, the chain rule, and graphing techniques. This shows students one connection between discrete and continuous mathematics. Other applications include annuities, amortization of loans, selection and mutation in genetics, the gambler's ruin, harvesting strategies, and population models with age structure.

Participants interested in attending any of the MAA Minicourses should have completed the MAA Minicourse Preregistration Form and sent it directly to the MAA office at the address given on the form so as to arrive prior to the November 6 deadline. DO NOT SEND THIS FORM TO PROVIDENCE. Please note that these MAA Minicourses are NOT the AMS Short Course.

The MAA Minicourses are open only to persons who register for the Joint Mathematics Meetings and pay the Joint Meetings registration fee.

The registration fee for MAA Minicourses #1, #2, #5, #7, #10, and #11 is $40 each. The registration fee for the other MAA Minicourses is $30 each.

**Contributed Papers**

Contributed papers were accepted on four topics in collegiate mathematics. The topics, organizers, their affiliations, and days they will meet are:

- *Teaching mathematical modeling*, Jeanne Agnew, Oklahoma State University, 1:00 p.m. Saturday.
- *History of contemporary mathematics*, Florence D. Fasanelli, Sidwell Friends School, Washington, DC,
Meetings

Victor J. Katz, University of District of Columbia, and V. Frederick Rickey, Bowling Green State University, Wednesday 8:30 a.m.
- Strategies for teaching geometry, Doris Schattschneider, Moravian College, 1:00 p.m. Saturday.
- Writing as part of the mathematics curriculum, Andrew Sterrett, Denison College, 2:15 p.m. Thursday, 8:00 a.m. Friday, and 1:00 p.m. Saturday.
Late papers will not be accepted.

Other MAA Sessions

Software Session
A panel discussion on Software issues - pricing, copy protection, copyright is being sponsored by the Committee on Computers in Mathematics Education (CCIME) and is scheduled from 8:30 a.m. to 10:55 a.m. on Wednesday, January 6. The moderator is Howard Anton, Drexel University. The participants are Michael C. Gemignani, University of Maine; William H. Graves, University of North Carolina; Kevin Howat, Wadsworth Publishing; Alan Jacobs, Addison-Wesley Publishing; and Peter Trotter, CONDUIT and University of Iowa. Software authors may be interested in attending this panel discussion as it will be concerned with a variety of important issues faced by authors of mathematical pedagogical software.

First Two Years Panel Discussion
The CUPM subcommittee on the First Two Years of College Mathematics is sponsoring a panel discussion titled Compressing five into four: How can we streamline the first two years of college mathematics? The session is scheduled from 9:00 a.m. to 10:55 a.m. on Wednesday, January 6, and will be moderated by Richard D. Anderson, Louisiana State University.

Two-Year College Reception
The Committee on Two-Year Colleges is sponsoring an informal reception for two-year college faculty from 4:30 p.m. to 6:00 p.m. on Wednesday, January 6.

ICME-6 Panel Discussion
A panel discussion titled What can mathematicians contribute to mathematics education? is scheduled from 2:15 p.m. to 4:15 p.m. on Thursday, January 7. The moderator is Eileen L. Poiani, St. Peter's College, and the lead speaker is Jeremy Kilpatrick, University of Georgia. The other participants are George Berzsenyi, Lamar University; Thomas J. Cooney, University of Georgia; Donald M. Hill, Florida A&M University; Warren Page, New York City Technical College; and Lynn A. Steen, St. Olaf College.

Task Force on Minorities Panel Discussion
The Task Force on Minorities in Mathematics is sponsoring a panel discussion titled Mathematics, minorities and the MAA - How do they fit together? It is scheduled from 2:15 p.m. to 4:15 p.m. on Thursday, January 7. The moderator is Reuben Hersh, University of New Mexico. The presenters are Manuel P. Berriozabal, University of Texas at San Antonio; Rogers J. Newman, Southern University; and Paul J. Sally, Jr., University of Chicago. The respondents are Lida K. Barrett, Mississippi State University; Wade Ellis, Jr., West Valley College; and Kenneth A. Ross, University of Oregon. About an hour will be available for open discussion.

MAA-NCTM Panel Discussion
An MAA-NCTM panel discussion on NCTM standards for school mathematics will take place on Friday, January 8, from 8:30 a.m. to 9:20 a.m. The moderator is John A. Dossey, Illinois State University and President of NCTM. Panelists include Christian Hirsch, Western Michigan University.

Computer Algebra Systems Symposium
The Committee on Computers in Mathematics Education (CCIME) is sponsoring a symposium on Applications and implications of computer algebra systems in mathematics instruction. The symposium is being organized by Warren Page, New York City Technical College, and will run from 8:30 a.m. to 10:55 a.m. on Friday, January 8. The program follows:
- 8:30 a.m. - 8:55 a.m. Technology at the high end of the low end: the HP-28C calculator, John W. Kenelly, Clemson University
- 9:00 a.m. - 9:25 a.m. Symbolic computation without a computer algebra system, David A. Smith, Duke University
- 9:30 a.m. - 9:55 a.m. The Colby experience: two classroom examples, Donald Small, Colby College
- 10:00 a.m. - 10:25 a.m. Title to be announced, Bruce W. Char, University of Tennessee at Knoxville
- 10:30 a.m. - 10:55 a.m. New perspectives, current concerns, future directions, Warren Page

NAM-MAA Panel Discussion
The National Association of Mathematicians and the Mathematical Association of America are cosponsoring a panel discussion on the Impact of computer science on the mathematics program, scheduled from 9:30 a.m. to 10:55 a.m. on Friday, January 8. Speakers include David W. Ballew, Western Illinois University, Tenure, promotion and living in a joint department; Mary Ellis, Hampton University, Should math and computer science departments be joint or separate?; Robert Weber, Longwood College, Retraining of math faculty to teach computer science and how do they keep them trained.
(continuing education)?, and MARION HARMON, Florida A&M University, How a computer scientist views teaching in a joint department.

TA/PTI Panel Discussion
The CTUM Subcommittee on Teaching Assistants and Part-Time Instructors is sponsoring a panel discussion scheduled from 10:00 a.m. to 10:55 a.m. on Friday, January 8. The organizer of the panel is BETTYE ANNE CASE, Florida State University. The participants are the organizer; THOMAS F. BANCOFF, Brown University; ANNETTE BLACKWELDER, Florida State University; and JOHN PHILIP HUNEKE, Ohio State University. Most of the time will be an informal exchange between the panel and the audience.

Presentation on Participation of Women
The Committee on the Participation of Women is sponsoring an address on New agenda for women in higher education by DONNA SHAVLIK, Director of the American Council on Education, Office of Women in Higher Education. The talk is scheduled from 1:30 p.m. to 2:20 p.m. on Friday, January 8.

Teaching experiences in Soweto
There will be a special presentation on Saturday, January 9, from 3:15 p.m. to 3:45 p.m. on Teaching experiences in Soweto, given by TERRY LLOYD JENKINS, University of Wyoming.

Audio-Visual Equipment
Rooms where MAA sessions will be held are equipped with one overhead projector and screen. (Invited 50-minute speakers are automatically provided with two overhead projectors.) BLACKBOARDS ARE NOT AVAILABLE.

Prize Session and Business Meeting
The MAA Prize Session and Business Meeting is scheduled from 5:00 p.m. to 6:00 p.m. on Friday, January 8. The Chauvenet Prize and the Award for Distinguished Service to Mathematics will be presented. Some bylaw changes allowing the creation of an Associate Secretary will be submitted to the membership. This meeting is open to all members of the Association.

Board of Governors
The MAA Board of Governors will meet at 9:00 a.m. on Tuesday, January 5. This meeting is open to all members of the Association.

Section Officers
There will be a Section Officers’ meeting at 7:00 p.m. on Tuesday, January 5.

Activities of Other Organizations
The Association for Women in Mathematics (AWM) will sponsor a panel discussion on Is the climate for women in mathematics changing? on Wednesday, January 6 at 3:20 p.m. The moderator is JUDITH ROITMAN, University of Kansas. Panelists include LOUISE HAY, University of Illinois at Chicago; MARY ELLEN RUDIN, University of Wisconsin; NANCY K. STANTON, University of Notre Dame; and KAREN UHLENBECK, University of Chicago.

The AWM Business Meeting will be held at 4:20 p.m. on Wednesday, January 6.

An open reception is being planned by AWM at 9:30 p.m. on Wednesday, January 6.

The AWM will also sponsor the eighth annual Emmy Noether Lecture at 9:00 a.m. on Thursday, January 7. The speaker is KAREN UHLENBECK, University of Chicago. The title of her lecture is Moment maps in stable bundles: Where analysis, algebra, and topology meet.

The Interagency Commission for Extramural Mathematics Programs (ICEMAP) will present a session at 7:15 p.m. on Wednesday, January 6. ICEMAP is a coordinating group of all federal funding agencies which sponsor basic and applied research in mathematical sciences. This includes NSF, DOE and DOD agencies such as AFOSR, ARO, DARPA, NSA and ONR. This forum will provide presentations by the key members of this group about the research opportunities and program trends at their respective agencies. The panel will be chaired/moderated by JUDITH SUNLEY, Director at NSF’s Division of Mathematical Sciences. Members will be available for informal discussion after the panel.

The Joint Policy Board for Mathematics (JPBM) Committee for Mathematics Department Heads has organized a National Meeting of Department Heads on Prolonging the life of faculty resources at 8:45 p.m. on Friday, January 8. Speakers include DONALD J. LEWIS, University of Michigan, Ann Arbor; JOHN A. MITCHEM, San Jose State University; and THOMAS W. TUCKER, Colgate University.

Information on a number of special events being planned for the Atlanta meetings in connection with 100 Years of American Mathematics can be found elsewhere in this announcement.

The National Association of Mathematicians (NAM) will receive the William W. S. Claytor Lecture at 9:00 a.m. on Saturday, January 9, from WADE ELLIS, JR., West Valley College.

NAM will also sponsor a panel discussion on Attracting minority students into undergraduate mathematics through pre-college programs on Saturday, January 9, at 10:00 a.m. The moderator is HARRIETT WALTON, Morehouse College. Panelists include JOHN ALEXANDER, Director, Blacks and Mathematics Program of MAA;
The National Science Foundation (NSF) will sponsor a session at 5:45 p.m. on Wednesday, January 6.

The NSF will also be represented at a booth in the exhibit area. NSF staff members will be available to provide counsel and information on NSF programs of interest to mathematicians. The booth will be open the same days and hours as the exhibits.

The Rocky Mountain Mathematics Consortium (RMMC) Board of Directors will meet on Thursday, January 7, from 2:15 p.m. to 4:15 p.m.

Other Events of Interest

Book Sales

Books published by the AMS and MAA will be sold at discounted prices somewhat below the cost for the same books purchased by mail. These discounts will be available only to registered participants wearing the official meeting badge. Visa and MasterCard credit cards will be accepted for book sale purchases at the meeting. The book sales will be open the same days and hours as the exhibits and are located in Ivy Hall, Hyatt Regency Atlanta.

Exhibits

The book and educational media exhibits will be located in Ivy Hall, Hyatt Regency Atlanta, and will be open Wednesday through Saturday, January 6–9. The hours they will be open are 1:00 p.m. to 5:00 p.m. on Wednesday, 9:00 a.m. to 5:00 p.m. Thursday and Friday, and 9:00 a.m. to noon on Saturday. All participants are encouraged to visit the exhibits during the meeting.

Participants visiting the exhibits will be asked to display their meeting badge or acknowledgment of preregistration from the Mathematics Meetings Housing Bureau in order to enter the exhibit area.

Mathematical Sciences Employment Register

Those wishing to participate in the Employment Register at the Atlanta meetings should read carefully the important article about the Register which follows this meeting announcement.

Accommodations

The rates listed below are subject to an 11 percent sales/occupancy tax. The estimated walking distance from the hotel to the headquarters hotel is given in parentheses following the telephone number. Checkout time for all hotels is 12:00 noon.

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

Reservations at these hotels cannot be made by calling the hotel directly until after December 9, 1987. After December 14, 1987, the rates below may not apply. It is imperative that all hotels listed on the back of the preregistration form be numbered in order of preference to insure accurate hotel assignments.

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

Petition Table

At the request of the AMS Committee on Human Rights of Mathematicians, a table will be made available in the meeting registration area at which petitions on behalf of named individual mathematicians suffering from human rights violations may be displayed and signed by meeting participants acting in their individual capacities.

Signs of moderate size may be displayed at the table, but must not represent that the case of the individual in question is backed by the Committee on Human Rights unless it has, in fact, so voted. Volunteers may be present at the table to provide information on individual cases, but notice must be sent at least seven (7) days in advance of the meeting to the Meetings Department in Providence (telephone 401-272-9500). Since space is limited, it may also be necessary to limit the number of volunteers present at the table at any one time. The Committee on Human Rights may delegate a person to be present at the table at any or all times, taking precedence over other volunteers.

Any material which is not a petition (e.g., advertisements, résumés) will be removed by the staff. When registration closes, any material on the table will be discarded, so individuals placing petitions on the table should be sure to remove them prior to the close of registration.
first-served basis. Any special requests or needs should be indicated on the back of the preregistration form.

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

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

Please make all changes to or cancellations of hotel reservations with the Mathematics Meetings Housing Bureau in Providence before December 23, 1987. The telephone number in Providence is 401-272-9500 (extension 290). After that date, changes should be made directly with the hotel. Cancellations must be made directly with the hotel 48 hours prior to date of arrival in order to receive refunds or deposits. A deposit of $50 is required for each room reservation and may be paid by check, VISA, MASTERCARD, or American Express (for housing only) credit cards. (Canadian checks should be marked “In U.S. funds”.)

The following hotels accept American Express, MasterCard, Visa, Carte Blanche, and Diners’ Club credit cards, personal checks with identification, and travelers’ checks as payment for room charges.

**Hyatt Regency Atlanta, Headquarters Hotel**
265 Peachtree Street Northeast
Atlanta, Georgia 30303
Telephone: 404-577-1234

- Singles $69
- Doubles $80 (1 or 2 beds)
- Triples $89
- Quads $98

There is no charge for children 17 years of age and younger. The Hyatt is a full-service hotel equipped with restaurants, lounge, and outdoor pool. Parking is $8 per day. Rates for suites vary upon request. There is also a small health club including free weights, Universal Paramount machine, sauna and steam room.

**Marriott Marquis**
265 Peachtree Center Avenue
Atlanta, Georgia 30303
Telephone: 404-521-0000 (1 block)

- Singles $71
- Doubles $81 (1 or 2 beds)
- Additional person $20 extra

There is no charge for children 17 years of age and younger. The Marriott is a full-service hotel equipped with restaurants, lounge, and indoor pool. Parking is $8 per day. Rates for suites vary upon request.

**Radisson**
Courtland & International Blvds.
Atlanta, Georgia 30303
Telephone: 404-659-6500 (2 blocks)

- Singles $60
- Doubles $65 (1 or 2 beds)
- Triples $70
- Triples $86 (with cot)
- Quads $75
- Quads $91 (with cot)

There is no charge for children 12 years and younger. The Radisson is a full-service hotel equipped with restaurant, lounge, and indoor pool. Parking is $4 per day. Rates for suites vary upon request.

**American**
Spring Street at International
Atlanta, Georgia 30303
Telephone: 800-621-7885 (2 blocks)

- Singles $55
- Doubles $60 (1 or 2 beds)
- Triples $65
- Triples $70 (with cot)
- Quads $65
- Quads $70 (with cot)

There is no charge for children 17 years and younger. The American is a full-service hotel equipped with restaurant, coffee shop, outdoor pool, and lounge. Parking is $2 per day. Rates for suites vary upon request.
DOWNTOWN ATLANTA

1. American Hotel
2. Atlanta Marriott Marquis
11. Days Inn Downtown
16. Hyatt Regency Atlanta (Headquarters)
20. Radisson Hotel Atlanta
Meetings

Days Inn Downtown
300 Spring Street
Atlanta, Georgia 30308
Telephone: 800-325-2525 (1 block)

Singles $55
Doubles $65 (1 or 2 beds)
Triples $65
Quads $65

The Days Inn Downtown is a full-service hotel equipped with a restaurant and outdoor pool. Parking is $3 per day. Rates for suites vary upon request.

Most hotel facilities are accessible to the handicapped. People with special requirements should contact the Mathematics Meetings Housing Bureau. The Hyatt has two specially equipped rooms for handicapped.

San Antonio Room Lottery Winners
The following participants received a complimentary hotel room during the San Antonio meetings. They qualified for these rooms by submitting their Preregistration/Housing Form by the early preregistration deadline. Since these rooms can be occupied by as many as four persons, this represented a considerable savings.

Hyatt Regency
John E. Sasser
Norman R. Howes
Robert L. Devaney

Travelodge
Michael J. Evans

Holiday Inn
Ronald D. Jamison

La Quinta Market Square
Greg A. Kirmayer
Donald E. Sarason
George Crocker

La Quinta Convention Center
Edwin E. Moise

Employment Register
Employer $100
Additional interviewers (each) $50
Applicant $20
Employer Posting fee $15

AMS Short Course
Student/Unemployed $15
All Other Participants $45

MAA Minicourses
(if openings available)
Minicourses # 1, 2, 5, 7, 10, or 11 $40
Minicourses # 3, 4, 6, 8, 9, 12, or 13 $30

AMS-MAA-TUG Workshop $80

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 enter the exhibit area, to obtain discounts at the AMS and MAA Book Sales, to cash a check with the meeting cashier, and to attend all sessions scheduled in the Regency Ballroom in the Hyatt Regency Atlanta. (If a preregistrant should arrive too late in the day to pick up his/her badge, he/she may show the acknowledgment of preregistration received from the Mathematics Meetings Housing Bureau as proof of registration.) The fees for Joint Meetings registration at the meeting listed below are 30 percent more than the preregistration fees.

Participants wishing to attend sessions for one day only may take advantage of the one-day fees listed below. These special fees are effective daily January 6 through 9, and are available at the meeting 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, CMS, MAA $79
Emeritus Member of AMS, MAA $22
Nonmember $122
Student/Unemployed $22

Joint Mathematics Meetings One-Day
Member of AMS, CMS, MAA $41
Nonmember $63

AMS Short Course
Student/Unemployed $15
All Other Participants $45

MAA Minicourses
(if openings available)
Minicourses # 1, 2, 5, 7, 10, or 11 $40
Minicourses # 3, 4, 6, 8, 9, 12, or 13 $30

AMS-MAA-TUG Workshop $80

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 American Express is being accepted by hotels for housing payments, unfortunately, only Visa or MasterCard can be accepted for registration.

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 from his or her latest position.

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

Registration Dates, Times, and Locations

AMS Short Course
Outside Essex A & B, Hyatt Regency Atlanta
Tuesday, January 5 8:00 a.m. to 2:30 p.m.

Joint Mathematics Meetings
[and MAA Minicourses (until filled)]
Ivy Hall, Hyatt Regency Atlanta
Tuesday, January 5 4:00 p.m. to 8:00 p.m.
Wednesday, January 6 through Friday, January 8 7:30 a.m. to 4:00 p.m.
Saturday, January 24 7:30 a.m. to 3:00 p.m.

AMS-MAA-TUG Workshop
Outside English Suite, Hyatt Regency Atlanta
Tuesday, January 5 8:00 a.m. to 9:30 a.m.

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

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

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

Rooms where special sessions and contributed paper sessions will be held are equipped with an overhead projector and screen. Blackboards will not be available.

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

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

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

Lost and Found
See the Joint Meetings cashier.

Information Table
The information table at Joint Meetings of the AMS and MAA is set up in the registration area for the dissemination of information of a nonmathematical nature of possible interest to the members. The administration of the information table is in the hands of the AMS-MAA Joint Meetings Committee, as are all arrangements for such joint meetings. The following rules and procedures apply.

1. Announcements submitted by participants should ordinarily be limited to a single sheet no more than 8 1/2”×14”.

2. A copy of any announcement proposed for the table is to be sent to the Director of Meetings, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940 to arrive at least one week before the first day of the scientific sessions.

3. The judgment on the suitability of an announcement for display rests with the Joint Meetings Committee. It will make its judgments on a case by case basis to establish precedents.

4. Announcements of events competing in time or place with the scheduled scientific program will not be accepted.

5. Copies of an accepted announcement for the table are to be provided by the proponent. Announcements are not to be distributed in any other way at the meeting (for example, not by posting or personal distribution of handbills).

6. It may be necessary to limit the number of events or the quantity of announcements distributed at a meeting.

7. At the close of registration, the table will be swept clean. A proponent who wishes the return of extra copies should remove them.
Mail
All mail and telegrams for persons attending the meetings should be addressed as follows: Name of Participant, c/o Joint Mathematics Meetings, Atlanta Convention and Visitors Bureau, 233 Peachtree Street NE, Suite 200, Peachtree Harris Building, Atlanta, GA 30043. Mail and telegrams so addressed may be picked up at the mailbox in the registration area during the hours the registration desk is open. U.S. mail not picked up will be forwarded after the meeting to the mailing address given on the participant’s registration record.

Personal and Telephone Messages
Participants wishing to exchange messages during the meeting should use the mailbox mentioned above. Message pads and pencils are provided. It is regretted that such messages left in the box cannot be forwarded to participants after the meeting is over.
A telephone message center is located in the registration area to receive incoming calls for participants. The center is open from January 5 through 9, during the hours that the Joint Mathematics Meetings registration desk is open. Messages will be taken and the name of any individual for whom a message has been received will be posted until the message has been picked up at the message center. The telephone number of the message center is 404-681-2456.

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

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

Miscellaneous Information
Child Care
There are two state-licensed child care facilities that are available. Reservations should be made directly with the facility of your choice.
ABC Atlanta Best Care, 404-451-2884-5, 3154 Shallowford Road, Atlanta 30341. Contact Wendy. All ages. In the Hyatt Regency Atlanta. Rates: $4 per hour, 4 hour minimum, $7.50 booking fee. Maximum $12. Please make reservations by December 1.
The Wonderful World of Children, 404-881-6668, 1316 West Peachtree, Atlanta 30309. Located near the Arts Center MARTA Station (See Local Information). Contact Melanie. Ages 6 weeks to 11 years. Hours: 24 hours per day, 7 days a week. Rates: $3.50 per hour under 30 months old; $3 per hour over 30 months old. One time insurance fee $10. Please make reservations at least one week in advance.

In addition, a Parent-Child Lounge will be located adjacent to the Joint Meetings registration area in Ivy Hall of the Hyatt. It will be furnished with casual furniture, cribs, a changing area, some assorted toys and a television set. Any child using this lounge MUST be accompanied by a parent (not simply an adult) who must be responsible for supervision of the child. This lounge will be unattended and parents assume all responsibility for their children. This lounge will only be open during the hours of registration and all persons must leave the lounge at the close of registration each day.
The Hyatt Regency Atlanta has a limited number of cribs. Reservations should be made by December 1 directly through the Mathematics Meetings Housing Bureau. Metal portacribs can be rented from Aaron Rents, 1853 Piedmont Road, Atlanta 30324, 404-873-1455. Reservations should be made by December 1. The cost is approximately $12.50 per week. Tax is 5 percent. Aaron Rents is about three miles from the Hyatt. They will deliver to the Hyatt for $31.50. Contact the manager, Scott Boswell.

Local Information
Atlanta, the state capitol, is located in the northwest part of Georgia. Since its inception, Atlanta has been a transportation hub, first with the railways and now with the airlines. Hartsfield Airport is the busiest in the world. Atlanta is a major commercial center and the home of Coca Cola.

Bus and rapid rail service are available by MARTA, Metropolitan Atlanta Rapid Transit Authority, 404-522-4711, where 152 bus routes feed into 26 rail stations. The Peachtree Center Station is one block from the Hyatt. Passengers can ride anywhere MARTA serves for 75 cents, exact change required. Tokens are 8 for $5 and 10 for $6. Tokens are available at the main Five Points station and from machines ($5 only) in all MARTA stations. The downtown Atlanta map shows rapid rail stations (see dotted line along Peachtree Street).
Downtown sights include:
Carter Presidential Center, (about three miles from Hyatt), 1 Copen Hill, 404-331-3942. President Jimmy Carter’s life and administration and the office of the presidency itself are portrayed. Accessible by MARTA bus #16 from the Five Points station.
Federal Reserve Bank, (about one mile from Hyatt), Monetary Museum, 104 Marietta Street, NW, 404-521-8747. The Monetary Museum traces the evolution of currency through the ages, and is located a few blocks from the Five Points station.
MICA, Inc., the official travel management firm for the Joint Mathematics Meetings to be held in Atlanta, January 6-9, 1988, has arranged for special discounts aboard Eastern and American Airlines.

Save 5% off all published promotional fares, meeting all restrictions, or 35% off regular roundtrip coach fares, with a 7-day advance purchase. It may be possible to receive an even lower airfare depending on your individual circumstances.

Win a free airline ticket...simply make your reservations through MICA's toll-free number and your name will be entered into a drawing for a free roundtrip ticket good for travel throughout the Continental U.S.

Additional savings...with all tickets purchased through MICA, you will receive a free transfer from the airport to the hotel.

Sample Airfares to Atlanta
(Quoted 8/21/87 and subject to change)

<table>
<thead>
<tr>
<th>Originating City</th>
<th>Coach Fares</th>
<th>Discounted Coach Fares</th>
<th>Discounted Promotional Fares</th>
<th>Non-Refundable Fares</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>$632.00</td>
<td>$410.80</td>
<td>$264.10</td>
<td>$278.00</td>
</tr>
<tr>
<td>Chicago</td>
<td>$630.00</td>
<td>$409.50</td>
<td>$283.10</td>
<td>$278.00</td>
</tr>
<tr>
<td>San Francisco</td>
<td>$1,022.00</td>
<td>$664.30</td>
<td>$311.60</td>
<td>$288.00</td>
</tr>
</tbody>
</table>

Please Note: The lowest published promotional fares require a Saturday night stay, are subject to an airline change/cancellation penalty, and must be purchased at least 30 days prior to departure. The airlines limit the number of promotional fares for each flight; therefore, we recommend that you make your reservations as early as possible.

Make your reservations today! MICA reservationists can obtain the lowest available fare on any airline. You may pay by credit card or ask to be invoiced. We urge you to purchase your airline tickets without delay using your credit card. This will confirm your reservation, the current airfare and protect you against later fare increases.

Remember, these special discounts are available only through MICA's toll-free number.

Call 1-800-888-MICA And Save!
Monday - Friday, 9:00 a.m. - 5:30 p.m. E.S.T.
Meetings

Fox Theater, (about one mile from Hyatt), 660 Peachtree Street, NE, 404-881-1977. The Fox is fancy outside with its minarets, onion domes and parapets and inside with Egyptian-Art Deco trappings. Hosts a wide range of live performance, and is adjacent to the North Avenue station.

Georgia State Capitol, (about one and one half miles from Hyatt), Capitol Hill at Washington Street, 404-656-2844. Besides the state offices included are natural science displays, A Hall of Flags and a Hall of Fame honoring outstanding Georgians; located one block south of the Georgia State station.

High Museum of Art, (about two miles from Hyatt), 1280 Peachtree Street, NE, 404-892-3600, 24-hour information line 892-HIGH. Contains collections of European and American paintings, sculpture and decorative arts, photography, prints and graphics and international traveling exhibits. Covered walk leads from adjacent Arts Center station.

High Museum at Georgia-Pacific Center, (about four blocks from Hyatt) 133 Peachtree Street, NE, 404-577-6940. Contains works from the “uptown” High Museum along with rotating traveling exhibits, adjacent to the Peachtree Center station.

Martin Luther King, Jr. Historical Site, Auburn Avenue between Jackson and Randolph Streets, two blocks associated with Martin Luther King, Jr., the Nobel Peace Prize winner and civil rights leader. The birth home: 507 Auburn Avenue, 404-331-5190. Ebenezer Baptist Church: 407 Auburn Avenue, 404-688-7263. Gravesite: 449 Auburn Avenue, 404-524-1956. MARTA bus #3 (Auburn Avenue) from Five Points and #3 (MLK) from Edgewood/Candler Park station.

Metropolitan highlights include:


Cyclorama, Grant Park, Georgia and Cherokee Avenues, SE, 404-658-7625. Immense painting in the round of the Civil War Battle of Atlanta, also a film and exhibits. Take Marta bus #31 (Grant Park), #97 (Atlanta Avenue/Georgia Avenue), #32 (Eastland) from Five Points station.

Georgia’s Stone Mountain Park, (about fifteen miles from Hyatt), Highway 78, Stone Mountain, GA, 404-498-5600. The world’s largest bas-relief sculpture on the world’s largest mass of granite, a 3200 acre park with skating, camping, swimming, fishing, tennis and golf. Take MARTA bus #120 from Avondale station, limited return bus service on weekdays.

Lenox Square, (about seven miles from Hyatt), 3393 Peachtree Road, NE, 404-233-6767. The South’s oldest and largest shopping center. Rich’s, Macy’s, Neiman-Marcus and over 100 shops, restaurants and boutiques; adjacent to Lenox station.

Smoking

Please note that smoking is not allowed in any of the session rooms in the Hyatt Regency Atlanta or the Atlanta Marriott Marquis.

Travel

In January, Atlanta is on Eastern Standard Time. The city is served by most major U.S. airlines. The airport lies about ten miles south of the Hyatt. The airport shuttle runs every half hour to the Hyatt. It costs $7.50 one way. Cab fare to the Hyatt should cost $14.

For some years now, the AMS-MAA Joint Meetings Committee has engaged a travel agent for the January and August Joint Meetings in an effort to ensure that everyone attending these meetings is able to obtain the best possible airfare. This service is presently being performed by Meetings, Incentives, Conventions of America, Inc. (MICA); their advertisement can be found elsewhere in this meeting announcement. Although any travel agent can obtain Supersaver or other such published promotional fares, only MICA can obtain the special additional 5 percent discount over and above these fares, and the 35 percent off regular coach fare. The latter, of course, is financially beneficial only when one does not qualify for one of the promotional fares. Participants should pay particular attention to the cancellation policies stated in the ad.

If you drive to Atlanta, you will approach the Hyatt from the North on I-75 and I-85. Exit the interstate onto Courtland Street, proceed south about three blocks and turn right onto International Boulevard. Proceed west two blocks and turn right onto Peachtree Center Avenue. The Hyatt parking entrance is about two blocks north on Peachtree Center Avenue. See map of downtown Atlanta.

If you approach the Hyatt from the south on I-75 and I-85, exit the interstate onto International Boulevard. Now follow the directions in the proceeding paragraph.

The interstate near the Courtland Street exit and the International Boulevard exit is being widened. Markers are temporary and are subject to change.

Weather

In January the normal high is 52 degrees F and the normal low is 37 degrees F. Rain is common and sleet is not uncommon. It rarely snows. Weather conditions may be variable, mild one day and cold the next.
### Timetable
(Eastern Standard Time)

The final version of the Timetable and Program, including room assignments, will be distributed at the meeting.

**Tuesday, January 5**

<table>
<thead>
<tr>
<th>Time</th>
<th>American Mathematical Society</th>
<th>Mathematical Association of America</th>
<th>Other Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MORNING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:00 a.m. - 9:30 a.m.</td>
<td>REGISTRATION FOR TUG WORKSHOP Outside English Suite, HR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:00 a.m. - 4:00 p.m.</td>
<td>BOARD OF GOVERNORS' MEETING</td>
<td></td>
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</tr>
<tr>
<td>9:00 a.m. - 9:00 p.m.</td>
<td>AMS-MAA-TUG WORKSHOP</td>
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<tr>
<td><strong>AFTERNOON</strong></td>
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<tr>
<td>4:00 p.m. - 8:00 p.m.</td>
<td>JOINT MEETINGS REGISTRATION Ivy Hall, HR</td>
<td></td>
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</tr>
<tr>
<td>5:00 p.m. - 10:00 p.m.</td>
<td>COUNCIL MEETING</td>
<td></td>
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<tr>
<td><strong>EVENING</strong></td>
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</tr>
<tr>
<td>7:00 p.m. - 9:00 p.m.</td>
<td>SECTION OFFICERS' MEETING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7:00 p.m. - 9:00 p.m.</td>
<td>MINICOURSE #1 (Part A) Using computer graphing to enhance the teaching and learning of calculus and precalculus mathematics Franklin D. Demana Bert K. Waits</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HR = Hyatt Regency
### TIMETABLE

**Wednesday, January 6**

#### MORNING

<table>
<thead>
<tr>
<th>7:30 a.m. - 4:00 p.m.</th>
<th><strong>American Mathematical Society</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>8:30 a.m. - 10:55 a.m.</th>
<th>COMMITTEE ON COMPUTERS IN MATHEMATICS EDUCATION PANEL DISCUSSION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Software issues - pricing, copy protection, copyright</td>
</tr>
<tr>
<td></td>
<td>Howard Anton (moderator)</td>
</tr>
<tr>
<td></td>
<td>Michael C. Gemignani</td>
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<td></td>
<td>William H. Graves</td>
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<td></td>
<td>Kevin Howat</td>
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<td></td>
<td>Alan Jacobs</td>
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<tr>
<td></td>
<td>Peter Trotter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8:30 a.m. - 10:55 a.m.</th>
<th>CONTRIBUTED PAPER SESSION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>History of contemporary mathematics</td>
</tr>
<tr>
<td></td>
<td>Florence D. Fasanelli</td>
</tr>
<tr>
<td></td>
<td>Victor J. Katz</td>
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<tr>
<td></td>
<td>V. Frederick Rickey</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9:00 a.m. - 9:50 a.m.</th>
<th>INVITED ADDRESS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Means and their iterates</td>
</tr>
<tr>
<td></td>
<td>Roger D. Nussbaum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9:00 a.m. - 10:55 a.m.</th>
<th>CUPM SUBCOMMITTEE ON THE FIRST TWO YEARS OF COLLEGE MATHEMATICS PANEL DISCUSSION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compressing five into four: How can we streamline the first two years of college mathematics?</td>
</tr>
<tr>
<td></td>
<td>Richard D. Anderson (moderator)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9:00 a.m. - 10:55 a.m.</th>
<th>MINICOURSE #2 (Part A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Computer software for differential equations</td>
</tr>
<tr>
<td></td>
<td>Howard Lewis Penn</td>
</tr>
<tr>
<td></td>
<td>James Buchanan</td>
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</tbody>
</table>

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<thead>
<tr>
<th>9:00 a.m. - 10:55 a.m.</th>
<th>MINICOURSE #3 (Part A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teaching mathematical modeling</td>
</tr>
<tr>
<td></td>
<td>Frank R. Giordano</td>
</tr>
<tr>
<td></td>
<td>Maurice D. Weir</td>
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</tbody>
</table>

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<thead>
<tr>
<th>9:00 a.m. - 10:55 a.m.</th>
<th>MINICOURSE #4 (Part A)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Teaching calculus with an HP-28C symbol manipulating calculator</td>
</tr>
<tr>
<td></td>
<td>John W. Kenelly</td>
</tr>
<tr>
<td></td>
<td>Thomas W. Tucker</td>
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</tbody>
</table>

**REGISTRATION**

Ivy Hall, HR

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**HR = Hyatt Regency**

JANUARY 1988, VOLUME 35, NUMBER 1 77
### Wednesday, January 6 (cont'd)

#### MORNING (cont'd)

- **9:00 a.m. - 9:30 a.m.**  
  Employment Register Orientation Session

- **9:30 a.m. - 4:00 p.m.**  
  Employment Register Registration

- **10:05 a.m. - 10:55 a.m.**  
  Invited Address  
  The Macdonald root system conjectures and their significance  
  Philip J. Hanlon

- **11:10 a.m. - noon**  
  AMS-MAA Invited Address  
  How computers have changed the way I teach  
  John G. Kemeny

#### AFTERNOON

- **1:00 p.m. - 2:00 p.m.**  
  Colloquium Lecture I  
  Spectral properties of Riemannian manifolds  
  Victor W. Guillemin

- **1:00 p.m. - 5:00 p.m.**  
  Exhibit and Book Sale  
  Book Sale

- **1:00 p.m. - 5:00 p.m.**  
  Ex Libris

- **2:15 p.m. - 3:15 p.m.**  
  Committee on Science Policy Special Presentation  
  Why the SDI software could never be trusted  
  David L. Parnas

- **2:15 p.m. - 3:05 p.m.**  
  Invited Address  
  Singularly perturbed equations - theory vs. applications  
  Jane Cronin Scanlon

- **2:15 p.m. - 5:35 p.m.**  
  Special Sessions  
  Banach space theory I
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
</table>
| 2:15 p.m. - 6:05 p.m. | SPECIAL SESSIONS  
Modern trends in matrix analysis and applications I |
| 2:15 p.m. - 6:05 p.m. | Measure theory and descriptive set theory I                        |
| 2:15 p.m. - 6:05 p.m. | Nonlinear differential delay equations I                           |
| 2:15 p.m. - 6:05 p.m. | Total positivity and applications I                                |
| 2:15 p.m. - 6:05 p.m. | Abelian groups I                                                   |
| 2:15 p.m. - 6:05 p.m. | Structural complexity theory I                                     |
| 2:15 p.m. - 6:05 p.m. | Optimization I                                                     |
| 2:15 p.m. - 6:05 p.m. | Combinatorics and group representations I                          |
| 2:15 p.m. - 4:15 p.m. | MINICOURSE #5 (Part A)  
Logo and problem solving  
Charles A. Jones |
| 2:15 p.m. - 4:25 p.m. | SESSIONS FOR CONTRIBUTED PAPERS  
Applied mathematics                                                   |
<p>| 2:15 p.m. - 5:40 p.m. | Boundary behavior and partial differential equations               |
| 2:15 p.m. - 5:25 p.m. | Complex analysis                                                    |
| 2:15 p.m. - 5:55 p.m. | General topology                                                    |
| 2:15 p.m. - 5:25 p.m. | Graph theory                                                        |
| 2:15 p.m. - 4:10 p.m. | History and education                                               |
| 2:15 p.m. - 5:40 p.m. | Number theory I                                                     |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Session/Activity</th>
</tr>
</thead>
</table>
| 2:15 p.m. - 5:25 p.m. | SESSION FOR CONTRIBUTED PAPERS  
                         | Probability and statistics                                                    |
| 3:20 p.m. - 4:10 p.m. | INVITED ADDRESS  
                        | Perpendicular arrays and graph decompositions  
                         | Charles C. Lindner                                                          |
| 3:20 p.m. - 4:20 p.m. | MINICOURSE #1 (Part B)  
                        | Using computer graphing to enhance the teaching and learning of calculus and precalculus mathematics  
                        | Franklin D. Demana  
                        | Bert K. Waits                                                               |
| 4:20 p.m. - 4:50 p.m. | MINICOURSE #6 (Part A)  
                        | Coloring and path following algorithms for approximating roots and fixed points  
                        | William F. Lucas                                                            |
| 4:30 p.m. - 6:00 p.m. | TWO-YEAR COLLEGE RECEPTION                                                        |
| 5:45 p.m. - 6:45 p.m. | NATIONAL SCIENCE FOUNDATION                                                       |
| 7:15 p.m. - 8:15 p.m. | INTERAGENCY COMMISSION FOR EXTRAMURAL MATHEMATICS PROGRAMS (ICEMAP)  
                        | Judith Sunley (moderator)                                                     |
|            | ASSOCIATION FOR WOMEN IN MATHEMATICS PANEL DISCUSSION  
                        | Is the climate for women in mathematics changing?  
                        | Louise Hay  
                        | Judith Roitman (moderator)  
                        | Mary Ellen Rudin  
                        | Nancy K. Stanton  
                        | Karen Uhlenbeck                                                            |
|            | AWM BUSINESS MEETING                                                             |
|            | PANEL DISCUSSION  
                        | Is the climate for women in mathematics changing?  
                        | Louise Hay  
                        | Judith Roitman (moderator)  
                        | Mary Ellen Rudin  
                        | Nancy K. Stanton  
                        | Karen Uhlenbeck                                                            |
|            | AWM BUSINESS MEETING                                                             |

**Wednesday, January 6 (cont'd)**

**AFTERNOON (cont'd)**
<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td><strong>Wednesday, January 6 (cont'd)</strong></td>
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</tr>
<tr>
<td>EVENING (cont'd)</td>
<td>JOSIAH WILLARD GIBBS LECTURE</td>
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<tr>
<td>8:30 p.m. - 9:30 p.m.</td>
<td>How natural is our mathematics? The example of equilibrium statistical mechanics. David P. Ruelle</td>
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<tr>
<td>9:30 p.m. - 11:00 p.m.</td>
<td>AWM OPEN RECEPTION</td>
<td></td>
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<tr>
<td><strong>Thursday, January 7</strong></td>
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<tr>
<td>MORNING</td>
<td>REGISTRATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7:30 a.m. - 4:00 p.m.</td>
<td>Ivy Hall, HR</td>
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</tr>
<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>SPECIAL SESSIONS</td>
<td></td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Banach space theory II</td>
<td></td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Modern trends in matrix analysis and applications II</td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Measure theory and descriptive set theory II</td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Nonlinear differential delay equations II</td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Total positivity and applications II</td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Abelian groups II</td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Structural complexity theory II</td>
<td></td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Optimization II</td>
<td></td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Combinatorics and group representations II</td>
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<th>American Mathematical Society</th>
<th>Mathematical Association of America</th>
<th>Other Organizations</th>
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<tbody>
<tr>
<td>8:05 a.m. - 10:45 a.m.</td>
<td><strong>SESSIONS FOR CONTRIBUTED PAPERS</strong></td>
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<tr>
<td></td>
<td><em>Algebraic topology and manifolds</em></td>
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<td>8:05 a.m. - 10:45 a.m.</td>
<td><em>Boundary behavior and approximation theory</em></td>
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<td>8:05 a.m. - 10:45 a.m.</td>
<td><em>Operator theory</em></td>
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<td>8:20 a.m. - 10:45 a.m.</td>
<td><em>Complex variables and special functions</em></td>
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<td>8:20 a.m. - 9:15 a.m.</td>
<td><em>Number theory II</em></td>
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<td>8:50 a.m. - 10:45 a.m.</td>
<td><em>Structures with order</em></td>
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<td>9:00 a.m. - 9:50 a.m.</td>
<td><strong>INVITED ADDRESS</strong></td>
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<tr>
<td></td>
<td><em>What does it mean to understand the function concept?</em></td>
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<td></td>
<td><em>Lawrence Couvillon</em></td>
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<td>9:00 a.m. - 10:00 a.m.</td>
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<td>9:00 a.m. - 10:55 a.m.</td>
<td><strong>MINICOURSE #5 (Part B)</strong></td>
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<td></td>
<td><em>Logo and problem solving</em></td>
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<td></td>
<td><em>Charles A. Jones</em></td>
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<td>9:00 a.m. - 5:00 p.m.</td>
<td><strong>EXHIBIT AND BOOK SALE</strong></td>
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<td>9:00 a.m. - 5:00 p.m.</td>
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<td>9:00 a.m.</td>
<td><strong>EMPLOYMENT REGISTER DISTRIBUTION OF SCHEDULES</strong></td>
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<td>9:05 a.m. - 10:45 a.m.</td>
<td><strong>SESSION FOR CONTRIBUTED PAPERS</strong></td>
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<td></td>
<td><em>Optimization and control</em></td>
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</table>

**AWM EMMY NOETHER LECTURE**
Moment maps in stable bundles: Where analysis, algebra, and topology meet
Karen Uhlenbeck

**NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY**
### Thursday, January 7 (cont'd)

#### MORNING (cont'd)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>9:30 a.m. - 5:30 p.m.</td>
<td>American Mathematical Society</td>
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<tr>
<td>9:50 a.m. - 10:45 a.m.</td>
<td>SESSION FOR CONTRIBUTED PAPERS Statistics</td>
</tr>
<tr>
<td>10:05 a.m. - 10:55 a.m.</td>
<td>INVITED ADDRESS Karmarkar's linear programming algorithm and nonlinear programming Jeffrey C. Lagarias</td>
</tr>
<tr>
<td>11:10 a.m. - noon</td>
<td>AMS-MAA INVITED ADDRESS Oscar Zariski and his work David Mumford</td>
</tr>
</tbody>
</table>

#### AFTERNOON

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>1:00 p.m. - 2:00 p.m.</td>
<td>COLLOQUIUM LECTURE II Spectral properties of Riemannian manifolds Victor W. Guillemin</td>
</tr>
<tr>
<td>2:15 p.m. - 3:05 p.m.</td>
<td>INVITED ADDRESS Hyperbolic conservation laws in classical physics: recent results and open problems Constantine M. Dafermos</td>
</tr>
</tbody>
</table>
### TIMETABLE

#### Thursday, January 7 (cont'd)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
</table>
| 2:15 p.m. - 4:15 p.m. | ICME-6 PANEL DISCUSSION  
What can mathematicians contribute to mathematics education?  
George Berzsenyi  
Thomas J. Cooney  
Donald M. Hill  
Jeremy Kilpatrick  
Warren Page  
Eileen L. Poiani (moderator)  
Lynn A. Steen |
| 2:15 p.m. - 4:10 p.m. | CONTRIBUTED PAPER SESSION  
Writing as part of the mathematics curriculum (Part A)  
Andrew Sterrett |
| 2:15 p.m. - 4:15 p.m. | MINICOURSE #2 (Part B)  
Computer software for differential equations  
Howard Lewis Penn  
James Buchanan |
| 2:15 p.m. - 4:15 p.m. | MINICOURSE #3 (Part B)  
Teaching mathematical modeling  
Frank R. Giordano  
Maurice D. Weir |
| 2:15 p.m. - 4:15 p.m. | MINICOURSE #4 (Part B)  
Teaching calculus with an HP-28C symbol manipulating calculator  
John W. Kenelly  
Thomas W. Tucker |
| 2:15 p.m. - 4:15 p.m. | ROCKY MOUNTAIN MATHEMATICS CONSORTIUM BOARD OF DIRECTORS' MEETING |
| 3:20 p.m. - 4:10 p.m. | INVITED ADDRESS  
Topology and combinatorics of affine subspaces of Euclidean space  
R. Mark Goresky |
<p>| 4:25 p.m. - 6:00 p.m. | BIRKHOFF PRIZE SESSION AND BUSINESS MEETING |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:00 p.m. - 9:00 p.m.</td>
<td><strong>MINICOURSE #3 (Part C) Teaching mathematical modeling</strong></td>
</tr>
<tr>
<td></td>
<td>Frank R. Giordano</td>
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<td>Maurice D. Weir</td>
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<td>7:00 p.m. - 9:00 p.m.</td>
<td><strong>MINICOURSE #6 (Part B) Coloring and path following algorithms</strong></td>
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<td>for approximating roots and fixed points</td>
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<td>William F. Lucas</td>
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**Friday, January 8**

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>7:30 a.m. - 4:00 p.m.</td>
<td><strong>REGISTRATION</strong></td>
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<td>Ivy Hall, HR</td>
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<td>8:00 a.m. - 10:55 a.m.</td>
<td><strong>CONTRIBUTED PAPER SESSION</strong> Writing as part of the mathematics</td>
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<td></td>
<td>curriculum (Part B)</td>
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<td>Andrew Sterrett</td>
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<td>8:30 a.m. - 9:20 a.m.</td>
<td><strong>MAA-NCTM PANEL DISCUSSION</strong> NCTM standards for school mathematics</td>
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<tr>
<td></td>
<td>John A. Dossey</td>
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<td>Christian Hirsch</td>
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<td>8:30 a.m. - 10:55 a.m.</td>
<td><strong>COMMITTEE ON COMPUTERS IN MATHEMATICS EDUCATION SYMPOSIUM</strong></td>
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<tr>
<td></td>
<td>Applications and implications of computer algebra systems</td>
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<td></td>
<td>in mathematics instruction</td>
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<td></td>
<td>Bruce W. Char</td>
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<td>John W. Kenelly</td>
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<td></td>
<td>Warren Page (organizer)</td>
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<td>Donald Small</td>
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<td>David A. Smith</td>
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**TIMETABLE**

**Friday, January 8 (cont'd)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</table>
| 9:00 a.m. - 9:50 a.m. | **INVITED ADDRESS**  
**Nonlinear Fourier analysis**  
Stephen William Semmes |
| 9:00 a.m. - 10:55 a.m. | **MINICOURSE #7 (Part A)**  
**Computer based discrete mathematics**  
Nancy Baxter  
Ed Dubinsky |
| 9:00 a.m. - 10:55 a.m. | **MINICOURSE #8 (Part A)**  
**Laboratory projects for first year calculus**  
L. Carl Leinbach |
| 9:00 a.m. - 10:55 a.m. | **MINICOURSE #9 (Part A)**  
**Constructing placement examinations**  
John G. Harvey |
| 9:00 a.m. - 5:00 p.m. | **EXHIBIT AND BOOK SALE**  
**BOOK SALE** |
| 9:00 a.m. - 5:00 p.m. | **EXHIBITS** |
| 9:00 a.m. | **EMPLOYMENT REGISTER DISTRIBUTION OF SCHEDULES** |
| 9:30 a.m. - 10:55 a.m. | **NAM-MAA PANEL DISCUSSION**  
**Impact of computer science on the mathematics program**  
David W. Ballew (moderator)  
Mary Ellis  
Robert Weber  
Marion Harmon |
| 9:30 a.m. - 5:30 p.m. | **EMPLOYMENT REGISTER INTERVIEWS** |
### Friday, January 8 (cont'd)

#### MORNING (cont'd)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</table>
| 10:00 a.m. - 10:55 a.m. | CTUM SUBCOMMITTEE ON TEACHING ASSISTANTS AND PART-TIME INSTRUCTORS PANEL DISCUSSION  
Thomas F. Banchoff  
Annette Blackwelder  
Bettye Anne Case (organizer)  
John Philip Huneke |
| 10:05 a.m. - 10:55 a.m. | INVITED ADDRESS  
Symplectic structures on manifolds  
Dusa McDuff |
| 11:10 a.m. - noon | AMS-MAA INVITED ADDRESS  
The European mathematicians' migration to America  
Lipman Bers |

#### AFTERNOON

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</table>
| 12:30 p.m. - 4:50 p.m. | SPECIAL SESSIONS  
Applications of differential equations to population ecology I |
| 1:00 p.m. - 2:00 p.m. | COLLOQUIUM LECTURE III  
Spectral properties of Riemannian manifolds  
Victor W. Guillemin |
| 1:00 p.m. - 4:50 p.m. | SPECIAL SESSIONS  
Ordered algebraic systems I  
Toeplitz operators and geometry I  
Algebraic number theory and algorithms I  
Stability of differential and integro-differential equations I  
Geometry of nonlinear control systems I  
Graph theory I |
<table>
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</table>
| 1:00 p.m. - 4:50 p.m. | **SPECIAL SESSIONS**  
Discrete-time optimal stopping theory I |
| 1:00 p.m. - 4:30 p.m. | Multidimensional inverse problems, related problems in analysis and applications I |
| 1:10 p.m. - 4:50 p.m. | **SESSIONS FOR CONTRIBUTED PAPERS**  
Abstract algebra |
| 1:10 p.m. - 4:50 p.m. | Combinatorics |
| 1:10 p.m. - 4:50 p.m. | Commutative algebra and algebraic geometry |
| 1:10 p.m. - 4:50 p.m. | Functional analysis |
| 1:10 p.m. - 4:35 p.m. | Function theory and measure theory |
| 1:10 p.m. - 4:50 p.m. | Group theory |
| 1:10 p.m. - 4:50 p.m. | Ordinary differential equations |
| 1:10 p.m. - 4:50 p.m. | Set-theoretic topology |
| 1:30 p.m. - 2:20 p.m. | **COMMITTEE ON PARTICIPATION OF WOMEN PRESENTATION**  
New agenda for women in higher education  
Donna Shavlik |
| 1:30 p.m. - 3:30 p.m. | **MINICOURSE #10 (Part A)**  
Computer graphics in elementary statistics  
Florence S. Gordon  
Sheldon P. Gordon |
| 2:45 p.m. - 3:35 p.m. | **INVITED ADDRESS**  
Calculus: Past, present, and future  
Ronald G. Douglas |
| 3:50 p.m. - 4:40 p.m. | **RETIRING PRESIDENTIAL ADDRESS**  
Celebrating mathematics  
Lynn A. Steen |
<table>
<thead>
<tr>
<th><strong>Friday, January 8 (cont’d)</strong></th>
<th><strong>American Mathematical Society</strong></th>
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<tbody>
<tr>
<td><strong>AFTERNOON (cont’d)</strong></td>
<td></td>
<td>PRIZE SESSION AND BUSINESS MEETING</td>
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<td>5:00 p.m. - 6:00 p.m.</td>
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<td><strong>EVENING</strong></td>
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<td>6:15 p.m. - 9:00 p.m.</td>
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<td>7:00 p.m. - 9:00 p.m.</td>
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<tr>
<td><strong>AMSI-MAA SPECIAL PROGRAM ON FORCES FOR CHANGE IN MATHEMATICS EDUCATION</strong></td>
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<tr>
<td>EXHIBITOR-Hosted OPEN RECEPTION AND LIGHT SNACK</td>
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<tr>
<td><strong>SESSION 1</strong></td>
<td><strong>Calculus for a new century</strong></td>
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<tr>
<td></td>
<td>Ronald G. Douglas</td>
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<td>Timothy O’Meara</td>
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<td>Lynn A. Steen</td>
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<tr>
<td><strong>SESSION 2</strong></td>
<td><strong>The beauty of fractals: A force for teaching the public</strong></td>
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<td></td>
<td>Hyman Bass</td>
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<td>Heinz-Otto Peitgen</td>
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<td><strong>SESSION 3</strong></td>
<td><strong>Who will teach mathematics?</strong></td>
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<td>F. Joe Crosswhite</td>
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<td>John A. Dossey</td>
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<td>Marc Tucker</td>
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<td>7:00 p.m. - 9:00 p.m.</td>
<td><strong>MINICOURSE #11 (Part A)</strong></td>
<td><strong>Eugene Herman</strong></td>
<td><strong>Charles Jepsen</strong></td>
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<td></td>
<td>The use of computing in teaching linear algebra</td>
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<td>7:00 p.m. - 9:00 p.m.</td>
<td><strong>MINICOURSE #12 (Part A)</strong></td>
<td><strong>Paul Zorn</strong></td>
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<td></td>
<td>Using computer algebra systems in undergraduate mathematics</td>
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<td>7:00 p.m. - 9:00 p.m.</td>
<td><strong>MINICOURSE #13 (Part A)</strong></td>
<td><strong>James T. Sandefur</strong></td>
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<td></td>
<td>Learning mathematics through discrete dynamical systems</td>
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## TIME TABLE

### Friday, January 8 (cont'd)

**EVENING (cont'd)**

8:45 p.m. - 9:45 p.m.

### Saturday, January 9

**MORNING**

7:30 a.m. - 3:00 p.m.

<table>
<thead>
<tr>
<th>7:30 a.m. - 10:50 a.m.</th>
<th>SPECIAL SESSIONS</th>
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<tbody>
<tr>
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<td>Discrete-time optimal stopping theory II</td>
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<td>8:00 a.m. - 10:50 a.m.</td>
<td>Toeplitz operators and geometry II</td>
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<td>8:00 a.m. - 10:20 a.m.</td>
<td>Stability of differential and integro-differential equations II</td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Applications of differential equations to population ecology II</td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Geometry of nonlinear control systems II</td>
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<tr>
<td>8:00 a.m. - 10:50 a.m.</td>
<td>Graph theory II</td>
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</tbody>
</table>

**SESSIONS FOR CONTRIBUTED PAPERS**

<table>
<thead>
<tr>
<th>8:20 a.m. - 10:45 a.m.</th>
<th>Differential and geometric topology</th>
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<tbody>
<tr>
<td>8:20 a.m. - 10:45 a.m.</td>
<td>Numerical analysis</td>
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<tr>
<td>8:20 a.m. - 10:45 a.m.</td>
<td>Set theory and foundations</td>
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</table>

**NATIONAL MEETING OF DEPARTMENT HEADS**

Prolonging the life of faculty resources

Donald J. Lewis
John A. Mitchem
Thomas W. Tucker

**REGISTRATION**

Ivy Hall, HR

HR = Hyatt Regency
<table>
<thead>
<tr>
<th>Time</th>
<th>Session Description</th>
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</table>
| 8:20 a.m. - 10:30 a.m. | SESSIONS FOR CONTRIBUTED PAPERS  
|               | Topological algebra                                          |
| 8:35 a.m. - 10:45 a.m. | Mathematical physics                                        |
| 8:50 a.m. - 10:45 a.m. | Hard analysis                                                |
| 8:50 a.m. - 10:45 a.m. | Matrices                                                     |
| 9:00 a.m. - 9:50 a.m.  | SPECIAL SESSIONS                                             
|               | Algebraic number theory and algorithms II                    |
| 9:00 a.m. - 10:50 a.m. | Multidimensional inverse problems, related problems in analysis and applications II |
| 9:00 a.m. - 10:00 a.m. |                                                             |
| 9:00 a.m. - 10:55 a.m. | MINICOURSE #10 (Part B)  
|               | Computer graphics in elementary statistics                   |
|               | Florence S. Gordon                                          |
|               | Sheldon P. Gordon                                           |
| 9:00 a.m. - noon  | EXHIBIT AND BOOK SALE                                       |
|               | BOOK SALE                                                    |
| 9:00 a.m. - noon  |                                                             |
| 9:35 a.m. - 10:45 a.m. | SESSION FOR CONTRIBUTED PAPERS  
|               | Computer Science                                             |
|               |                                                             |
|               | INVITED ADDRESS                                             
|               | Codes and designs - existence and uniqueness                 |
|               | Vera S. Pless                                               |
|               |                                                             |
|               | NATIONAL ASSOCIATION FOR MATHEMATICIANS WILLIAM W.S. CLAYTOR LECTURE |
|               | Wade Ellis, Jr.                                             |
### Saturday, January 9 (cont'd)

#### MORNING (cont'd)

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>10:00 a.m. - 10:55 a.m.</td>
<td><strong>AMS-MAA INVITED ADDRESS</strong>&lt;br&gt;Mathematics and computing - 25 years of collaboration&lt;br&gt;Donald L. Kreider</td>
</tr>
<tr>
<td>11:10 a.m. - noon</td>
<td><strong>AMS-MAA INVITED ADDRESS</strong>&lt;br&gt;Georg Cantor: The battle for transfinite set theory&lt;br&gt;Joseph W. Dauben</td>
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#### AFTERNOON

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<tr>
<td>1:00 p.m. - 2:00 p.m.</td>
<td><strong>COLLOQUIUM LECTURE IV</strong>&lt;br&gt;Spectral properties of Riemannian manifolds&lt;br&gt;Victor W. Guillemin</td>
</tr>
<tr>
<td>1:00 p.m. - 3:00 p.m.</td>
<td><strong>AAAS-AMS-MAA COMMITTEE ON OPPORTUNITIES IN MATHEMATICS FOR DISADVANTAGED GROUPS</strong>&lt;br&gt;PANEL DISCUSSION&lt;br&gt;How does ethno-mathematics make sense at the college level?&lt;br&gt;Marcia Ascher&lt;br&gt;Ubiratan D'Ambrosio&lt;br&gt;Solomon A. Garfunkel&lt;br&gt;Gloria Gilmer (organizer)&lt;br&gt;Arthur B. Powell, Jr.</td>
</tr>
<tr>
<td>1:00 p.m. - 3:00 p.m.</td>
<td><strong>MINICOURSE #11 (Part B)</strong>&lt;br&gt;The use of computing in teaching linear algebra&lt;br&gt;Eugene Herman&lt;br&gt;Charles Jepsen</td>
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<td>Time</td>
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</table>
| 1:00 p.m. - 3:00 p.m. | MINICOURSE #12 (Part B) Using computer algebra systems in undergraduate mathematics  
Paul Zorn |
| 1:00 p.m. - 3:00 p.m. | MINICOURSE #13 (Part B) Learning mathematics through discrete dynamical systems  
James T. Sandefur |
| 1:00 p.m. - 4:55 p.m. | CONTRIBUTED PAPER SESSION Strategies for teaching geometry  
Doris Schattschneider |
| 1:00 p.m. - 4:55 p.m. | CONTRIBUTED PAPER SESSION Writing as part of the mathematics curriculum (Part C)  
Andrew Sterrett |
| 1:00 p.m. - 5:30 p.m. | CONTRIBUTED PAPER SESSION Teaching mathematical modeling  
Jeanne Agnew |
| 1:00 p.m. - 2:00 p.m. |MINICOURSE #7 (Part B) Computer based discrete mathematics  
Nancy Baxter  
Ed Dubinsky |
| 2:15 p.m. - 3:05 p.m. | INVITED ADDRESS Determinants of Laplacians, heights and finiteness  
Peter Clive Sarnak |
| 3:15 p.m. - 3:45 p.m. |INVITED ADDRESS Applied number theory  
H. W. Lenstra, Jr. |
| 3:20 p.m. - 4:10 p.m. | SPECIAL PRESENTATION Teaching experiences in Soweto  
Terry Lloyd Jenkins |
| 3:30 p.m. - 5:30 p.m. | MINICOURSE #12 (Part B) Using computer algebra systems in undergraduate mathematics  
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Paul Zorn |
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<tr>
<th>Time</th>
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| 3:30 p.m. - 5:30 p.m. | MINICOURSE #8 (Part B)  
Laboratory projects for first year calculus  
L. Carl Leinbach | MINICOURSE #9 (Part B)  
Constructing placement examinations  
John G. Harvey |
Program of the Sessions

Abstracts of papers presented by the AMS Gibbs Lecturer, AMS Colloquium Lecturer, AMS invited 50-minute speakers, MAA invited 50-minute speakers and speakers in other MAA sessions will be found in a colored insert in the program given to registrants. Abstracts of papers presented in AMS Special Sessions and AMS Sessions for Contributed Papers will be found in the January issue of Abstracts of papers presented to the American Mathematical Society, which will also be provided to registrants at the meeting. Abstracts for talks other than AMS and MAA are not available.

To maintain the schedule, beginning and ending times of presentations will be strictly enforced.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting. Where a presenter is visiting another institution, the permanent affiliation is given first, followed by the name of the institution being visited.

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<tr>
<th>TUESDAY, JANUARY 5</th>
<th>MAA Session on the History of Contemporary Mathematics</th>
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<tr>
<td>MAA Board of Governors</td>
<td>8:30 a.m.–10:55 a.m.</td>
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<tr>
<td>9:00 a.m.–4:00 p.m.</td>
<td>8:30 a.m. Introductory remarks</td>
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<tr>
<td>AMS-MAA-TUG Workshop</td>
<td>8:40 a.m. Calculus and the first course: Historical impacts.</td>
</tr>
<tr>
<td>9:00 a.m.–9:00 p.m.</td>
<td>(1) Diane M. Spresser, James Madison University</td>
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<tr>
<td>AMS Council</td>
<td>9:00 a.m. From old math to new math to discrete math: A history of abstract algebra in the college curriculum.</td>
</tr>
<tr>
<td>5:00 p.m.–10:00 p.m.</td>
<td>(2) Robert Hayden, Plymouth State College</td>
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<tr>
<td>MAA Section Officers</td>
<td>9:20 a.m. Green's functions and nineteenth century potential theory.</td>
</tr>
<tr>
<td>7:00 p.m.–9:00 p.m.</td>
<td>(3) Thomas Archibald, Acadia University</td>
</tr>
<tr>
<td>MAA Minicourse #1: Part A</td>
<td>9:40 a.m. Jean d'Alembert, mixed mathematics and the teaching of mathematics.</td>
</tr>
<tr>
<td>7:00 p.m.–9:00 p.m.</td>
<td>(4) Gary Brown, College of St. Benedict</td>
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<tr>
<td>7:00 p.m.–9:00 p.m.</td>
<td>10:00 a.m. A historical gem from Vito Volterra.</td>
</tr>
<tr>
<td>Using computer graphing to enhance the teaching and learning of calculus and precalculus mathematics.</td>
<td>(5) William Dunham, Hanover College and Ohio State University, Columbus</td>
</tr>
<tr>
<td>Franklin D. Demana and Bert K. Waits, Ohio State University</td>
<td>10:20 a.m. Who was Eugene-Charles Catalan?</td>
</tr>
<tr>
<td>9:00 a.m.–9:50 a.m.</td>
<td>(6) Richard Johnsonbaugh, DePaul University</td>
</tr>
<tr>
<td>MAA Invited Address</td>
<td>10:40 a.m. Discussion period</td>
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<tr>
<td>9:00 a.m.–9:50 a.m.</td>
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<tr>
<td>9:00 a.m. Means and their iterates.</td>
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<tr>
<td>(7) Roger Nussbaum, Rutgers University, New Brunswick (839-47-123)</td>
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<tr>
<th>WEDNESDAY, JANUARY 6</th>
<th>MAA CUPM Subcommittee on the First Two Years of College Mathematics Panel Discussion</th>
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<tr>
<td>MAA Committee on Computers in Mathematics Education Panel Discussion</td>
<td>9:00 a.m.–10:55 a.m.</td>
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<td>8:30 a.m.–10:55 a.m.</td>
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<tr>
<td>8:30 a.m.</td>
<td>9:00 a.m. Compressing five into four: How can we streamline the first two years of college mathematics?</td>
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<tr>
<td>Software issues—pricing, copy protection, copyright.</td>
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Program of the Sessions

**WEDNESDAY, JANUARY 6**

**MAA Minicourse #2: Part A**

9:00 a.m.-10:55 a.m.
9:00 a.m. *Computer software for differential equations.*
Howard Lewis Penn and James Buchanan, U.S. Naval Academy

**MAA Minicourse #3: Part A**

9:00 a.m.-10:55 a.m.
9:00 a.m. *Teaching mathematical modeling.*
Frank R. Giordano, U.S. Military Academy and Maurice D. Weir, Naval Postgraduate School

**MAA Minicourse #4: Part A**

9:00 a.m.-10:55 a.m.
9:00 a.m. *Teaching calculus with an HP-28C symbol manipulating calculator.*
John W. Kenelly, Clemson University and Thomas W. Tucker, Colgate University

**AMS Invited Address**

10:05 a.m.-10:55 a.m.
10:05 a.m. *The Macdonald root system conjectures and their significance.*
Philip J. Hanlon, University of Michigan, Ann Arbor (839-65-404)

**AMS-MAA Invited Address**

11:10 a.m.-12:00 noon
11:10 a.m. *How computers have changed the way I teach.*
John G. Kemeny, Dartmouth College

**AMS Colloquium Lectures: Lecture I**

1:00 p.m.-2:00 p.m.
1:00 p.m. *Spectral properties of Riemannian manifolds.* I
Victor W. Guillemin, Massachusetts Institute of Technology

**AMS Committee on Science Policy Special Presentation**

2:15 p.m.-3:15 p.m.
2:15 p.m. *Why the S/3i software could not be trusted.*
(11) David L. Parnas, Queens University

**MAA Invited Address**

2:15 p.m.-3:05 p.m.
2:15 p.m. *Singularly perturbed equations: theory vs. applications.*
Jane Cronin Scanlon, Rutgers University, New Brunswick

**AMS Special Session on Banach Space Theory, I**

2:15 p.m.-5:35 p.m.
2:15 p.m. *Geometry of vector-valued function spaces.*
(13) Peter Greim, The Citadel (839-65-458)
2:45 p.m. *The Denjoy extension of the Bochner, Pettis, and Dunford integrals.*
Russell A. Gordon, Whitman College (839-28-62)
3:15 p.m. *Complexity of weakly null sequences.* Preliminary report.
(15) Dale Alspach*, Oklahoma State University, Stillwater, and Spiros Argyros, University of Crete, Greece (839-66-191)
3:45 p.m. *Mazur’s intersection property.*
(16) J. H. M. Whitfield, Lakehead University (839-66-77)
4:15 p.m. *On James’ type constructions.*
(17) R. Haydon, Brasenose College, England, and E. Odell*, University of Texas, Austin (839-66-348)
4:45 p.m. *More quasi-reflexive subspaces.*
(18) Steven F. Bellenot, University of Texas, Austin, and Florida State University (839-66-326)
5:15 p.m. *Points of continuity in the dual of Hagler’s tree space.*
(19) Carol S. Schumacher, University of Texas, Austin (839-66-251)

**AMS Special Session on Modern Trends in Matrix Analysis and Applications, I**

2:15 p.m.-6:05 p.m.
2:15 p.m. *Stochastic complementation with application to uncoupling Markov chains and nearly completely reducible systems.*
Carl D. Meyer, Jr., North Carolina State University (839-66-71)
AMS Special Session on Nonlinear Differential Delay Equations, I

2:15 p.m.–6:05 p.m.

2:15 p.m. Monotone dynamical systems generated by scalar delay equations.
Hal L. Smith, Arizona State University (839-34-22)

2:45 p.m. A comparison of dispersion strategies for survival of spatially heterogeneous populations.
Douglas P. Hardin, Peter Takac and G. F. Webb*, Vanderbilt University (839-34-14)

3:15 p.m. Bifurcation functions for the existence of periodic orbits with the Melnikov function as a limiting case. Preliminary report.
Xiao-Biao Lin, Michigan State University (839-34-115) (Sponsored by S. N. Chow)

3:45 p.m. Uniqueness vs. multiplicity of transition layers for a singularly perturbed delay differential equation.
John Mallet-Paret, Brown University (839-39-569)

4:15 p.m. State dependent time delays in biological and economic models.
Michael C. Mackey*, McGill University, and J. Belair, Université de Montréal (839-34-183)

Harlan W. Stech, University of Minnesota, Duluth (839-34-336) (Sponsored by Joseph A. Gallian)

5:15 p.m. Bifurcation of a unique stable periodic orbit from a homoclinic orbit in infinite dimensional systems.
Shui-Nee Chow and Bo Deng*, Michigan State University (839-58-595)

5:45 p.m. Discussion period

AMS Special Session on Total Positivity and Applications, I

2:15 p.m.–6:05 p.m.

2:15 p.m. Interpolation by piecewise linear radial basis functions. Preliminary report.
W. A. Light and E. W. Cheney*, University of Texas, Austin (839-41-325)

2:45 p.m. Best approximation by splines with free knots.
G. Nürnberger and H. Strauss, University of Erlangen, West Germany, M. Sommer, Katholische University, West Germany, and L. Schumaker*, Texas A & M University, College Station (839-41-402)

3:15 p.m. Total positivity and hypergeometric functions of matrix argument.
Kenneth I. Gross, University of Vermont, and Donald St. P. Richards*, University of Virginia (839-33-273)

3:45 p.m. Generalized Wronskians and disconjugacy of function spaces.
J. S. Muldowney, University of Alberta (839-34-43)

4:15 p.m. Splicing of Markov systems.
T. A. Kilgore* and R. A. Zalik, Auburn University, Auburn (839-41-51)
**WEDNESDAY, JANUARY 6**

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<tr>
<th>Time</th>
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<tr>
<td>4:45 p.m.</td>
<td>Positivity results applied to difference equations.</td>
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<td>(47) Allan Peterson, University of Nebraska, Lincoln (839-34-04)</td>
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<tr>
<td>5:15 p.m.</td>
<td>$L_1$-approximation by generalized convex functions.</td>
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<tr>
<td>(48) D. Zwick, University of Vermont (839-41-417)</td>
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<tr>
<td>5:45 p.m.</td>
<td>Remarks on definitions of nondegeneracy in Tchebyshev systems.</td>
</tr>
<tr>
<td>(49) Friedel Schwenker and Roland Zie1ke*, University of Osnabrück, West Germany (839-41-546)</td>
<td>(Sponsored by R. A. Zalik)</td>
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**AMS Special Session on Abelian Groups, I**

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<tr>
<td>2:15 p.m. -- 6:05 p.m.</td>
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<tr>
<td>2:15 p.m.</td>
<td>Categorical properties of A-solvable Abelian groups.</td>
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<tr>
<td>(50) Ulrich Albrecht, Auburn University, Auburn (839-20-275)</td>
<td>(Sponsored by R. A. Zalik)</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>The classification of certain Butler groups. Preliminary report.</td>
</tr>
<tr>
<td>(51) Paul Hill, Baylor University, and Charles Megibben*, Vanderbilt University (839-20-333)</td>
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<tr>
<td>3:15 p.m.</td>
<td>Invariants for a class of torsion-free abelian groups.</td>
</tr>
<tr>
<td>(52) D. Arnold, New Mexico State University, Las Cruces, and C. Vinsonhaler*, University of Connecticut, Storrs (839-20-91)</td>
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<tr>
<td>3:45 p.m.</td>
<td>Coxeter functors and Abelian groups. Preliminary report.</td>
</tr>
<tr>
<td>(53) David M. Arnold*, New Mexico State University, Las Cruces, and Charles I. Vinsonhaler, University of Connecticut, Storrs (839-20-135)</td>
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<tr>
<td>4:15 p.m.</td>
<td>Generalizations of irreducible and strongly homogeneous torsion-free Abelian groups.</td>
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<tr>
<td>(54) Jutta Hausen, University of Houston, University Park (839-20-192)</td>
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<tr>
<td>4:45 p.m.</td>
<td>Preradicals induced by torsion free Abelian groups.</td>
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<tr>
<td>(55) Manfred Dugas and Edwin P. Oxford*, Baylor University (839-20-183)</td>
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<tr>
<td>5:15 p.m.</td>
<td>Hyper-types.</td>
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<tr>
<td>(56) P. Goeters, Auburn University, Auburn, and C. Vinsonhaler and W. Wickless*, University of Connecticut, Storrs (839-20-107)</td>
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<tr>
<td>5:45 p.m.</td>
<td>Irreducible groups and their quasi-endomorphism algebras.</td>
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<td>(57) James D. Reid, Wesleyan University (839-20-323)</td>
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**AMS Special Session on Structural Complexity Theory, I**

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<td>2:15 p.m. -- 6:05 p.m.</td>
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<tr>
<td>2:15 p.m.</td>
<td>Separating polynomial-time Turing and truth-table degrees of tally sets. Preliminary report.</td>
</tr>
<tr>
<td>(58) Shouwen Tang and Ronald V. Book*, University of California, Santa Barbara (839-68-184)</td>
<td>(Sponsored by John Doner)</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>Kolmogorov complexity and degrees of Tally sets.</td>
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<tr>
<td>(59) Preliminary report.</td>
<td></td>
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<tr>
<td>3:15 p.m.</td>
<td>On nondeterministic space and existential quantifiers.</td>
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<td>(60) Neil Immerman, Yale University (839-03-217)</td>
<td>(Sponsored by Stephen R. Mahaney)</td>
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<tr>
<td>3:45 p.m.</td>
<td>Zero-one laws and their decision problem.</td>
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<td>(61) Phokion G. Kolaitis, Stanford University (839-68-414)</td>
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<td>4:15 p.m.</td>
<td>Higher-order logic as a specification environment.</td>
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<td>4:45 p.m.</td>
<td>Discussion period</td>
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<tr>
<td>5:15 p.m.</td>
<td>Minimum disclosure proofs of knowledge.</td>
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<tr>
<td>(63) Gilles Brassard, Université de Montréal, David Chaum, Centre for Mathematics and Computer Science, The Netherlands, and Claude Crépeau*, Massachusetts Institute of Technology (839-68-478)</td>
<td>(Sponsored by Stephen R. Mahaney)</td>
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<tr>
<td>5:45 p.m.</td>
<td>Encrypted oracle queries.</td>
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<td>(64) Martin Abadi, DEC Systems Research Center, Palo Alto, California, Joan Feigenbaum*, AT&amp;T Bell Laboratories, Murray Hill, New Jersey, and Joe Kilian, Massachusetts Institute of Technology (839-68-268)</td>
<td>(Sponsored by Steve Mahaney)</td>
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**AMS Special Session on Optimization, I**

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<td>2:15 p.m. -- 6:05 p.m.</td>
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<tr>
<td>2:15 p.m.</td>
<td>The change of variable and the sum formulas for conjugate functions.</td>
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<td>(65) Stephen Simons, University of California, Santa Barbara (839-49-172)</td>
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<tr>
<td>2:45 p.m.</td>
<td>What should be the $c$-subdifferential of a saddle function? Preliminary report.</td>
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<td>(66) Lynn McLinden, University of Illinois, Urbana-Champaign (839-47-544)</td>
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<tr>
<td>3:15 p.m.</td>
<td>Semifinite convex programming.</td>
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<td>(67) Jon Borwein, Dalhousie University (839-90-177)</td>
<td>(Sponsored by Lynn McLinden)</td>
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<tr>
<td>3:45 p.m.</td>
<td>Zero duality gap and stability for an infinitely constrained nonconvex problem.</td>
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<tr>
<td>(68) V. Jeyakumar* and Henry Wolkowicz, University of Waterloo (839-90-186)</td>
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<td>Time</td>
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<tr>
<td>4:15 p.m.</td>
<td>On Mosco convergence of convex sets.</td>
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<td><strong>Gerald Beer</strong>, California State University, Los Angeles</td>
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<td>(839-52-456)</td>
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<tr>
<td>4:45 p.m.</td>
<td>Unconstrained optimization methods for eigenvalue problems. Preliminary report.</td>
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<td><strong>Giles Auchmuty</strong>, University of Houston, University Park</td>
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<td>(839-49-95)</td>
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<td>5:15 p.m.</td>
<td>A uniqueness theorem for a differential inclusion. Preliminary report.</td>
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<td><strong>Peter R. Wolenski</strong>, University of Washington</td>
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<td>(839-49-282)</td>
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<tr>
<td>5:45 p.m.</td>
<td>Relaxed trajectories of evolution equations and optimal control.</td>
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<td><strong>Nikolaos Papageorgiou</strong>, University of California, Davis</td>
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<td>(839-49-398)</td>
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<td><strong>AMS Session on Applied Mathematics</strong></td>
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<td>2:15 p.m.</td>
<td>A geometric analysis of the apportionment problem.</td>
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<td><strong>Brent Bradberry</strong>, Lewis-Clark State College</td>
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<td>(839-90-483)</td>
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<td>2:30 p.m.</td>
<td>Linear complementarity problems. Preliminary report.</td>
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<td><strong>M. Seetharama Gowda</strong>, University of Maryland, Baltimore County</td>
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<td>(839-90-490)</td>
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<td>2:45 p.m.</td>
<td>Environmental effects on spread of epidemics.</td>
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<td><strong>J. B. Shukla</strong>, University of Alberta, Manju Agarwal, IET, India</td>
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<td>(839-92-127)</td>
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<tr>
<td>3:00 p.m.</td>
<td>Modelling the role of long infectious periods in the dynamics of HIV</td>
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<td><strong>Carlos Castillo-Chavez</strong>, Cornell University, Kenneth L. Cooke</td>
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<td>(839-92-355)</td>
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<tr>
<td>3:15 p.m.</td>
<td>Bifurcation and instability of small periodic solutions in a density-</td>
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<td>dependent producer-consumer ecosystem modeled on a chemostat.</td>
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<td><strong>M. N. Antonios</strong>, Memphis State University</td>
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<tr>
<td>3:30 p.m.</td>
<td>Solution of linear two-point boundary-value problems via polynomial</td>
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<td>series.</td>
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<td><strong>Mohsen Razzaghi</strong>, Mississippi State University</td>
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<td>(839-93-201)</td>
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<tr>
<td>3:45 p.m.</td>
<td>On near-optimum regulators for large-scale systems.</td>
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<td></td>
<td>Preliminary report.</td>
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<td><strong>G. S. Ladde</strong>, University of Texas, Arlington, and O. Sirisaengtaksin*</td>
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<tr>
<td></td>
<td>(839-93-484)</td>
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<tr>
<td>4:00 p.m.</td>
<td>An RKH-space characterization of weak controllability for a class of</td>
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<td>linear heredity systems.</td>
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<tr>
<td></td>
<td>Preliminary report.</td>
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<td><strong>James A. Reneke</strong> and Anil K. Bose, Clemson University</td>
</tr>
<tr>
<td></td>
<td>(839-95-555)</td>
</tr>
<tr>
<td>4:15 p.m.</td>
<td>Branching inset entropies on open domains.</td>
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<td></td>
<td><strong>Bruce R. Ebanks</strong>, University of Louisville</td>
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<tr>
<td></td>
<td>(839-94-394)</td>
</tr>
<tr>
<td></td>
<td><strong>AMS Session on Boundary Behavior and Partial Differential Equations</strong></td>
</tr>
<tr>
<td>2:15 p.m.</td>
<td>Small solutions of resonant boundary value problems with large</td>
</tr>
<tr>
<td></td>
<td>nonlinearities. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td><strong>Lew Lefton</strong>, University of California, Riverside</td>
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<tr>
<td></td>
<td>(839-34-593)</td>
</tr>
<tr>
<td>2:30 p.m.</td>
<td>On a classical boundary value problem involving a small parameter.</td>
</tr>
<tr>
<td></td>
<td>Preliminary report.</td>
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<tr>
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<td><strong>Steve Kirschvink</strong>, San Diego State University</td>
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<tr>
<td></td>
<td>(839-34-593)</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>A version of Runge’s theorem for the Helmholtz equation with</td>
</tr>
<tr>
<td></td>
<td>applications to scattering theory.</td>
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<tr>
<td></td>
<td><strong>Robert Cichs</strong>, Jr., Iowa State University</td>
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<td>(839-35-23)</td>
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# Program of the Sessions

**WEDNESDAY, JANUARY 6**

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<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker/Institution</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>On 2-D inverse problem for heat equation in a noncylindrical domain.</td>
<td>I. Malyshev, San Jose State University (839-35-46)</td>
</tr>
<tr>
<td>3:15 p.m.</td>
<td>A potential theoretic inverse problem in the plane.</td>
<td>Edward M. Arnold, Eastern Montana College (839-35-57)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>A local analytic existence and uniqueness theorem for symplectic Monge amphiere equations with type singularities.</td>
<td>Marek Kossowski, University of South Carolina (839-35-567)</td>
</tr>
<tr>
<td>3:45 p.m.</td>
<td>Relation between growth and regularity of solutions of hypoelliptic equations.</td>
<td>M. Shafii-Mousavi, Indiana University, South Bend, and Z. Zielezny, State University of New York, Buffalo (839-35-295)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Nonlinear hyperbolic equations with delay. Preliminary report.</td>
<td>H. Poorkarimi* and J. Wiener, Pan American University (839-35-302)</td>
</tr>
<tr>
<td>4:15 p.m.</td>
<td>Elliptic-parabolic equations of the fourth order and anisotropic plates that lose stiffness. Preliminary report.</td>
<td>Robert G. Root, University of Delaware (839-35-309)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Method of upper and lower solutions and interval method for the Euler-Poisson-Darboux equation. Preliminary report.</td>
<td>C. Y. Chan and A. S. Vatsala*, University of Southern Louisiana (839-35-370)</td>
</tr>
<tr>
<td>4:45 p.m.</td>
<td>Coupled system of reaction-diffusion equations and applications. Preliminary report.</td>
<td>Wei Feng, North Carolina State University (839-35-442)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Global solutions for a semilinear integral equation.</td>
<td>J. H. Lightbourne III, West Virginia University (839-35-443)</td>
</tr>
<tr>
<td>5:15 p.m.</td>
<td>Generalized soliton properties. Preliminary report.</td>
<td>Ralph Kelsey, Bradley University (839-35-519)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>The uniqueness theorem for hyperbolic partial differential equations with discontinuous coefficients.</td>
<td>M. E. Khalifa, Mansoura University, Egypt (839-35-536)</td>
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**AMS Session on Complex Analysis**

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<tr>
<th>Time</th>
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<th>Speaker/Institution</th>
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<tbody>
<tr>
<td>2:15 p.m.</td>
<td>Angular limits of holomorphic and meromorphic functions.</td>
<td>K. F. Barth*, Syracuse University, P. J. Rippon, The Open University, United Kingdom, and L. R. Sons, Northern Illinois University (839-30-41)</td>
</tr>
<tr>
<td>2:30 p.m.</td>
<td>The complete multivalence of Ćakalov-Distler sums.</td>
<td>A. W. Goodman, University of South Florida, Tampa (839-30-158)</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>Properties of Cauchy-Stieltjes transforms.</td>
<td>R. Hibschweiler, State University of New York, Albany (839-30-200)</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>Singular manifolds of harmonic functions in several variables.</td>
<td>Peter A. McCoy, United States Naval Academy (839-30-238)</td>
</tr>
<tr>
<td>3:15 p.m.</td>
<td>A gap condition for the zeros of certain polynomials in Kaplan classes $K(\alpha, \beta)$.</td>
<td>Massoud Jahangiri, University of California, Davis (839-30-239) (Sponsored by Evelyn Marie Silvia)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>The partial zeta function of an order in a nonsemisimple algebra.</td>
<td>Michael D. Seyfried, Shippensburg University (839-99-601)</td>
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<tr>
<td>3:45 p.m.</td>
<td>Property preserving operators. Preliminary report.</td>
<td>Evelyn Marie Silvia, University of California, Davis (839-30-305)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Entire functions and their Schroeder functions.</td>
<td>Preliminary report. Lawrence Crone, The American University (839-30-368)</td>
</tr>
<tr>
<td>4:15 p.m.</td>
<td>Besov-type characterizations for the Bloch space.</td>
<td>Karel Stroethoff, University of Montana (839-30-460)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Backward extensions and strong Hamburger moment sequences.</td>
<td>E. P. Merkes*, University of Cincinnati, and Marion Wetzel, Denison University (839-30-524)</td>
</tr>
<tr>
<td>4:45 p.m.</td>
<td>Growth of entire functions of order larger than one.</td>
<td>R. N. Mera, University of Puerto Rico, Humacao College (839-30-597)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Embedding $H^p$ into weighted Sobolev spaces.</td>
<td>Preliminary report. Daniel H. Luecking, University of Arkansas, Fayetteville (839-30-577)</td>
</tr>
<tr>
<td>5:15 p.m.</td>
<td>Totally positive and totally bounded functions.</td>
<td>Alan Horwitz*, Pennsylvania State University, Media, and Lee Rubel, University of Illinois, Urbana-Champaign (839-30-492)</td>
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</tbody>
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**AMS Session on General Topology**

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<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker/Institution</th>
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<tbody>
<tr>
<td>2:15 p.m.</td>
<td>Pixley-Roy spaces on infinite graphs.</td>
<td>R. N. Mera, University of Puerto Rico, Humacao College (839-30-460)</td>
</tr>
<tr>
<td>2:30 p.m.</td>
<td>Cell-like maps and approximate inverse systems.</td>
<td>Sibe Mardešić, University of Zagreb, Yugoslavia, and Leonard R. Rubin*, University of Oklahoma (839-30-256)</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>Periodic points on the triod.</td>
<td>Stewart Baldwin, Auburn University, Auburn (839-54-374)</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>On the construction of $n$-homogeneous continuum.</td>
<td>Paul R. Stallings, Auburn University, Auburn (839-54-375)</td>
</tr>
</tbody>
</table>
### AMS Session on Graph Theory

<table>
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<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
<th>Code</th>
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<tbody>
<tr>
<td>2:15 p.m.</td>
<td>Vertex transitive graphs of toughness exactly one are bipartite.</td>
<td>Kunwarjit S. Bagga and Mark J. Lipman*</td>
<td>Indiana University-Purdue University</td>
<td>(132)</td>
</tr>
<tr>
<td>2:30 p.m.</td>
<td>Graceful labelings of triangular snakes.</td>
<td>David Moulton</td>
<td>University of California, Berkeley</td>
<td>(133)</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>Transfer principles for graph semiuniformity.</td>
<td>Terry A. McKee</td>
<td>Wright State University</td>
<td>(134)</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>Existence and non-existence of universal graphs.</td>
<td>Lawrence S. Moss</td>
<td>University of Michigan</td>
<td>(135)</td>
</tr>
<tr>
<td>3:15 p.m.</td>
<td>Some upper bounds for the number of proper colorings of graphs.</td>
<td>Felix Lazebnik</td>
<td>University of Delaware</td>
<td>(136)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Minimal birigid graphs.</td>
<td>Brigitte Servatius*</td>
<td>Worcester Polytechnic Institute</td>
<td>(137)</td>
</tr>
<tr>
<td>3:45 p.m.</td>
<td>Enumeration of Hamiltonian cycles in certain generalized Petersen graphs.</td>
<td>Allen J. Schwenk*</td>
<td>Western Michigan University</td>
<td>(138)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Trail covers of trees.</td>
<td>Thomas Kratzke</td>
<td>University of Illinois, Urbana-Champaign</td>
<td>(139)</td>
</tr>
<tr>
<td>4:15 p.m.</td>
<td>On the existence of a reasonable upper bound for the van der Waerden Numbers.</td>
<td>Bruce M. Landman* and Raymond N. Greenwell</td>
<td>Hofstra University</td>
<td>(140)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>On economical and spannable forests.</td>
<td>Curtis Clark*</td>
<td>Georgia State University</td>
<td>(141)</td>
</tr>
<tr>
<td>4:45 p.m.</td>
<td>Which toroidal graphs require six colors? Preliminary report.</td>
<td>Walter Stromquist</td>
<td>Temple University, Philadelphia</td>
<td>(142)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>On the 2-reprintability of the generalized Petersen graphs.</td>
<td>Gerald Schrag* and Larry Cammack*</td>
<td>Central Missouri State University</td>
<td>(143)</td>
</tr>
<tr>
<td>5:15 p.m.</td>
<td>Ramsey numbers and the nonplanarity of graphs with more than three vertices.</td>
<td>S. M. Kim</td>
<td>Korea</td>
<td>(144)</td>
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### AMS Session on History and Education

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<th>Speaker(s)</th>
<th>Institution(s)</th>
<th>Code</th>
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<tbody>
<tr>
<td>2:15 p.m.</td>
<td>Some remarks on girls' math scores. Preliminary report.</td>
<td>Anne Hughes</td>
<td>St. John's University</td>
<td>(145)</td>
</tr>
<tr>
<td>2:30 p.m.</td>
<td>Is mathematics as a career field on the decline among the top-notch math students of our country?</td>
<td>Nura D. Turner</td>
<td>State University of New York, Albany</td>
<td>(146)</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>Thomas Jefferson and the four-center ellipse.</td>
<td>J. J. Tattersall</td>
<td>Providence College</td>
<td>(147)</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>On an approximate trisection of the angle. Preliminary report.</td>
<td>George Baloglou</td>
<td>University of Kansas</td>
<td>(148)</td>
</tr>
<tr>
<td>3:15 p.m.</td>
<td>Errors in computer calculations. Preliminary report.</td>
<td>Peter Shenkin*</td>
<td>John Jay College of Criminal Justice</td>
<td>(149)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Visualizing ideas in calculus. Preliminary report.</td>
<td>Agnes Wieschenberg</td>
<td>John Jay College of Criminal Justice</td>
<td>(150)</td>
</tr>
<tr>
<td>3:45 p.m.</td>
<td>Symbolic differentiation and integration in teaching of calculus.</td>
<td>Robert L. Lamphere</td>
<td>Francis Marion College</td>
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</table>
### Program of the Sessions

**WEDNESDAY, JANUARY 6**

<table>
<thead>
<tr>
<th>4:00 p.m.</th>
<th>An experiment in calculus with a calculator.</th>
<th>M. Sayrafiezadeh, Medgar Evers College, City University of New York (839-98-381)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:15 p.m.–5:40 p.m.</td>
<td>AMS Session on Number Theory, I</td>
<td></td>
</tr>
<tr>
<td>2:15 p.m.</td>
<td>On Diophantine equations arising from Egyptian fractions. Preliminary report.</td>
<td>Mohammad H. Ahmadi, University of Dubuque (839-11-583)</td>
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<tr>
<td>2:30 p.m.</td>
<td>Some nonlinear theta functions. Preliminary report.</td>
<td>Phillip E. Parker, Wichita State University (839-11-427)</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>p-adic interpolation of Dedekind sums.</td>
<td>C. Snyder, University of Maine, Orono (839-11-246)</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>k-reverse multiples.</td>
<td>Bruce Reznick, University of Illinois, Urbana-Champaign (839-11-230)</td>
</tr>
<tr>
<td>3:15 p.m.</td>
<td>The nth-cyclotomic polynomial and its analogs.</td>
<td>R. Sivaramakrishnan, University of Kansas (839-11-157) (Sponsored by Paul J. McCarthy)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Forms derived from the arithmetic-geometric inequality.</td>
<td>Anil Kumar, University of Illinois, Urbana-Champaign (839-11-467)</td>
</tr>
<tr>
<td>3:45 p.m.</td>
<td>On a theorem of Kokosma on uniform distribution.</td>
<td>Davusha Us, University of Nevada, Las Vegas (839-11-572)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>On a Rogers-Ramanujan type identity with a convolution property. Preliminary report.</td>
<td>A. K. Agarwal, Pennsylvania State University, Mont Alto Campus (839-11-573)</td>
</tr>
<tr>
<td>4:15 p.m.</td>
<td>The formal group of the Jacobian of an algebraic curve.</td>
<td>Margaret N. Freije, College of the Holy Cross (839-11-457)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Some results in corresponding residue systems.</td>
<td>Steven R. Benson, University of Illinois, Urbana-Champaign (839-11-410)</td>
</tr>
<tr>
<td>4:45 p.m.</td>
<td>On the range of n/s(n).</td>
<td>Curtis N. Cooper and Robert E. Kennedy, Central Missouri State University (839-11-387)</td>
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<tr>
<td>5:00 p.m.</td>
<td>On the natural density of the range of the terminating nines function.</td>
<td>Robert E. Kennedy and Curtis N. Cooper, Central Missouri State University (839-11-388)</td>
</tr>
<tr>
<td>5:15 p.m.</td>
<td>Some extensions of J.-P. Serre’s theorem on p-adic representations. Preliminary report.</td>
<td>Wenchen Chi, University of Pennsylvania (839-11-344)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>The number of Fermat-type primes is finite.</td>
<td>C. Musés, San Diego State University (839-11-438) (Sponsored by K. Demys)</td>
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</tbody>
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#### AMS Session on Probability and Statistics

<p>| 2:15 p.m.–5:25 p.m. | | |
| 2:15 p.m. | Continuous extensions of skew product diffusions. | K. Bruce Erickson, University of Washington (839-60-20) |
| 2:30 p.m. | Finite moment conditions for GI/G/1 busy periods. | Saeed Ghaframani, Towson State University, and Ronald W. Wolff, University of California, Berkeley (839-60-63) (Sponsored by Houshang H. Sohrab) |
| 2:45 p.m. | A simple formula for conditional Wiener integrals with applications. | Chull Park, Miami University, Oxford, and David Skoug, University of Nebraska, Lincoln (839-60-65) |
| 3:00 p.m. | Sojourn and waiting times in a single-server system with service rate depending linearly on the number of customers. Preliminary report. | John A. Morrison, AT&amp;T Bell Laboratories, Murray Hill, New Jersey (839-60-108) |
| 3:15 p.m. | The Prokhorov theorem for vector valued measures. | Preliminary report. |
| 3:30 p.m. | Identification of parameters by the distribution of the maximum. | Arunava Mukherjea, University of South Florida, and Richard Stephens, West Carolina University (839-60-211) |
| 3:45 p.m. | On estimation of random variables via the Martingale convergence theorem. | Alan E. Wessel and Gary L. Wise, University of Texas, Austin (839-60-389) |
| 4:00 p.m. | The tail of a multiple stable integral. | Gennady Samorodnitsky, Boston University, and Jerzy Szulga, Auburn University, Auburn (839-60-390) |
| 4:15 p.m. | Killing and birthing a Markov process under a stationary measure. | Ellen Toby, University of California at San Diego, La Jolla (839-60-480) |
| 4:30 p.m. | Invariance of conditional probabilities under group actions. | Thomas E. Armstrong, University of Maryland, Baltimore County (839-60-481) |
| 4:45 p.m. | A generalization of the Eulerian numbers with applications to probability theory. | Bernard Harris, University of Wisconsin, Madison (839-60-517) |
| 5:00 p.m. | Stochastic perturbations of hyperbolic invariant manifolds for functional differential equations. Preliminary report. | Mou-Hsiung Chang, University of Alabama, Huntsville (839-60-526) |</p>
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<td>5:15 p.m.</td>
<td><strong>Program of the Sessions</strong></td>
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<tr>
<td></td>
<td>Time reversal of solutions of stochastic differential equations (SDEs) driven by Levy processes.</td>
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<td>P. Sundar, Louisiana State University, Baton Rouge (839-60-534)</td>
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<tr>
<td>3:20 p.m.</td>
<td><strong>MAA Invited Address</strong></td>
</tr>
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<td>Perpendicular arrays and graph decompositions.</td>
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<td>Charles C. Lindner, Auburn University, Auburn</td>
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<tr>
<td>3:20 p.m.</td>
<td><strong>AWM Panel Discussion</strong></td>
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<tr>
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<td>Is the climate for women in mathematics changing?</td>
</tr>
<tr>
<td>3:20 p.m.</td>
<td><strong>AWM Business Meeting</strong></td>
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<tr>
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<td>4:20 p.m.-4:50 p.m.</td>
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<tr>
<td></td>
<td><strong>MAA Minicourse #1: Part B</strong></td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Using computer graphing to enhance the teaching and learning of calculus and precalculus mathematics.</td>
</tr>
<tr>
<td></td>
<td>Franklin D. Demana and Bert K. Waits, Ohio State University</td>
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<tr>
<td>4:30 p.m.</td>
<td><strong>MAA Minicourse #6: Part A</strong></td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Coloring and path following algorithms for approximating roots and fixed points.</td>
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<td>William F. Lucas, Claremont Graduate School</td>
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<tr>
<td>5:45 p.m.</td>
<td><strong>National Science Foundation</strong></td>
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<td></td>
<td>Interagency Commission for Extramural Mathematics Programs (ICEMAP)</td>
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<tr>
<td>7:15 p.m.</td>
<td><strong>AMS Josiah Willard Gibbs Lecture</strong></td>
</tr>
<tr>
<td>8:30 p.m.</td>
<td>How natural is our mathematics? The example of equilibrium statistical mechanics</td>
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<td>David P. Ruelle, Institut des Hautes Etudes Scientifiques, France</td>
</tr>
<tr>
<td>8:00 a.m.</td>
<td><strong>THURSDAY, JANUARY 7</strong></td>
</tr>
<tr>
<td>8:00 a.m.</td>
<td><strong>AMS Special Space Session on Banach Space Theory, II</strong></td>
</tr>
<tr>
<td></td>
<td>Uniform approximation by polynomials in two functions.</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>[182] superspaces of span of independent random variables.</td>
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<td></td>
<td>Alvaro Arias, Texas A &amp; M University, College Station (839-46-286)</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>On intersection of Lebesgue spaces.</td>
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<td></td>
<td>Stephen J. Dilworth, University of South Carolina, Columbia (839-46-146)</td>
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<tr>
<td>9:30 a.m.</td>
<td>The approximation property for Banach spaces.</td>
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<td></td>
<td>Peter G. Casazza, University of Missouri, Columbia (839-46-16)</td>
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<tr>
<td>10:00 a.m.</td>
<td>Computation of two-dimensional projection constants.</td>
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<td></td>
<td>Preliminary report.</td>
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<td>William J. Davis, Ohio State University, Columbus (839-46-550)</td>
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<tr>
<td>10:30 a.m.</td>
<td>Discussion period.</td>
</tr>
<tr>
<td>8:00 a.m.</td>
<td><strong>AMS Special Session on Modern Trends in Matrix Analysis and Applications, II</strong></td>
</tr>
<tr>
<td>8:00 a.m.</td>
<td>The Laplacian spectrum of a graph. Preliminary report.</td>
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<td>Robert Grone*, San Diego State University, Russell Merris, California State University, Hayward, and V. S. Sunder, Indian Statistical Institute, India (839-15-548)</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>Extensions of Birkhoff's theorem.</td>
</tr>
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<td>Richard A. Brualdi, University of Wisconsin, Madison (839-15-585)</td>
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<tr>
<td>9:00 a.m.</td>
<td>Nonnegative matrices, recent trends.</td>
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<td>Charles R. Johnson, The College of William and Mary (839-15-92)</td>
</tr>
</tbody>
</table>
THURSDAY, JANUARY 7

9:30 a.m.  A nonrelation on the Smith invariants of a product of integral matrices.
Robert C. Thompson, University of California, Santa Barbara (839-15-169)

10:00 a.m.  Crypto-splittings and Drazin inverses. Preliminary report.
Robert E. Hartwig, North Carolina State University (839-94-549) (Sponsored by F. Hall)

10:30 a.m.  Convex and monotone matrix functions, and matrix inequalities.
M. Zuhair Nashed, University of Delaware (839-15-396)

AMS Special Session on Measure Theory and Descriptive Set Theory, II

8:00 a.m.–10:50 a.m.

8:00 a.m.  Measurable spaces and continuous restrictions of real functions.
Jack B. Brown, Auburn University, Auburn (839-28-269)

8:30 a.m.  On cardinals \( \kappa \) satisfying \( \exp(\lambda) = \exp(\kappa) \) whenever \( \kappa \leq \lambda < \exp(\kappa) \).
Karel Prikry, University of Minnesota, Minneapolis (839-04-215)

9:00 a.m.  Groups of measurable automorphisms. Preliminary report.
R. M. Shortt, Wesleyan University (839-28-86)

9:30 a.m.  The packing measure of some random sets.
S. James Taylor, University of Virginia (839-28-161)

10:00 a.m.  Invariant descriptive set theory.
Robert Vaught, University of California, Berkeley (839-54-327)

10:30 a.m.  Hausdorff dimension in graph directed constructions.
S. C. Williams*, Utah State University, and R. Daniel Mauldin, North Texas State University (839-28-409)

AMS Special Session on Nonlinear Differential Delay Equations, II

8:00 a.m.–10:50 a.m.

8:00 a.m.  Discussion period

8:30 a.m.  Periodic solutions of a differential-delay equation and the fixed point index. Preliminary report.
Steven A. Chapin, Ohio University, Athens (839-34-165)

9:00 a.m.  A Poincaré-Bendixson’s theory for discrete systems in the plane. Preliminary report.
Stavros Busenberg, Harvey Mudd College, Kenneth Cooke, Pomona College, and Mario Martelli*, California State University, Fullerton (839-34-104)

9:30 a.m.  Differential delay equations with negative feedback. Preliminary report.
George Sell, University of Minnesota, Minneapolis (839-34-477)

10:00 a.m.  Mixed functional differential equations. Preliminary report.
Aldo Rustichini, AT&T Bell Laboratories, Murray Hill, New Jersey (839-39-350)

10:30 a.m.  Discussion period

AMS Special Session on Abelian Groups, II

8:00 a.m.–10:50 a.m.

8:00 a.m.  Generalized polynomial \( L_1 \) approximation with rates. Preliminary report.
George Anastassiou, Memphis State University (839-41-143)

8:30 a.m.  The partial basis problem.
James T. Lewis, University of Rhode Island, and Oved Shisha*, Ohio State University, Columbus, and University of Rhode Island (839-41-346)

9:00 a.m.  Properties of minors of the Wronskian for solutions of \( L_n^p + p(x)y = 0 \) as related to \( (k, n-k) \) disfocality. Preliminary report.
Gary Jones*, Murray State University, and Marvin Keener, Oklahoma State University, Stillwater (839-34-208)

9:30 a.m.  Multi node splines with boundary conditions.
R. B. Barrar and H. L. Loeb*, University of Oregon, and Z. Ziegler, Technion, Israel (839-41-111)

10:00 a.m.  Generalized disconjugacy and comparison theorems. Preliminary report.
Lynn H. Erbe, University of Alberta (839-34-209)

10:30 a.m.  Analogues of Markov and Descartes systems of solutions for difference equations.
Paul Ello*, University of Dayton, and Johnny Henderson, Auburn University, Auburn (839-39-112)
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>9:00 a.m.</td>
<td>Essentially indecomposable Abelian $p$-groups having a prescribed filtration.</td>
</tr>
<tr>
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<td>Doyle Cutler*, University of California, Davis, Adolf Mader, University of Hawaii, Honolulu, and Charles Megibben, Vanderbilt University (839-20-274)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>$E$-transitive groups in $L$.</td>
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<td>Manfred Dugas*, Baylor University, and Saharon Shelah, Hebrew University, Israel (839-20-27)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Infinite rank Butler groups, II.</td>
</tr>
<tr>
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<td>Manfred Dugas, Baylor University, and K. M. Rangaswamy*, University of Colorado, Colorado Springs (839-20-277)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>A theorem on the closure of $\Omega$-pure subgroups of $C_2^g$-groups in the $\Omega$-topology.</td>
</tr>
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<td>Patrick Keef, Whitman College (839-20-210) (Sponsored by Robert A. Fontenot)</td>
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**AMS Special Session on Structural Complexity Theory, II**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:00 a.m.</td>
<td>Minimal polynomial degrees.</td>
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<tr>
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<td>Steven Homer, Boston University (839-68-134) (Sponsored by Ralph D'Agostino)</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>On collapsing degrees.</td>
</tr>
<tr>
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<td>James S. Royer, University of Chicago (839-68-347)</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>One-way functions, isomorphisms, and complete sets.</td>
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<td>Timothy J. Long, Ohio State University, Columbus (839-68-394) (Sponsored by Stephen R. Mahaney)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>One-way functions and the isomorphism conjecture.</td>
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<tr>
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<td>J. Hartmanis*, Cornell University, and L. Hemachandra, Columbia University (839-68-168)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Natural self-reducible sets.</td>
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<tr>
<td></td>
<td>Alan Selman, Northeastern University (839-68-196) (Sponsored by Stephen R. Mahaney)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>A hierarchy of notions of randomness.</td>
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<td>Stuart A. Kurtz, University of Chicago (839-68-395)</td>
</tr>
</tbody>
</table>

**AMS Special Session on Optimization, II**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:00 a.m.</td>
<td>Constraint qualifications in nondifferentiable programming.</td>
</tr>
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<td>Robert Merkovsky*, Purdue University, Calumet Campus, and Doug Ward, Miami University, Oxford (839-90-38)</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>Piecewise $C^1$ functions in nonsmooth optimization.</td>
</tr>
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<td>Robin W. Chaney, Western Washington University (839-49-106)</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>Constrained least squares problems for linear inclusions in Hilbert spaces.</td>
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<tr>
<td></td>
<td>M. Zuhair Nashed, University of Delaware (839-49-399)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Continuation methodology for constrained optimization. Preliminary report.</td>
</tr>
<tr>
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<td>Aubrey B. Poore, Colorado State University (839-49-545) (Sponsored by L. McLinden)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Approximate fixed points and the ellipsoid algorithm.</td>
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<tr>
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<td>Jonathan E. Spingarn, Georgia Institute of Technology (839-90-211)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>The nonlinear proximal point algorithm and multiplier methods.</td>
</tr>
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<td>Javier Luque, University of Puerto Rico, Rio Piedras (839-90-105)</td>
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**AMS Session on Algebraic Topology and Manifolds**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:05 a.m.</td>
<td>Fixed points of extensions of the complex power maps. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>Robert F. Brown* and Robert E. Greene, University of California, Los Angeles, and Helga Schirmer, Carleton University (839-55-144)</td>
</tr>
<tr>
<td>8:20 a.m.</td>
<td>A classification of weakly flat 2-spheres in $S^4$.</td>
</tr>
<tr>
<td></td>
<td>Craig R. Guilbault, University of Tennessee, Knoxville (839-57-376)</td>
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## Program of the Sessions

### THURSDAY, JANUARY 7

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<th>Time</th>
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<tr>
<td>8:35 a.m.</td>
<td>Global stability and bifurcation in a finite difference model for a pine forest. Preliminary report.</td>
</tr>
<tr>
<td>(235)</td>
<td>John E. Franke and Aziz Yakubu, North Carolina State University (839-58-260)</td>
</tr>
<tr>
<td>8:50 a.m.</td>
<td>Lie groups which are closed at infinity.</td>
</tr>
<tr>
<td>(236)</td>
<td>Harry F. Hoke III, University of Richmond (839-58-510)</td>
</tr>
<tr>
<td>9:05 a.m.</td>
<td>A stronger form of Olech's theorem on globally one-to-one mappings of the plane.</td>
</tr>
<tr>
<td>(237)</td>
<td>Gary Meisters*, University of Nebraska, Lincoln, and Czeslaw Olech, Math. Inst. PAN, Poland (839-58-259)</td>
</tr>
<tr>
<td>9:20 a.m.</td>
<td>The effect of an isotopy of a knot in $S^2\times S^1$ on the surgery 3-manifold groups. II. Preliminary report.</td>
</tr>
<tr>
<td>(238)</td>
<td>Francis D. Lonergan, Webster, Massachusetts (839-55-55)</td>
</tr>
<tr>
<td>9:35 a.m.</td>
<td>Invariants in the boundary of $P_u$. Preliminary report.</td>
</tr>
<tr>
<td>(239)</td>
<td>Thomas Bengtson, Pennsylvania State University, Delaware County Campus (839-57-503)</td>
</tr>
<tr>
<td>9:50 a.m.</td>
<td>Higher order flatness of real projective spaces.</td>
</tr>
<tr>
<td>(240)</td>
<td>Preliminary report. Gregory A. Fredricks*, Lewis and Clark College, and Phillip E. Parker, Wichita State University (839-57-449)</td>
</tr>
<tr>
<td>10:05 a.m.</td>
<td>Homology sphere decompositions.</td>
</tr>
<tr>
<td>(241)</td>
<td>David F. Snyder, University of Tennessee, Knoxville (839-57-306)</td>
</tr>
<tr>
<td>10:20 a.m.</td>
<td>Approximating cell-like resolutions by ones with 1-dimensional point preimages.</td>
</tr>
<tr>
<td>(242)</td>
<td>Zoran Nevajdic, University of Tennessee, Knoxville (839-57-307) (Sponsored by Robert J. Daverman)</td>
</tr>
<tr>
<td>10:35 a.m.</td>
<td>A variant of Ky Fan’s theorem.</td>
</tr>
<tr>
<td>(243)</td>
<td>S. P. Singh, Memorial University of Newfoundland (839-99-591)</td>
</tr>
</tbody>
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### AMS Session on Boundary Behavior and Approximation Theory

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>8:05 a.m.–10:45 a.m.</td>
<td></td>
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<tr>
<td>8:05 a.m.</td>
<td>New mixed-type boundary value problems. Preliminary report.</td>
</tr>
<tr>
<td>(244)</td>
<td>John M. Rassias, The American College of Greece (839-35-122)</td>
</tr>
<tr>
<td>8:20 a.m.</td>
<td>Wave propagation at computational domain boundaries and radiation boundary conditions for nonlinear wave equations.</td>
</tr>
<tr>
<td>(245)</td>
<td>Henry Warchall, North Texas State University (839-35-241)</td>
</tr>
<tr>
<td>8:35 a.m.</td>
<td>Asymptotic behavior of solutions to $\Delta u + Ke^{ix} = 0$ and $\Delta u + Ku^2 = 0$ on $T \times R$. Preliminary report.</td>
</tr>
<tr>
<td>(246)</td>
<td>Jeanne Trubek, Northeastern University (839-35-304) (Sponsored by Robert C. McOwen)</td>
</tr>
<tr>
<td>8:50 a.m.</td>
<td>A semilinear boundary value problem of Ambrosetti-Prodi type. Preliminary report.</td>
</tr>
<tr>
<td>(247)</td>
<td>Greg Harris, Auburn University, Auburn (839-35-311)</td>
</tr>
<tr>
<td>9:05 a.m.</td>
<td>Reaction-diffusion systems with nonlinear boundary conditions. Preliminary report.</td>
</tr>
<tr>
<td>(248)</td>
<td>Weihua Ruan, North Carolina State University (839-35-441)</td>
</tr>
<tr>
<td>9:20 a.m.</td>
<td>A system of conservation laws exhibiting a parabolic degeneracy on two intersecting lines.</td>
</tr>
<tr>
<td>(249)</td>
<td>Barbara Bohannon, Hofstra University (839-35-592)</td>
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<tr>
<td>9:35 a.m.</td>
<td>Limit periodic iteration.</td>
</tr>
<tr>
<td>(250)</td>
<td>John Gill, University of Southern Colorado (839-41-247)</td>
</tr>
<tr>
<td>9:50 a.m.</td>
<td>On some extremal properties of algebraic and trigonometric polynomials.</td>
</tr>
<tr>
<td>(251)</td>
<td>A. K. Varma, University of Florida (839-41-371)</td>
</tr>
<tr>
<td>10:05 a.m.</td>
<td>Inequalities for maximum modulus of polynomials.</td>
</tr>
<tr>
<td>(252)</td>
<td>Narendra K. Govil, Auburn University, Auburn (839-41-444) (Sponsored by Johnny L. Henderson)</td>
</tr>
<tr>
<td>10:20 a.m.</td>
<td>On polynomial monosplines with fixed point evaluations.</td>
</tr>
<tr>
<td>(253)</td>
<td>Diane L. Johnson, University of Rhode Island (839-41-446)</td>
</tr>
<tr>
<td>10:35 a.m.</td>
<td>Mean convergence of the Hermite-Fejer interpolation.</td>
</tr>
<tr>
<td>(254)</td>
<td>Preliminary report. Attila Máté*, Brooklyn College, City University of New York, and Paul Nevai, University of South Carolina, Columbia (839-41-518)</td>
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### AMS Session on Operator Theory

<table>
<thead>
<tr>
<th>Time</th>
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<tr>
<td>8:05 a.m.–10:45 a.m.</td>
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<tr>
<td>8:05 a.m.</td>
<td>Hyponormality of Toeplitz operators.</td>
</tr>
<tr>
<td>(255)</td>
<td>Carl Cowen, Purdue University, West Lafayette (839-47-67)</td>
</tr>
<tr>
<td>8:20 a.m.</td>
<td>Spectral mapping theorem on tensor products.</td>
</tr>
<tr>
<td>(256)</td>
<td>Ram Verma, Mount Olive College (839-47-130)</td>
</tr>
<tr>
<td>8:35 a.m.</td>
<td>The minimal normal extension for $M_z$ on the Hardy space of a planar region.</td>
</tr>
<tr>
<td>(257)</td>
<td>John Spraker, Western Kentucky University (839-47-140)</td>
</tr>
<tr>
<td>8:50 a.m.</td>
<td>Invariant subspaces of the Dirichlet shift.</td>
</tr>
<tr>
<td>(258)</td>
<td>Stefan Richter, University of Virginia (839-47-180)</td>
</tr>
<tr>
<td>9:05 a.m.</td>
<td>Terraced matrices. Preliminary report.</td>
</tr>
<tr>
<td>(259)</td>
<td>Crawford Rhaly, Murray State University (839-47-195)</td>
</tr>
<tr>
<td>9:20 a.m.</td>
<td>Characterizations of integral operators on $C(K)$.</td>
</tr>
<tr>
<td>(260)</td>
<td>Lutz Weis, Louisiana State University, Baton Rouge (839-47-252)</td>
</tr>
<tr>
<td>9:35 a.m.</td>
<td>Nonanalytic functional calculi and spectral maximal spaces.</td>
</tr>
<tr>
<td>(261)</td>
<td>Michael M. Neumann, Southwest Missouri State University (839-47-290)</td>
</tr>
<tr>
<td>9:50 a.m.</td>
<td>Solvability of nonlinear hyperbolic equations at resonance.</td>
</tr>
<tr>
<td>(262)</td>
<td>P. S. Milojevic, New Jersey Institute of Technology (839-47-303)</td>
</tr>
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Program of the Sessions

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<tr>
<td>8:20 a.m.-10:45 a.m.</td>
<td>AMS Session on Complex Variables and Special Functions</td>
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</table>

**AMS Session on Number Theory, II**

8:20 a.m.-9:15 a.m.

- 8:20 a.m. Two differential-difference equations arising in number theory.  
  Ferrel S. Wheeler, University of Illinois, Urbana-Champaign (839-11-229)
- 8:35 a.m. Hypergeometric functions over finite fields and representations of SL(2, q).  
  John Greene, Southern Illinois University, Carbondale (839-11-316)
- 8:50 a.m. Minimum period (modulo M) of a class of infinite integer sequences.  
  Y. H. Harris Kwong, State University of New York, College at Fredonia (839-11-315)
- 9:05 a.m. Orthogonally indecomposable sums of integral quadratic forms.  
  Larry J. Gerstein, University of California, Santa Barbara (839-11-182)

**AMS Session on Structures with Order**

8:50 a.m.-10:45 a.m.

- 8:50 a.m. Weakly regular trees and their color algebras.  
  Stephen D. Comer, The Citadel (839-06-129)
- 9:05 a.m. Retracts of saturated chains.  
  Teo Sturm, University of Natal, South Africa (839-11-116)
- 9:20 a.m. Principal continuum congruences and regular-classes.  
  K. D. Magill, Jr., State University of New York, Buffalo, and P. R. Misra*, College of Staten Island, City University of New York (839-06-116)
- 9:35 a.m. Filtered breadth-first enumeration, vectorized for supercomputers.  
  William David Miller, Kansas State University (839-06-341)
- 9:50 a.m. Lattices generated by cuts.  
  Constantin Dumitrescu, Romania (839-99-600)
- 10:05 a.m. The Gorenstein lift of a quasi-order.  
  Leslie Cohn, The Citadel (839-06-588)
- 10:20 a.m. Maximal quotient BCK-algebras.  
  Elias Deeba*, J. Ashen and A. B. Thaheem, University of Houston, Downtown (839-06-511)
- 10:35 a.m. Properties of the lattice of subnormal subgroups of a finite group.  
  Karen Gragg* and Joseph P. S. Kung, North Texas State University (839-06-203)
THURSDAY, JANUARY 7

MAA Invited Address

9:00 a.m.–9:50 a.m.
9:00 a.m. What does it mean to understand the function concept? Lawrence Couvillon, Southern University

AWM Emmy Noether Lecture

9:00 a.m.–10:00 a.m.
9:00 a.m. Moment maps in stable bundles: Where analysis, algebra, and topology meet. Karen Uhlenbeck, University of Chicago

MAA Minicourse #5: Part B

9:00 a.m.–10:55 a.m.
9:00 a.m. Logo and problem solving. Charles A. Jones, Grinnell College

AMS Session on Optimization and Control

9:05 a.m.–10:45 a.m.
9:35 a.m. Finite dimensional approximation in infinite dimensional mathematical programs. Preliminary report. Irwin E. Schochetman*, Oakland University, and Robert L. Smith, University of Michigan, Ann Arbor (839-49-253)
10:05 a.m. Attractor and repeller holding sets in control systems. Preliminary report. Emilio Roxin, University of Rhode Island (839-49-411)

10:35 a.m. Numerical solutions of external problems II. John Gregory, Southern Illinois University, Carbondale (839-49-580) (Sponsored by Don Redmond)

AMS Session on Statistics

9:50 a.m.–10:45 a.m.
10:05 a.m. A class of Bayes invariant estimators of the common mean of three normal distributions. Preliminary report. J. Choudhury*, University of Baltimore, and B. K. Sinha, University of Maryland, Baltimore County (839-62-181)
10:20 a.m. A comprehensive assessment of the physical conditions of students of Yunnan Province. Preliminary report. Xueren Wang, Yunnan University, China (839-62-353) (Sponsored by J. M. Dolan)
10:35 a.m. Bounds on the distribution function for radial error. Roger B. Nelsen*, Lewis and Clark College, and Berthold Schweizer, University of Massachusetts, Amherst (839-62-516)

MAA Invited Address

10:05 a.m.–10:55 a.m.
10:05 a.m. Karmarkar’s linear programming algorithm and nonlinear programming. Jeffrey C. Lagarias, AT&T Bell Laboratories

AMS-MAA Invited Address

11:10 a.m.–12:00 noon
11:10 a.m. Oscar Zariski and his work. David Mumford, Harvard University

AMS Colloquium Lectures: Lecture II

1:00 p.m.–2:00 p.m.
1:00 p.m. Spectral properties of Riemannian manifolds. II Victor W. Guillemin, Massachusetts Institute of Technology
### Program of the Sessions

#### AMS Invited Address

2:15 p.m.–3:05 p.m.

2:15 p.m. Hyperbolic conservation laws in classical physics: Recent results and open problems.
Constantine M. Dafermos, Brown University (839-35-405)

#### MAA Task Force on Minorities in Mathematics Panel Discussion

2:15 p.m.–4:15 p.m.

2:15 p.m. Mathematics, minorities and the MAA—How do they fit together?

#### MAA ICME-6 Panel Discussion

2:15 p.m.–4:15 p.m.

2:15 p.m. What can mathematicians contribute to mathematics education?

#### MAA Session on Writing as Part of the Mathematics Curriculum, Part A

2:15 p.m.–4:10 p.m.

2:15 p.m. Report on the Bard College Conference on using writing to teach math and science.
Paul Perdew, University of Scranton

2:30 p.m. A writing-intensive mathematics course at Western Michigan University.
Arthur T. White, Western Michigan University

2:45 p.m. Written homework: A learning experience or a certificate of drudgery?
J. J. Price, Purdue University, West Lafayette

3:00 p.m. Writing on historical topics in calculus.
Raymond Smith, Whittier College

3:15 p.m. Writing in G. E. Statistics.
Barbara Jir, University of Tennessee, Chattanooga

3:30 p.m. Examples demonstrating learning through writing in calculus.
Coreen Mett, Radford University

3:45 p.m. How to respond to students' first efforts at writing mathematics.
George D. Gopen* and David A. Smith, Duke University

4:00 p.m. Mathematics/computer science colloquium at Xavier University.
Susan Fredine, Xavier University

#### MAA Minicourse #2: Part B

2:15 p.m.–4:15 p.m.

2:15 p.m. Computer software for differential equations.
Howard Lewis Penn and James Buchanan, U. S. Naval Academy

#### MAA Minicourse #3: Part B

2:15 p.m.–4:15 p.m.

2:15 p.m. Teaching mathematical modeling.
Frank R. Giordano, U. S. Military Academy and Maurice D. Weir, Naval Postgraduate School

#### MAA Minicourse #4: Part B

2:15 p.m.–4:15 p.m.

2:15 p.m. Teaching calculus with an HP-28C symbol manipulating calculator.
John W. Kenelly, Clemson University and Thomas W. Tucker, Colgate University

#### Rocky Mountain Mathematics Consortium Board of Directors' Meeting

2:15 p.m.–4:15 p.m.

#### AMS Invited Address

3:20 p.m.–4:10 p.m.

3:20 p.m. Topology and combinatorics of affine subspaces of Euclidean space.
R. Mark Goresky, Northwestern University (839-99-590)

#### AMS Birkhoff Prize Session and Business Meeting

4:25 p.m.–6:00 p.m.

100 Years of American Mathematics Banquet

7:00 p.m.–9:00 p.m.
THURSDAY, JANUARY 7

MAA Minicourse #3: Part C
7:00 p.m.–9:00 p.m.
7:00 p.m. Teaching mathematical modeling.
Frank R. Giordano, U. S. Military Academy and Maurice D. Weir, Naval Postgraduate School

MAA Minicourse #6: Part B
7:00 p.m.–9:00 p.m.
7:00 p.m. Coloring and path following algorithms for approximating roots and fixed points.
William F. Lucas, Claremont Graduate School

FRIDAY, JANUARY 8

MAA Session on Writing as Part of the Mathematics Curriculum, Part B
8:00 a.m.–10:55 a.m.
8:00 a.m. Getting started incorporating writing in your curriculum.
Agnes Azzolino, Middlesex County College
8:15 a.m. A writing-intensive approach to introductory computer programming.
Robert Webber, Longwood College
8:30 a.m. Writing as a step toward liberating mathematics education.
Philip A. DeMarois, National College of Education
8:45 a.m. If they can write it, then they know it.
JoAnne S. Grownney, Bloomsburg University
9:00 a.m. Locally original mathematics through writing.
William P. Berlinghoff, Southern Connecticut State University
9:15 a.m. Writing and mathematics: A partnership for learning.
Marcia Birkin, Rochester Institute of Technology
9:30 a.m. Explorative writing and learning mathematics.
Sandra Keith, St. Cloud State University
9:45 a.m. The advanced writing requirement at St. Mary’s College.
Joanne R. Snow, Saint Mary’s College
10:00 a.m. Mathematics as part of a writing curriculum.
David T. Burkam, University of Michigan, Ann Arbor
10:15 a.m. Using student writing in mathematics classes.
Gary L. Britton, University of Wisconsin, West Bend
10:30 a.m. Proofs in essay form.
Richard J. Trudeau, Stonehill College

10:45 a.m. A writing assignment on the delta-E definition of a limit.
Lawrence Neff Stout, Illinois Wesleyan University

MAA-NCTM Panel Discussion
8:30 a.m.–9:20 a.m.
8:30 a.m. NCTM standards for school mathematics

MAA Committee on Computers in Mathematics Education Symposium
8:30 a.m.–10:55 a.m.
8:30 a.m. Applications and implications of computer algebra systems in mathematics instruction

AMS Invited Address
9:00 a.m.–9:50 a.m.
9:00 a.m. Nonlinear Fourier analysis.
Stephen William Semmes, Rice University (839-42-190)

MAA Minicourse #7: Part A
9:00 a.m.–10:55 a.m.
9:00 a.m. Computer based discrete mathematics.
Nancy Baxter, Dickinson College Ed Dubinsky, Purdue University

MAA Minicourse #8: Part A
9:00 a.m.–10:55 a.m.
9:00 a.m. Laboratory projects for first year calculus.
L. Carl Leinbach, Gettysburg College

MAA Minicourse #9: Part A
9:00 a.m.–10:55 a.m.
9:00 a.m. Constructing placement examinations.
John G. Harvey, University of Wisconsin at Madison
Program of the Sessions

NAM-MAA Panel Discussion
9:30 a.m.-10:55 a.m.
9:30 a.m. Impact of computer science on the mathematics program

MAA CTUM Subcommittee on Teaching Assistants and Part-time Instructors Panel Discussion
10:00 a.m.-10:55 a.m.

AMS Invited Address
10:05 a.m.-10:55 a.m.
10:05 a.m. Symplectic structures on manifolds.
(327) Dusa McDuff, State University of New York, Stony Brook (839-53-541)

AMS-MAA Invited Address
11:10 a.m.-12:00 noon
11:10 a.m. The European mathematician's migration to America.
(328) Lipman Bers, Columbia University

AMS Special Session on Applications of Differential Equations to Population Ecology, I
12:30 p.m.-4:50 p.m.
12:30 p.m. Successful invasion of a food web in a chemostat.
(329) Preliminary report.
Gail S. K. Wolkowicz, McMaster University (839-34-30)
1:00 p.m. A classification of persistent three-species competition dynamics.
(330) Hal. L. Smith*, Arizona State University, and Paul Waltman, Emory University (839-34-26)
1:30 p.m. Persistence and stability in 3-dimensional competitive systems.
(331) Morris W. Hirsch, University of California, Berkeley (839-34-321)
2:00 p.m. A model for competing size-structured species.
(332) Preliminary report.
J. M. Cushing, University of Arizona (839-92-50)
2:30 p.m. Travelling wave solutions for equations of gene-culture coevolution. Preliminary report.
(333) Steven R. Dunbar, University of Nebraska, Lincoln (839-92-73)
3:00 p.m. Travelling waves for a pair of diffusing mutualist species.
(334) Vivian Hutson, University of Utah (839-92-72)
(335) Bifurcation in a competition model with genetic variation. Preliminary report.
Eduardo M. Munoz and James F. Selgrade*, North Carolina State University (839-34-74)
4:00 p.m. Global stability and persistence of ecological systems with diffusion.
(336) Yasuhiro Takeuchi, University of Alberta (839-34-80)
(337) P. Van Den Driessche, University of Victoria (839-92-19)

AMS Colloquium Lectures: Lecture III
1:00 p.m.-2:00 p.m.
1:00 p.m. Spectral properties of Riemannian manifolds, III
(338) Victor W. Guillemin, Massachusetts Institute of Technology

AMS Special Session on Ordered Algebraic Systems, I
1:00 p.m.-4:50 p.m.
1:00 p.m. f-rings, subdirect products of totally ordered rings, and the prime ideal theorem.
(339) David Feldman, University of New Hampshire, and Melvin Henriksen*, Harvey Mudd College (839-06-82)
1:30 p.m. Pseudoprime f-ideals in a class of f-rings.
(340) Suzanne Larson, Loyola Marymount University (839-06-174)
2:00 p.m. On lattice-ordered semigroup algebras. Preliminary report.
(341) Stuart Steinberg, University of Toledo (839-06-400)
2:30 p.m. Free products of lattice-ordered modules.
(342) Mona Cherri, University of Central Arkansas (839-06-292)
3:00 p.m. Epicompleteness in Archimedean lattice-ordered groups and vector lattices.
(343) Richard N. Ball, Boise State University, and Anthony W. Hager*, Wesleyan University (839-06-288)
3:30 p.m. Adjoining units to lattice-ordered groups.
(344) Paul Conrad, University of Kansas, and Jorge Martinez*, University of Florida (839-06-119)
4:00 p.m. A method for constructing interesting examples of lattice-ordered groups.
(345) Paul Conrad*, University of Kansas, and Jorge Martinez, University of Florida (839-06-285)
4:30 p.m. Semialgebraic geometry and equational theories of ordered algebras.
(346) James J. Madden, Indiana University, South Bend (839-06-198)
### FRIDAY, JANUARY 8

#### AMS Special Session on Toeplitz Operators and Geometry, I

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#### AMS Special Session on Graph Theory, I

**1:00 p.m. – 4:50 p.m.**

1:00 p.m. New separator theorems for graphs and their applications to speech recognition. Preliminary report.  
**Margaret B. Cozzens**, Northeastern University (839-05-102)

1:30 p.m. On separating vertices in graphs. Preliminary report.  
**Lowell W. Beineke**, Kunwarjit S. Bagga, Marc J. Lipman and Raymond E. Pippert, Indiana University-Purdue University, Ft. Wayne (839-05-287)

2:00 p.m. Graph extremal problems and network reliability.  
**Frank Boesch**, Stevens Institute of Technology (839-68-167) (Sponsored by Milos Dostal)

2:30 p.m. Perfect graphs and 0 - 1 Gaussian elimination on clique-vertex incidence matrices.  
**Alan Tucker**, State University of New York, Stony Brook (839-05-393)

3:00 p.m. Tolerance intersection graphs.  

3:30 p.m. Mean distance in a tree.  
**Peter Winkler**, Emory University (839-05-219)

4:00 p.m. On-line algorithms for graph coloring. Preliminary report.  
**Laszlo Lovasz**, Mathematical Institute, Hungary, **Michael Saks**, Rutgers University, New Brunswick, and Belcore, Morristown, New Jersey, and **Tom Trotter**, Arizona State University (839-05-278)

#### AMS Special Session on Multidimensional Inverse Problems, Related Problems in Analysis and Applications, I

**4:30 p.m.** A fractional view of graph theory. Preliminary report.  
**N. Chandrasekharan**, S. T. Hedetniemi**, R. Laskar** and **A. Majumdar**, Clemson University (839-05-166) (Sponsored by Renu Laskar)

### AMS Special Session on Discrete-Time Optimal Stopping Theory, I

**1:00 p.m. – 4:50 p.m.**

1:00 p.m. Limit theorems for threshold-stopped random variables.  

1:30 p.m. Prophet problem for transforms of processes.  
**Louis Sucheston**, Ohio State University, Columbus (839-60-284)

2:00 p.m. Maximizing $E[\max_{1 \leq k \leq n} S_k]/ES_1$: a prophet inequality for sums of i.i.d. mean zero variates.  
**Michael J. Klass**, University of California, Berkeley (839-60-538)

2:30 p.m. A two-sided maximal inequality for Martingales.  
**Lester E. Dubins**, University of California, Berkeley (839-60-351)

3:00 p.m. Some sharp Martingale inequalities and optimally stopped Brownian motion.  
**David Gilat**, Tel-Aviv University, Israel (839-60-138) (Sponsored by Robert P. Kertz)

3:30 p.m. A converse to the optional sampling theorem for everywhere finite stop rules.  
**William D. Sudderth**, University of Minnesota, Minneapolis (839-60-330)

4:00 p.m. Application of Wald type identities for stopped Martingales.  
**David Siegmund**, Stanford University (839-60-331) (Sponsored by Robert P. Kertz)

4:30 p.m. On the structure of optimal stopping times in nonstandard situations.  
**Albrecht Irle**, Christian-Albrechts-Universität, West Germany (839-60-137) (Sponsored by Robert P. Kertz)
Program of the Sessions

FRIDAY, JANUARY 8

2:30 p.m. Marginals of two-valued functions.
(395) L. A. Shepp, AT&T Bell Laboratories, Murray Hill, New Jersey (839-28-02)
3:10 p.m. The \(\bar{\partial}\)-bar approach to inverse scattering.
(396) Richard Beals* and R. R. Coifman, Yale University (839-35-324)
3:50 p.m. Discussion period

AMS Session on Abstract Algebra

1:10 p.m.–4:50 p.m.

1:10 p.m. Group representations and algebraic K-theory: II.
(397) Clayton Sherman, Southwest Missouri State University (839-19-364)
1:25 p.m. Dinatural transformations and polymorphism.
(398) Preliminary report.
Cameron Smith, University of Illinois, Urbana-Champaign (839-18-499)
1:40 p.m. Adjointness and bicategories.
(399) Steven M. Amgott, Villanova University (839-18-489)
1:55 p.m. Krull dimension in serial rings. Preliminary report.
Mary H. Wright, Southern Illinois University, Carbondale (839-16-142)
2:10 p.m. Freeness of infinite dimensional Hopf algebras over grouplike subalgebras.
(400) Warren D. Nichols, Florida State University, and M. Bettina Zoeller*, Western Kentucky University (839-16-145)
2:25 p.m. Large subdirect product of projective modules.
(401) Philippe Loustaunau, University of Wisconsin, Milwaukee (839-16-153)
2:40 p.m. The primitives of the continuous linear dual of a Hopf algebra as the dual Lie algebra of a Lie coalgebra.
Walter J. Michaelis, University of New Orleans (839-16-224)
2:55 p.m. Involutions in a compact ring.
(402) Jo-Ann Cohen* and Kwangil Koh, North Carolina State University (839-16-223)
James Stasheff, University of North Carolina, Chapel Hill (839-18-322)
3:25 p.m. A generalization of Freyd's adjoint functor theorem.
(403) Alexandru Solan*, University of North Carolina, Charlotte, and T. M. Viswanathan, Unicamp, Brazil and University of North Carolina, Charlotte (839-18-363)
3:40 p.m. In a right alternative algebra an alternator need not cube to zero. Preliminary report.
I. R. Hentzel*, Iowa State University, and D. J. Pokrass, Clemson University (839-17-01)

AMS Session on Combinatorics

1:10 p.m.–4:50 p.m.

1:10 p.m. Summation theorems for basic hypergeometric series in \(U(n)\), and related series.
(412) Stephen C. Milne, University of Kentucky (839-05-75)
1:25 p.m. Isomorphisms of objects admitting elementary Abelian \(p\)-group actions.
(413) Neal Brand, North Texas State University (839-05-227)
1:40 p.m. Power product expansions.
(414) David W. Roeder* and Steven J. Janke, Colorado College, Yahya Ould Hamidoune, Université Pierre et Marie Curie, France, Todd H. Fell, Denison University, and Richard Koo, Cornell University (839-05-512)
1:55 p.m. The probability of splitters in a list.
(415) Preliminary report.
John R. Stankewitz, University of Illinois, Urbana-Champaign (839-05-471)
2:25 p.m. Algorithms for old and new sequence generating functions.
(416) Kenneth Walter Johnson, Pennsylvania State University, Abington (839-05-491)
2:40 p.m. Group determinants and their generalizations.
(417) Donald R. Snow, Brigham Young University (839-05-485)
3:10 p.m. Resolvable group divisible designs. Preliminary report.
(418) Ahmed Assaf, Auburn University, Auburn (839-05-361) (Sponsored by R. A. Zalik)
3:25 p.m. Frequency cubes-enumeration and classification.
(419) Larry J. Brand*, Gerontology Research Center, National Institute on Aging, Baltimore, Maryland, and Gary L. Mullen, Pennsylvania State University, University Park (839-05-154)
3:40 p.m. The smallest rounded sets of binary matroids.
(420) James G. Oxley and Talmage James Reid*, Louisiana State University, Baton Rouge (839-05-155)
3:55 p.m. Difference sets in Abelian 2-groups.
(421) Preliminary report.
James Davis, Lafayette College (839-05-318)
### AMS Session on Commutative Algebra and Algebraic Geometry

<table>
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<tr>
<th>Time</th>
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<th>Authors/Raffiliations</th>
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<tr>
<td>3:40 p.m.</td>
<td>Character tables of associations schemes obtained from the action of orthogonal groups (2_{2n+1}(a)) on the sets of nonisotropic points. Preliminary report.</td>
<td>Eiichi Bannai and Sung Yell Song*, Ohio State University, Columbus (839-05-425)</td>
</tr>
<tr>
<td>3:55 p.m.</td>
<td>On a transformation of (S_n).</td>
<td>Rodica Simion, George Washington University (839-05-594)</td>
</tr>
<tr>
<td>4:10 p.m.</td>
<td>Infinite Latin squares containing nested sets of mutually orthogonal finite Latin squares.</td>
<td>J. V. Brawley, Clemson University, and Gary L. Mullen*, Pennsylvania State University, University Park (839-05-532)</td>
</tr>
<tr>
<td>4:25 p.m.</td>
<td>Application of higher dimensional determinants to enumeration of Young tableaux. Preliminary report.</td>
<td>Sudhir Ghorpade, Purdue University, West Lafayette (839-05-514)</td>
</tr>
<tr>
<td>4:40 p.m.</td>
<td>Classification and detection of obstructions to planarity.</td>
<td>Almira Karabeg, University of California at San Diego, La Jolla (839-05-426)</td>
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### AMS Session on Functional Analysis

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<tr>
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<tr>
<td>1:10 p.m.</td>
<td>A characterization of homomorphisms between Banach algebras.</td>
<td>Edward Beckenstein*, St. John’s University, Staten Island, Lawrence Narici, St. John’s University, Queens, and Seth Warner, Duke University (839-46-113)</td>
</tr>
<tr>
<td>1:55 p.m.</td>
<td>Endomorphisms of an extremal algebra. Preliminary report.</td>
<td>Herbert Kamowitz* and Dennis Wortman, University of Massachusetts, Boston (839-46-187)</td>
</tr>
<tr>
<td>2:10 p.m.</td>
<td>Relative numerical ranges of elements of B-algebras.</td>
<td>A. K. Gaur*, Duquesne University, and T. Husain, McMaster University (839-46-188)</td>
</tr>
<tr>
<td>2:25 p.m.</td>
<td>Weakly precompact operators on continuous function spaces. Preliminary report.</td>
<td>Catherine Abbott, North Texas State University (839-46-248) (Sponsored by Paul Lewis)</td>
</tr>
<tr>
<td>2:40 p.m.</td>
<td>Weak precompactness and the weak RNP.</td>
<td>Elizabeth M. Bator and Paul W. Lewis*, North Texas State University (839-46-250)</td>
</tr>
<tr>
<td>2:55 p.m.</td>
<td>Dynamic systems from function algebras.</td>
<td>Timothy J. Pennings*, Hope College, and Justin Peters, Iowa State University (839-46-378)</td>
</tr>
<tr>
<td>3:25 p.m.</td>
<td>A theorem on compactness in Banach spaces.</td>
<td>Shuetao Chen, Harbin Normal University, People’s Republic of China, and California State University, Northridge (839-46-487) (Sponsored by Kwang-nan Chow)</td>
</tr>
</tbody>
</table>
Friday, January 8

3:10 p.m.
Contractive and hypercontractive estimates on the unit circle.
William McMillen, University of South Alabama (839-46-488)

3:25 p.m.
A minimax proof of the Krein-Smulian theorem.
B. Rodrigues*, Loyola University, and S. Simons, University of California, Santa Barbara (839-46-530)

3:40 p.m.
Derivations and prime ideals in commutative Banach algebras.
Ramesh Garimella, Northwest Missouri State University (839-46-542) (Sponsored by Dennis R. Malm)

3:55 p.m.
Linear isometries of subalgebras of $l_\infty$ which contain c. Preliminary report.
J. Connor* and I. Loomis, Loyola University (839-45-556)

4:10 p.m.
Compact weighted composition operators on Banach lattices. Preliminary report.
William Feldman, University of Arkansas, Fayetteville (839-46-558)

4:25 p.m.
Duals of Banach spaces of entire functions.
John Duncan, University of Arkansas, Fayetteville (839-46-578)

4:40 p.m.
Fixed points of nonexpansive order preserving maps.
Michael Lin, Ben-Gurion University, Israel, and Robert Sine*, Iowa State University (839-46-581)

AMS Session on Function Theory and Measure Theory

1:10 p.m. - 4:35 p.m.

1:10 p.m.
Regular variation in $\mathbb{R}^k$.
Mark M. Meerschaert, Albion College (839-26-39)

1:25 p.m.
Connectedness in (real) function theory.
Jacek Jedrzejewski, University of Lodz, Poland (839-26-99) (Sponsored by Andrzej Bucki)

1:40 p.m.
A connection between mean value theorems for integrals.
Alfonso G. Azpeitia, University of Massachusetts, Boston (839-26-131)

1:55 p.m.
Generalized Farkas' theorem and its application for set functions.
Hang-C. Lai, NTHU and University of Iowa (839-26-132) (Sponsored by Bor Luh Lin)

2:10 p.m.
Semigroups of density-continuous functions.
Krzysztof Ostaszewski, University of Louisville (839-26-162)

2:25 p.m.
Quasi-analytic collections of square integrable functions.
John W. Neuberger, North Texas State University (839-26-207)

2:40 p.m.
The calculus of fractal interpolation functions.
Michael F. Barnsley, Georgia Institute of Technology, and Andrew N. Harrington*, Loyola University (839-26-225)

2:55 p.m.
J. Marshall Ash, DePaul University (839-26-419)

3:10 p.m.
Superadditive functions and a statistical application.
S. Y. Trimble*, University of Missouri, Rolla, Jim Wells, University of Kentucky, and F. T. Wright, University of Missouri, Rolla (839-26-461)

3:25 p.m.
Some integral inequalities related to Copson's inequalities.
R. N. Mohapatra* and K. Vajravelu, University of Central Florida (839-26-501)

3:40 p.m.
Borel measurability of extreme local derivatives.
Aliashgar Alikhani-Koopaei, Pennsylvania State University, Reading (839-26-523)

3:55 p.m.
Completeness in the dual system
< $L_1(\mu, X), L_\infty(\mu, X^*)$ >. Preliminary report.
Georg Schluchtermann, Northern Illinois University (839-28-94) (Sponsored by Robert F. Wheeler)

4:10 p.m.
Some remarks concerning an example of a minimal, non-uniquely ergodic interval exchange transformation.
John Coffey, Union College (839-28-367)

4:25 p.m.
Fixed points of multi-valued mappings.
K. L. Singh, Fayetteville State University (839-99-604)

AMS Session on Group Theory

1:10 p.m. - 4:50 p.m.

1:10 p.m.
On the lower near Frattini subgroups of generalized free products. Preliminary report.
Mohammad K. Azarian, University of Evansville (839-20-40)

1:25 p.m.
$\omega_1$-separable groups and Kaplansky's test problems.
Bernhard Thomé, University of California, Irvine (839-20-76) (Sponsored by Paul Eklof)

1:40 p.m.
The semigroup of one-to-one transformations with finite defects.
Inessa Levi*, University of Louisville, and Boris M. Schein, University of Arkansas, Fayetteville (839-20-152)

1:55 p.m.
Products of simple groups, III.
Gary Walls, University of Southern Mississippi (839-20-312)

2:10 p.m.
Finite coverings by 2-Engel groups.
Luisa-Charlotte Kappe, State University of New York, Binghamton (839-20-291)

2:25 p.m.
Centers of generic Hecke algebras.
Leonard Jones, Shippensburg University (839-20-383)

2:40 p.m.
Kernels of saturated formations. Preliminary report.
H. Bechtell, University of New Hampshire (839-20-379)
**AMS Session on Ordinary Differential Equations**

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<th>Time</th>
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<th>Speaker(s) and Institution(s)</th>
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<tbody>
<tr>
<td>2:55 p.m.</td>
<td>Graph subgroups of graph groups.</td>
<td>Herman Servatius, Worcester, Massachusetts, and Carl Droms*, James Madison University</td>
</tr>
<tr>
<td>3:10 p.m.</td>
<td>Decomposing tensor products.</td>
<td>Daniel E. Flath, National University of Singapore, Singapore</td>
</tr>
<tr>
<td>3:25 p.m.</td>
<td>Groups with quasi-representing graphs and quasi-corepresenting graphs.</td>
<td>Anthony J. Giovannitti, University of Southern Mississippi</td>
</tr>
<tr>
<td>3:40 p.m.</td>
<td>Generators for the automorphism group of a graph group.</td>
<td>Herman Servatius, Worcester, Massachusetts</td>
</tr>
<tr>
<td>3:55 p.m.</td>
<td>Automorphisms of the lattice of subgroups of ( \mathbb{Z}_p \times \mathbb{Z}_q ).</td>
<td>Charles Holmes, Miami University, Oxford</td>
</tr>
<tr>
<td>4:10 p.m.</td>
<td>The locally free cancellation property of the integral group ring ( ZG ).</td>
<td>Hain-Fong Chen, Pennsylvania State University, Mont Alto Campus</td>
</tr>
<tr>
<td>4:25 p.m.</td>
<td>An HNN-extension with cyclic associated subgroups and with unsolvable conjugacy problem.</td>
<td>Jody Meyer Lockhart, Indiana University, South Bend</td>
</tr>
<tr>
<td>4:40 p.m.</td>
<td>More on commutator identities in groups.</td>
<td>I. D. MacDonald*, Memphis State University, and B. H. Neumann, Australian National University</td>
</tr>
</tbody>
</table>

**AMS Session on Set-theoretic Topology**

<table>
<thead>
<tr>
<th>Time</th>
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</thead>
<tbody>
<tr>
<td>2:40 p.m.</td>
<td>Decoupling process and boundary value problems for large-scale singularly perturbed linear systems.</td>
<td>G. S. Ladde and M. Kathirkamanayagan*, University of Texas</td>
</tr>
<tr>
<td>2:55 p.m.</td>
<td>On the zeros of solutions of ( w' + A(z)w = 0 ) where ( A ) is a polynomial. Preliminary report.</td>
<td>Enid M. Steinbart, University of Illinois, Urbana-Champaign</td>
</tr>
<tr>
<td>3:10 p.m.</td>
<td>Disconjugacy in difference equations. Preliminary report.</td>
<td>Darrel Hankerson, Auburn University, Auburn</td>
</tr>
<tr>
<td>3:25 p.m.</td>
<td>Polynomial flows and symmetry groups.</td>
<td>Brian Coomes, University of Nebraska, Lincoln</td>
</tr>
<tr>
<td>3:40 p.m.</td>
<td>Stability properties for nonautonomous differential systems in terms of two measures.</td>
<td>V. Lakshmikantham and Xinzhi Liu*, University of Texas</td>
</tr>
<tr>
<td>3:55 p.m.</td>
<td>The method of mixed monotony for second order nonlinear integro-differential systems.</td>
<td>Mohammad Khavanin, University of North Dakota, Grand Forks</td>
</tr>
<tr>
<td>4:10 p.m.</td>
<td>Bifurcation properties for a sequence of approximations of delay equation.</td>
<td>Ovide Arino, University of Mississippi, and Rachid Benkhalt*, Pacific Lutheran University</td>
</tr>
<tr>
<td>4:25 p.m.</td>
<td>Monotone iterative technique for boundary value problems of first order singular differential systems.</td>
<td>Josaphat A. Uvah*, University of Southwestern Louisiana, Baton Rouge, and A. S. Vatsala, University of Southwestern Louisiana</td>
</tr>
<tr>
<td>4:40 p.m.</td>
<td>A method obtaining averaged solutions of the stochastic singularly perturbed system.</td>
<td>Janusz Stanislaw Golec, University of Texas</td>
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## FRIDAY, JANUARY 8

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<tr>
<th>Time</th>
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<tr>
<td>2:10 p.m.</td>
<td>More on densely homogeneous spaces.</td>
</tr>
<tr>
<td>(505)</td>
<td>Ben Fitzpatrick, Jr.*, Auburn University, Auburn, and Hao-Xuan Zhou, Sichuan University, People's Republic of China (839-54-07)</td>
</tr>
<tr>
<td>(506)</td>
<td>S. P. Franklin, Memphis State University, and M. Rajagopalan*, Tennessee State University (839-54-391) (Sponsored by Raymond Richardson)</td>
</tr>
<tr>
<td>2:40 p.m.</td>
<td>Cofinalities of countable ultraproducts: the existence theorem.</td>
</tr>
<tr>
<td>(507)</td>
<td>R. Michael Canjar, University of Baltimore (839-04-358)</td>
</tr>
<tr>
<td>2:55 p.m.</td>
<td>Homogeneity properties of F. B. Jones connected graph of a discontinuous additive function.</td>
</tr>
<tr>
<td>(508)</td>
<td>R. W. Heath, University of Pittsburgh, Pittsburgh (839-54-566)</td>
</tr>
<tr>
<td>3:10 p.m.</td>
<td>Extending a topology from a subset to a group.</td>
</tr>
<tr>
<td>(509)</td>
<td>Preliminary report.</td>
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<td></td>
<td>Bradd Clark* and Victor Schneider, University of Southwestern Louisiana (839-22-500)</td>
</tr>
<tr>
<td>3:25 p.m.</td>
<td>The minimal ideal of compact subsemigroups of B. S.</td>
</tr>
<tr>
<td>(510)</td>
<td>Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>Dennis E. Davenport, Miami University, Oxford (839-22-382) (Sponsored by Charles S. Holmes)</td>
</tr>
<tr>
<td>3:40 p.m.</td>
<td>D-completely regular spaces.</td>
</tr>
<tr>
<td>(511)</td>
<td>Giuseppe Di Maio, Universita di Napoli, Italy, Som Naimpally*, Lakehead University, and Chandra Mohan Pareek, Kuwait University (839-54-124)</td>
</tr>
<tr>
<td>3:55 p.m.</td>
<td>Stone spaces noncoabsolute with dyadic spaces.</td>
</tr>
<tr>
<td>(512)</td>
<td>Ananda V. Gubbi*, Southwest Missouri State University, and Andrzej Szymanski, Slippery Rock State University (839-54-352)</td>
</tr>
<tr>
<td>4:10 p.m.</td>
<td>Hyperspace topologies and some selection theorems.</td>
</tr>
<tr>
<td>(513)</td>
<td>P. L. Sharma*, Butler University, S. A. Naimpally, Lakehead University, and Anna D. Concilio, University of Salerno, Italy (839-54-263)</td>
</tr>
<tr>
<td>4:25 p.m.</td>
<td>Set-set topologies and semitopological groups.</td>
</tr>
<tr>
<td>(514)</td>
<td>Kathryn F. Porter, Ball State University (839-54-470)</td>
</tr>
<tr>
<td>4:40 p.m.</td>
<td>Internal characterization of hyperspaces. Preliminary report.</td>
</tr>
<tr>
<td>(515)</td>
<td>Bruce S. Burdick, Bates College (839-54-448)</td>
</tr>
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### MAA Committee on Participation of Women Presentation

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<tr>
<td>1:30 p.m.</td>
<td>New agenda for women in higher education.</td>
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### MAA Minicourse #10: Part A

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<tr>
<td>1:30 p.m.</td>
<td>Computer graphics in elementary statistics.</td>
</tr>
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<td>Florence S. Gordon, New York Institute of Technology and Sheldon P. Gordon, Suffolk Community College</td>
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### MAA Invited Address

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<td>2:45 p.m.</td>
<td>Calculus: past, present, and future.</td>
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<td>(516)</td>
<td>Ronald G. Douglas, State University of New York, Stony Brook</td>
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### MAA Retiring Presidential Address

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<td>3:50 p.m.</td>
<td>Celebrating mathematics.</td>
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<td>(517)</td>
<td>Lynn Arthur Steen, St. Olaf College</td>
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### MAA Prize Session and Business Meeting

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<th>Time</th>
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<td>5:00 p.m.</td>
<td>AMS-MAA Special Program on Forces for Change in Mathematics Education</td>
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### MAA Minicourse #11: Part A

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<tr>
<td>7:00 p.m.</td>
<td>The use of computing in teaching linear algebra.</td>
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<td>Eugene Herman and Charles Jepsen, Grinnell College</td>
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### MAA Minicourse #12: Part A

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<td>7:00 p.m.</td>
<td>Using computer algebra systems in undergraduate mathematics.</td>
</tr>
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<td>Paul Zorn, St. Olaf College</td>
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</table>
### MAA Minicourse #13: Part A

_7:00 p.m.–9:00 p.m._

**7:00 p.m.** Learning mathematics through discrete dynamical systems.

*James T. Sandefur*, Georgetown University

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### Joint Policy Board for Mathematics: National Meeting of Department Heads

**8:45 p.m.–9:45 p.m.**

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### SATURDAY, JANUARY 9

#### AMS Special Session on Discrete-Time Optimal Stopping Theory, II

_7:30 a.m.–10:50 a.m._

**7:30 a.m.** Optimal stopping of two-parameter processes with values in a Banach space.

*Robert C. Dalang*, University of California, Berkeley (839-60-560) (Sponsored by Theodore P. Hill)

**8:00 a.m.** Separation properties and Borel-measurable stopping rules.

*A. Maitra, V. Pestien* and S. Ramakrishnan, University of Miami (839-60-537)

**8:30 a.m.** A measure induced by a strategy. Preliminary report.

*A. Maitra, V. Pestien* and S. Ramakrishnan*, University of Miami (839-60-539)

**9:00 a.m.** Optimal selection with ordinal input.

*Stephen M. Samuels*, Purdue University, West Lafayette (839-60-139) (Sponsored by Robert P. Kertz)

**9:30 a.m.** Some time invariant stopping rule problems. Preliminary report.

*Thomas S. Ferguson* and James B. MacQueen, University of California, Los Angeles (839-90-136)

**10:00 a.m.** Continuity properties of optimal stopping value.

*John Elton*, Georgia Institute of Technology (839-60-328)

**10:30 a.m.** Stochastic control for problems of proofreading and debugging. Preliminary report.

*Robert P. Kertz*, Georgia Institute of Technology, and *Kyle Siegrist*+, University of Alabama, Huntsville (839-60-329)

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### AMS Special Session on Ordered Algebraic Systems, II

_8:00 a.m.–10:50 a.m._

**8:00 a.m.** Absolutely normal-valued and representable groups. Preliminary report.

*Michael R. Darnel*, Indiana University, South Bend (839-60-429)

**8:30 a.m.** Special amalgamations of lattice ordered groups.

*(Wayne B. Powell)*, Oklahoma State University, Stillwater, and *Constantine Tsirakis*, Vanderbilt University (839-60-455)

**9:00 a.m.** Groupable lattices. Preliminary report.

*Constantine Tsirakis*, Vanderbilt University (839-60-482)

**9:30 a.m.** Tyings in ε-permutation groups.

*(Richard N Ball)*, Boise State University, and *Stephen H. McCleary*, University of Georgia (839-60-421)

**10:00 a.m.** The closure of a lattice-ordered permutation group.

*(Richard N. Ball)*, Boise State University, and *Stephen H. McCleary*+, University of Georgia (839-60-411)

**10:30 a.m.** Representation of order automorphisms by words.

*(W. Charles Holland)*+, Bowling Green State University, and *Samson A. Adeleke*, Western Illinois University (839-60-118)

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### AMS Special Session on Toeplitz Operators and Geometry, II

_8:00 a.m.–10:50 a.m._

**8:00 a.m.** Submodules of the Hardy module for the bidisk algebra. Preliminary report.

*Ronald G. Douglas*, State University of New York, Stony Brook (839-46-29)

**8:30 a.m.** Toeplitz operators along the leaves of a foliation.

*Jerome Kaminker*, Indiana University-Purdue University, Indianapolis (839-46-464)

**9:00 a.m.** Restriction problems and related operators in H^2 of the polydisk.

*Douglas N. Clark*, University of Georgia (839-32-17)

**9:30 a.m.** Representing measures on multiply connected domains, theta functions and related Hardy spaces.

*Kevin Clancey*, University of Georgia (839-47-58)

**10:00 a.m.** Generalized analytic Toeplitz operators and real indices. Preliminary report.

*Raul Curto and Paul S. Muhly*+, University of Iowa, and *Jingbo Xia*, State University of New York, Buffalo (839-47-08)

**10:30 a.m.** The K-theory and the invertibility of almost periodic Toeplitz operators.

*Jingbo Xia*, State University of New York, Buffalo (839-47-12)
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<td><strong>SATURDAY, JANUARY 9</strong></td>
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<tr>
<td><strong>AMS Special Session on Stability of Differential and Integrodifferential Equations, II</strong></td>
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<tr>
<td>8:00 a.m.–10:20 a.m.</td>
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</table>
| 8:00 a.m. | Superstability: a new qualitative phenomenon in ODE.  
| 8:30 a.m. | Dissipative Lienard oscillators and global asymptotic stability.  
George Seift, Iowa State University (839-34-280) (538) | Preliminary report. |
| 9:00 a.m. | Boundedness in functional differential equations.  
| 9:30 a.m. | Exponential dichotomies and Fredholm operators.  
Kenneth Palmer, University of Miami (839-34-44) (540) | Preliminary report. |
| 10:00 a.m. | Riccati inequalities and dichotomies for linear differential systems.  
C. H. V. Evans and J. S. Muldowney*, University of Alberta (839-34-42) (541) | Preliminary report. |
| **AMS Special Session on Applications of Differential Equations to Population Ecology, II** |                                                                 |
| 8:00 a.m.–10:50 a.m. |                                                                 |
| 8:00 a.m. | Environmental effects on ecosystems.  
| 8:30 a.m. | Relative boundedness for stochastic population models.  
Thomas C. Gard, University of Georgia (839-92-31) (543) | Preliminary report. |
| 9:00 a.m. | Effects of toxicants on populations.  
| 9:30 a.m. | On the optimal policy for combined harvesting of a 2-species ecosystem.  
| 10:00 a.m. | A mathematical analysis of biological resource conservation issues in an evolving agro-ecosystem.  
| 10:30 a.m. | On the limit cycles of Gause-type predator-prey systems.  
Yang Kuang, University of Alberta (839-34-89) (547) | Preliminary report. |
| **AMS Special Session on Geometry of Non-linear Control Systems, II** |                                                                 |
| 8:00 a.m.–10:50 a.m. |                                                                 |
| 8:00 a.m. | Local equivalence of n-state systems with scalar control.  
Preliminary report.  
David Thompson, University of North Carolina, Chapel Hill (839-13-562) (548) | Preliminary report. |
| 8:30 a.m. | Decoupling and disturbance decoupling of homogeneous polynomial systems.  
Preliminary report.  
| 9:00 a.m. | Non-linear control systems.  
Preliminary report.  
Christopher Byrnes, Arizona State University (839-49-566) (550) | Preliminary report. |
| 9:30 a.m. | On the total feedback linearizability of nonlinear dynamic systems.  
Preliminary report.  
| 10:00 a.m. | Time optimal control in low dimensions.  
Preliminary report.  
Heinz Schaeffer, Washington University (839-49-403) (552) | Preliminary report. |
| 10:30 a.m. | Desingularization of families of subanalytic sets and regularity of optimal trajectories.  
Preliminary report.  
Hector Sussmann, Rutgers University, New Brunswick (839-49-293) (553) | Preliminary report. |
| **AMS Special Session on Graph Theory, II** |                                                                 |
| 8:00 a.m.–10:50 a.m. |                                                                 |
| 8:00 a.m. | On automorphism groups of strips.  
Preliminary report.  
Wilfried Imrich, Montanuniversität, Austria, and Mark E. Watkins*, Syracuse University (839-05-452) (554) | Preliminary report. |
| 8:30 a.m. | Generalized distance in graphs.  
Preliminary report.  
| 9:00 a.m. | Neighborhood closures in graphs.  
Preliminary report.  
Ralph Faudree, Memphis State University, Ronald Gould, Emory University, Michael Jacobson, University of Louisville, and Linda Lesniak*, Drew University (839-05-53) (556) | Preliminary report. |
| 9:30 a.m. | Some Ramsey and Turán problems involving the family of graphs \( \{K_r + K_m\} \).  
Preliminary report.  
C. C. Rousseau, Memphis State University and University of Waterloo (839-05-216) (557) | Preliminary report. |
| 10:00 a.m. | Hamilton-decomposable digraphs of infinite valence.  
Preliminary report.  
Dave Witte, Mathematical Sciences Research Institute, Berkeley (839-05-176) (558) | Preliminary report. |
| 10:30 a.m. | Some recent results on well-covered graphs.  
Preliminary report.  
M. D. Plummer, Vanderbilt University (839-05-279) (559) | Preliminary report. |
AMS Session on Differential and Geometric Topology

8:20 a.m.-10:45 a.m.

8:20 a.m.  (560) *On generalizing Euclidean theorems.* Preliminary report.
Paul Fjelstad, The Paracollege of St. Olaf College (839-51-254)

8:35 a.m.  (561) The complete classification of finite, face-transitive and
edge-transitive polyhedra that are not vertex-transitive. Preliminary report.
Steven L. Farris, Ball State University (839-51-469)

8:50 a.m.  (562) Reptiling triangles.
John K. Williams, University of Hartford (839-51-522)

9:05 a.m.  (563) *Polar duals of convex sets.* Preliminary report.
Mostafa Ghandehari*, Santa Clara University, and
Anthony François, University of San Francisco (839-52-24)

9:20 a.m.  (564) *W* paths in the Klein bottle and two-holed torus.
Elizabeth Engelhardt, Pacific Lutheran University (839-52-310)

Merle Guay*, University of Maine, and John H. M. Whitfield, Lakehead University (839-52-554)

9:50 a.m.  (566) Minimal hypersurfaces of $S^4$ with zero Gauss-Kronecker curvature. Preliminary report.
Jayakumar Ramanathan, University of Illinois, Urbana-Champaign (839-53-255)

10:05 a.m.  (567) External gauge fields and invariant connections. Preliminary report.
David Betounes, University of Southern Mississippi (839-53-300) (Sponsored by Mylan Betounes)

10:20 a.m.  (568) Controllability of linear systems, differential geometry of
curves in Grassmannian, and Riccati equations.
L. Drager, R. Foote, and C. Martin, Texas Tech University, and J. Wolper, Hamilton College (839-53-463)

10:35 a.m.  (569) Quasi-Quaternion structures and connections on
manifolds. Preliminary report.
Andrzej Bucki, Lycoming College (839-53-552)

AMS Session on Set Theory and Foundations

8:20 a.m.-10:45 a.m.

8:20 a.m.  (580) Nonstandard analysis as a chapter in point set topology. Preliminary report.
David Ballard*, Sonoma State University, and William Davidon, Haverford College (839-03-125)

8:35 a.m.  (581) Nonstandard methods in combinatorial number theory. Preliminary report.
Steven Leth, University of Wisconsin, Madison (839-03-506)

8:50 a.m.  (582) Measures on the real spectrum. Preliminary report.
Robby Robson, Oregon State University (839-03-109)

9:05 a.m.  (583) Some cardinality and complexity properties of a Turing degree spectrum.
Valentina Harizanov, George Washington University (839-03-356)

9:20 a.m.  (584) Rich-in-itself relations: certain logical and
recursion-theoretic aspects.
Abhijit Dasgupta, University of Rochester (839-03-357)

9:35 a.m.  (585) Involutions of the standard URS. Preliminary report.
Robert Byerly, Texas Tech University (839-03-473)

9:50 a.m.  (586) Is there a point of $\beta N \backslash N$ which sees all others?
Neil Hindman, Howard University (839-04-342)

AMS Session on Numerical Analysis

8:20 a.m.-10:45 a.m.

8:20 a.m.  (570) Limit of partial sum of Fourier expansion of a
real-valued continuous function. Preliminary report.
Krishnanand Verma, University of Nevada, Las Vegas, and Prabha Varma*, B.G.H. School, India (839-65-13) (Sponsored by L. J. Simonoff)

8:35 a.m.  (571) Some irreversible numerical transformations of
Fokker-Planck's equation.
G. Boma Princewill and Jozeft Wilk*, R/S University of Science and Technology, Nigeria (839-65-98) (Sponsored by Andrzej Bucki)

8:50 a.m.  (572) Numerical integration of periodic functions. Preliminary report.
Claudia Pinter, California Polytechnic State University (839-65-178)

9:05 a.m.  (573) Interpolation techniques for grid functions. Preliminary report.
C. Wayne Mastin, Mississippi State University (839-65-265) (Sponsored by J. L. Solomon)

9:20 a.m.  (574) The accuracy of numerical conformal mapping methods. Preliminary report.
Thomas K. DeLillo, Duke University (839-65-267)

9:35 a.m.  (575) A projection method for solving Fredholm integral equations of the second kind.
Hideaki Kaneko, Old Dominion University (839-65-482)

9:50 a.m.  (576) Analysis of funicular shells by FEM.
S. Elangovan, Anna University, India (839-99-602) (Sponsored by M. Sambandham)

10:05 a.m.  (577) The numerical solution of boundary-value problems for
differential equations with state dependent deviating arguments.
V. L. Bakke* and Z. Jackiewicz, University of Arkansas, Fayetteville (839-65-559)

10:20 a.m.  (578) Extensions of discrete maximum principle results for
collocation methods. Preliminary report.
Elizabeth G. Yanik, Virginia Commonwealth University (839-65-571) (Sponsored by Joe Yanik)

10:35 a.m.  (579) Numerical solution of a system of random Volterra
integral equations. Preliminary report.
Negash Medhin and Masilamani Sambandaham*, Atlanta University (839-65-587)
SATURDAY, JANUARY 9

AMS Session on Topological Algebra

8:20 a.m.-10:30 a.m.

8:20 a.m. Cancellation diagrams on surfaces and quadratic equations in groups.
Zhi-Bin Gu, North Texas State University (839-20-171) (Sponsored by John Ed Allen)

8:35 a.m. Cells in Weyl groups of type $A_1, B_1$ associated with the reflection representation.
J. Matthew Douglass, University of Oregon (839-20-343)

8:50 a.m. A representation of the free elementary orthodox semigroup.
Carl Eberhart, University of Kentucky, and W. Wiley Williams*, University of Louisville (839-20-385)

9:05 a.m. Using finitely generated subgroups to show the simple connectivity at infinity of a finitely presented group. Preliminary report.
Joseph S. Profio, Vanderbilt University (839-20-576)

9:20 a.m. Compact totally disconnected $k$-divisible semigroups.
J. A. Hildebrant* and M. R. Schäferkotter, Louisiana State University, Baton Rouge (839-22-120)

9:35 a.m. One parameter submonoids of generalized differentiable monoids. Preliminary report.
Mitch Anderson, Auburn University, Auburn (839-22-366)

9:50 a.m. Determining a complex analytic group from its representative functions. Preliminary report.
Nazih Nahtus, University of Oklahoma (839-22-431) (Sponsored by Andy Magid)

10:05 a.m. Modular maximal vectors and the Kostant cone.
Robert W. Deckhart, Northern Arizona University (839-22-509)

10:20 a.m. Suspensions of topological transformation groups.
David B. Ellis, Vassar College (839-22-543)

AMS Session on Mathematical Physics

8:35 a.m.-10:45 a.m.

8:35 a.m. Geometric and stability analysis of a flexible planar body.
Anthony Bloch, University of Michigan, Ann Arbor (839-70-338)

8:50 a.m. A complete system of functions in an elasticity problem with moments.
Christian Constanda, University of Strathclyde, Scotland (839-73-486)

9:05 a.m. An exact periodic solution of a hydromagnetic flow in a horizontal channel.
K. Vajravelu, University of Central Florida (839-76-175)

9:20 a.m. On hydromagnetic flows of a dusty fluid between two oscillating plates.
Lokenath Debnath, University of Central Florida (839-76-266)

9:35 a.m. Fluid dynamics with pressure diffusion.
Clark D. Jeffries, Clemson University (839-76-527) (Sponsored by John D. Fulton)

9:50 a.m. Existence and nonexistence theorems of steady fluid flows over an obstacle.
Samuel S. P. Shen*, Texas A & M University, College Station, and M. C. Shen, University of Wisconsin, Madison (839-76-584)

Stephen F. Fatt, University of Delaware (839-76-521)

10:20 a.m. A counter example to the adiabatic approximation theorem in quantum mechanics and consequences.
Harry Gingold, West Virginia University, Morgantown (839-81-97) (Sponsored by P. Hsieh)

10:35 a.m. Clifford algebras and fields on manifolds. Preliminary report.
Eric Clarkson, Murray State University (839-81-234)

AMS Session on Hard Analysis

8:50 a.m.-10:45 a.m.

8:50 a.m. The thermal stresses due to a uniform heat flow past two collinear cracks.
Gordon Melrose* and John Tweed, Old Dominion University (839-44-445)

9:05 a.m. Multi-dimensional Laplace transforms and applications.
R. S. Dahiya and T. H. Mughrabi*, Iowa State University (839-44-579)

9:20 a.m. Uniform $L^1$ behavior in classes of integrodifferential equations with convex kernels.
Richard Noren, Old Dominion University (839-45-100)

9:35 a.m. The local stability of positive solutions to the Hammerstein equation with a nonmonotonic Nemytskii operator.
Peter Takáč, Vanderbilt University (839-45-173)
### Program of the Sessions

#### 9:00 a.m.-10:50 a.m.

- **9:00 a.m.-9:50 a.m.**
  - Quasiminimal distal functions.
  - R. D. Pandian, North Central College (839-43-156)
  - Harmonic functions on operator groups. Preliminary report.
  - R. E. Lewkowicz, Wright State University, Dayton (839-43-496)
- **10:00 a.m.**
  - Pettis decomposition for universally scalarly measurable functions.
  - Elizabeth M. Bator, North Texas State University (839-46-249)
- **10:10 a.m.**
  - Infinite dimensional Fock spaces and Schrodinger equations.
  - John Schmeekl, Virginia Commonwealth University (839-46-380)

#### AMS Special Session on Algebraic Number Theory and Algorithms, II

- **9:00 a.m.**
  - The absolute discriminant of \(\mathbb{Q}(\zeta_7)\).
  - David R. Dorman, Middlebury College (839-12-70)
- **9:30 a.m.**
  - Iwasawa invariants of CM fields.
  - James S. Kraft, University of Rochester (839-11-337)
- **10:00 a.m.**
  - Quintic polynomials and real cyclotomic fields with large class numbers.
  - Rene Schoof, Università di Pisa, Italy, and Lawrence C. Washington*, University of Maryland, College Park (839-11-271)

#### AMS Special Session on Multidimensional Inverse Problems, Related Problems in Analysis and Applications, II

- **9:00 a.m.**
  - An inverse problem for a weakly inhomogeneous two dimensional acoustic medium.
  - Paul Sacks, Iowa State University (839-35-10)
- **9:40 a.m.**
  - Uniqueness for an inverse problem for the wave equation.
  - Rakesh, University of Delaware (839-35-15)
- **10:20 a.m.**
  - Fractal drum, inverse spectral problem for elliptic operators and a partial solution of the Weyl-Berry conjecture.
  - Michel L. Lapidus, University of Georgia (839-35-105)

#### NAM William W. S. Claytor Lecture

- **9:00 a.m.-10:00 a.m.**
  - Title to be announced.
  - Wade Ellis, Jr., West Valley College

#### MAA Minicourse #10: Part B

- **9:00 a.m.-10:55 a.m.**
  - Computer graphics in elementary statistics.
  - Florence S. Gordon, New York Institute of Technology and Sheldon P. Gordon, Suffolk County Community College
### SATURDAY, JANUARY 9

#### AMS Session on Computer Science

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
<th>Phone Numbers</th>
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<tbody>
<tr>
<td>9:35 a.m.-10:45 a.m.</td>
<td>A randomized setting for information-based complexity.</td>
<td>Edward W. Packel, Lake Forest College</td>
<td>(839-68-33)</td>
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<td>Computability in splicing systems.</td>
<td>R. W. Gatterdam, University of Alaska, Fairbanks</td>
<td>(839-68-299)</td>
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<td>Word problem public key cryptosystems.</td>
<td>M. Garzon* and Y. Zalcstein, Memphis State University</td>
<td>(839-68-472)</td>
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<tr>
<td>10:35 a.m.</td>
<td>Sequential regularities in the Collatz 3x + 1 problem.</td>
<td>J. Michael Dolan and Shan Manickam*, Western Carolina University</td>
<td>(839-68-553)</td>
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#### NAM Panel Discussion

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<th>Time</th>
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<tbody>
<tr>
<td>10:00 a.m.-10:55 a.m.</td>
<td>Attracting minority students into undergraduate mathematics through pre-college programs</td>
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#### MAA Invited Address

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<tr>
<td>10:05 a.m.-10:55 a.m.</td>
<td>Mathematics and computing—25 years of collaboration.</td>
<td>Donald L. Kreider, Sharon, Vermont</td>
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#### AMS-MAA Invited Address

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<tr>
<td>11:10 a.m.-12:00 noon</td>
<td>Georg Cantor: The battle for transfinite set theory.</td>
<td>Joseph Dauben, Herbert H. Lehman College, City University of New York</td>
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#### AMS Colloquium Lectures: Lecture IV

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<th>Time</th>
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<tbody>
<tr>
<td>1:00 p.m.-2:00 p.m.</td>
<td>Spectral properties of Riemannian manifolds. IV</td>
<td>Victor W. Guillemin, Massachusetts Institute of Technology</td>
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#### AAAS-AMS-MAA Committee on Opportunities in Mathematics for Disadvantaged Groups Panel Discussion

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<tr>
<td>1:00 p.m.-3:00 p.m.</td>
<td>How does ethno-mathematics make sense at the college level?</td>
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#### MAA Minicourse #11: Part B

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<tbody>
<tr>
<td>1:00 p.m.-3:00 p.m.</td>
<td>The use of computing in teaching linear algebra.</td>
<td>Eugene Herman and Charles Jepsen, Grinnell College</td>
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#### MAA Minicourse #12: Part B

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<th>Time</th>
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<tbody>
<tr>
<td>1:00 p.m.-3:00 p.m.</td>
<td>Using computer algebra systems in undergraduate mathematics.</td>
<td>Paul Zorn, St. Olaf College</td>
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#### MAA Minicourse #13: Part B

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<tr>
<td>1:00 p.m.-3:00 p.m.</td>
<td>Learning mathematics through discrete dynamical systems.</td>
<td>James T. Sandefur, Georgetown University</td>
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#### MAA Session on Strategies for Teaching Geometry

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<tbody>
<tr>
<td>1:00 p.m.-4:55 p.m.</td>
<td>A first course for secondary mathematics teaching majors.</td>
<td>Hubert J. Ludwig, Ball State University</td>
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<td>1:15 p.m.</td>
<td>College geometry for secondary mathematics teachers: A “three-ring circus” approach involving Euclidean-type theorem-proving, geometric calculations, and geometric transformations.</td>
<td>Earl Perry, West Georgia College</td>
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<tr>
<td>1:30 p.m.</td>
<td>A thematic approach to teaching college geometry.</td>
<td>Martin E. Flashman, Humboldt State University</td>
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<tr>
<td>1:45 p.m.</td>
<td>Teaching geometry via applications.</td>
<td>Joseph Malkevitch, York College, City University of New York</td>
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<td>2:00 p.m.</td>
<td>Galileo’s floating cone.</td>
<td>Emory Whitaker, Mercer University</td>
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<tr>
<td>2:15 p.m.</td>
<td>A “history-based” course in synthetic geometry.</td>
<td>William Durham, Hanover College and Ohio State University, Columbus</td>
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</tbody>
</table>
Program of the Sessions

2:30 p.m. Plane geometry through elementary vector methods.
   (647) Gerald Itzkowitz, Queens College, City University of New York
2:45 p.m. Projective geometry without nonsense.
   (648) Robert Bix, University of Michigan, Flint
3:00 p.m. Resurrecting analytic geometry
   (649) S. C. Bhatnagar, University of Nevada, Las Vegas
3:15 p.m. Using computer graphics to teach geometry.
   (650) James R. Smart, San Jose State University
3:30 p.m. Patterns in geometric proofs.
   (651) John L. Tilley, Mississippi State University
3:45 p.m. A language for reporting solutions to construction problems in a transformation geometry course.
   (652) Patrick C. Collier, University of Wisconsin, Oshkosh
4:00 p.m. Geometry, a finite approach.
   (653) Rita M. Ehrmann, Villanova University
4:15 p.m. The geometry of “unit” or “unit” origami.
   (654) David Masunaga, Woodrow Wilson National Fellowship Foundation
4:30 p.m. Geometrical patterns in African artifacts.
   (655) Don Hill, Florida A&M University
4:45 p.m. Approximately trisecting an angle.
   (656) Bil Asian* and John Lamb, Jr., East Texas State University

MAA Session on Writing as Part of the Mathematics Curriculum, Part C

1:00 p.m.–4:55 p.m.
1:00 p.m. A mathematics course with writing assignments—results and analysis.
   (657) Rosalyn A. Lee, Duquesne University
1:15 p.m. An integrated program of writing and speaking in the undergraduate curriculum.
   (658) Catherine Gorini, Maharishi International University
1:30 p.m. Some experiences in making writing part of a course.
   (659) Robert Norton, College of Charleston
1:45 p.m. Writing across the algebra curriculum.
   (660) Lawrence A. Trivieri, Mohawk Valley County College
2:00 p.m. Writing: A method of enhancing critical thinking skills in the geometry classroom.
   (661) Ronald N. Bell, Midland Valley High School
2:15 p.m. An evaluation of the microtheme as a writing strategy in mathematics courses.
   (662) Sylvia M. Svitak, Queensborough Community College, City University of New York
2:30 p.m. Using writing assignments to improve student learning of mathematics and statistics.
   (663) Robert Hayden, Plymouth State College
2:45 p.m. Learning mathematics by writing.
   (664) Sharon M. Stenglein, College of St. Catherine
3:00 p.m. Writing: Why, what and ways?
   (665) Arthur B. Powell, Rutgers University, New Brunswick
3:15 p.m. Pitfalls and pleasures of writing assignments in a mathematics class.
   (666) Bryan V. Hearsey, Lebanon Valley College
3:30 p.m. Getting started incorporating writing.
   (667) Richard Vincent
3:45 p.m. Writing as a mode for learning mathematics.
   (668) Bryan Smith, University of Puget Sound
4:00 p.m. Using writing as an intermediary symbol system in the teaching of mathematics.
   (669) Rosemary O'Donoghue* and Ann Luciano, Western New England College
4:15 p.m. Importance of mathematical expression.
   (670) S. C. Bhatnagar, University of Nevada, Las Vegas
4:30 p.m. Understanding through writing—writing in lower and upper division mathematics courses.
   (671) Thomas Q. Sibley, St. John’s University
4:45 p.m. Learning to write proofs in a tutorial setting.
   (672) Martin E. Flashman, Humboldt State University

MAA Session on Teaching Mathematical Modeling

1:00 p.m.–5:30 p.m.
1:00 p.m. Teaching mathematical modeling at the United States Coast Guard Academy.
   (673) Ernest J. Manfred, United States Coast Guard Academy
1:20 p.m. A mathematical modeling course for freshmen.
   (674) G. Dotseth, University of Northern Iowa
1:35 p.m. The teaching of applied mathematics.
   (675) Gilbert Strang, Massachusetts Institute of Technology
2:00 p.m. Designing a linear irrigation system.
   (676) J. S. Hartzler, Pennsylvania State University, University Park
2:15 p.m. Modeling pizza prices.
   (677) Robert W. Hayden, Plymouth State College
2:30 p.m. A routing system based on spacefilling curves.
   (678) J. J. Bartholdi* and L. K. Platzman, Georgia Institute of Technology
2:45 p.m. The creative art of modeling—a special challenge for engineering students.
   (679) Joan R. Hundhausen, Colorado School of Mines
3:00 p.m. Short-term modeling projects.
   (680) Courtney S. Coleman* and Robert L. Borrelli, Harvey Mudd College
3:20 p.m. The math contest as an educational tool.
   (681) B. A. Fusaro, Salisbury State College and United States Military Academy
3:40 p.m. Leaf raking with Pollak and Riemann.
   (682) Lawrence S. Braden, Woodrow Wilson National Fellowship Foundation
3:55 p.m. How to use weighted voting to avoid redistricting.
   (683) William F. Lucas, Claremont Graduate School, and John C. Maceli*, Ithaca College
4:10 p.m. Non-calculus models in the social sciences.
   (684) Raymond H. Rolwing* and Maita Levine, University of Cincinnati
SATURDAY, JANUARY 9

4:25 p.m.  Applications in mathematics (AIM).
(685) Jeanne Agnew and John Jobe*, Oklahoma State University, Stillwater

4:45 p.m. The Mantis file—a problem in communication analysis.
(686) William H. Ruckle, Clemson University

5:05 p.m. Discrete mathematics—a ready source for topics to use in developing mathematical models in problem solving.
(687) Sherraiyn D. Craven, Central Missouri State University

5:20 p.m. A problem for computer simulation.
(688) Diane D. Schwartz, Ithaca College

NAM Business Meeting
1:00 p.m.—2:00 p.m.

AMS Invited Address
2:15 p.m.—3:05 p.m.
2:15 p.m. Determinants of Laplacians, heights and finiteness.
(689) Peter Clive Sarnak, Stanford University (839-53-28)

MAA Special Presentation
3:15 p.m.—3:45 p.m.
3:15 p.m. Teaching experience in Soweto.

AMS Invited Address
3:20 p.m.—4:10 p.m.
3:20 p.m. Applied number theory.
(690) Hendrik W. Lenstra, Jr., University of California, Berkeley (839-11-507)

MAA Minicourse #7: Part B
3:30 p.m.—5:30 p.m.
3:30 p.m. Computer based discrete mathematics.
Nancy Baxter, Dickinson College and Ed Dubinsky, Purdue University

MAA Minicourse #8: Part B
3:30 p.m.—5:30 p.m.
3:30 p.m. Laboratory projects for first year calculus.
L. Carl Leinbach, Gettysburg College

MAA Minicourse #9: Part B
3:30 p.m.—5:30 p.m.
3:30 p.m. Constructing placement examinations.
John G. Harvey, University of Wisconsin at Madison

W. Wistar Comfort
AMS Associate Secretary
Middletown, Connecticut

Kenneth A. Ross
MAA Secretary
Eugene, Oregon
Presenters of Papers

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

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- MAA Invited Lecturer
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1988 Employment Register in Atlanta

The Employment Register will take place in the International Hall South of the Atlanta Marriott Marquis, on Wednesday, Thursday, and Friday, January 6, 7, and 8, 1988. A short (optional) orientation session will be conducted by the AMS-MAA-SIAM Committee on Employment Opportunities at 9:00 a.m. on Wednesday, January 6. The purpose of the orientation session is to familiarize participants with the operation of the Register and with the various forms involved. Following orientation, participants should pick up their material for participating in the Employment Register. Computer-scheduled interviews will be held on Thursday and Friday, January 7 and 8. No interviews will be held on Wednesday.

Fifteen-minute intervals are allowed for interviews, including two or three minutes between successive interviews. The interviews are scheduled in half-day sessions: Thursday morning and afternoon, and Friday morning and afternoon, amounting to four half-day sessions for interviews. There are ten time periods (9:30 – 11:45 a.m.) in which interviews can be scheduled in the morning and fourteen time periods (1:15 – 5:00 p.m.) in the afternoon. It is possible that an applicant or employer may be scheduled for the maximum number of interviews in a session. Requests for interviews will be accommodated depending on the availability of participants. The scheduling program does not have a provision allowing participants to specify particular times for interviews beyond the choice of session (day, and morning or afternoon). Such requests cannot be accommodated.

Requests for interviews taking place during the two sessions on Thursday MUST BE SUBMITTED on Wednesday between 9:30 a.m. and 4:00 p.m. Requests for interviews to take place during the Friday sessions must be submitted on Thursday before 4:00 p.m. Those who fail to do so cannot be included in the pool of available participants when the matching program which schedules the interviews is run on the computer that night. This applies to all employers and applicants both preregistered and on-site registrants. Forms submitted with preregistration achieve registration for the Employment Register only. These forms do not automatically include the participant in the interviewing process. The interview request forms handed out at the Employment Register must be turned in before the 4:00 p.m. deadline in order to receive a computer printed schedule the next day.

On Thursday and Friday mornings at 9 a.m. all schedules for applicants and employers for the day (both morning and afternoon sessions) will be available for distribution in the International Hall South.

The Friday afternoon session is the annual “employers’ choice” session. For this session interviews will be scheduled on the basis of requests made by employers. Applicants do not submit specific interview requests for this session; but, in order to participate they must indicate their availability for the session by returning the Interview Request Form for Friday, indicating that they will attend the afternoon session that day.

Applicants should be aware of the fact that interviews arranged by the Employment Register represent only an initial contact with employers, and that hiring decisions are not ordinarily made during or immediately following such interviews. Applicants are advised to bring a number of copies of their vitae or résumés so that they may leave them with prospective employers.

The Mathematical Sciences Employment Register is sponsored by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics; it is operated by members of the AMS staff under the general supervision of the joint AMS-MAA-SIAM Committee on
Employment Opportunities.

Anyone with questions about the Employment Register should contact Carole Kohanski at the American Mathematical Society at 401-272-9500, extension 286. The telephone number to be used after the Register begins is 404-688-4142. Participants should note that this number will be for those who will be participating in the Employment Register and is not for contacting participants or taking messages. Those who wish to leave messages should call the message center telephone number found in the Atlanta meeting announcement.

Preregistered Employers/Applicants

Employers and applicants who have preregistered for the Employment Register may pick up their MSER material after 9:30 a.m. on Wednesday, January 6, in the International Hall South. (This material includes the interview request forms which are handed out at the meeting only.) These are not the forms that are submitted with preregistration.

Employers' job listings and applicants' résumés will be posted at the meeting, so that applicants and employers may review them.

Material for the Employment Register will not be mailed in advance.

Nonpreregistered Applicants and Employers

Employers and applicants who wish to participate in the Register who have neither preregistered nor paid the Employment Register fee must first go to the Joint Mathematics Meetings registration desk in Ivy Hall, Hyatt Regency Atlanta, in order to complete their registration.

No provision will be made to handle cash transactions at the site of the Employment Register. Registration for the Joint Meetings is required for participation in the Employment Register. It is also required that all participating employer interviewers register for the Joint Mathematics Meetings.

Onsite registration for the Employment Register is $100 for employers and an additional $50 for each additional interviewer and $20 for applicants. The registration fee for employers covers the cost of a copy of the December Issue of Employment Information in the Mathematical Sciences (EIMS). This publication contains printed copies of the résumés of applicants who preregistered prior to the deadline and a copy of the Winter List of Applicants.

After registration has been completed, applicants and employers should come to International Hall South in the Marriott to fill out the forms necessary to participate in the Employment Register.

Nonparticipating Employers

Employers who attend the Joint Mathematics Meetings, but do not want to interview, can post job descriptions, subject to approval, at the Employment Register. Postings will not be allowed in the Joint Meetings registration area. A fee of $15 will be charged payable to the cashier at the Joint Mathematics Meetings registration desk. Participants should be sure to inform the cashier that they would like to post a job description but are not planning to interview and obtain the proper receipt in order to receive the form necessary for posting at the Employment Register desk.

Winter Lists of Applicants and Employers

The Winter List of Applicants, which is a summary of the résumés of preregistered applicants, will be available for sale at the AMS Exhibits and Book Sale at the meeting. The price at the meeting is $5 each. Any copies remaining after the meeting will be available from the Providence office of the Society for $7 each.

The Winter List of Employers consists of summaries of the position listings submitted by the employers who preregistered for the meeting; it will be distributed to the applicants participating in the Register. Others may purchase the Winter List of Employers at the AMS Exhibits and Book Sale at the meeting or from the Providence office after the meeting. The prices are the same as stated in the previous paragraph.

Please note that these lists will not be updated with onsite employers or applicants after the Employment Register has concluded.

December Issue of Employment Information in the Mathematical Sciences

For several years the periodical Employment Information in the Mathematical Sciences (EIMS) has published six issues per year listing open positions in academic, governmental and industrial organizations, primarily in North America, along with a few listings from countries in other parts of the world. EIMS is a joint project of the American Mathematical Society (publisher), the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

The December issue of EIMS contains résumés of persons seeking professional positions in the mathematical sciences. Résumés of applicants taking part in the Employment Register and those not attending will be included in the December 1987 issue provided they are received before the November 6 deadline and are in satisfactory condition. Other mathematical scientists who wish to be included may have their résumés printed if the same deadline is observed and if the copy supplied meets the same technical requirements described in the following section.

Copies of the December issue of EIMS will be distributed in Atlanta to the employers who participate in the Employment Register.
Meetings

Please note that the December issue of EIMS contains the Winter List of Applicants, but does not contain the Winter List of Employers.

Additional copies of the December Issue of EIMS will be available for sale at the AMS Exhibits and Book Sale at the meeting. Prices at the meeting are $8 each for the December issue. Any copies remaining after the meeting will be available from the Providence office of the Society for $13.
East Lansing, Michigan
Michigan State University
March 18–19

Second Announcement

The eight hundred and fortieth meeting of the American Mathematical Society will be held at Michigan State University in East Lansing, Michigan on Friday, March 18 and Saturday, March 19, 1988. This meeting will be in conjunction with a meeting of the Association for Symbolic Logic.

Invited Addresses

By invitation of the Committee to Select Hour Speakers for Central Sectional Meetings, there will be four invited one-hour addresses. The speakers, their affiliations, and titles when available are as follows:

BARBARA L. KEYFITZ, University of Houston, Systems of conservation laws that change type.

BRIAN PARSHALL, University of Illinois at Urbana-Champaign.

KARL RUBIN, Ohio State University.

WILLIAM P. ZIEMER, Indiana University, Fine regularity in partial differential equations.

Special Sessions

By invitation of the same committee, there will be several special sessions of selected twenty-minute papers. Topics and the names and affiliations of the organizers and partial lists of tentative speakers are:

Algebraic groups and related topics, WILLIAM HABOUSCH and BRIAN PARSHALL, University of Illinois.


Phase transition and connection matrices, KONSTANTIN MISCHAIKOW and AMY NOVICK-COHEN, Michigan State University.

Non-linear partial differential equations, DAN PHILLIPS, Purdue University. Tentative speakers include Christoph Borgers, Kuo-Shung Cheng, Amy Novick-Cohen, Ronald Gariepy, David Hoff, Bradley Lucier, Nicholas Owen, Dan Phillips, Jean-Michel Rakotoson, Paul Sacks, Marshall Slemrod and Joel Smoller.


Most of the papers to be presented at these special sessions will be by invitation. However, anyone submitting an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these special sessions should indicate this clearly on the abstract form and submit it by December 24, 1987, three weeks before the deadline for contributed papers, in order that it may be considered for inclusion. Participants are reminded that a charge of $16 is imposed for retyping abstracts that are not in camera-ready form.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in the Departments of Mathematics. Abstracts should be sent to the Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, so as to arrive before the January 14, 1988 abstract deadline. Participants are reminded that a charge of $16 is imposed for retyping abstracts that are not in camera-ready form. Late papers will not be accommodated.

Registration

The registration desk will be open on Friday, March 18 and Saturday morning, March 19 in the C-Wing lobby of Wells Hall. The registration fees are $30 for members of the AMS, $45 for nonmembers, and $10 for students or unemployed mathematicians.
Meetings

Petition Table
A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Atlanta meeting announcement on page 962 of the October issue of Notices.

Accommodations
Blocks of rooms are being held at the following locations. Participants should make their own reservations and mention the AMS meeting to obtain rates listed below. Please note that the rates are subject to change and do not include appropriate taxes. The deadline to make reservations is March 1, 1988.

Kellogg Center (on campus)
Michigan State University, East Lansing 48824-1027
Telephone: 517-355-5090
Single $49   Double $54

University Inn (.5 mile)
1100 Trowbridge, East Lansing 48823
Telephone: 517-351-5500
Single $39.50
All rooms have two (2) single beds

Red Roof Inn (2 miles)
Dunkel, East Lansing
Telephone: 517-332-2575
Single $27.95   Double $34.95

Comfort Inn (4 miles)
2209 University Park, Mason 48854
Telephone: 517-349-8700
Single $43.20

Food Service
The cafeteria in the International Center adjacent to Wells Hall is open on Friday from 7:00 a.m. to 4:00 p.m. There is a cafeteria and dining room in the Kellogg Center and fast food restaurants in the student union and adjacent to campus. A list of nearby restaurants will be available at registration.

Travel
The East Lansing area is serviced by Capital City Airport and by the following airlines: Piedmont, American Eagle, Northwest Orient, United Express and ComAir. There is taxi service available to the campus and area motels from the airport.

East Lansing and Michigan State University are located off of Interstate 96 and Interstate 69. From the East, take I-96 from Detroit; from the West take I-94 to I-69; from the South take I-69 or Highway 127.

Each of the above routes leads you to Interstate 496 from which you should take the exit for Trowbridge Road to the edge of the MSU campus. At the end of the exit, take a left on Harrison Road, and take a right onto Kalamazoo Road. Follow the signs for the parking lots at the north end of the football stadium.

Parking
There is public parking available at the north end of the football stadium which participants should use on Friday, which is a short walk from the C-Wing of Wells Hall where registration and all sessions are scheduled. On Saturday, participants can park in available spaces around Wells Hall as well as the north and south public parking lots of the football stadium.

Robert M. Fossum
Associate Secretary
Urbana, Illinois
The eight hundred and forty-first meeting of the American Mathematical Society will be held at the Knoxville Hilton in Knoxville, Tennessee on Friday, March 25 and Saturday March 26, 1988. The meeting will be hosted by the Department of Mathematics, University of Tennessee.

**Invited Addresses**

By invitation of the Committee to Select Hour Speakers for Central Sectional Meetings, there will be four invited one-hour addresses. The speakers and their affiliations are as follows:

- **J. Alan George**, University of Tennessee and Oak Ridge National Laboratories, *Solutions of large sparse equations*.
- **Louis N. Howard**, Florida State University, *Some aspects of double-diffusive convection*.
- **Craig Huneke**, Purdue University, *Applications of Frobenius in commutative algebra*.
- **S. James Taylor**, University of Virginia, *The measure theory of random fractals*.

**Special Sessions**

By invitation of the same committee, there will be several special sessions of selected twenty-minute papers. A partial listing of topics and the names and affiliations of the organizers is as follows:

- **Numerical linear algebra**, James Bunch, University of California, San Diego.
- **Finite field theory and applications**, Robert McConnel, University of Tennessee.
- **Commutative algebra**, Matthew Miller, University of South Carolina.
- **Topics in stochastic processes**, Balram Rajput, University of Tennessee.

Most of the papers to be presented at these special sessions will be by invitation. However, anyone submitting an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these special sessions should indicate this clearly on the abstract form and submit it by December 24, three weeks before the deadline for contributed papers, in order that it may be considered for inclusion. Participants are reminded that a charge of $16 is imposed for retyping abstracts that are not in camera-ready form.

**Contributed Papers**

There will also be sessions for contributed ten-minute papers. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in the Departments of Mathematics. Abstracts should be sent to the Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, so as to arrive before the January 15, 1988, abstract deadline. Participants are reminded that a charge of $16 is imposed for retyping abstracts that are not in camera-ready form. Late papers will not be accommodated.

**Other Activities**

In conjunction with the AMS sectional meeting, the University of Tennessee will host a conference on probability and stochastic processes, coordinated by Balram Rajput. The conference will be held on Thursday, March 24 and Friday, March 25. There will be four one-hour invited addresses. The speakers and their affiliations are:

- **Burgess Davis**, Purdue University.
- **Alejandro de Acosta**, Case Western Reserve University.
- **Olay Kallenberg**, Auburn University.
- **Malcolm R. Leadbetter**, University of North Carolina-Chapel Hill.

Persons interested in participating should contact Balram Rajput, Department of Mathematics, University of Tennessee, Knoxville, TN 37996-1300.

**Registration**

The meeting registration desk will be located on the second floor lobby of the Knoxville Hilton. The session...
rooms will be adjacent to the lobby. The desk will be open from 8:00 a.m. to 5:00 p.m. on Friday, and from 8:00 a.m. to noon on Saturday. The registration fees are $10 for members, $16 for nonmembers, and $5 for students or unemployed mathematicians.

**Social Event**

A party is planned for Friday evening, March 25 at the Knoxville Hilton. The menu includes beer, soft drinks and snacks. The cost of the party is $6.50 per person. Tickets may be purchased at the meeting registration desk, at the door, or in advance by sending your check to Barbara Jendrucko, Department of Mathematics, University of Tennessee, Knoxville, TN 37996-1300.

**Petition Table**

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Atlanta meeting announcement on page 962 of the October issue of Notices.

**Accommodations**

Blocks of rooms are being held at the following hotels. Participants should make their own reservations directly with the hotel of their choice and be sure to identify themselves with the AMS meeting at the University. **Please make reservations by February 24, 1988.** After that date, reservations will be accepted on a space available basis. Rates do not include applicable taxes and are subject to change.

**The Knoxville Hilton**
501 West Church Street, Knoxville 37902
Telephone: 615-523-2300

Single $51 Double $51

**Best Western Campus Inn (1 mile from Hilton)**
1706 West Cumberland Ave, Knoxville 37916
Telephone: 615-524-4681

Single $32 Double $36

Although rooms have not been blocked at any of these locations, they are included for information purposes.

**Holiday Inn World's Fair (3 blocks)**
Henley Street, Knoxville 37902
Telephone: 615-522-2800 or Toll Free: 800-238-8000

Single: $48 Double: $58

**Quality Inn Hotel Downtown (6 blocks)**
Summit Hill Drive, Knoxville 37902
Telephone: 615-522-2600 or Toll Free: 800-223-7778

Single: $40 Double: $40

**Holiday Inn-Central (2.5 miles)**
Dale Avenue, Knoxville 37921
Telephone: 615-525-5371 or Toll Free: 800-238-8000

Single: $38 Double: $40

**Days Inn Merchants (7 miles)**
Merchants Center Boulevard, Knoxville 37912
Telephone: 615-687-8989

Single: $33 Double: $35

**Food Service**

The Hilton, both Holiday Inns, the Quality Inn, and the Best Western Campus Inn have restaurants for breakfast, lunch and dinner. Downtown Knoxville and the surrounding area have many fine restaurants including Regas, the Copper Cellar, Ruby Tuesday's, Chesapeake's (seafood), Naple's and Pero's (Italian), The Butcher Shop (steak house), Casa Gallardo (Mexican) and many others. The downtown and campus areas also have many diners and national fast food chains. Information on the downtown and area restaurants will be included in a welcome packet available at the meeting registration desk.

**Travel**

The University of Tennessee campus is located approximately 10 miles from the Knoxville McGhee-Tyson Airport which is served by most major airlines including Delta, Northwest Orient, American, United, Eastern, TWA and other regional and commuter airlines. Participants can also arrive by Greyhound and Trailways buslines.

Participants traveling by car may reach Knoxville via Interstate 40 from the east and west, and Interstate 75 from the north and south.

**Parking and Local Travel Arrangements**

Complimentary parking will be available in the Hilton garage for guests and conference participants. Please obtain a complimentary parking pass at the hotel registration desk at the time of your departure.

Knoxville is served by a mass transit system of buses. Bus stops are located near the Best Western Campus Inn and Holiday Inn at Dale Avenue. The standard fare is 75 cents.

Frank T. Birtel
Associate Secretary
New Orleans, Louisiana
The eight hundred and forty-second meeting of the American Mathematical Society will be held at the New Mexico State University in Las Cruces, New Mexico on Friday, April 8 and Saturday, April 9, 1988.

Invited Addresses
By invitation of the Committee to Select Hour Speakers for Central Sectional Meetings, there will be three invited one-hour addresses. The speakers and their affiliations are as follows:

- **John L. Canny**, University of California, Berkeley, *Robot motion planning and real geometry*.
- **David Leigh Donoho**, University of California, Berkeley, title to be announced.

Special Sessions
By invitation of the same committee, there will be six special sessions of selected twenty-minute papers. A listing of topics and the names and affiliations of the organizers follows:

- **Algebraic topology and algebraic K-theory**, Gerald J. Dunn, Reinhard Laubenbacher, Gerlad M. Lodder, David J. Pengelley, Clayton C. Sherman, and Francis D. Williams, New Mexico State University.
- **Hypercube theory**, Frank Harary, New Mexico State University.
- **Applications of parallel computing**, Mary A. Maher, New Mexico State University.
- **Probability and statistics**, H. T. Nguyen, New Mexico State University.
- **Mathematics of computer vision, computer graphics and robotics**, Keith L. Phillips, New Mexico State University.
- **Non-commutative rings and their applications**, Robert B. Warfield, Jr.

Most of the papers to be presented at these special sessions should indicate this clearly on the abstract form and submit it by **December 24**, three weeks before the deadline for contributed papers, in order that it may be considered for inclusion. Participants are reminded that a charge of $16 is imposed for retyping abstracts that are not in camera-ready form.

Contributed Papers
There will also be sessions for contributed ten-minute papers. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in the Departments of Mathematics. Abstracts should be sent to the Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, so as to arrive before the **January 15, 1988, abstract deadline**. Participants are reminded that a charge of $16 is imposed for retyping abstracts that are not in camera-ready form. Late papers will be accepted for presentation at the meeting, but will not appear in the printed program.

Registration
The meeting registration desk will be located in the main lobby at the east end of Science Hall, and will be open from noon to 4:30 pm on Friday, April 8 and 8:00 am to 1:30 pm on Saturday, April 9. The registration fees are $30 for members, $45 for nonmembers, and $10 for students and unemployed mathematicians.

Social Events
There will be an informal welcome reception with a cash bar on Thursday evening, April 7 in the Plaza Suites at the Holiday Inn de Las Cruces. A banquet will be held at the Holiday Inn on Friday evening, April 8. Advance payment will be necessary. Further information will be available in future issues of *Notices*.

An outing/walk/hike on the Pine Tree Loop Trail at Aguirre Springs in the nearby Organ Mountains is
Meetings

Meetings being planned for Sunday morning, April 10, following the meeting. The Organ Mountains rise dramatically with organlike spires to 9,000 feet just east of Las Cruces. The Aguirre Springs area encompasses diverse ravines and creeks at just over 6,000 feet underneath the spires. Interested participants should arrange their El Paso air departures for the afternoon, and be prepared for an early start on Sunday, especially if they have an early afternoon departure. Good walking shoes, sunhat, sunglasses and sunscreen are advised. The weather will probably not be hot, but the sun can be intense.

The outing will be coordinated with direct transportation to the El Paso airport. However, the local organizers must have ample advance notification of the air departure times of those interested. Interested participants should notify David Pengelley, Department of Mathematics, NMSU, Las Cruces, NM 88005 by mail or phone 505-646-3901.

Anyone who may wish to visit Juarez, Mexico should bring appropriate papers for regaining entry into the United States.

Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Atlanta meeting announcement on page 962 of the October issue of Notices.

Accommodations

Participants should make their own reservations directly with the motel of their choice. Except as noted, rates are subject to possible change and do not include any applicable local taxes.

Special rates for AMS participants have been arranged at the Holiday Inn de Las Cruces, where an informal reception will be held on Thursday evening, April 7 and a banquet dinner on Friday evening, April 8. Special scheduled transportation will also be provided between the Holiday Inn and the NMSU campus.

Holiday Inn de Las Cruces (1 mile)
201 East University Avenue, corner of Valley Drive, Las Cruces 88005
Telephone: 505-526-4411

Plaza Suites Single: $34
Plaza Suites Double: $37
Central Rooms Single: $46
Central Rooms Double: $50

Plaza suites surround the courtyard and outdoor pool. Central Rooms surround courtyard dining and indoor pool. Rates for the Plaza Suites include complimentary continental breakfast and free happy hour.

To receive the special guaranteed meeting rates, participants should make their reservations directly with the Sales Manager, Millie Folberg, by mail or telephone and identify themselves as attending the AMS meeting.

Howard Johnson’s Motor Lodge (1 mile)
South Valley Drive, Las Cruces 88005
Telephone: 505-526-4441

Single: $28.25 Double: $30.00

In order to be guaranteed the rates quoted above, participants need to identify themselves as attending the meeting at NMSU and ask for the NMSU rate.

Motel 6 (1 mile)
La Posada Lane, Las Cruces 88005
Telephone: 505-525-1010

Single: $20.95 Double: $25.95

Super 8 Motel (1 mile)
La Posada Lane, Las Cruces 88005
Telephone: 505-523-8695
Toll Free: 800-843-1991

Single: $24.95 Double: $27.65

The Howard Johnson’s, Motel 6 and Super 8 are within walking distance to the Holiday Inn Las Cruces.

Hilton Las Cruces (4 miles)
South Telshor Boulevard, Las Cruces 88001
Telephone: 505-522-4300

Single: $50 Double: $55

Food Service

The Holiday Inn, Howard Johnson’s and the Hilton have full service restaurants. Information on other restaurants will be available at registration.

Travel

Most participants coming from afar should use the El Paso (Texas) International Airport, which is less than one hour from Las Cruces. El Paso is served by several airlines including: American, America West, Continental, Delta, Southwest, and United. Scheduled limousine service is available from the airport to Las Cruces, with stops at the Holiday Inn and Hilton. The limousine will stop at other locations by advance arrangement. Reservations are required and a special rate of $10 each way has been arranged for meeting participants. To make advance reservations, call Super Shuttle at 505-525-1784 and mention the special AMS agreement.

Some participants may wish to rent a car at the El Paso Airport. All major companies are represented. There
Meetings

are Avis and Hertz rental car agencies in Las Cruces, at
the Holiday Inn and Howard Johnson's respectively.

It is possible to fly directly to Las Cruces with Mesa
Airlines. This service is available from Albuquerque and
smaller cities served by Mesa Airlines in the surrounding
southwestern states.

Las Cruces is also served by Greyhound buslines and
Amtrak rail service.

For those participants arriving by car directions are
as follows.

From the east (El Paso) on Interstate 10: Follow
signs for Tucson until the New Mexico State University
exit. Turn immediately right onto University Avenue,
then turn right at the second light on Espina into the
University. At the second stop sign, turn left on to
Stewart. Continue for one block to Sweet Street. You
will see street parking to the right and Science Hall is visible
across the far left corner of the intersection. It is a long
building with tinted windows.

From the west on Interstate 10: Exit at Main Street.
Turn right at the end of the exit onto Main Street and
right at the traffic light onto University Avenue. Continue
on University Avenue and take a right turn at the third
traffic light onto Espina and then proceed as above.

From the north on Interstate 25: Exit at University
Avenue and turn right. At the third traffic light, turn left
on Espina and proceed as above.

Parking

There is free on-street parking approximately one block
south of Science Hall. Park only where curbing is
WHITE. Lot restrictions do not apply on evenings or
weekends in University parking lots.

Local Information

Las Cruces, with a population over 50,000, lies near the
foot of the Organ Mountains, in the Mesilla Valley of
southern New Mexico on the Rio Grande. The valley
is rich farmland, with the country's largest pecan farm,
chile, cotton and other crops. The surrounding mesas
represent the northern edge of the Chihuahuan desert,
and nearby mountain ranges, the southern edge of the
Rockies that rise to over 12,000 feet.

Weather

Las Cruces lies at an altitude just under 4,000 feet.
The climate is typical of the northern edge of the
Chihuahuan desert: low humidity, much sunshine and
large daily temperature fluctuation. In April, the average
midday high is 77 degrees F and the nighttime low
averages 41 degrees F.

Lance W. Small
Associate Secretary
La Jolla, California
Invited Speakers and Special Sessions

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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 1988 Meeting in East Lansing**
Central Section
Deadline for organizers: Expired
Deadline for consideration: December 24, 1987
William Haboush and Brian Parshall, *Algebraic groups and related topics*
Jonathan Hall and Bernt Stellmacher, *Groups and geometries*
Konstantin Mischaikow and Amy Novick-Cohen, *Phase transition and connection matrices*
Dan Phillips, *Non-linear partial differential equations*
Bruce Sagan, *Algebraic combinatorics*

**March 1988 Meeting in Knoxville**
Southeastern Section
Deadline for organizers: Expired
Deadline for consideration: December 24
Balram S. Rajput, *Topics in stochastic processes*
James R. Bunch, *Numerical linear algebra*
Robert M. McConnel, *Finite field theory and applications*
Matthew Miller, *Commutative algebra*

**April 1988 Meeting in Las Cruces**
Far Western Section
Deadline for organizers: Expired
Deadline for consideration: December 24
Gerald J. Dunn, Reinhard Laubenbacher, Gerlad M. Lodder, David J. Pengelley, Clayton S. Sherman, and Francis D. Williams, *Algebraic topology and algebraic K-theory*
Frank Harary, *Hypercube theory*
Mary A. Maher, *Applications of parallel computing*
H. T. Nguyen, *Probability and statistics*
Keith Phillips, *Mathematics of computer vision, computer graphics and robotics*
Robert Warfield, *Non-commutative rings and their applications*

April 1988 Meeting in College Park  
Eastern Section  
Deadline for organizers: Expired  
Deadline for consideration: February 8

August 1988 AMS Centennial Celebration  
in Providence  
There will be no Special Sessions.

January 1989 Meeting in Phoenix  
Associate Secretary: Lance W. Small  
Deadline for organizers: March 15, 1988  
Deadline for consideration: on or about September 19, 1988

**Information for Organizers**

Special Sessions at Annual and Summer Meetings are held under the general supervision of the Program Committee. They are administered by the Associate Secretary in charge of the meeting with staff assistance from the Society office in Providence.

Some Special Sessions arise from an invitation to a proposed organizer issued through the Associate Secretary. Others are spontaneously proposed by interested organizers or participants. Such proposals are welcomed by the Associate Secretaries.

The number of Special Sessions at a Summer or Annual Meeting is limited to twelve. Proposals, invited or offered, that are received at least nine months prior to the meeting are screened for suitability of the topic and of the proposed list of speakers, and for possible overlap or conflict with other proposals. (Specific deadlines for requesting approval for Special Sessions at national meetings are given above.) If necessary, the numerical limitation is enforced.

Proposals for Special Sessions should be submitted directly to the Associate Secretary in charge of the meeting (at the address given in the accompanying box). If such proposals are sent to the Providence office, addressed to *Notices*, or directed to anyone other than the Associate Secretary, they will have to be forwarded and may not be received before the quota is filled.

In accordance with an action of the Executive Committee of the Council, no Special Session may be arranged so late that it may not be announced in *Notices* early enough to allow any member of the Society who wishes to do so to submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration.

Special Sessions are effective at Sectional Meetings and can usually be accommodated. They are arranged by the Associate Secretary under the supervision of the Committee to Select Hour Speakers for the section. The limitation on the number of sessions depends on the space and time available. The same restriction as for national meetings applies to the deadline for announcing Special Sessions at sectional meetings: no Special Session may be approved too late for its announcement to appear in time to allow a reasonable interval for members to prepare and submit their abstracts prior to the special early deadline set for consideration of papers for Special Sessions.

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*.

**Send Proposals for Special Sessions to the Associate Secretaries**

The programs of sectional meetings are arranged by the Associate Secretary for the section in question:

- **Far Western Section (Pacific and Mountain)**  
  - Lance W. Small, Associate Secretary  
  - Department of Mathematics  
  - University of California, San Diego  
  - La Jolla, CA 92093  
  - (Telephone 619 – 534 – 3590)

- **Central Section**  
  - Andy Roy Magid, Associate Secretary  
  - Department of Mathematics  
  - University of Oklahoma  
  - 601 Elm PHSC 423  
  - Norman, OK 73019  
  - (Telephone 405 – 325 – 2052)

- **Eastern Section**  
  - W. Wistar Comfort, Associate Secretary  
  - Department of Mathematics  
  - Wesleyan University  
  - Middletown, CT 06457  
  - (Telephone 203 – 347 – 9411)

- **Southeastern Section**  
  - Frank T. Birtel, Associate Secretary  
  - Department of Mathematics  
  - Tulane University  
  - New Orleans, LA 70118  
  - (Telephone 504 – 865 – 5646)

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.

**Information for Speakers**

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled. Contributors should know that there is a limitation in size of a single special session, so that it is sometimes true that all places are filled by invitation.
Papers not accepted for a Special Session are considered as ten-minute contributed papers.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Editorial Department, American Mathematical Society, P. O. Box 6248, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.
A special symposium on American Mathematics Entering its Second Century will be held on Saturday and Sunday, February 13–14, 1988, in the John B. Hynes Convention Center as part of the annual meeting of the American Association for the Advancement of Science. The symposium is sponsored by the American Mathematical Society in celebration of its Centennial year.

The members of the Organizing Committee are HYMAN BASS, Columbia University (chairman); RAOUl H. BOTT, Harvard University; RONALD L. GRAHAM, AT&T Bell Laboratories; ROBION C. KIRBY, University of California, Berkeley; GEORGE DANIEL MOSTow, Yale University; LYNN ARTHUR STEEN, St. Olaf College; and DENNIS P. SULLIVAN, City University of New York.

After 100 years of fundamental internal theoretical developments, two major trends are apparent in American mathematical research. First is the rejuvenation of the bonds with the natural sciences. Second is the emergence of the modern computer, which was first conceived and designed by mathematicians, and whose exploitation draws heavily on mathematical tools.

The symposium presents four areas of important mathematical research and activity illustrating the above trends.

Computer aided mathematical modeling has become a fundamental research tool in almost every field of science and technology. Three distinguished practitioners will present cases of this methodology:

GEORGE F. CARRIER, Harvard University, The modeling of fire spread;

DAVID MUMFORD, Harvard University, Mathematical models in the cognitive sciences;

CHARLES S. PESKIN, Courant Institute of Mathematical Sciences, A mathematical model of the heart and the computer-assisted design of prosthetic heart valves.

Fundamental structures in mathematics and the physical sciences are governed by principles of symmetry. Speakers and titles are:

GEORGE DANIEL MOSTow, Yale University, Groups and symmetry;

JOHN CONWAY, Princeton University, Packing spheres;

PERSI DiaCONIS, Harvard University, will conclude the session on symmetry with The mathematics of mixing things up.

Revolutionary developments in low dimensional geometry have occurred in the last decade. These have revealed striking and unanticipated connections between diverse branches of mathematics and theoretical physics. Presenters for this session include:

JOHN MORGAN, Harvard University and Columbia University, A guide to the baffling fauna and flora of low dimensional topology;

DAVID A. HoffMAN, University of Massachusetts, Amherst, Soap films and soap bubbles: Surface interfaces in nature;

WILLIAM P. THURSTON, Princeton University, Topology’s quintessential problem, elusive as ever;

ROBION C. KIRBY, University of California, Berkeley, Dimension 4: Not the place to do your calculus homework.

The plenary address will be delivered by RAOUl H. BOTT, Harvard University, on Sunday, February 14 titled Mathematics and physics: An uneasy but pre-ordained collaboration.

The theme of the final session of the symposium centers on the close alliance of physics and mathematics including topics on fluid dynamics, dynamical systems and string theory. The list of speakers will include:

DANIEL G. QUILLEN, Oxford University, Analytic functions and conformal quantum fields;

JAMES A. YORKE, University of Maryland, Obstructions to predictability in dynamical processes;

JAMES G. GLIMM, Courant Institute of Mathematical Sciences, Lumps in the continuum soup.
Registration

Registration for the Symposium will be handled by AAAS. There will be a convention registration area in the John B. Hynes Convention Center which is attached to the Sheraton Boston Hotel. The deadline for preregistration is January 20, 1988. Registration fees are $65 for AAAS members, $95 for nonmembers of AAAS. Registration fees for students, retired persons, spouses and secondary school teachers are $35 for AAAS members and $50 for nonmembers of AAAS. After January 20, registration fees will be $95 for all categories. One-day registration can be purchased on site for $35 per day; one-day student registrations will be $15 per day.

Preregistration forms are available in the November 6 issue of Science; by calling John Balletto, Symposium Conference Coordinator, 1-800-556-7774; or writing the Meetings Office, AAAS, 1333 H Street, NW, Washington, DC 20005.

Exhibits

There will be a science and technology exhibition in conjunction with the 154th AAAS Annual Meeting. Exhibitors span a variety of areas and disciplines—from publishers to scientific and technical societies to government agencies. The American Mathematical Society will be represented in Booths #313-315. There will be a display of various AMS publications, membership information, and demonstrations of MathSci, the AMS online database and TeX software. Participants attending the symposium are urged to visit the AMS booths in order to obtain preliminary information about the Society's Centennial Celebration, which will be held in Providence, August 8-12. Morning coffee, compliments of the AMS Centennial Committee, will be served.

Exhibits are located in the Hynes Convention Center-Exhibit Hall A and will be open Friday, February 12 from 10:00 a.m. - 4:00 p.m. and again at 5:30 p.m. - 7:30 p.m.; Saturday, February 13 from 10:00 a.m. - 4:00 p.m.; and Sunday, February 14 from 10:00 a.m. - 3:00 p.m.

Accommodations

AAAS has secured blocks of rooms at several Boston hotels. Housing information and reservation forms are available in the November 6 issue of Science; by calling John Balletto, Symposium Conference Coordinator, 1-800-556-7774; or writing the Meetings Office, AAAS, 1333 H Street, NW, Washington, DC 20005.

Participants are instructed NOT to call hotels directly for reservations. The reservations deadline is January 20, 1988. After that date, reservations will be accepted on a space and rate available basis only.

Travel

Boston's Logan International Airport is serviced by all major airlines. Car rental is available at each terminal. Airport to downtown Boston transfers by limo cost approximately $5 per person; taxi rates are about $8. Bus and subway rapid transit, the "T", cost 60 cents. Boston's rapid transit system links all sections of the city and many suburban communities. For the Sheraton Boston and the John B. Hynes Convention Center, exit at Prudential Center/Auditorium.

Boston is accessible from routes I-90, I-95 and I-93 from the west, south, and north respectively. From Interstate 90 (Massachusetts Turnpike) take the Copley Square/Prudential Center exit. Follow signs to the Prudential Center. Parking is available in the Center. The Hynes Convention Center and Sheraton Boston are attached to the Center.

From Interstates 93/95 North, exit at Massachusetts Avenue. Follow Massachusetts Avenue to Boylston Street. Take a right on Boylston Street and an immediate right on Dalton Street. Enter the parking garage for the Sheraton Boston.

From Interstate 93/95 South, exit at the McGrath-O'Brien Highway exit. At the end of the exit, take a left on to the McGrath-O'Brien Highway. Follow the highway until you see the Museum of Science on your left. You will approach a fork in the road; take the right fork to Memorial Drive. The Charles River will now be on your left. Follow Memorial Drive to Massachusetts Avenue. Take a left on Massachusetts Avenue and continue to Boylston Street. Take a left on Boylston Street to the Hynes Convention Center. Parking will be available at the Prudential Center or the Sheraton Boston Hotel.

On street parking is very limited in Boston and is not recommended.
The American Association for the Advancement of Science prominently features a program in mathematics at its 154th Annual Meeting, February 11–15, 1988 in Boston, Massachusetts. This will be by far the largest exposure that mathematics has ever received at such meetings, attended by approximately 4,500 scientists from all fields.

The American Mathematical Society, in celebration of its Centennial year, presents a Symposium on American Mathematics Entering its Second Century as part of the special series of events known as 100 Years of American Mathematics.

All sessions will be held in Room 101, John B. Hynes Convention Center, except the Plenary Address, which will be in Exhibit Hall B.

### Saturday, February 13

**Mathematical Modeling**

Presider: George Carrier, Harvard University

- 8:30 a.m. *The modeling of fire spread*, George Carrier
- 9:30 a.m. *Mathematical models in the cognitive sciences*, David Mumford, Harvard University
- 10:30 a.m. *A mathematical model of the heart, and computer-assisted design of prosthetic valves*, Charles Peskin, Courant Institute of Mathematical Sciences, New York University

**Groups, Symmetry and Randomness**

Presider: George Daniel Mostow, Yale University, President, American Mathematical Society

- 2:30 p.m. *Groups and symmetry*, George Daniel Mostow
- 3:30 p.m. *Packing spheres*, John Conway, Princeton University
- 4:30 p.m. *The mathematics of mixing things up*, Persi Diaconis, Harvard University

### Sunday February 14

**Spaces of Dimensions Two, Three and Four: Finding Them and Telling Them Apart**

Presider: John Morgan, Harvard University and Columbia University

- 8:30 a.m. *A guide to the baffling fauna and flora of low dimensional topology*, John Morgan
- 9:00 a.m. *Soap films and soap bubbles: Surface interfaces in nature*, David Allen Hoffman, University of Massachusetts, Amherst
- 10:45 a.m. *Dimension 4: Not the place to do your calculus homework*, Robion C. Kirby, University of California, Berkeley

**Plenary Address**

1:00 p.m. – 2:15 p.m.

*Mathematics and physics: An uneasy but pre-ordained collaboration*, Raoul H. Bott, Harvard University

**Mathematics and the Physical Sciences**

Presider: James G. Glimm, Courant Institute of Mathematical Sciences

- 2:30 p.m. *Analytic functions and conformal quantum fields*, Daniel G. Quillen, Mathematics Institute, Oxford University
- 3:30 p.m. *Obstructions to predictability in dynamical processes*, James A. Yorke, University of Maryland
- 4:30 p.m. *Lumps in the continuum soup*, James G. Glimm
Symposium on Some Mathematical Questions in Biology
Las Vegas, Nevada
May 4, 1988

The twenty-second annual Symposium on Some Mathematical Questions in Biology on *The dynamics of excitable media* will be held on Wednesday, May 4, during the annual meeting of the Federation of American Societies for Experimental Biology, May 1-6, 1988. The symposium is sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics, and the Society for Mathematical Biology.

The AMS-SIAM Committee on Mathematics in the Life Sciences serves as the Organizing Committee for the symposium. The committee consists of Gail A. Carpenter (Northeastern University); Kenneth L. Lange (Massachusetts Institute of Technology); Hans G. Othmer (University of Utah); Alan S. Perelson (Los Alamos National Laboratory); Richard E. Plant, chairman (University of California, Davis); and John Rinzel (National Institutes of Health). Professor Othmer is the organizer of the symposium.

The theme of the symposium is *The Dynamics of Excitable Media*. There will be two half-day sessions, each including three one-hour lectures.

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**Program**

Chairman: Hans G. Othmer

9:00 a.m. – Presiding: HANS G. OTHMER, University of Utah

*An analysis of bursting in excitable cells.* JAMES C. ALEXANDER, University of Maryland

Cardiac pacemaking: A consensus of sinus node cells. JOSE JALIFE, SUNY Upstate Medical Center

*Aspects of propagation failure in excitable media.* JAMES KEENER, University of Utah

2:00 p.m. – Presiding: HANS G. OTHMER, University of Utah

Wave propagation in aggregation fields of "*Dictyostelium discoideum"*. PETER MONK, University of Delaware

*The use of a bidomain model for propagation studies in cardiac tissue.* ROBERT PLONSEY, Duke University

Collective behavior in the hippocampus. ROGER TRAUB, Thomas J. Watson Research Center and New York University
Symposium on The Legacy of John von Neumann
Hempstead, New York

May 29–June 4, 1988

With the anticipated support of the National Science Foundation and the Alfred P. Sloan Foundation, a symposium on The Legacy of John von Neumann will take place Sunday through Saturday, May 29–June 4, 1988 at Hofstra University in Hempstead, New York. The topic was selected by the AMS Committee on Summer Institutes and Special Symposia whose members at the time of selection were: ALBERT BAERNSTEIN II, ERIC FRIEDLANDER, H. BLAINE LAWSON, JR., LINDA PREISS ROTHSCHILD, ROBERT B. WARFIELD, JR., and JOHN WERMER.

The symposium will be sponsored by the American Mathematical Society, Hofstra University and the Society for Industrial and Applied Mathematics.

The Organizing Committee for the symposium includes JAMES G. GLIMM, Courant Institute of Mathematical Sciences, HERMAN H. GOLDSTINE, American Philosophical Society, JOHN IMPAGLIAZZO, Hofstra University, GEORGE W. MACKEY, Harvard University, I. M. SINGER, MIT (Co-chair), MARSHALL H. STONE, University of Chicago/University of Massachusetts (Co-chair), and SHMUEL WINOGRAD, T. J. Watson Research Center, IBM Corporation.

John von Neumann is considered one of the foremost mathematicians of the twentieth century. Born in Hungary on December 28, 1903, he excelled brilliantly in his studies, and at the age of twenty-two had received his doctorate in mathematics from the University of Budapest with extensive studies in experimental physics and chemistry. Von Neumann soon was recognized as a mathematical genius and by 1933 he was accepted into the Institute for Advanced Study at Princeton, New Jersey.

John von Neumann, often called “Johnny” by his colleagues and associates, was a man of great warmth, presence and humor. Possessing an incredible memory, he could recite verbatim the contents of a book after just one reading. His genius touched many fields of study in mathematics, physics, computability, and economics. Computer science, logic, ergodic theory, fluid mechanics, quantum mechanics, atomic energy, algebra, measure theory, econometrics and ordinance are just a few areas that were deeply influenced by von Neumann’s work. Known as the “father of the modern computer”, von Neumann was a leader in many organizations and agencies such as the American Philosophical Society, National Academy of Sciences, Atomic Energy Commission, Los Alamos Scientific Laboratory and, in 1951, President of the American Mathematical Society.

Von Neumann died on February 8, 1957 at a relatively young age. In spring 1988, on the occasion of the 85th anniversary of his birth, and during the 100th anniversary of the American Mathematical Society, it is only fitting that a symposium of this scope and magnitude be given in his honor, reviewing his many contributions to science and to discuss the current state of research in the mathematical fields he developed.

Preregistration and housing for the symposium will be handled by the Mathematics Meetings Housing Bureau at the Providence office. Further details will be available in the February issue of Notices.
Joint Summer Research Conferences in the Mathematical Sciences

Bowdoin College, Brunswick, Maine, June 11 to August 5, 1988

The 1988 Joint Summer Research Conferences in the Mathematical Sciences will be held at Bowdoin College, Brunswick, Maine, from June 11 to August 5. It is anticipated that the series of conferences will be supported by grants from the National Science Foundation and other agencies.

There will be ten conferences in ten different areas of mathematics. The topics and organizers for the conferences were selected by the AMS-IMS-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 are similar in scientific structure to 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 will be mailed to all who are invited to attend the conferences. The brochure will include information on room and board rates, the residence and dining hall facilities, travel and local information and a Residence Housing Form to use for on-campus housing accommodations. Information on off-campus housing will also be included in the brochure. Participants are required to make their own housing and travel arrangements. Each participant will be required to pay a fee of $25 to cover the cost of social events and refreshments served at breaks, in addition to a small registration fee.

Those interested in attending one of the conferences should send the following information to Carole Kohanski, Summer Research Conference Coordinator, American Mathematical Society, Post Office Box 6248, Providence, RI 02940.

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 and home
5. 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 applications is February 19, 1988. After that date the Organizing Committee for each conference will consider the requests (selection of the participants and the allocation of support is made by the Organizing Committee.) You will be notified by the AMS of the committee's decision no later than May 1, 1988. Requests received past the deadline will be returned. Funds available for these conferences are limited and individuals who can obtain support from other sources should do so. 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 chairman 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 1988 conferences: William B. Arveson, James Daniel, Martin Golubitsky, Ronald L. Graham, James I. Lepowsky, John R. Martin, Tilla Klotz Milnor, Evelyn Nelson, and Ingram Olkin.

Descriptions of the subject matter of each of the 1988 Conferences appeared in the November Notices, pages 1133–1136; they were accompanied by lists of members of the respective organizing committees.
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<td>Mathematical problems posed by anisotropic materials</td>
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1988 Summer Research Institute

Operator Theory/Operator Algebras and Applications
University of New Hampshire, Durham, New Hampshire, July 3–23

The thirty-sixth Summer Research Institute sponsored by the American Mathematical Society will be devoted to Operator theory/operator algebras and applications and will take place at the University of New Hampshire, Durham, New Hampshire. Members of the Organizing Committee include: WILLIAM B. ARVESON, University of California, Berkeley (co-chair), RONALD G. DOUGLAS, SUNY at Stony Brook (co-chair), CIPRIAN I. FOIAS, Indiana University, I. C. GOHBERG, Tel Aviv University, PETER D. LAX, Courant Institute of Mathematical Sciences, DONALD SARAISON, University of California, Berkeley, BARRY SIMON, California Institute of Technology, and DAN-VIRGIL VOICULESCU, University of California, Berkeley. 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 1986 Committee on Summer Institutes and Special Symposia whose members were ALBERT BAERNSTEIN II, ERIC FRIEDLANDER, H. BLAINE LAWSON, JR., LINDA PREISS ROTHSCHILD, ROBERT B. WARFIELD, JR. and JOHN WERMER.

During the last twenty years operator theory has come of age. The subject has developed in several directions, using new and powerful methods that have led to the solutions of basic problems thought to be inaccessible in the sixties. Some of these developments have made mutually enriching contacts with other areas of mathematics, including algebraic topology and index theory, complex analysis in one and several variables, and probability theory.

The period has seen the full characterization of quasitriangular operators in terms of the Fredholm index, the classification of families of essentially normal operators via C*-algebraic extensions, and the subsequent development of the latter subject culminating in the unification of C*-algebraic K-homology and K-cohomology in the Kasparov KK-bifunctor. The invariant subspace problem has been solved for subnormal operators and related classes. The classical Weyl-von Neumann theorem has been vastly generalized to separable C*-algebras. The Ringrose problem has been solved, using algebraic methods that have provided striking insight into the behavior of operators under similarity transforms. The classical perturbation theory for Schrodinger operators has been transformed and simplified by the use of path integrals and the Feynman-Kac formula. A rich theory of completely positive and completely bounded maps of C*-algebras has emerged, and this has had significant implications for operator theory, including dilation theory, the characterization of operators having annular spectral sets, and the partial solution of Sz.-Nagy's problem. The C*-algebras of Toeplitz operators associated with a large class of domains in C^n are now clearly understood. Finally, the structure of broad classes of reflexive operator algebras has been penetrated and put into the context of "noncommutative" harmonic analysis.

These algebraic methods are diverse, and they touch upon a broad area of mathematics. In addition to the interrelations alluded to above, there have been direct applications to systems theory, complex variables, and statistical mechanics. Moreover, significant problems and motivations have arisen from the subject's traditional underpinnings with partial differential equations. While it would not be possible or perhaps even desirable to attempt to unify these results and methodology, it is time to pause, summarize progress and examine the common points of view that now run through the subject.

The three weeks of the Summer Research Institute are planned to cover various aspects of operator theory/operator algebras and applications with roughly the following schedule:

WEEK ONE: Mathematical physics, Schrödinger operators, scattering theory, path integral methods, differential operators, symmetric and selfadjoint operators. One and several complex variables, Toeplitz and Wiener-Hopf operators, Hankel operators, integral operators, algebraic and complex geometric methods. Invariant subspaces, subnormal operators, hyponormal operators, spectral operators, noncommutative approximation theory, non-selfadjoint operators.

WEEK TWO: Dilation theory and operator maps, model theory, spectral and functional calculus.

WEEK THREE: Index theory, $K$-theory, non-commutative topology and geometry, cyclic cohomology. Selfadjoint operator algebras, non-selfadjoint operator algebras, similarity of nests.

Accommodations will be available in the campus residence halls for participants and their families; cafeteria style meals will be available. All facilities will be accessible to the handicapped.

Information on housing, dining, travel and the local area will be sent to invited participants in the spring. Each participant will pay a registration fee and a social fee to cover the costs of social events scheduled during the institute.

Those interested in receiving an invitation to participate in the institute should send the following information to John Balletto, Summer Institute Conference Coordinator, American Mathematical Society, Post Office Box 6248 Providence, RI 02940 prior to April 1, 1988.

Please type or print the following:
1. Full name
2. Mailing address
3. Telephone number and area code for office and home
4. Your scientific background relevant to the institute topic
5. Financial assistance requested
6. Indicate if support is not required, and if interested in attending even if support is not offered.

Requests for invitations will be forwarded to the Organizing Committee for consideration. Requests will be considered after April 1, 1988 and applicants selected will receive formal invitations and notification of financial assistance beginning in mid-May.
# 1988 Summer Seminar in Applied Mathematics

**Computational Solution of Nonlinear Systems of Equations**  
Colorado State University, Fort Collins, Colorado, July 18 – 29

The nineteenth AMS-SIAM Summer Seminar in Applied Mathematics will be held July 18 – 29, 1988, at Colorado State University, Fort Collins, Colorado. The seminar will be sponsored jointly 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 Society in the *Lectures in Applied Mathematics* series.

The aim of the conference is to provide a wide-ranging survey of current major thrusts in the numerical solution of nonlinear systems of equations. The conference will be of two weeks duration. The conference will simultaneously have entry-level Summer School aspects for young researchers and a frontier-level research aspect. Throughout, the emphasis will be placed upon the computational aspects and applications. A significant number of anticipated participants will be scientists and mathematicians employed in national and industrial research laboratories. It is also planned to gain participants from several foreign countries.

Among the currently active topics to be treated will be continuation methods, quasi-Newton and nonlinear conjugate gradient methods, piecewise-linear methods, mesh refinement and multigrid methods, and complexity of nonlinear methods. The Organizing Committee consists of E. L. Allgower, Colorado State University; H. B. Keller, California Institute of Technology; H.-O. Peitgen, Universität Bremen and University of California at Santa Cruz; W. C. Rheinboldt, University of Pittsburgh; and S. Smale, University of California, Berkeley. The principal speakers will be announced in the next issue of the *Notices*.

A brochure will be available from the AMS office which will include a description of the scientific program, information on accommodations, and local information. Each participant will pay a registration and social fee.

Those interested in attending the seminar should send the following information to Betty A. Verducci, Summer Seminar Conference Coordinator, American Mathematical Society, P. O. Box 6248, Providence, RI 02940, E-Mail: BAV@Seed.AMS.Com. **before May 6, 1988.**

- Please type or print the following:
  1. Full name;
  2. Mailing address;
  3. Telephone number and area code for office and home;
  4. Anticipated arrival and departure dates;
  5. Your scientific background relevant to the topic of the seminar;
  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.

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.

Program: There will be a dual emphasis on topics related to manifolds of nonpositive sectional curvature and to exterior differential systems and control theory. A workshop format with short term visitors will be typical.

Information: P. Eberlein or R. Gardner, Department of Mathematics, University of North Carolina, Chapel Hill, North Carolina 27514.


December 1987


14–18. Workshop on Applications of Combinatorics and Graph Theory to Computer Science, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, Minnesota. (August 1987, p. 813)

15–18. The Ramanujan Centennial Conference, Annamalainagar, India. (October 1987, p. 997)


26–28. Ramanujan Birth Centenary Year International Symposium on Analysis, Pune, India. (June 1987, p. 685)


January 1988

3–5. Conference on Cohomology and Representation Theory of Finite and Algebraic Groups, University of Georgia, Athens, Georgia. (November 1987, p. 1138)

4–6. Fourth Haifa Matrix Conference, Haifa, Israel. (October 1987, p. 997)

4–8. Fifth Caribbean Conference in Combinatorics and Computing, University of the West Indies, Cave Hill, Barbados. (June 1987, p. 685)

5–6. 1988 AMS Short Course: Computational Complexity Theory, Atlanta, Georgia.

Information: For further details, see the Meetings section of this issue of Notices.

Meetings and Conferences

Information: For further details, see the Meetings section of this issue of Notices.

February 1988

1-5. Fourth International Conference on Data Engineering, Los Angeles Airport Hilton, Los Angeles, California.


8-12. Workshop on Representations of p-adic Groups and Applications to Automorphic Forms, Mathematical Sciences Research Institute, Berkeley, California. (August 1987, p. 813)

11-15. 154th National Meeting of the American Association for the Advancement of Science (AAAS), Boston, Massachusetts.

Program: There will be eleven public lectures dealing with popular aspects of science and the AAAS Science Film Festival, featuring some 50 of the best recent science films, in addition to some 125 meeting symposia.


18-22. Workshop on Application of Combinatorics and Graph Theory to the Biological and Social Sciences, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, Minnesota. (August 1987, p. 813)

March 1988

4-5. Illinois Number Theory Conference, University of Illinois, Urbana-Champaign, Illinois.

Program: Several invited lectures and several sessions for contributed papers.

Information: K. Stolarsky, Department of Mathematics, University of Illinois, 1409 West Green Street, Urbana, Illinois 61801 or P. Bateman, 217-333-4996.

7-10. Second International Conference on Computer Workstations, Santa Clara, California. (October 1987, p. 997)


8-11. 1988 International Zurich Seminar on Digital Communications, Zurich, Switzerland. (October 1987, p. 997)

9-15. International Conference on Algebraic Geometry, Berlin, German Democratic Republic.

Information: M. Roczen, Sektion Mathematik, Humboldt Universität, Post Office Box 1297, DDR-1086 Berlin, German Democratic Republic.


Meetings and Conferences

**April 1988**


Principal Speaker: H. Shapiro, Royal Institute of Technology, Sweden.


Call for Papers: Contributed papers should be submitted before February 15, 1988.

Information: D. Khavinson or I. Monroe, Department of Mathematical Sciences, SCEN 301, University of Arkansas, Fayetteville, Arkansas 72701.

8-9. **Conference on Applied Mathematics**, Central State University, Edmond, Oklahoma.

Program: E. Sudarshan will deliver the keynote address. N. Smith will be the banquet speaker, and D. Ballew will deliver a special address marking the 100th anniversary of the production of Hertz waves.

Call for Papers: Papers emphasizing the application of mathematics are solicited as well as any novel uses of mathematics.

Information: S. Rao, Director of the Conference, Department of Physics, Central State University, Edmond, Oklahoma 73060.


11-15. **Institute of Electrical and Electronics Engineers Computer Society's 10th International Conference on Software Engineering**, Raffles City, Singapore. (October 1987, p. 998)


Principal Speaker: A. Beardon, University of Cambridge.

Theme: The hyperbolic metric in complex analysis.

Program: The principal speaker will present a series of talks; a small number of additional speakers will present 30 and 60 minute talks.

Information: K. Stephenson, Department of Mathematics, University of Tennessee, Knoxville, TN 37996-1300.

15-16. **Fifth Annual Auburn Miniconference on Real Analysis**, Auburn University, Auburn University, Alabama.

Principal Speakers: J. Uhl, University of Illinois, and M. Evans, North Carolina State University.

Program: Principal speakers will deliver hour addresses and there will be two days of sessions for contributed 20-minute papers.

Information: J. Brown or G. DeSouza, Division of Mathematics, Parker Hall, Auburn University, Auburn University, Alabama 36849, 204-826-4290.


Information: For further details, see the News and Announcements section of this issue of Notices.

23-24. **842nd Meeting of the AMS**, College Park, Maryland.

Information: John Balletto, American Mathematical Society, Meetings Department, Post Office Box 6248, Providence, Rhode Island 02940.


**May 1988**

**Symposium on Some Mathematical Questions in Biology: The Dynamics of Excitable Media**, Las Vegas, Nevada.

Information: For further details, see the Meetings section of this issue of the Notices. (Exact dates for this symposium are undetermined).


Meetings and Conferences

INFORMATION: A. Zeller-Meier, CIRM, Luminy, Case 916, F-13288 Marseille Cedex 9, France.


16–20. 1988 Mathematical Sciences Congress and 32nd Annual General Meeting of the Australian Mathematical Society, Canberra, Australia. (June 1987, p. 685)


ORGANIZING COMMITTEE: S. Chern, R. Osserman (chairman), and R. Schoen.

INFORMATION: I. Kaplansky, Mathematical Sciences Research Institute, Berkeley, California 94720.

16–21. Theorie des Representations des Groupes Finis, Marseille, France.

INFORMATION: A. Zeller-Meier, CIRM, Luminy, Case 916, F-13288 Marseille Cedex 9, France.

*23–26. Economie Mathematique, Marseille, France.

INFORMATION: A. Zeller-Meier, CIRM, Luminy, Case 916, F-13288 Marseille Cedex 9, France.


INFORMATION: For further details, see the Meetings section in this issue of Notices.


*30–June 3. Theorie des Nombres, Marseille, France.

INFORMATION: A. Zeller-Meier, CIRM, Luminy, Case 916, F-13288 Marseille Cedex 9, France.


PROGRAM: This conference will be mainly devoted to recent and very important advances in Hyperplane Sections. Special lectures will cover also general topics and recent progress in other branches of Algebraic Geometry. The program will consist of invited lectures.


INFORMATION: E. Livorni, Dipartimento di Matematica, Universita degli Studi dell'Aquila, Via Roma, Italy.

30–June 3. Canadian Applied Mathematics Society Conference on Continuum Mechanics and its Applications, Simon Fraser University, British Columbia, Canada. (Note changes from October 1987, p. 998)

June 1988

4–August 11. Joint Summer Research Conferences in the Mathematical Sciences, Bowdoin College, Brunswick, Maine.

INFORMATION: For further details, see the Meetings section in this issue of Notices.


5–9. Institute of Electrical and Electronics Engineers Computer Society's Conference on Computer Vision and Pattern Recognition, University of Michigan, Ann Arbor, Michigan. (October 1987, p. 998)


TOPICS: The conference themes will include Numerical Analysis, Pattern Recognition/Image Processing & Computer Vision, Artificial Intelligence, Reservoir Simulation & Seismic Processing, Parallel Programming Languages (such as ADA), and Large Scale Scientific Computations.


INFORMATION: Conference Secretary, Berit Hilt, Bergen Scientific Centre, IBM, Allégent 36, 5007 Bergen, Norway.

*6–24. SMS-NATO ASI: Methods in Field and Superstring Theories, Université de Montréal, Montréal, Canada.


INFORMATION: G. David, Département de mathématiques et de statistique, Université de Montréal, Carte Postale 6128, Montréal H3C 3J7, Canada.


15–17. Ninth National Educational Computing Conference (NECC '88), Anatole Hotel, Dallas, Texas. (October 1987, p. 999)
Meetings and Conferences


Program: The purpose of the conference is to provide a forum for presentation of recent progress in the mathematical modeling of renewable resources.

Principal speakers: J. Sarukhan, National Autonomous University of Mexico; A. McCall, Southwest Fisheries Center; J. Pickering, University of Georgia; A. Starfield, University of Minnesota; and G. Swartzman, University of Washington.

Call for papers: Those who wish to present a paper (20 minutes) at the meeting should submit an abstract to W. Getz, Department of Entomology, University of California, Berkeley, California 94720, 415-642-7191, by May 1, 1988.

Information: H. Heras, Ecologia Marina, CICESE, Post Office Box 4844, San Ysidro, California 92073.


Program: A mini-series of lectures will be given by M. Gromov, V. Milman, W. Johnson, and B. Maurey. There will also be a number of longer lectures given by other leading specialists and sessions for shorter contributed talks.

Information: N. Tomczak-Jaegermann, Department of Mathematics, University of Alberta, Edmonton, Alberta, Canada T6G 2G1.


20-24. Fifth International Conference on Boundary and Interior Layers: Computational and Asymptotic Methods, Shanghai, China. (June 1987, p. 685)


Program: There will be three survey lectures on the professional work of Butler, delivered by E. Barbeau, L. Erbe, and H. Freedman. Keynote speakers will be F. Atkinson, J. Cushing, K. Hader, J. Hofbauer, A. Minagrelli, K. Palmer, G. Sell, K. Schmitt, and H. Smith.

Information: Differential Equations, Department of Mathematics, University of Alberta, Edmonton, Alberta, Canada T6G 2G1.


27-July 15. Microprogram on the Structure of Banach Spaces, Mathematical Sciences Research Institute, Berkeley, California. (June 1987, p. 685)

July 1988


Information: For further details, see the Meetings section in this issue of Notices.

4-8. Infinite Dimensional Lie Algebras and Groups, Marseille, France. (November 1987, p. 1139)

Information: A. Zeller-Meier, CIRM, Luminy Case 916, F-13288 Marseille Cedex 9, France.


17-27. Ninth Congress of the International Association of Mathematical Physics, Swansea, Wales. (February 1987, p. 364)


18-29. AMS-SIAM Summer Seminar on Computational Solution of Nonlinear Systems Equations, Colorado State University, Fort Collins, Colorado.

Information: For further details, see the Meetings section of this issue of Notices.

20-31. Ninth Latin American School of Mathematics, Santiago, Chile. (November 1987, p. 1140)


*31-August 6. Nonstandard Analysis, University of Massachusetts, Amherst, Massachusetts, and Smith College, Northampton, Massachusetts.

Invited speakers: H. Keisler, University of Wisconsin, Madison; E. Nelson, Princeton University; and E. Perkins, University of British Columbia.

Information: J. Henle, Department of Mathematics, Smith College, Northampton, Massachusetts 01063, or F. Wattenberg, Department of Mathematics, University of Massachusetts, Amherst, Massachusetts 01003.

August 1988

1-5. Fifteenth Annual Conference and Exhibition on Computer Graphics and Interactive Techniques (SIGGRAPH '88), Georgia World Congress Center, Atlanta, Georgia. (October 1987, p. 999)

4-11. Algebraic Logic Conference, Budapest, Hungary. (October 1987, p. 999)


Purpose: To strengthen undergraduate teaching of calculus, linear algebra, differential equations, numerical methods, through presentation and discussion of new ideas.

Information: G. Strang, Room 2-240, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.
Meetings and Conferences

8–12. AMS Centennial Celebration, Providence, Rhode Island. (April 1987, p. 553)

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

9–12. International Symposium in Real Analysis, University of Ulster, Coleraine, Northern Ireland. (February 1987, p. 364)

9–13. First International Symposium on Algebraic Structures and Number Theory, Hong Kong. (November 1987, p. 1140)


14–27. Harmonic Analysis on Reductive Groups, Bowdoin College, Brunswick, Maine. (This conference has been postponed. For further details, see the announcement for July 30–August 12, 1989, in this section of Mathematical Sciences Meetings and Conferences)

15–19. New Directions in Dynamical Systems, Brown University, Providence, Rhode Island. (October 1987, p. 999)


21–27. Seventeenth International Congress of Theoretical and Applied Mechanics, Grenoble, France. (January 1987, p. 135)

21–27. International Conference on General Algebra, Krems/Donau, Austria. (November 1987, p. 1140)


22–26. 20th Nordic Congress of Mathematicians, Trondheim, Norway. (November 1987, p. 1140)

*23–30. 1988 Association for Symbolic Logic European Summer Meeting, Padova, Italy.

INFORMATION: R. Ferro, Dipartimento di Matematica Pura e Applicata, Universita di Padova, via Belzoni 7, 35131 Padova, Italy.

29–September 2. ICO Topical Meeting on Optical Computing, Orsay, France. (October 1987, p. 1000)

29–September 2. Orbit Method in Representation Theory, Copenhagen, Denmark. (October 1987, p. 1000)

September 1988

*13–16. Workshop on Arboreal Group Theory, Mathematical Sciences Research Institute, Berkeley, California.

PROGRAM: This workshop is the first of three in Mathematical Sciences Research Institute's yearlong program on Combinatorial Group Theory and Geometry.

ORGANIZING COMMITTEE: R. Alperin (chairman), H. Bass, and D. Kaplansky.

INFORMATION: W. Barker, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, California 94720, 415-643-6059.

26–October 1. Fifth International Conference on Complex Analysis, Halle, German Democratic Republic. (October 1987, p. 1000)

December 1988


January 1989

8–11. First Caribbean Conference on Fluid Dynamics, Saint Augustine, Trinidad, West Indies. (June 1987, p. 686)


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

July 1989

5–19. Microprogram on Noncommutative Rings, Mathematical Sciences Research Institute, Berkeley, California. (June 1987, p. 686)


PROGRAM: Four lecture series (3-5 lectures each) will form the central focus of the Conference. In addition to the series lectures, approximately 24 other one-hour talks will be given.

INVITED SPEAKERS: J. Bernstein, Harvard University; R. Howe, Yale University; W. Schmid, Harvard University; and D. Vogan, Massachusetts Institute of Technology.

INFORMATION: W. Barker, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, California 94720, 415-643-6059.

August 1989


January 1990


INFORMATION: H. Daly, American Mathematical Society, Meetings Department, Post Office Box 6248, Providence, Rhode Island 02940.
New AMS Publications

I HAVE A PHOTOGRAPHIC MEMORY
Paul Halmos

Paul R. Halmos, eminent mathematician and brilliant expositor, is also a snapshot addict. For the past 45 years, Halmos has snappped mathematicians, their spouses, their brothers and sisters and other relatives, their offices, their dogs, and their carillon towers. From 6000 or so photographs in his collection, Halmos has chosen about 600 for this book. The pictures are candid shots showing mathematicians just being themselves, and the accompanying captions, in addition to identifying the subjects, contain anecdotes and bits of history that reveal Halmos' inimitable wit, charm, and insight. This delightful collection of mathematical memorabilia is certain to become a favorite browsing book as well as a valuable historical record.

1980 Mathematics Subject Classifications: 00, 01
336 pages (hardcover), January 1988
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REVIEWS IN NUMERICAL ANALYSIS
1980–86

These five volumes bring together a wealth of bibliographic information in the area of numerical analysis. Containing over 17,600 reviews of articles, books, and conference proceedings, these volumes represent all the numerical analysis entries that appeared in Mathematical Reviews between 1980 and 1986. Classified according to the 1980 Mathematics Subject Classification scheme, the reviews are listed in each subsection according to their MR classification number. Accompanying each entry is a list of all subsequent reviews that cite the entry as a reference. In addition, author and key indexes appear at the end of volume 5.

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PROCEEDINGS OF THE INTERNATIONAL CONGRESS OF MATHEMATICIANS 1986
AUGUST 3–11, 1986
BERKELEY, CA USA

The tradition of the International Congress of Mathematicians began in Zurich, Switzerland in 1897. Since then, the Congress has been held every four years, except during the first and second world wars. In a time when increasing specialization has divided mathematics into many subfields, ICM serves an important role. Its purpose is to foster personal relationships between mathematicians from different countries and to present a survey of the current state of mathematical research. In addition, the Congress has provided the occasion for awarding the prestigious Fields Medals and Nevanlinna Prize.

In August 1986, more than 3500 mathematicians gathered in Berkeley, California for the nineteenth ICM. These proceedings, printed in two volumes, represent a complete account of the activities of the Berkeley Congress. Volume 1 contains the official record of the ICM, the list of members, presentations made on the work of the Fields medalists and the Nevanlinna Prize winner, and the 16 one-hour plenary session addresses. More than 140 45-minute invited addresses were given, and these have been grouped into 19 mathematical sections which are listed below. Those addresses from sections 1-8 appear in Volume 1, with the remaining 11 sections in Volume 2. More than 400 short communications were presented at ICM, and the names of the communicators and the titles of their papers appear in the proceedings.

Contents of Scientific Program

Plenary Session Addresses
L. DeBranges, Underlying concepts in the proof of the Bieberbach conjecture
S. K. Donaldson, The geometry of 4-manifolds
G. Faltings, Neure Entwicklungen in der arithmetischen algebraischen Geometrie
F. W. Gehring, Topics in quasiconformal mappings
M. Gromov, Soft and hard symplectic geometry
H. W. Lenstra, Elliptic curves and number-theoretic algorithms
R. Schoen, Recent progress in geometric partial differential equations
A. Schónhage, Equations solving in terms of computational complexity
S. Shelah, Taxonomy of universal and other classes
A. V. Skorohod, Random processes in infinite dimensional spaces
S. Smale, Algorithms for solving equations

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E. M. Stein, Problems in harmonic analysis related to curvature and oscillatory integrals
A. A. Suslin, Algebraic K-theory of fields
D. A. Vogan, Representations of reductive Lie groups
E. Witten, Physics and geometry

Sections of Forty-five Minutes Addresses
1. Mathematical logic and foundations
2. Algebra
3. Number theory
4. Geometry
5. Topology
6. Algebraic geometry
7. Complex analysis
8. Lie groups and representations
9. Real and functional analysis
10. Probability and mathematical statistics
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12. Ordinary differential equations and dynamical systems
13. Mathematical physics
14. Numerical methods and computing
15. Discrete mathematics and combinatorics
16. Mathematical aspects of computer science
17. Applications of mathematics to nonphysical sciences
18. History of mathematics
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A FORMALIZATION OF SET THEORY
WITHOUT VARIABLES
Alfred Tarski and Steven Givant
(William and Mary, Volume 41)

Completed in 1983, this work culminates nearly half a century of the late Alfred Tarski's foundational studies in logic, mathematics, and the philosophy of science. Written in collaboration with Steven Givant, the book appeals to a very broad audience, and requires only a familiarity with first-order logic. It is of great interest to logicians and mathematicians interested in the foundations of mathematics, but also to philosophers interested in logic, semantics, algebraic logic, or the methodology of the deductive sciences, and to computer scientists interested in developing very simple computer languages rich enough for mathematical and scientific applications.

The authors show that set theory and number theory can be developed within the framework of a new, different, and simple equational formalism, closely related to the formalism of the theory of relation algebras. There are no variables, quantifiers, or sentential connectives. Predicates are constructed from two atomic binary predicates (which denote the relations of identity and set-theoretic membership) by repeated applications of four operators that are analogues of the well-known operations of relative product, conversion, Boolean addition, and complementation. All mathematical statements are expressed as equations between predicates. There are ten logical axiom schemata and just one rule of inference: the one of replacing equals by equals, familiar from high school algebra.

Though such a simple formalism may appear limited in its powers of expression and proof, this book proves quite the opposite. The authors show that it provides a framework for the formalization of practically all known systems of set theory, and hence for the development of all classical mathematics.

The book contains numerous applications of the main results to diverse areas of foundational research: propositional logic; semantics; first-order logics with finitely many variables; definability and axiomatizability questions in set theory, Peano arithmetic, and real number theory; representation and decision problems in the theory of relation algebras; and decision problems in equational logic.

BIOGRAPHY

Alfred Tarski studied philosophy and mathematics at the University of Warsaw, receiving his Ph.D. in 1924 under the direction of the philosopher Lesniewski. For the next fifteen years he taught at the Zeromski Lyceum and continued his affiliation with the University of Warsaw as assistant, and later as adjunct, to Łukasiewicz's philosophical seminar.

Following an American lecture tour in 1939, Tarski took temporary positions at Harvard, the Institute for Advanced Studies, and the City College of New York. In 1942 he obtained a permanent position at the University of California, Berkeley, where he went on to found his famous school of logic. He became a Professor Emeritus in 1968, but continued to teach for about five more years. The last part of his life, until his death in 1985, was spent collaborating with Steven Givant on the book, A formalization of set theory without variables.

Tarski's prolific and fundamental contributions to foundational research in mathematics cover an astounding range of subjects. He published more than one hundred research papers, and authored or coauthored over ten research monographs.

Steven Givant attended Dartmouth College, and later the University of California at Berkeley, where he studied logic with Henkin, Tarski, and Vaught. He received his Ph.D. in 1975 under the direction of Vaught. He is currently a Professor of Mathematics at Mills College.

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EQUIVARIANT SURGERY AND CLASSIFICATION OF FINITE GROUP ACTIONS ON MANIFOLDS
Karl Heinz Dovermann and Melvin Rothenberg
(Memoirs of the AMS, Number 379)

This work is concerned primarily with the development of the surgery sequence as a practical tool for studying problems in transformation groups. The classification of broad classes of finite group actions on manifolds has become a viable project with the development of modern geometric topology. The principal tool used is surgery theory, or, more specifically, the Sullivan-Wall exact sequence. Here the authors develop an equivariant Sullivan-Wall surgery exact sequence in the category of smooth and locally linear actions of finite groups satisfying the gap hypothesis. This machinery is then applied to various problems of classifying group actions on manifolds. As applications, the authors classify finite group actions on disks and construct certain locally linear actions.

Contents

Statement of results
Discrete invariants of a $G$ manifold ($G$ posets)
Equivariant finiteness obstructions
Bundle data, ambient maps, cobordism, and the surgery sequence
Equivariant surgery and normal cobordism
Surgery below the middle dimension, simple $G$ homotopy theory, and simple $G$ surgery theory
Surgery in the middle dimension and the $\pi_\ast \pi$ theorem
Addition of equivariant surgery obstructions
The exact surgery sequence
Computations of equivariant surgery obstruction groups
Rational surgery obstructions
Classification of group actions on disks
Closed manifolds which are not $G$ homotopy equivalent to finite $G$ CW-complexes
THE EXACT HAUSDORFF DIMENSION IN RANDOM RECURSIVE CONSTRUCTIONS
Siegfried Graf, R. Daniel Mauldin, and S. C. Williams
(Memoirs of the AMS, Number 381)

This volume is a detailed investigation of the Hausdorff dimension of statistically self-similar random fractals. Recent work of Mauldin, Williams, and, independently, Falconer, showed that, for each statistically self-similar recursion in Euclidean space, there is associated a number \( \alpha \) which is almost surely the Hausdorff dimension of the fractal generated by the recursion. In general, the \( \alpha \)-dimensional measure of the fractal is zero. In this book, the authors determine the exact scale function for a wide class of these random constructions. They show that the fractal has positive finite measure with respect to the measure induced by a scale function of the form \( h(t) = t^\alpha (\log \log t)^\beta \). The techniques of proof involve martingale theory, moment growth conditions, random measures, and geometry. To illustrate the generality of the results, many examples are given, including the dimension of zero sets in Brownian motion, of random Sierpinski curves, and of dust-like Cantor sets generated by Mandelbrot's "canonical curdling."

Contents

Random constructions and the \( Q \)-measure

The radius of convergence for the moment generating function of \( X^\beta, \beta > 1 \)

An upper bound for the Hausdorff dimension

A lower bound for the Hausdorff dimension

Main results

Examples

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EXISTENCE THEOREMS FOR MINIMAL SURFACES OF NON-ZERO GENUS SPANNING A CONTOUR
Friedrich Tomi and Anthony J. Tromba
(Memoirs of the AMS, Number 382)

In 1931 Jesse Douglas and Tibor Rado simultaneously solved the famous problem of Plateau, which states that every Jordan wire in \( R^n \) bounds at least one disk type surface of least area. In this paper, the authors approach this classical problem using purely differential geometric concepts. In addition to reproofing the results of Douglas, the authors develop a new geometric criterion on a given finite system of disjoint Jordan curves in 3-dimensional Euclidean space. This criterion guarantees the existence of a minimal surface having a prescribed genus and having these curves as boundary.

Contents

On Teichmüller theory for oriented surfaces

The variational problem

Compactness in the moduli space

The general existence theorem

Application to Plateau's problem in \( R^3 \)

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HOMOTOPY THEORIES
Alex Heller
(Memoirs of the AMS, Number 383)

Since Eilenberg and Steenrod produced the axioms for homology about 40 years ago, there have been repeated attempts to produce analogous results for homotopy theory. However, almost all of these descriptions attempt to define the homotopy theory of a particular object, with the aim of making that object sufficiently general as to encompass all conceivable examples. In contrast, this book presents a more general description of homotopy theory. The author shows that a particular hyperfunctor possesses certain properties which can be taken as axioms of homotopy theory. From these properties, the author recreates much of the familiar structure of homotopy theory, including standard theorems on homotopy limits and localization. In addition, he provides a

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description of algebras-up-to-homotopy designed to illuminate the theory of loop-spaces.

Contents

Categorical preliminaries
Homotopy theories
Properties of homotopy theories
Tensor structures
Localization
Homotopical algebra

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MATHEMATICAL INTUITIONISM: INTRODUCTION TO PROOF THEORY
A. G. Dragalin
(Translations of Mathematical Monographs, Volume 67)

In the area of mathematical logic, a great deal of attention is now being devoted to the study of nonclassical logics. Nonclassical logics are used in the theory of computations, in information theory, and for the description of systems of heuristic programming. Intuitionistic logic is a particularly important nonclassical logic. The aim of this book is to present the most important methods of proof theory in intuitionistic logic and to acquaint the reader with the principal axiomatic theories based on intuitionistic logic. The exposition, accessible to a wide audience, requires only an introductory course in classical mathematical logic.

Contents

Logic
Arithmetic
Algebraic models
Analysis
Eliminability of cuts in the intuitionistic simple theory of types in the form of a sequent calculus with extensionality
Appendix A: An algebraic approach to models of realizability type
Appendix B: A strong form of the normalization theorem

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SEVEN PAPERS TRANSLATED FROM THE RUSSIAN
I. V. Kovalishina and V. P. Potapov
(American Mathematical Society Translations, Series 2, Volume 138)

The papers in this collection focus on topics in matrix theory, and generalized complex function theory.

Contents

I. V. Kovalishina and V. P. Potapov, The multiplicative structure of analytic real \( J \)-expansive matrix-valued functions
V. P. Potapov, General theorems on the structure and the splitting off of elementary factors of analytic matrix-valued functions
I. V. Kovalishina and V. P. Potapov, An indefinite metric in the Nevanlinna-Pick problem
V. P. Potapov, Linear fractional transformations of matrices
I. V. Kovalishina and V. P. Potapov, The radii of a Weyl disk in the matrix Nevanlinna-Pick problem
V. P. Potapov, A theorem on the modulus. I: Main concepts. The modulus
V. P. Potapov, A theorem on the modulus. II

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INVESTIGATIONS ON THE THEORY OF FUNCTIONS OF SEVERAL REAL VARIABLES AND THE APPROXIMATION OF FUNCTIONS
S. L. Sobolev, Editor
(Proceedings of the Steklov Institute, Volume 172)

This volume is dedicated to Academician Sergei Mikhailovich Nikol’skii on the occasion of his eightieth birthday. An acknowledged leader in Soviet mathematical sciences, Nikol’skii has made profound contributions to functional analysis, the theory of approximation of functions, numerical methods, the theory of imbedding of function spaces, direct
methods in the calculus of variations, and the theory of boundary value problems for partial differential equations. The papers in this collection are in one way or another related to Nikol'skii's ideas.

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Bochkarev, S. V., Construction of a dyadic interpolation basis in the space of continuous functions using Besov, Nikol'skii, Bochkarev, Ya. V., Approximation of the functions of Periodic functions by Fourier sums
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Burenkov, V. I., Extension of functions with preservation of Sobolev seminorm
Volkov, E. A., An exponentially converging method for the Neumann problem on multiply connected polygons
Gavrilyuk, V. T. and Stechkin, B., Approximation continuous periodic functions by Fourier sums
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Kalyabin, G. A., Theorems on extension, multipliers and diffeomorphisms for generalized Sobolev-Liouville classes in domains with a Lipschitz boundary
Kashin, B. S., On approximation properties of complete orthonormal systems
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Terekhin, A. P., Multiplicative estimates of moduli of mixed operator smoothness
Ul'yanov, P. L., Compositions of functions and Fourier series

The following listing is being repeated with corrections from the November 1987 issue.

ALGEBRAIC GEOMETRY—BOWDOIN 1985
Spencer J. Bloch, Editor
(Proceedings of Symposia in Pure Mathematics, Volume 46)

This volume contains the proceedings of the Summer Research Institute on Algebraic Geometry, held in July 1985 at Bowdoin College. Representing contributions by some of the most prominent researchers in the field, the collection covers the following topics: algebraic varieties, curves, surfaces, threefolds, affine algebraic geometry, groups in algebraic geometry, vector bundles, geometry in characteristic $p$, Hodge theory, enumerative geometry, algebraic cycles, and commutative algebra.

1980 Mathematics Subject Classification: 14
ISBN (Set) 0-8218-1481-8; (Part 1) 0-8218-1476-1; (Part 2) 0-8218-1480-X, ISSN 0082-0717
496 pages (part 1); 528 pages (part 2) (hardcover), January 1988
Set: Individual member $71, List price $119, Institutional member $95
Part 1: Individual member $36, List price $60, Institutional member $48
Part 2: Individual member $39, List price $65, Institutional member $52
To order, please specify PSPUM/46N (set), PSPUM/46.1N (part 1), PSPUM/46.2N (part 2)
QUESTIONS ARE WELCOMED from AMS members regarding mathematical matters such as details of, or references to, vaguely remembered theorems, sources of exposition of folk theorems, or the state of current knowledge concerning published or unpublished conjectures. This is not intended as a problem corner, except for occasional lists of problems collected at mathematical meetings.

REPLIES from readers will, when appropriate, be edited into a composite answer and published in a subsequent column. All answers received will be forwarded to the questioner.

QUERIES and RESPONSES should be typewritten if at all possible and sent to Queries Column, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940.

385. Seung Jin Bang (Department of Mathematics, Seoul National University, Seoul 152, Korea). The Laplacian $\Delta$ of a connected, compact, globally symmetric Riemannian space $M$ of rank one splits as $\Delta_1 + \Delta'$, with $\Delta_1$ the radial part and $\Delta'$ the Laplacian on the $t$-sphere in $M$. For $\Delta_1$ one has the formula $d^2/dt^2 + (\log A(t))' \cdot d/dt$, with $A(t)$ = surface area of the $t$-sphere. What is the explicit form for $\Delta'$?

386. Vladik Ya. Kreinovich (P.O. Box 21 (761), Leningrad 22, 197022 USSR). R. R. Pimenov proved (1982, unpublished) that the following implies the Riemann Hypothesis: For any $n$ the sum $S = \sum \exp(2\pi ir)$, where $r$ runs over the rationals of the form $a/b$ with $0 < a \leq b \leq n$, is real and negative; he tested it for some large $n$. Is anything known about this?

387. Vladik Ya. Kreinovich (P.O. Box 21 (761), Leningrad 22, 197022 USSR). Consider trigonometric polynomials of the form

$$p(t) = \sum_{k=1}^{N} A_k \cos(kt + \phi_k).$$

It is known for the sup-norm $\| \cdot \|$ and $L_2$-norm $\| \| \|$ that max($\|p\|/\|p\|$) is obtained for $\phi_k = 0$. Where does the minimum occur? The minimum function tends, for $N \to \infty$, to a step function $f$ with at most two values. Is the min obtained for finite $N$, when $p$ is the “best approximation” to this $f$?

The special case of all $A_k$ equal is of interest. These questions have to do with generating test signals for measuring devices.

388. Teresa Przytycka and Józef Przytycki (University of British Columbia, Computer Science, 6356 Agricultural Road, Vancouver, B.C., Canada, V6T 1W5). In the representation of a closed surface of genus $p$ by a regular $4p$-gon in the hyperbolic plane with vertex angle $\pi/2p$ (and identification of opposite sides), are the edges and the diameters (from the midpoint of an edge to the midpoint of the opposite edge) shortest geodesics on the surface? Where does one find a suitable reference?
AMS Reports and Communications

Recent Appointments

Committee members’ terms of office on standing committees expire on December 31 of the year given in parentheses following their names, unless otherwise specified.

P. Emery Thomas has been appointed to the Committee on Travel Grants for the AMS Centennial, a subcommittee of the Centennial Committee by President G. D. Mostow. Continuing members of the committee are Richard W. Beals, chairman, John W. Bunce, Anthony W. Hager, William F. Lucas, and Frank Uhlig.

Krzysztof Galicki and Alexander Smith were appointed Tellers for the election of 1987 by President G. D. Mostow.


David Drasin (1989) and Robert J. Zimmer (1989) have been appointed by President G. D. Mostow to the Committee to Select Hour Speakers for Central Sectional Meetings. Donald G. Aronson (1988) has been appointed chairman. Continuing members of the committee are Jerry Kaminker (1988), and Andy Roy Magid (ex officio).

President G. D. Mostow has appointed Ruth M. Charney (1989) to the Committee to Select Hour Speakers for Eastern Sectional Meetings. Lesley M. Sibner (1988) has been appointed chairman. Other members of the committee are W. Wistar Comfort (ex officio), Richard H. Herman (1988), and Thomas Crawford Spencer (1988).

Ronald J. DiPerna (1989) and William M. Kantor (1989) have been appointed to the Committee to Select Hour Speakers for Far Western Sectional Meetings by President G. D. Mostow. Murray M. Schacher (1988) has been appointed chairman. Continuing members of the committee are Heinz-Otto Kreiss (1988), and Lance W. Small (ex officio).

Patrick B. Eberlein (1989) has been appointed by President G. D. Mostow to the Committee to Select Hour Speakers for Southeastern Sectional Meetings. Frank S. Quinn III (1988) has been appointed chairman. Continuing members of the committee are Frank T. Birtel (ex officio), and Jon F. Carlson (1988).


Steven L. Kleiman (1990) and Paul H. Rabinowitz (1989) have been appointed to the Committee on Summer Institutes and Special Symposia by President G. D. Mostow. John Wermer (1988) has been appointed chairman. Continuing members of the committee are Eric M. Friedlander (1988), Thomas C. Spencer (1990), and Robert B. Warfield, Jr. (1989). Terms expire on February 28.


Errata

Two names were misspelled in the Recent Appointments of the October 1987 Notices. The correct names and committees are George Lusztig, Committee on Research Fellowships, and L. G. Makar-Limanov, Committee on Translations from Russian and Other Slavic Languages.
Minc (1987), and B. F. Wells. The IMS subcommittee members are Eugene Dynkin, chairman, B. Pittel, A. Rukhin, and W. J. Studden.

President G. D. Mostow has appointed Arthur Ogus (AMS) to the AMS-IMS-SIAM Ad Hoc Executive Committee of the Evaluation Panel for NSF Postdoctoral Fellowships in the Mathematical Sciences. The other members of the committee are Dianne O’Leary (SIAM), chairman, and George C. Tiao (IMS).


Guido L. Weiss (1990) has been appointed the representative of the Society to the Committee on the American Mathematics Competition. The term expires on June 30.

Reports of Past Meetings

The April Meeting in Kent

The eight hundred and thirty-third meeting of the American Mathematical Society was held at Kent State University, Kent, Ohio on Friday, April 3 and Saturday, April 4, 1987. There were 179 registrants, including 153 members of the Society.

Invited Addresses. By invitation of the Committee to Select Hour Speakers for the Central Sectional Meetings, there were four invited addresses as follows:

WILLIAM G. DWYER, University of Notre Dame, Solving classification problems in algebraic topology. Professor Dwyer was introduced by Clarence Wilkerson.

PETER LOEB, University of Illinois Urbana—Champaign, Standard Brownian motion is non-standard coin tossing. He was introduced by J. Jerry Uhl.

L. RIDGWAY SCOTT, Penn State University, Discretization of incompressibility constraints. He was introduced by William Hager.

LUCIEN SZPIRO, Universite de Paris VI and MSRI, Elliptic curves and Diophantine equations. He was introduced by the Associate Secretary.

Special Sessions. By invitation of the same committee there were seven special sessions of selected twenty-minute papers. The topics of the sessions and the names and affiliations of the organizers are:

Algebraic combinatorics: Association schemes and related topics. EIICHI BANAI, Ohio State University and PAUL TERRILLIGER, University of Wisconsin Madison.

Summability theory. JOHN A. FRIDY, Kent State University.

Characters of finite groups. STEPHEN M. GAGOLA, Jr., Kent State University and DAVID C. BUCHTEL, University of Akron.

Noncommutative ring theory. TIMOTHY J. HODGES and JAMES OSTERBURG, University of Cincinnati.

Boundaries in potential theory. PETER A. LOEB, University of Illinois, Urbana-Champaign.

Cyclic homology and applications. HENRI MOSCOVICI, Ohio State University and Dan Burghelea, IHES, France.

Scientific computation. L. RIDGWAY SCOTT.

Geometry of Banach spaces and harmonic analysis. ANDREW M. TONGE and JOE DIESTEL, Kent State University.

Unstable homotopy theory. CLARENCE WILKERSON, Wayne State University.

Contributed papers. There was one session of contributed papers chaired by Thomas Drucker, Dickinson College; it consisted of 8 papers.

Related Activities. Professor Per Enflo presented a Piano Recital on Friday evening to which all meeting participants were invited. Everyone enjoyed the 16 inches of snow that appeared between this concert and the first sessions on Saturday morning. The undersigned Associate Secretary thanks the Local Arrangements Committee and Kent State University for hosting this meeting.

Robert Fossum
Associate Secretary
Urbana, Illinois

Report from the Committee on Human Rights of Mathematicians

Situation in Chilean Universities

I’m writing again as Chair of the AMS Committee for Human Rights of Mathematicians to report on the situation of mathematicians and other academics in Chile. Recently our committee received word that the mathematics student, Cristian Meneses Torres, who was the subject of an earlier letter from our committee to the Notices has been released from prison. Although we never received any reply to inquiries to Chilean officials, I think we can feel fairly confident that the interest of the AMS and other professional societies in Meneses’s case was useful.

However, the professional situation of our colleagues in Chile has, if anything, gotten worse in recent months. A short strike at the University of Chile for better salaries, after a breakdown of negotiations, was met with draconian measures by authorities. The university was closed down for an extended period. Three deans were dismissed, 35 professors were fired, and 300 students were expelled for participating in the protest. Since many of the professors involved, among them several scientists and at least one mathematician, are
more highly qualified academically than the majority of their colleagues, the reason for the firings is clear—to complain is grounds for dismissal.

Our committee wishes to keep the Society aware of the continuing turmoil in Chilean universities. The authorities at the University of Chile may not be finished yet with their “housecleaning.” Let us not abandon our Chilean colleagues through ignorance of their ordeal.

Herbert Clemens

Our committee wishes to keep the Society aware of the continuing turmoil in Chilean universities. The authorities at the University of Chile may not be finished yet with their “housecleaning.” Let us not abandon our Chilean colleagues through ignorance of their ordeal.

Herbert Clemens

Turkish Mathematician Freed

We reported previously (“Berkeley mathematician imprisoned in Turkey,” Notices 34, 569) that the logician Ali Nesin, a Turkish citizen, had been convicted and imprisoned on apparently political charges and, although his sentence had been served, was having trouble getting permission to leave Turkey. Several postscripts complete the story.

After some legal maneuvering, Dr. Nesin won a new trial, which ended with his acquittal in May. His counter-suit for false prosecution remains in the courts. His right to travel abroad, which the government had promised to restore if he was acquitted, was still not granted. The AMS and other foreign organizations repeated their questioning of this refusal. In the end, he was allowed to leave.

The gap in his professional career has been one whole academic year. Meanwhile, he accepted a position at the University of Notre Dame, and he is now teaching there.

Chandler Davis

Miscellaneous

Personal Items

Paul J. Campbell, Associate Professor of Mathematics and Computer Science at Beloit College, has been appointed Director of Academic Computing.

Joel E. Cohen, Professor of Populations at the Rockefeller University, has been elected to the honor of Fellow of the American Statistical Association.

Lawrence H. Cox, Senior Mathematical Statistician at the Bureau of the Census, has been elected to the honor of Fellow of the American Statistical Association.

David Folk, of the University of Michigan, has been appointed Assistant Professor at Eastern Michigan University.

Solomon Friedberg has been promoted to Associate Professor at the University of California, Santa Cruz.

Svetlana Katok has been promoted to Assistant Professor at the University of California, Santa Cruz.

Eugene M. Laska, Director of the Statistical Sciences and Epidemiology Division at the Nathan S. Kline Institute for Psychiatric Research, has been elected to the honor of Fellow of the American Statistical Association.

Richard A. Mollin has been promoted to Professor of Mathematics at the University of Calgary.

Kenneth Shiskowski has been granted tenure at Eastern Michigan University.

Richard A. Vitale, of the Claremont Graduate School, has been appointed Professor of Statistics at the University of Connecticut at Storrs.

Mary Yorke has been promoted to Assistant Professor and granted tenure at Eastern Michigan University.

Deaths

Anders Bager, Lecturer at the Hjöring Gymnasium, Denmark, died on September 2, 1987, at the age of 68. He was a member of the Society for 23 years.

Robert Bantegnie, Professor at the University of Besancon, France, died on September 18, 1987, at the age of 59. He was a member of the Society for 17 years.

Istvan Fenyo, Professor Emeritus at the Technical University of Budapest, Hungary, died on July 28, 1987, at the age of 70. He was a member of the Society for 9 years.

Michael J. Kascic, Jr., Director of Algorithms Research at the Supercomputing Research Center in Lanham, Maryland, died October 12, 1987, at the age of 46. He was a member of the Society for 10 years.
Ioan Marusciac, Professor of Mathematics at Babes-Bolyai University, Romania, died on May 3, 1987. He was a member of the Society for 7 years.

Edmondo Morgantini, Professor at the Semin. Matem., Italy, died on June 13, 1987, at the age of 71. He was a member of the Society for 14 years.

H. Randolph Pyle, retired, died in June 1987, at the age of 82. He was a member of the Society for 47 years.

Marvin Shinbrot, of the University of Victoria, died on September 18, 1987, at the age of 59. He was a member of the Society for 16 years.

Joseph Tomasovic, Associate Professor at the College of Misericordia, died on July 20, 1987, at the age of 42. He was a member of the Society for 18 years.

Visiting Mathematicians
(Supplementary List)

Mathematicians visiting other institutions during the 1987-1988 academic year have been listed in recent issues of Notices: June 1987, pages 696-698; August 1987, page 824; October 1987, pages 1008-1009; and November 1987, pages 1149-1150. The listing below gives the name and home country, the host institution, period of visit and field of special interest of additional visiting mathematicians.

Solomon Friedberg (U.S.A.), Tata Institute of Fundamental Research, India, January 1988 to February 1988, automorphic forms and number theory; Hebrew University, Israel, May 1988 to June 1988, automorphic forms and number theory.

Octavio C. Garcia (Mexico), Knox College, September 1987 to September 1988, universal algebra and theoretical computer science.

Jens Carsten Jantzen (West Germany), University of Massachusetts at Amherst, January 1988 to June 1988, Lie algebras.

Zvia Markovits (Israel), San Diego State University, August 1987 to May 1989, mathematics education.

Centennial Celebration

The first Executive Director of the Society was Holbrook M. MacNeille, who served from 1949 to 1954.

American Mathematical Society • Providence • August 8-12, 1988
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In particular, readers should note that the Equal Employment Opportunity Act (42 U.S.C., §§2000e et seq.), which prohibits discrimination in employment on the basis of race, religion, sex, or national origin, contains (in §2000e-1) an exception from the provisions of the Act for any religious corporation, association, educational institution, or society with respect to employment of individuals of a particular religion to perform work connected with the carrying on by such corporation, association, educational institution, or society of its activities.

The Age Discrimination Act of 1967 (29 U.S.C., §§621 et seq., as amended), makes it unlawful for an employer to discriminate against any individual between the ages of 40 and 70 because of age. Thus it is legal to seek as an employee someone who is "over 30," but not one "over 50," neither is it legal to express a preference for someone who is "young," or is a "recent graduate," since the latter tend (on statistical grounds) to be young.
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### POSITIONS AVAILABLE

**College of Staten Island (CUNY)**

**Department of Mathematics**

A tenure-track position in mathematics is available for Fall 1988. Requirements: Ph.D.; demonstrated potential for research; strong commitment to teaching. All mathematics research areas will be considered with special preference given to probability and statistics. Rank and salary commensurate with qualifications. The College of Staten Island is a senior college in CUNY. Send resume and three letters of reference to: Dr. Jane Coffee, Mathematics Department, College of Staten Island, 715 Ocean Terrace, Staten Island, N.Y. 10301 by March 1, 1988. AA/EOE Employer.

A tenure track position (Assistant Professor) in mathematics is available beginning in September 1988. Applicants should have a Ph.D. in mathematics and a strong commitment to quality teaching. The teaching load is twelve hours per semester. Salary and fringe benefits are competitive, commensurate with credentials and experience.

Applicants should send resume, transcripts and three letters of reference to Dr. Richard Escobales, Chairman, Department of Mathematics, Canisius College, Buffalo, New York 14208. AA/EOE.

### INDIANA STATE UNIVERSITY

**DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE**

Applications are invited for tenure-track positions at the assistant professor level beginning September 1988. The department has 24 full-time faculty members and offers B.A. and B.S. Degrees in mathematics and computer science, and the M.A. and M.S. in mathematics. Applicants should possess an earned doctorate and potential for teaching and research excellence. Preferred specializations are applied mathematics/numerical analysis and computer science education. Ability to teach statistics is desirable. Indiana State University has extensive computing facilities, including a Cyber 830, an IBM 4361, a VAX-8350 and several microcomputer laboratories. The department operates its own microcomputer laboratory and a VAX-11/750 with both Bell and Berkeley Unix available. Send letter of application, vita and names of three references to Dr. Donald F. Reynolds, Chairperson, Dept. of Mathematics & Computer Science, Indiana State University, Terre Haute, IN 47809. Applicants should be U.S. Citizens or hold a resident visa. Applications received after Feb. 12, 1988 cannot be guaranteed consideration. Indiana State University is an EO/AA employer.

### UNIVERSITY OF CALIFORNIA, IRVINE

**DEPARTMENT OF MATHEMATICS**

UCI VISITING ASSISTANT PROFESSORSHIP 1988-89. The position enables mathematicians (of any age) beginning their career who show definite promise in research to participate in an environment of vigorous mathematical research and instruction. Appointment is for one year; can be renewed for second year. Annual salary: $30,000. Teaching duties comparable to those of regular faculty. Appointees are expected to direct seminars in their specialty. Applications and three letters of recommendation must be received by February 15, and should be accompanied by a curriculum vitae and an account of works in print or preparation, and a brief description of research plans. All inquiries and applications should be sent to: The UCI Visiting Assistant Professorships in Mathematics, Department of Mathematics, University of California, Irvine, CA 92717. An Affirmative Action/Equal Opportunity Employer.

### TENURE TRACK POSITION IN MATHEMATICS

The department of mathematics at Lehigh University will have at least one tenure track position available beginning in Fall 1988. Applications in the area of geometry, algebra, analysis, numerical analysis, and applied mathematics will be considered with preference given to those candidates whose research interests best complement the activities of the department. Teaching load is approximately six hours per week. A strong commitment to and demonstrated excellence in both teaching and research are required. Send curriculum vitae and have letters from three references sent to:

Professor G. T. McAllister
Chairman, Search Committee
Department of Mathematics
Building #14
Lehigh University
Bethlehem, PA 18015

Minority and female applicants are encouraged to apply. Lehigh University is an equal opportunity affirmative action employer.
TEACH IN ASIA OR EUROPE

The University of Maryland University College seeks excellent teachers for openings on U.S. military bases overseas. Appointments begin August, 1988. 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. Milis, Assistant to the Chancellor, Overseas Programs, The University of Maryland University College, College Park, MD 20742-1642. AA/EOE.

MARY WASHINGTON COLLEGE
DEPARTMENT OF MATHEMATICS

A tenure-track assistant professor in mathematics position is anticipated starting Fall '88. Candidates should have (by Aug. '88) a Ph.D. in pure or applied mathematics, and must possess both a strong commitment to teaching and to continuing scholarly development. MWC is a small (3200), state-supported, coeducational, selective, undergraduate, liberal arts college located 50 miles from Richmond and Washington, D.C. Teaching load is approx. 110 students each semester in 9 or 12 contact hrs/wk. Send resume, graduate transcript, and 3 letters of reference — all to arrive by January 11, 1988 — to: John R. Tucker, Search Committee Chairman, Department of Mathematics, Monroe 209D, Mary Washington College, Fredericksburg, VA 22401-5358. AA/EOE.

DREXEL UNIVERSITY
Head, Department of Mathematics and Computer Science

Candidates must have a strong research record and a demonstrated commitment to applied mathematics, probability and statistics, and computer science. Send vita and names of references to Dr. Jet Wimp, Search Committee, Department of Mathematics and Computer Science, Drexel University, Philadelphia, Pennsylvania 19104.

Applications from women and minorities are actively solicited.

Drexel University is an AA/EOE.

EMORY UNIVERSITY
Mathematics

The Department of Mathematics and Computer Science has three openings in mathematics to begin September 1, 1988. The positions are at the level of tenure-track assistant professor, or higher, in the case of exceptional candidates. Applicants must have a Ph.D. in mathematics and a strong record (or promise) of research.

The following areas are of particular interest to us: geometric analysis, numerical analysis, combinatorics, and applied mathematics (differential equations). Applications will be considered, however, from candidates with strong research credentials in any area of mathematics.

The department presently has 20 permanent members comprising several active research groups. Our graduate program offers the Ph.D. in mathematics and master's degrees in mathematics and computer science. Teaching requirements are 6 hours per week, including graduate and undergraduate courses. Salaries are competitive, and commensurate with experience.

Send vita and names of three references to: Prof. Peter Winkler, Dept. of Mathematics and Computer Science, Emory University, Atlanta, GA 30322. Please have reference letters forwarded to us. Screening of applications will begin Feb. 1, 1988.

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THE UNIVERSITY OF ALABAMA
AT BIRMINGHAM
DEPARTMENT OF MATHEMATICS

The department of mathematics has faculty positions at all ranks. The department is especially interested in establishing a group in Numerical PDE/Scientific computation over the next five years. Access to the Alabama Super Computer (using a Sun Station and a T-1 line to a Cray X-MP/24) will be available in February, 1988. Other areas which will enhance our proposed Ph.D. in Applied Mathematics will be seriously considered. Applicants for senior positions must demonstrate excellence in research, while applicants for junior positions must exhibit the promise of excellence. Send as soon as possible a curriculum vitae, list of publications, a few selected reprints, and the names of three references to Search Committee, Department of Mathematics, University of Alabama at Birmingham, Birmingham, AL 35294. UAB is an Affirmative Action/Equal Opportunity Employer.

MILLSAPS COLLEGE
DEPARTMENT OF MATHEMATICS
JACKSON, MS 39210

Applications are invited for a tenure track position starting Fall 1988. Candidates must possess a Ph.D. in Mathematics and a dedication to quality teaching. Rank is open and salary will be competitive. Candidates from all areas of mathematics are encouraged to apply. Submit a letter of application, resume, and three letters of recommendation to Dr. Cecil E. Robinson, Jr., Chair, Department of Mathematics, Millsaps College, Jackson, MS 39210. Applications will, however, be considered until the position is filled. Millsaps College is an Equal Opportunity Employer and encourages applications from women and minorities.

UNIVERSITY OF LOUISVILLE
DEPARTMENT OF MATHEMATICS

UNIVERSITY OF LOUISVILLE, DEPARTMENT OF MATHEMATICS, LOUISVILLE, KY 40292. CHAIR. University of Louisville, Department of Mathematics, seeks an established mathematician to be Department Chair. Candidates should have active research program, substantial scholarly achievement, teaching and administrative experience and interest in both undergraduate and graduate program development. Ph.D. in mathematics required. Research areas compatible with those already in Department are desirable, but not required. Experience directing Ph.D. theses desirable, but not essential. Appointment will be at Associate Professor or Professor level, depending upon qualifications. Interested candidates should send letter of application, vita and at least three letters of recommendation to: Search Committee Chair, Department of Mathematics. Deadline for applications is January 4, 1988. AA/EOE.
**MACALESTER COLLEGE**

Two tenure-track positions in mathematics (subject to administrative approval), for September 1988. Candidates should have Ph.D. in mathematics and interest in teaching and research in four-year liberal arts college. Teaching load is 6-9 hrs/wk. Competitive salary, good benefits, urban residential location. Send resume and three references to John Schue, Math/Computer Science, Macalester College, St. Paul, MN 55105 by Feb. 1, 1988. Equal opportunity, affirmative action employer, women and minorities especially encouraged to apply.

**ILLINOIS WESLEYAN UNIVERSITY**

DEPARTMENT OF MATHEMATICS
BLOOMINGTON, IL 61702

Applications are invited for one or more tenure track positions at the rank of Assistant Professor starting the fall semester 1988. Candidates must possess a Ph.D. in mathematics, a dedication to quality teaching in an independent, liberal arts university, and active research interests. Preference may be given to individuals who have active professional interests in applied mathematics and either engineering or computer science. Candidates should submit a vita and three letters of recommendation to Melvyn W. Jeter, Head, Department of Mathematics, Illinois Wesleyan University, Bloomington, IL 61702. Equal Opportunity Employer.

**University of Missouri-Rolla**

Chair — Department of Mathematics and Statistics

The Department invites applications for the position of Department Chair, to begin September 1, 1988. The Rolla campus is one of four within the University of Missouri system, has an enrollment of about 5500, and emphasizes engineering and science. The Department has 22 faculty and offers bachelor, master, and doctoral programs in mathematics and statistics. Candidates should have a strong research record and a commitment to excellent teaching. The review of applications will begin October 1, 1987, and will continue until the position is filled. A vita and at least three references should be sent to Professor Glen Haddock, Department of Mathematics and Statistics, University of Missouri-Rolla, Rolla, MO 65401. Applications by minorities are encouraged. AA/EOE.

**Department of Mathematics**

UNIVERSITY OF KANSAS

Anticipate some instructorships beginning fall semester 1988, which are normally renewable for second and third year. Salary to be determined. Research interests should be in areas closely related to those of current staff. Ph.D. or dissertation accepted with only formalities to be completed. Send detailed resume and dissertation abstract; arrange for three letters of reference to be sent directly to C. J. Himmelberg, Chairman, Department of Mathematics, University of Kansas, Lawrence, KS 66045-2142. Deadline: December 1, 1987, then monthly until August 1, 1988. The University of Kansas is an Affirmative Action/Equal Opportunity Employer.

**ILLINOIS WESLEYAN UNIVERSITY**

DEPARTMENT OF MATHEMATICS
BLOOMINGTON, IL 61702

Applications are invited for tenure-track and temporary positions at all levels, commencing August 16, 1988 or as negotiated. Field is unrestricted but preference will be given to algebra, combinatorics and numerical analysis, and to areas meshing well with the department's needs. Require Ph.D., or Ph.D. dissertation accepted with only formalities to be completed. Application, detailed resume with description of research and three recommendation letters should be sent to C. J. Himmelberg, Chairman, Department of Mathematics, University of Kansas, Lawrence, KS 66045-2142.

Deadlines: December 1, 1987 for first consideration, then monthly until August 1, 1988. The University of Kansas is an AA/EOE.

**UNIVERSITY OF WYOMING**

Department of Mathematics

Invites applications for the following positions:

- A senior-level position in the area of computational mathematics. Candidates should have an outstanding record of accomplishment in an area of applied mathematics that makes significant use of high speed computers. The appointee will be expected to interact with our Center for Computational Mathematics and Mechanics and to provide leadership in the developing field of scientific computation.

- One or more tenure-track positions at the assistant professor level in the area of applied mathematics.

- One or more visiting positions at levels appropriate for the applicant.

Send resume and direct three letters of recommendation to:

Professor R. A. Mena
Chairman, Recruiting Committee
Mathematics Department
University of Wyoming
Laramie, WY 82071
307-766-4222

Applications completed by January 31, 1988 will be given first consideration. The University of Wyoming is an Equal Opportunity Employer.

**MILLS COLLEGE**

Department of Mathematics and Computer Science
Oakland, California 94613

Mills College is seeking outstanding candidates for a tenure-track position as Assistant, Associate or Full Professor of Mathematics commencing Fall 1988. Candidates must submit evidence of superior teaching and research abilities, and demonstrate a commitment to become involved in a highly innovative and energetic department. Rank and salary will depend on experience and qualifications. The initial contract will be for three years, subject to final administrative approval. Mills College is an Affirmative Action/Equal Opportunity Employer.

Send vita and direct three letters of reference to:

Professor Richard Bassein
Chair of the Mathematics Search Committee
Mills College
Oakland, CA 94613
Deadline for application: January 15, 1988

**MATHMATICS DEPARTMENT**

WILLAMETTE UNIVERSITY

SALEM, OR 97301

Two positions beginning Aug. 1988, one tenure-track and one a one-year sabbatical replacement. PhD in mathematics is required. Assistant Professorship preferred. Postmark a letter of application detailing commitment to teaching and scholarship and interest in the liberal arts, 3 letters of recommendation and graduate transcript by February 5, 1988 to: Steve Prothro, Chairman, Mathematics Department. Independent and coeducational, University has 1500 undergraduates, a College of Law and a Graduate School of Management. An Equal Opportunity Employer; women and minorities are encouraged to apply.
UCLA DEPARTMENT OF MATHEMATICS
REGULAR POSITIONS IN PURE MATHEMATICS

Four or five regular positions in pure mathematics. Specific fields of interest include algebra/number theory, analysis, differential equations, geometry/topology, logic, probability, and statistics. Very strong research and teaching background required. Positions initially budgeted at the assistant professor level. Sufficiently outstanding candidates at higher levels and/or in other fields will also be considered. Teaching load: Averaging 1.5-courses per Quarter, or 4.5 Quarter courses per year.

To apply, write to Theodore W. Gamelin, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555.

UCLA is an equal Opportunity/Affirmative action employer.

UCLA DEPARTMENT OF MATHEMATICS
REGULAR POSITIONS IN MATHEMATICAL COMPUTER SCIENCE

One or two positions in mathematical computer science. Preference will be given to candidates in analysis of algorithms, coding theory, computational complexity, and the theory of programming languages. Very strong research and teaching background required. Positions initially budgeted at the assistant professor level. Sufficiently outstanding candidates at higher levels and/or in other fields will also be considered. Teaching load: Averaging 1.5 courses per Quarter, or 4.5 Quarter courses per year.

To apply, write to Theodore W. Gamelin, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-155.

UCLA is an equal Opportunity/Affirmative action employer.

UNIVERSITY OF MASSACHUSETTS AT AMHERST
Dept. of Mathematics & Statistics

Applications are invited for several anticipated tenure-track positions at the rank of Assistant Professor, starting September 1, 1988. Exceptionally well qualified candidates may be considered for appointments at higher rank if funding permits. Candidates are expected to demonstrate strong research potential as well as a commitment to teaching at both undergraduate and graduate levels. Priority will be given to candidates whose research interests interact broadly with current areas of strength in the department, such as: algebraic geometry and number theory; applied mathematics and scientific computation; complex manifolds and Hodge Theory; differential geometry and global analysis; Lie groups and algebraic groups; probability and statistics. Salary commensurate with qualifications and experience. Submit curriculum vitae and have three letters of recommendation sent to: Hiring Committee, Dept. of Mathematics & Statistics, Lederle Graduate Research Tower, U. of Massachusetts, Amherst, MA 01003. For full consideration, applications should be complete by February 1, 1988. The University of Massachusetts is an Affirmative Action/Equal Opportunity Employer.

DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE
RUTGERS UNIVERSITY AT NEWARK

The Department of Mathematics and Computer Science anticipates several openings beginning September 1988. These include:

(i) One Full Professorship. Candidates should exhibit strong research accomplishments and be able to play a leadership role in the department. Salary and teaching load are negotiable.

(ii) One or two tenure track assistant or associate professorships. Assistant Professorships may possibly carry a Henry Rutgers Research Fellowship. Candidates should exhibit strong research accomplishments or potential. Salary and teaching load are negotiable.

(iii) One one-year visiting research lecturer at the rank of associate or full professor.

Applicants from all fields are invited. Areas of research interest in the department include number theory, representa-
Qualifications: A Ph.D. in an Applied Mathematics field or a Ph.D. in Mathematics with experience in Operations Research or Applied Statistics is required. Teaching and/or field experience preferred, but not required.

Send letter of application, resume, transcripts, and three letters of reference to Search Committee A, Department of Mathematics, Indiana University of Pennsylvania, Indiana, PA 15705. Review of applications will begin on January 10, 1988 and continue until the position is filled.

IUP is an affirmative action/equal opportunity employer.

THE GEORGE WASHINGTON UNIVERSITY DEPARTMENT OF MATHEMATICS


INQUIRIES SHOULD BE ADDRESSED TO THE DIRECTOR, ICASE, MAILSTOP 132C, NASA Langley Research Center, Hampton, Virginia 23665. AN EQUAL OPPORTUNITY EMPLOYER.

Inquiries should be addressed to the Director, ICASE, Mailstop 132C, NASA Langley Research Center, Hampton, Virginia 23665. An Equal Opportunity Employer.

WASHINGTO6 COLLEGE DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE CHESTERTOWN, MARYLAND 21620

Washington College announces a tenure track position at the assistant professor level. This is a teaching position, involving instruction throughout the normal undergraduate mathematics curriculum and some computer science. A Ph.D. is required, with experience in computer science desirable. Applicants should send a resume, transcripts, at least three letters of recommendation, and a letter of application including a brief essay on the role of mathematics in a liberal arts education to Dr. Albert W. Briggs, Jr. at the address above. Evaluation of candidates will begin on 4 January 1988 and continue until the position is filled. However, interviews will be conducted at the annual meeting in Atlanta. Washington College is an equal opportunity employer.

Inquiries should be addressed to the Director, ICASE, Mailstop 132C, NASA Langley Research Center, Hampton, Virginia 23665. An Equal Opportunity Employer.

I Institute for Computer Applications in Science and Engineering (ICASE). A limited number of visiting appointments are available for both junior- and senior-level researchers at the Institute for Computer Applications in Science and Engineering (ICASE) which is operated by the Universities Space Research Association. ICASE serves as a center for interaction between Langley Research Center staff and the academic community in the areas of applied and numerical mathematics, applied computer science, and development of mathematical models in a variety of application areas. Applications for partial support while on sabbatical leave are encouraged as are applications from Ph.D.'s for two-year renewable appointments. Inquiries should be addressed to the Director, ICASE, Mailstop 132C, NASA Langley Research Center, Hampton, Virginia 23665. An Equal Opportunity Employer.
WEST VIRGINIA UNIVERSITY
EBERLY FAMILY DISTINGUISHED PROFESSORSHIP
IN APPLIED MATHEMATICS

The Department of Mathematics invites applications and nominations for the Eberly Family Distinguished Professorship in Applied Mathematics.

The holder of the Eberly Professorship will provide academic leadership in the department's applied mathematics program.

The successful candidate must have outstanding scholarly accomplishments in applied mathematics, a record of funded research and a commitment to excellence in teaching.

Applications, nominations or requests for information should be directed to:
Dr. Alphonse Baartmans, Chair
Department of Mathematics
West Virginia University
Morgantown, WV 26506

The deadline for applications and nominations is January 15, 1988. The position will be available August 16, 1988. Candidates should submit a letter of application, a current vita and the names and addresses of five references. WVU is an Affirmative Action/Equal Opportunity employer.

WAKE FOREST UNIVERSITY
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

Applications are invited for a tenure-track position as assistant professor of mathematics, beginning August 1988. A Ph.D. is required. Send resume to Marcel Lus E. Waddill, Chairman, Department of Mathematics and Computer Science, Wake Forest University, Box 7311, Winston-Salem, North Carolina 27109. AA/EOE employer.

N.C. STATE UNIVERSITY
DEPARTMENT OF MATHEMATICS

Applications are invited for a junior level tenure track position in partial differential equations, beginning July 1, 1988.

Candidates should have a Ph.D. in Mathematics and a strong record or potential in research and instruction. Research interests may include numerical or analytical treatment of pde's. Specialists in hyperbolic equations are especially encouraged to apply.

Send a resume, reprints and three letters of recommendation to Professor M. Shearer, Search Committee Chairman, Box 8205, N.C. State University, Raleigh, NC 27695-8205.

N.C. State University is an Affirmative Action and Equal Opportunity Employer.

WEST VIRGINIA UNIVERSITY
DEPT. OF MATHEMATICS

The Department of Mathematics invites applications for anticipated tenure track positions at the Assistant/Associate Professor rank, beginning Fall 1988. Applicants must have a Ph.D. degree, a strong commitment to teaching and research. Fields of preference include numerical analysis, applied analysis, combinatorics, algebra. Preference will be given to applicants who can participate in the department's research program involving interdisciplinary ties.

Send vita and arrange for three letters of recommendation to be sent to:
Prof. Alphonse Baartmans, Chair/Dept. of Mathematics, West Virginia University, Morgantown, WV 26506. For information regarding these positions, please write or call (304) 293-2011. Review of applications will begin Jan. 15, 1988 and continue until the positions are filled. WVU is an AA/EOE employer.

N. C. STATE UNIVERSITY
DEPARTMENT OF MATHEMATICS

Beginning July 1, 1988, a junior level tenure track position will be available in mathematical physics/differential geometry. Candidates should have a Ph.D. in mathematics and a strong record or potential in both research and teaching.

Resumes, relevant reprints and preprints, thesis abstracts and three letters of reference should be sent to Professor A. C. Faustieroy, Search Committee Chairman, Box 8205, N. C. State University, Raleigh, NC 27695-8205.

N. C. State University is an Affirmative Action and Equal Opportunity Employer.

COLLEGE OF CHARLESTON
DEPARTMENT OF MATHEMATICS

Applications are invited for at least 3 full-time tenure-track positions at the Assistant Professor level beginning August 1988, at least one of which is in an applied area. 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 for those engaged in research.

The salary is competitive. Internal grants for release time or financial support for research projects are available as is travel support. 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 11, 1988, but applications will be considered until the positions are filled. The College of Charleston is an Affirmative Action/Equal Opportunity Employer.

CHAIR
DEPARTMENT OF MATHEMATICS
AND STATISTICS

Description of Position: The Department of Mathematics and Statistics at Miami University is seeking a department chair at the rank of full professor for a five-year renewable term beginning July 1, 1988. The department has 44 faculty on the Oxford Campus, 10 faculty at two regional campuses in Hamilton and Middletown and 30 graduate students at the Master's level.

Candidates qualifications include a strong commitment to quality undergraduate education, continuous significant published research, national distinction, and demonstrated administrative competence. Salary will be commensurate with qualifications and experience.

Application Deadline: All credentials, including applications and at least three letters of reference, should be received no later than December 30, 1987. Minority candidates are encouraged to apply. Equal opportunity in education and employment M/F/H. Inquiries and nominations are welcome. Please address all correspondence to:
Dr. Robert Sherman, Chair
Mathematics & Statistics Chair Search Committee
College of Arts and Science
Miami University, Oxford, OH 4505
THE UNIVERSITY OF ALABAMA MATH FACULTY POSITIONS

Two positions are available beginning August 16, 1988 probably at the rank of assistant professor, but possibly at higher rank. Applicants should have or reasonably expect to have by August 16, a Ph.D. or the equivalent. Excellence in both teaching and research is required. Applications are invited both for tenure track and visiting positions. Each position may be filled either way. Women and minorities are particularly encouraged to apply. A curriculum vitae, reprints and/or preprints, and at least three letters of recommendation should be sent to: Search Committee, Box 1416, Tuscaloosa, AL 35487-1416. THE UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

AUBURN UNIVERSITY, AL 36849-3501
DIVISION OF MATHEMATICS FOUNDATIONS, ANALYSIS AND TOPOLOGY

One tenure-track appointment in Analysis at the level of Assistant Professor is expected for Fall 1988. We hope to hire someone in Partial Differential Equations but will also consider other applicants. At least one visiting appointment is also expected in an area compatible with faculty interest. Minorities and women are urged to apply. Send vita and have 3 letters of reference sent to George Kozlowski, Head, Department of Foundations, Analysis, and Topology.

AUBURN UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

KENYON COLLEGE MATHEMATICS DEPARTMENT GAMBIER, OH 43022

Two tenure-track positions starting 88-89. One Asst. Prof. or beginning Assoc. Prof., other Asst. Prof. Must have PhD by 8/88. Must have broad background in math. For one position, preference for candidates in prob/stats. Some background in CS or numerical analysis or combinatorics or modeling is an asset. Strong commitment to undergrad teaching is required. Teach 3 courses per sem. Write or call for more information promptly. Write to Stephen Slack at the above address or call (614)427-5267. Candidates will be considered until the position is filled. Kenyon will have representatives at the Jan. AMS/MAA meeting in Atlanta. Kenyon is an EOE and encourages applications from women and minority candidates.

LOYOLA UNIVERSITY DEPARTMENT OF MATHEMATICAL SCIENCES

The Department of Mathematical Sciences anticipates at least one tenure track position and several one year positions beginning in August, 1988. Requirements are the Ph.D., an active research program in any area, and a commitment to quality teaching; preference will be given to individuals interested in participating in our computer science and/or statistics program. Visitors interested in working with department faculty may apply for at least one of the temporary positions. Interviews will begin in January and continue until all positions are filled. Send detailed C.V. and three letters of recommendation to:

Professor R. J. Lucas
Department of Mathematical Sciences
Loyola University of Chicago
Chicago, IL 60626
Loyola University of Chicago is an Equal Opportunity/Affirmative Action Employer.

NORTHWESTERN UNIVERSITY MATHEMATICS DEPARTMENT

The Mathematics Department invites application for tenure or tenure track positions at all levels from mathematicians with strong research interests. A very substantial research record and the ability to provide scientific leadership is required for a tenured appointment. Preference will be given to those areas which complement the present department strengths. Applications should include a Curriculum Vitae (including a list of publications) and the applicant should have three reference letters sent to the Chairman, Personnel Committee, Department of Mathematics, Northwestern University, Evanston, IL 60208.

Northwestern University is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF ILLINOIS AT CHICAGO MATHEMATICS AND COMPUTER EDUCATION

The Department of Mathematics, Statistics, and Computer Science invites applications for tenure-track or tenured positions in Mathematics and Computer Science Education.

The Department offers the stimulating environment of a highly rated mathematics department coupled with a strong commitment to the improvement of pre-college education. Current programs in mathematics education include: two major N.S.F. grants for elementary school math and science curriculum development and implementation; private and state grants to support primary and secondary teacher enhancement programs; undergraduate and graduate programs for the certification of elementary and secondary teachers; M.S.T. and D.A. degree programs; and extensive program of continuing education for teachers. The state has provided funding to expand and improve these activities and to support research in the teaching and learning of mathematics.

Applicants must have a Ph.D. or a D.A. in Mathematics, Mathematics Education, Computer Science, or related field; an outstanding research and publication record;
experience in undergraduate and graduate teaching; and previous involvement with teacher education programs. Candidates with experience and interest in working directly with teachers and schools will be given preference.

Applications are also invited for visiting positions for 1 or more quarters. Send vita and direct 3 letters of reference to Chair, Search Committee, Dept. of Mathematics, Statistics, and Computer Science, Univ. of Illinois at Chicago, Box 4348, Chicago, IL 60680. UIC is an affirmative action/equal opportunity employer.

NORTHEASTERN UNIVERSITY
Department of Mathematics

Applications are invited for position of Assistant or Associate Professor and one Post-Doctoral Lectureship. A Ph.D. is required, and priority will be given to candidates with strong records of scholarship and excellence in teaching. Particular needs of the department are in Statistics and Applied Mathematics. All positions start Fall 1988. Please send resume and 3 letters of references to: Hiring Committee Chairman, Department of Mathematics, Northeastern University, Boston, MA 02115. Northeastern is an Equal Opportunity/Affirmative Action Employer.

OKLAHOMA STATE UNIVERSITY
DEPARTMENT OF MATHEMATICS

Several tenured, tenure-track and visiting positions at all professorial ranks are anticipated for Fall, 1988. All areas are currently under consideration, but we especially encourage applications in Algebraic Geometry, Complex/Harmonic Analysis, Lie Groups and Representation Theory, Numerical Analysis and Partial Differential Equations.

Minimum qualifications are a Ph.D. in Mathematics, evidence of research achievement or potential, and a commitment to teaching. Post-doctoral experience is desirable. Normal duties include research and at most six hours teaching per semester. For full consideration, send a resume and arrange to have three confidential letters of reference sent by January 15, 1988 to A. Ghosh, Appointments Committee Chairman, Department of Mathematics, Oklahoma State University, Stillwater, OK 74078-0613. O.S.U. is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

Southern Methodist University
Department of Mathematics

Applications are invited for two positions beginning fall semester 1988, one at the full professor level. For the professorship, all distinguished researchers in applied mathematics will be considered, but the department has particular interest in the study of areas such as fluid dynamics, shocks, solitons, chaotic dynamics, and inverse scattering. Supervision of doctoral dissertations and a successful grant record are desirable.

We anticipate making the second appointment a tenure-track assistant professor. However, applicants with qualifications for a higher rank will be considered. Candidates should have an outstanding research record or superior potential. Preference will be given to candidates who can contribute to our Ph.D. program in Applied Mathematics, Numerical Analysis, and Scientific Computation.

Our growing faculty now include ten active applied mathematicians doing research in areas such as mathematical modeling, nonlinear wave phenomena, perturbation methods, computational fluid dynamics, parameter estimation, numerical bifurcation, and mathematical software for differential equations. The teaching load for both positions is two courses (six hours) per semester. A commitment to excellence in teaching is expected.

Review of applications will begin October 1, 1987 (full professor) and January 15, 1988 (assistant professor), and will continue until the positions are filled. Applicants should send a vita (and, for the junior position, three letters of recommendation) to Richard Haberman, Chairman, Department of Mathematics, Southern Methodist University, Dallas, TX 75275, or call him at (214) 692-2506.

The University is an Equal Opportunity/Affirmative Action/Title IX employer.

DEPARTMENT OF MATHEMATICS
The University of Texas at Austin
Austin, Texas 78712

A number of appointments are expected for Fall 1988 at the Instructor level (customarily new Ph.D.'s) and the Assistant Professor level (customarily at least two years experience beyond the Ph.D.). Candidates should have strong research credentials. Salaries will be competitive. Applicants should send vita, detailed summary of research interests, and at least three letters of recommendation to the Recruiting Commit-
UNIVERSITY OF ARIZONA
DEPARTMENT OF MATHEMATICS
TUCSON, ARIZONA 85721

The Mathematics Department at the University of Arizona is happy to announce several postdoctoral fellowships (Research Associate) which will be available beginning August '88. Applicants with areas of strength in applied mathematics, computational science and nonlinear optics may qualify for special Center of Excellence Awards. Only candidates with outstanding research records or potential should apply. Applications received by February 1, 1988 will be considered first, if suitable candidates are not found then late applications will be reviewed. Send applications (please include Social Security number if possible) to Department Head, Department of Mathematics. The University of Arizona is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA,
MATHEMATICS DEPARTMENT
SANTA BARBARA, CA 93106

Special Visiting Assistant Professorships 1988-89. Four one-year positions involving research, with possibility of a second year, a teaching load of 5 one-quarter courses with an approximate salary of $32,600. Candidates must have Ph.D. degree by June 30, 1988. Successful candidates must have a strong promise in mathematical research and superior teaching ability. Applicants should send vitae and publication lists, and arrange for three letters of recommendation to be sent to: Professor Alex Rosenberg, Chair, at above address. Applications must be received by January 30, 1988. UCSB is an Affirmative Action/Equal Opportunity 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).

DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE
UNIVERSITY OF MIAMI

One or two tenure-track positions in Mathematics are anticipated beginning January or August, 1988. Ranks and salaries are open, commensurate upon qualifications of the applicants. Candidate must have the Ph.D. degree and excellent research record, or a definite research potential, with a strong commitment to teaching and research. Applicants should send vitae and three letters of reference to: Shair Ahmad, Chairman, Department of Mathematics & Computer Science, University of Miami, P. O. Box 249085, Coral Gables, Florida 33124. The University of Miami is an EO/AA Employer.

UNIVERSITY OF SOUTHERN CALIFORNIA
Department of Mathematics
Los Angeles, CA 90089-1113

Applications are invited for several tenure-track Assistant Professorships, beginning September 1988, and for possible tenured positions at the ranks of Professor and Associate Professor. Visiting Professorships and Visiting Associate Professorships will also be available.

Assistant Professors are expected to teach two courses per semester, and must show strong research promise. Applicants for senior positions should have an outstanding record of research and scholarly achievement.

Applications should be addressed to: Chairman, Search Committee, Department of Mathematics - DRB 306, University of Southern California, Los Angeles, CA 90089-1113.

U.S.C. is an Equal Opportunity/Affirmative Action employer.

NORTHERN ARIZONA UNIVERSITY
DEPARTMENT OF MATHEMATICS
BOX 5717, FLAGSTAFF, AZ 86011

Assistant or Associate Professor starting 8/88. Tenure track position in statistics, combinatorial algebra or geometry, or qualitative theory of differential equations. Qualifications include Ph.D., evidence of teaching effectiveness and potential for an active mathematical research program.

Send resume, three letters of recommendation to: Screening Committee, Department of Mathematics, Box 5717, Northern Arizona University, Flagstaff, AZ 86011. The search will remain open until the position is filled; however, the screening committee will begin reviewing applications on 1/15/88. NAU is an Equal Opportunity/ Affirmative Action Institution. Women and minorities are encouraged to apply.

UNIVERSITY OF CALIFORNIA,
IRVINE, CALIFORNIA 92717

Applications for a tenured position in Differential Geometry opening in 1988 are invited:

Candidates for this position must have a Ph.D. and a research record. Duties include research, undergraduate and graduate teaching. Send applications, curriculum vitae, work in print or in preparation, and three names of references to: Professor Abel Klein, Chairman of the Recruitment Committee, Department of Mathematics, University of California, Irvine, CA 92717.

University of Toronto
Department of Mathematics

Applications are invited for a tenure-stream position in Applied Mathematics at the level of Assistant Professor. This position is subject to final budgetary approval and is to begin July 1, 1988. The University of Toronto encourages both men and women to apply.

Candidates must have a Ph.D. and demonstrate clear strength in both research and teaching. Priority will be given to candidates of exceptional promise working on fundamental problems in their field.

Applicants should send their complete curriculum vitae, together with a list of publications and arrange to have at least three recent letters of reference sent directly to:

Professor D. R. Masson
Associate Chairman
Department of Mathematics
University of Toronto
Toronto, Canada M5S 1A1

To insure full consideration, applications and letters of reference should be received before February 1, 1988.

ARIZONA STATE UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for tenured-track positions at all ranks and in all areas of mathematics beginning in August of 1988. All tenure-faculty positions require an earned doctorate and involve teaching, research, and service responsibilities commensurate with the policy of the Arizona Board of Regents which calls for Arizona State University to "continue development as a major research university" and "to become competitive with the best public universities in the nation". Visiting faculty appointments will be considered for candidates whose research interests support and reinforce the research activities of the regular faculty. Faculty Associate positions are available for candidates who hold at least a Masters Degree in Mathematics or a related field and have an outstanding record in teaching.

Over the next five year period, the Department of Mathematics will embark on a major development program which will result in a substantial increase in both the size of the department and the quality of its research and instructional programs. Through this development process, the department intends to build nationally recognized research groups of four to seven faculty members in targeted areas: Computational Mathematics, Differential Equations (including PDE's), Discrete Mathematics, Dynamical Systems, Operator Theory, and Systems and Control. Outstanding candidates in other areas of specialization including both pure and applied disciplines will also be considered when such an appointment reinforces existing strengths in the Department.

We anticipate that the majority of the tenure-track appointments will be made at the Assistant Professor level. For such an appointment, a candidate must have demonstrated potential for outstanding research while providing effective teaching at both the undergraduate and graduate level in a public university environment. For candidates at the Associate Professor level, additional requirements include a proven record of outstanding research accomplishments and versatile and effective teaching. At the Full Professor level, applicants should be recognized nationally for the quality and scope of their scholarly research and their leadership activities in their area of specialization. Salaries are competitive and commensurate with experience and qualifications.

Arizona State University has over 42,000 students and is located in the rapidly growing Phoenix Metropolitan area — a center of business, finance, and high technology. The valley offers a wide range of educational, cultural and recreational opportunities. Pleasant and convenient housing is widely available near the university campus.

Applications should be received by January 15, 1988. This deadline will be extended if all available positions are not filled. The Department will begin to review applications on January 1, 1988.

Applications should send their resume and arrange for at least three letters of recommendation to be sent to: William T. Trotter, Chair, Department of Mathematics, Arizona State University, Tempe, AZ 85287.

Arizona State University is an Equal Opportunity/Affirmative Action Employer and does not discriminate on the basis of sex, race, religion, color, national origin, age, disabled or Vietnam-era veterans status, or disability in its admission, employment or educational programs or activities. Women and minorities are encouraged to apply.

SOUTHERN ILLINOIS UNIVERSITY
AT EDWARDVILLE
Chair, Mathematics and Statistics

Applications and nominations are invited for the position of Chair of the Department of Mathematics and Statistics. Applicants should have a doctorate in Mathematics or Statistics, a record of successful teaching, research, and other creative activities. The Department of Mathematics and Statistics is part of the School of Sciences, which includes departments of biology, chemistry, physics, and computer science. The Department of Mathematics and Statistics has experienced rapid growth in the past 5 years, with the number of students increasing from approximately 1,000 to over 3,000. The Department has 27 full-time faculty members, 90 undergraduate majors and 45 master's candidates.

The University occupies a beautiful 2,600 acre campus in the St. Louis metropolitan area. Current enrollment is approximately 10,000 students, the majority of whom are residents of the area.

Initial screening of candidates will begin February 1, 1988, and continue until the position is filled. The earliest appointment date is September 1, 1988. Rank and salary will be commensurate with qualifications and experience. Send nominations and letters of application to Chair Search Committee, Department of Mathematics and Statistics, Southern Illinois University at Edwardsville, Edwardsville, IL 62026-1653. SIUE is an Affirmative Action, Equal Opportunity Employer.

The Calvin College Department of Mathematics and Computer Science will have tenure track openings and temporary openings for the 1988-89 academic year. Applicants in Mathematics, Mathematics Education, Computer Science, and Mathematical Statistics are encouraged to apply. The department currently has 18 full-time faculty positions and nearly 100 majors at the junior-senior level. Calvin College is a Christian liberal arts college, and each faculty member is expected to demonstrate a
Reformed and Christian perspective in her teaching. To apply, contact Professor R. H. Jager, Chairman, Dept. of Mathematics and Computer Science, Calvin College, Grand Rapids, MI 49506. Calvin College is an equal opportunity, affirmative action employer.

ILLINOIS STATE UNIVERSITY

Department of Mathematics

Illinois State University has two tenure track positions in mathematics. Applicants should have a Ph.D. by August 1988; a research interest in the areas of analysis, graph theory, or algebra; and a strong research record or research potential. Candidates should also have sufficient background to teach undergraduate mathematics in a variety of areas. To ensure consideration send vita, three letters of recommendation and official transcripts by February 1 to: Dr. Jane M. Swafford, Department of Mathematics, Illinois State University, Normal, IL 61761. State law mandates demonstrable oral proficiency in the English language as a requirement for this position. AA/EOE Employer.

The Ohio State University

Department of Mathematics

Nominations and applications are invited for a Chair in Numerical Analysis and Scientific Computation. This position is funded in part by the Eminent Scholar program of the State of Ohio and includes the appointment as Professor in the Department of Mathematics. It has been created to attract an internationally recognized scholar with a distinguished record of research and teaching.

The person filling this position must have strong and broad interests impacting pure, applied, and computational mathematics. He or she will be expected to provide leadership for the research programs in applied mathematics. The University has committed substantial resources to the support of research activities of the Eminent Scholar, including access to a CRAY X-MP on campus.

Nominations, applications and requests for further information should be sent to:

Joseph Ferrar, Chairman
Department of Mathematics
The Ohio State University
231 W. 18th Avenue
Columbus, Ohio 43210
Telephone: (614) 292-7173
The Ohio State University is an Equal Opportunity/Affirmative Action Employer.

Department of Mathematics and Statistics
University of Nebraska-Lincoln
Lincoln, NE 68588-0323

Tenure-track positions at the Assistant Professor level available Fall 1988. Ph.D. required along with strong potential for research and quality teaching. Priority will be given to candidates whose research interests interface well with the research strengths in the department. Send vita and three letters of recommendation to Prof. Sylvia Wiegand, Chair of Search Committee, by January 25, 1988, or later if positions are not filled. AA/EOE. Women and minorities are especially encouraged to apply.

RUTGERS UNIVERSITY

DEPARTMENT OF MATHEMATICAL SCIENCES
CAMDEN, NEW JERSEY 08102

Attractive position at the assistant professor level (Tenure Track) starting July 1, 1988. Candidate must have exceptional teaching and research credentials as to qualify for a Henry Rutgers Research Fellowship. The Fellowship allows for a very attractive salary package and teaching load. The Rutgers University Campus in Camden is just across the river from center city Philadelphia, and the general location affords a healthy research environment.

Exceptional candidates only please apply. U.S. permanent residency required. Send resume to Dr. G. A. Artico, Chairman. Rutgers University is an equal opportunity employer.

UNIVERSITY OF SOUTH FLORIDA
Department of Mathematics

Tenure-track teaching and research positions are available beginning August 1988. Applicants must possess a Ph.D. degree. Applicants specializing in Approximation Theory, Discrete Mathematics (Algebra, Theoretical Computer Science), Numerical Analysis, Probability, and Statistics are preferred but other outstanding candidates will be considered. Rank and salary will depend on credentials. To apply send curriculum vitae and have three letters of recommendation sent to Kenneth L. Pothoven, Chairman, Tampa, FL 33620-5700. Application Deadline: February 10, 1988. The University of South Florida is an equal opportunity employer.

OCCIDENTAL COLLEGE

The Department of Mathematics invites applications for one or two regular positions beginning September 1988. Ph.D. in Mathematical Sciences required. One position is for an entry level assistant professor with expertise in computer science. Candidates expected to demonstrate excellence in teaching and active research interests. Other position open. Occidental is a liberal arts college offering A.B. in mathematics with optional computer science emphasis. Two courses per term (8-9 hours). Occidental actively supports affirmative action; applications from ethnic minorities and women strongly encouraged. Interviews at AMS meeting in Atlanta, January 1988. Send vita and three letters of reference (one on teaching) to Nalsey Tinberg, Dept. of Mathematics, Occidental College, Los Angeles, CA 90041, by March 1, 1988.

DEPARTMENT OF MATHEMATICS
KANSAS STATE UNIVERSITY

Subject to budgetary approval, applications are invited for a tenure-track position at the assistant professorship level commencing August 18, 1988. All fields will be considered, but preference will be given to candidates in Harmonic 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. Applications, detailed resume with description of research and three letters of recommendation should be sent to: Louis Pigno, Head Department of Mathematics Cardwell Hall 137 Kansas State University Manhattan, KS 66506 Deadline: February 1, 1988. AA/EOE.
Opportunity/Affirmative Action

THE UNIVERSITY OF MISSOURI
ST. LOUIS

Applications are invited for a tenure-track assistant professorship in statistics. Qualifications include a Ph.D. degree, evidence of good teaching skills, and strong research potential. The primary duties of the position are teaching and conducting a high quality research program in statistics. The current teaching load is two courses per semester. The ability to teach one or more computer science courses would be advantageous to a candidate. Send resume and at least three letters of reference to Grant Welland, Chairman of the Search Committee, Department of Mathematics and Computer Science, University of Missouri-St. Louis, 8001 Natural Bridge Road, St. Louis, Missouri 63121-4499. The University of Missouri-St. Louis is an Equal Opportunity/Affirmative Action Employer.

THE UNIVERSITY OF MISSOURI
ST. LOUIS

The Department of Mathematics and Computer Science seeks applicants for two, possibly three tenure-track positions in computer science beginning in Fall 1988. It is our intention to fill these positions with people having overlapping research interests that are also shared by one or more members of our present faculty. Areas that are presently under consideration are Algorithms and Complexity, Database Design, Numerical Analysis, and Denotational Semantics of Programming Languages.

Applicants who have an active interest in both teaching and research are encouraged to apply. Please send all applications, resumes and letters of reference to Jerrol Siegel, Chairman, Department of Mathematics and Computer Science, University of Missouri-St. Louis, 8001 Natural Bridge Road, St. Louis, Missouri 63121-4499. The University of Missouri-St. Louis is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF MISSOURI
ST. LOUIS

The Department of Mathematics is housed in the College of Engineering and offers both undergraduate and graduate degrees in computer science. Active research areas in the department include artificial intelligence, computer architecture, computer vision/robotics, database systems, data communication, theoretical CS, VLSI design. On-campus Ph.D. level research and study are available through cooperation with other participating institutions of the Microelectronics Center of N.C. (MCNC). A wide variety of excellent computing facilities including IBM, VAX, Burroughs, Harris, Xerox, Sun, and others are available to support educational and research activities. Also, as a participant in MCNC, UNCC has access to state-of-the-art computing, VLSI design, and fabrication facilities. Charlotte is the largest city in the Carolinas with excellent housing, good schools and mild climate.

Vita, transcript and four letters of reference should be sent to Chairperson, Faculty Search Committee, Department of Computer Science, The University of North Carolina at Charlotte, Charlotte, NC 28223. UNCC IS AN EOE/AA EMPLOYER.

Several tenure-track positions at all levels will be available beginning September 1988. Applicants showing significant research accomplishments or exceptional research promise, as well as evidence of good teaching ability, are invited to apply. Initial tenure-track appointment is for four years. There is no restriction as to field. In addition to a curriculum vitae, candidates should send a summary of research plans, available preprints or reprints, and have at least three reference letters sent to:

Samuel Gitler, Chairman
Mathematics Department
University of Rochester
Rochester, New York 14627

An equal opportunity/affirmative action employer.

UNIVERSITY OF VICTORIA
DEPARTMENT OF MATHEMATICS

The Department of Mathematics invites applications for a position at the Professor or Associate Professor rank beginning in the Fall of 1988. Applicants will be expected to have an outstanding record of research and extensive experience in undergraduate and graduate teaching. Preference will be given to applicants who can provide direction to research programs in the department in one or more of the areas of applied mathematics and differential equations, discrete mathematics, or functional analysis.

Canadian immigration regulations require the University to assess applications from Canadian citizens and permanent residents of Canada before assessing applications from other persons. The University of Victoria offers equal employment opportunities to qualified male and female applicants. Women are particularly encouraged to apply.

Applicants should send a curriculum vitae and the names of four references to Dr. C. R. Miers, Chairman, Department of Mathematics, University of Victoria, Victoria, British Columbia, Canada, V8W 2Y2. The closing date for applications is February 15, 1988.

ST. MARY’S COLLEGE OF CALIFORNIA
Department of Mathematical Sciences
Moraga, CA 94575

Two tenure-track assistant professorships beginning fall 1988. A Ph.D. and a commitment to both liberal arts education and continued research are expected of candidates to join a young and growing department. For 1 of the 2 positions, preference will be given to candidates with computer science expertise. St. Mary’s is a coeducational college of about 3300 students, located 10 miles east of Berkeley. Current salary range is $26,234-$31,223.

Send resume and 3 letters of recommendation, at least 1 of which must speak to teaching ability, to J. R. Sangwine-Yager, Chair, Dept. of Mathematical Sciences, P.O. Box 517, St. Mary’s College, Moraga, CA 94575. Deadline, February 5, 1988. Interviews will be held at the AMS meeting in Atlanta, GA, January 1988. An EO/AA employer.
The Mathematics Department has an opening at the senior level. Candidates must show evidence of continuing research, which should include recent publications. Strong undergraduate teaching and some administrative experience is preferred. Salary is dependent upon qualifications and will be competitive. Applications should include a vita and names and addresses of at least three references. Applications should be made by December 15, 1987 To: Dr. B. G. Hodges, Chair, Department of Mathematics, Winthrop College, Rock Hill, SC 29733.

Winthrop College is an affirmative action/equal opportunity employer.

**SUNY COLLEGE AT BROCKPORT**

Tenure-track assistant professorship in Mathematics available September 1988. Applicants should have a Ph.D. in Mathematics with expertise in Discrete Math, Probability, Statistics, Applied Mathematics, or Operations Research, and a strong commitment to teaching of Mathematics at the Undergraduate and Masters' level. For details, contact Dr. K. Nakano, Chairperson, Department of Mathematics/Computer Science (phone: 716-395-2194). To apply, send a letter of application and resume, and have three letters of reference sent by January 15, 1988 to the Office of Faculty/Staff Relations, SUNY College at Brockport, Brockport, NY 14420. EO/AAE

**QUEEN MARY COLLEGE**

**UNIVERSITY OF LONDON**

**LECTURESHIP IN PURE MATHEMATICS**

Applications are invited for a permanent lectureship in pure mathematics, to be taken up on 1st October 1988.

The College’s research interests in pure mathematics centre on algebra, especially algebraic and matrix groups, homological algebra and representation theory, including integral representations. It is hoped by appointment to strengthen the research base in representation theory, particularly as it relates to arithmetic and topology. But this is not a restriction and candidates in related areas are encouraged to apply.

Salary either on Lecturer Scale A, £9,260−£14,500, or Scale B £15,105−£19,130, depending on age and experience, plus London allowance of £1,393. For further particulars and applications forms contact Prof. I. W. Roxburgh, Head, School of Mathematical Sciences, Queen Mary College, Mile End Road, London E1 4NS. Completed application forms, together with Curriculum vitae, publications list, the names of 3 referees and a description of research interests to reach QMC by 15th December, 1987.

**ROLLINS COLLEGE**

**DEPT. OF MATHEMATICAL SCIENCES**

Winter Park, FL 32789

One tenure track position, preferably at the Assistant Professor level, is available for Sept. 1988. The area of specialization is open, but a doctorate, strong commitment to teaching undergraduates and continued professional activity are required. The Department offers majors in mathematics and computer science and an ability to teach in both areas is viewed as a plus. The Department also has a strong interest in the instructional use of computers, particularly computer algebra systems. 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 insure full consideration, applications must be complete by 15 Feb. 1988. Send resume, transcripts and 3 letters of recommendation (at least one of which must comment on teaching) to: David Kurtz, Chair. Please indicate availability for interviews at the AMS-MAA meetings in Atlanta. Rollins is committed to equal opportunity/affirmative action.

**USC-COASTAL CAROLINA COLLEGE**

**DEPARTMENT OF MATHEMATICS**

Coastal Carolina College is seeking a person committed to excellence in classroom instruction, sensitivity to student needs and program development. Ph.D. in Mathematics required; teaching experience and Statistical background preferred. Tenure track position at rank of Assistant or Associate Professor available Fall, 1988. Salary competitive and negotiable. Coastal Carolina College is the fastest growing 4-year regional campus of the University of South Carolina and is located 9 miles west of Myrtle Beach. Send curriculum vitae and names and addresses of references to:

Dr. Subhash Saxena, Chairperson
Department of Mathematics
USC-Coastal Carolina College
P.O. Box 1954
Conway, South Carolina 29526

Screening of applications will begin on February 1, 1988, and will continue until position is filled. An Affirmative Action/Equal Opportunity Employer. Applications from women and minorities are especially encouraged.

**STOCKTON STATE COLLEGE**

Tenure-track position in mathematics is available for Jan. or Sept. 1988 at Assistant Professor or Instructor level. Ph.D. required for Assistant Professorship ($26,437−$30,404). A.B.D. required for Instructorship ($21,749−$25,010). We seek an excellent, versatile teacher to be part of a strong, ten-person mathematics department in a young, liberal arts college in rural South Jersey. Area of specialty open, but interest in computer science a plus. Screening will begin on Dec. 1, 1987. Send resume and three letters of reference to Dr. Donald Plank, Chairman, Division of Natural Sciences and Mathematics; Stockton State College; Pomona, NJ 08240. Stockton is an AA/EO Employer. Women and minorities are encouraged to apply.

**FURMAN UNIVERSITY**

Greenville, SC 29609

Two tenure track positions in mathematics beginning September 1988. A Ph.D. in a mathematical science or mathematics education is required. Excellence in teaching and continued scholarly activity are expected. Rank and salary will be based on qualifications. All areas of specialization are
acceptable. Individuals with expertise in mathematics education are encouraged to apply for one of the positions. Vita, graduate and undergraduate transcripts, and three letters of recommendation should be sent to Dr. Robert Fray, Department of Mathematics. Application deadline: February 1, 1988.

WESTERN WASHINGTON UNIVERSITY
Department of Mathematics

Applications are invited for tenure-track and visiting positions to begin Fall 1988. A Ph.D. in Mathematics is required.

Candidates are especially sought in: (1) Ordinary or Partial Differential Equations. Linear differential equations and spectral theory preferred. (2) Mathematics Education. Responsibilities will include teaching upper division mathematics courses, mathematics methods courses, and the development of an active in-service program. Elementary teaching experience preferred.

Rank and salary are open, but a substantial research record will be required for appointments above the Assistant Professor level. The normal teaching load for research faculty is two courses per quarter.

Western Washington University is located on Bellingham Bay in an area of outstanding natural beauty within an hour’s drive of the Seattle and Vancouver, B.C. metropolitan areas and the Cascade Mountains. The department has a strong undergraduate program with a somewhat applied flavor and a flourishing Master’s program with more than twenty students.

Applications should be sent to Professor Thomas T. Read, Chairman, Department of Mathematics, Western Washington University, Bellingham, WA 98225.

Interested candidates should submit a letter of application, complete transcripts, a vita, and three letters of recommendation. Deadline for applications is February 1, 1988; later applications will be considered if positions remain available. Positions are subject to the continuing availability of funds. The University is an EO/AA employer.

WESLEYAN UNIVERSITY
DEPARTMENT OF MATHEMATICS

Tenure-track assistant professorship, with initial appointment for four years beginning academic year 1988-89. Preferred specialty is algebra, including algebraic geometry, group theory and algebraic number theory; outstanding applicants from all fields welcome. Six hours teaching weekly, in undergraduate and graduate programs. Candidates should have a serious interest in teaching and an ongoing research program. Send vita and three letters of recommendation to: Search Committee, Department of Mathematics, Wesleyan University, Middletown, CT 06457 by January 31, 1988. Wesleyan University is an Equal Opportunity Affirmative Action Employer.

CHAIR
DEPARTMENT OF MATHEMATICS
COLBY COLLEGE

Colby College invites nominations and applications for the Carter Professor of Mathematics and Chair of the Mathematics Department. Appointment begins September 1, 1988. A Ph.D. in one of the mathematical sciences is required. Desirable qualifications include a distinguished record as a teacher and scholar, demonstrated departmental and college leadership, including the ability to nurture faculty development and research programs, and commitment to the liberal arts and undergraduate mathematics education. Salary and rank commensurate with qualifications and experience.

Colby is a highly selective, residential liberal arts college of 1700 students and 140 faculty members. The Mathematics Department, including computer science and statistics, has 9 FTEs.

Search and selection procedures will be closed when a sufficient number of qualified candidates have been identified, but not earlier than January 15, 1988. Please forward Applications (including letter of application, resume, list of references, and nominations to H. T. Hayslett Jr., Chair, Mathematics Department, Colby College, Waterville ME 04901.

Colby is an AA/EO employer and specifically encourages applications from minorities and women.

NEW COLLEGE, UNIVERSITY OF SOUTH FLORIDA, LEONARD S. FLORESHEIM CHAIR IN THE LIBERAL ARTS AND SCIENCES beginning August 1988. Qualifications: national reputation in a liberal arts/sciences discipline; concerns across several fields; outstanding teaching record. Duties: excellent teaching, general contribution to the intellectual life of a small, highly selective honors college; involving gifted undergraduates in research. Salary, research support, travel provided by a million dollar endowment. Send nominations, applications and three recommendations before 1/15/88 to Prof. L. Deme, Chair, Florsheim Search Committee, c/o Provost’s Office, New College, University of South Florida, Sarasota, FL 34243. Equal Opportunity/Affirmative Action.

THE UNIVERSITY OF CALIFORNIA
Department of Mathematics
and Computer Sciences

Applications are invited for one or more Visiting Professorships beginning in September 1988. Positions are funded in the Assistant Professorship salary range and have a maximum duration of two years. Candidates possessing the Ph.D. and significant accomplishments or high potential in both teaching and research are sought. No restriction as to area of specialization in Mathematics or Computer Science. Minority and women candidates are particularly urged to apply.

Applicants should send a curriculum vitae and see that at least three letters of recommendation are sent to:

Chair
Computer Science Search Committee
Department of Mathematics and Computer Science
University of California
Riverside, CA 92521
University of California, Riverside, is an Affirmative Action/Equal Opportunity Employer.

THE UNIVERSITY OF CALIFORNIA
Department of Mathematics
and Computer Science

Applications are invited for a tenure-track or tenure position in Computer Science beginning Fall 1988. Candidates must have demonstrated excellence in research and teaching. Research specialties in all areas of Computer Science will be considered but we are particularly interested in research areas in Computer Systems and Computer Methodology and Applications.

The position is open as to the level of appointment.

Applicants should send a curriculum vitae and see that at least three letters of
Applications are invited for a tenure-track position as Asst./Assoc. professor of mathematics. We seek candidates in the following areas: algebra (with interest in computer related applications such as computability, analysis of algorithms, and coding), mathematical programming (especially discrete optimization with applications in operations research), non-linear or functional analysis (with interest in applications, preferably with experience in scientific computing). Other specialties will be considered. Ph.D. required. Duties include teaching, scholarship and service. The department has 30 faculty and offers bachelor's degrees in pure and applied mathematics and computer science. We are in the process of planning a master's degree program in mathematics. Campus computing facilities include two VAX-11/785's running VMS and a modern PC lab. The department has two networked UNIX machines and PDP-11/34. Closing date is February 1, 1988 but applications will be considered until the position is filled. Apply to Douglas D. Smith, Chairman, Math. Sciences Department, Univ. of N.C. at Wilmington, Wilmington, N.C. 28403, (919) 395-3291. An EOE/AA employer.

University of Georgia
Department of Mathematics
Athens, GA 30602

The department may have some tenure track positions available for the 1988-89 academic year at the assistant and associate professor levels. The rank and salary will be commensurate with the applicant's abilities and experience. The principal requirement is excellence in teaching and research. Some preference will be given to areas in which the department is already well represented. Send curriculum vitae and four letters of recommendation to Ray A. Kunze, Head (address above) by April 30, 1988. UGA is an Equal Opportunity/Affirmative Action Employer.

Assistant Professor (outstanding senior considered); academic year, tenure-track; 1/2 Math Department, 1/2 Statistics Program. Duties include teaching, research and some consulting. PhD in statistics or related field required. Area of specialization open, preference given to interests in statistical computing, response surface design, quality control or other area of engineering application. Closing date: February 1, 1988. Vita and 3 letters of reference sent to Professor Michael Jacroux, Chair, Statistics Search Committee, Department of Math, Washington State University, Pullman, WA 99164-2930. WSU IS AN EO/AA EDUCATOR AND EMPLOYER. PROTECTED GROUP MEMBERS ARE ENCOURAGED TO APPLY AND TO IDENTIFY THEIR STATUS.

ANTICIPATED VACANCY

Tenure-track position in the Department of Mathematics, September 1988. Earned doctorate and excellence in teaching required. Research potential/experience is desired. The selected candidate will join an established program with traditional and computer-oriented degrees and will have the opportunity to participate in developing mathematics courses for growing undergraduate and graduate programs of the CS Department.

Application deadline: FEBRUARY 28, 1988. Applications, including resume, transcript, and three letters of reference should be sent to:

RUFUS A. WINSOR, CHAIRPERSON
DEPARTMENT OF MATHEMATICS
SOUTHEASTERN MASSACHUSETTS UNIVERSITY
NORTH DARTMOUTH, MASSACHUSETTS 02747
SMU IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.
APPLICATIONS FROM MEMBERS OF MINORITY GROUPS AND WOMEN ARE PARTICULARLY ENCOURAGED.

GEORGIA SOUTHERN COLLEGE
Head, Department of Mathematics and Computer Science

Applications and nominations are invited for the position of Department Head to begin on September 1, 1988. Candidates should have the Ph.D. in one of the mathematical sciences or computer science, scholarship and teaching experience appropriate to senior rank, proven leadership and administrative skills, and a record of excellent teaching. Georgia Southern is the largest and most comprehensive of the 15 senior colleges of the University System of Georgia with a projected enrollment for 1988-89 of 9500. The 457-acre campus is in Statesboro, a community of approximately 20,000 located 50 miles from historic Savannah and the Atlantic Coast.

The Department of Mathematics and Computer Science has 35 full-time faculty and offers undergraduate degrees in mathematics, computer science, and mathematics education and graduate degrees in mathematics education. Specialties of the faculty include analysis, algebra, computer science, mathematics education, probability, statistics, and topology. A variety of computer systems are available both on campus and through the University System of Georgia Computer Network.

Submit a letter of application and current vita, and have four letters of recommendation sent to Dr. John A. Rafter, Search Chair, Department of Mathematics and Computer Science, Georgia Southern College, Statesboro, GA 30460-8093. Application Deadline: February 1, 1988.

Georgia Southern College is an Affirmative Action, Equal Opportunity Employer which invites and encourages applications from minorities and women.

 Classified Advertisements

APPLICATIONS FROM MINORITY GROUPS AND MEN ARE PARTICULARLY ENCOURAGED.

QUEENS COLLEGE OF THE CITY UNIVERSITY OF NEW YORK

The Department of Mathematics invites applications for a tenure track position beginning with the Fall Semester 1988. Applicants must have a Ph.D. or its equivalent. Rank and salary are dependent on academic accomplishments. The successful applicant will be expected to conduct a vigorous research program and seek external funding in addition to making a significant contribution to the department's teaching program. Applicants should send a curriculum vita and three letters of recommendation to Professor Gerald Roskes, Chairman, Department of Mathematics, Queens College, Flushing, New York 11367. Deadline February 15, 1988. Queens College is an Affirmative Action/Equal Opportunity Employer.
THE UNIVERSITY OF IOWA
Iowa City, Iowa 52242

The Department of Mathematics at the University of Iowa anticipates authorization to make at least one tenure-track appointment at a junior level and possibly one at a distinguished senior level. Some visiting positions are also anticipated. Qualified applicants in all areas will be considered, and women and minority candidates are especially encouraged to apply. The Department hopes to make tenure-track appointments commensurate with long term goals of a hiring plan now under development. At present this plan calls for development and/or strengthening of research programs in Numerical Analysis, Differential Geometry, Harmonic Analysis, Stochastic Analysis, and Topology. Applicants must have a Ph.D. in Mathematics, or equivalent training, and possess the ability to teach effectively at both the undergraduate and graduate level. Visiting appointments will reflect the teaching needs of the Department and the ability of the candidate to interact with existing faculty in current research projects. Applicants should provide a curriculum vita and have three letters of recommendation sent to William A. Kirk, Chair, Department of Mathematics, University of Iowa, Iowa City, Iowa 52242. The University of Iowa is an Equal Opportunity Employer.

Rice University
Department of Mathematical Sciences
(Opening for Tenure-Track Applied Analysis)

The Department of Mathematical Sciences seeks applications for a tenure-track position in Applied Analysis for the Fall, 1988. Applications at all levels and in all areas of Applied Analysis will be considered, however preference will be given to junior applicants with interests in partial differential equations, particularly fluid dynamics and/or wave propagation. Candidates are sought with demonstrated potential in both teaching and research. Applications should be submitted to Professor William W. Symes, Department of Mathematical Sciences, P.O. Box 1892, Houston, Texas 77251-1892. Application materials should include a statement of research interests and the names of at least three individuals to serve as references. (Rice is an Affirmative Action/Equal Opportunity Employer.)

UNIVERSITY OF NORTH CAROLINA
AT CHARLOTTE
DEPARTMENT OF MATHEMATICS,
CHARLOTTE, N.C. 28223

Tenure-track positions available, one Assoc/Full Prof. Also one Lect/Asst. Prof., others possible. Ph.D. required for tenure-track. Preference given to candidates in the areas of Numer. Analysis, Dynamical Sys/ODE, Algebra, OR/Applied Prob., Statistics, Prob/Analysis, PDE. Strong candidates in other areas are encouraged to apply. Also possible are visiting and lecturer (one or two year renewable: MA/MS required) positions. Send vita and 4 letters of recommendation to Prof. Hae-Soo Oh at the above address. Letters must be specifically addressed to Prof. Oh. Closing date: Feb. 5, 1988, but applications will be considered until the positions are filled. UNCC IS AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER.

IOWA STATE UNIVERSITY

One or more tenure-track positions, assistant professor or above, are available beginning August 21, 1988. The number of positions and salary will depend upon qualifications and the availability of funding. Areas of preferred specialty are applied mathematics and numerical analysis. Other areas of interest are discrete mathematics, mathematics education, partial differential equations, stochastics/biomathematics. Candidates must have a PhD or equivalent, good communication skills, and demonstrate potential for excellence in teaching and research. Candidates for senior positions should be in applied mathematics or numerical analysis with an interest in long-term interactions with interdisciplinary projects. Of particular interest are persons knowledgeable in the asymptotic and numerical techniques applied to nonlinear and time-dependent phenomena in continuum theories of fluids and solids. Women and minorities are encouraged to apply.

Please submit letter of application, curriculum vitae and three letters of reference to K. A. Heimes, Chair, Department of Mathematics, Iowa State University, Ames, Iowa 50011. For full consideration, applications for senior positions should be received by December 1, 1987 and for beginning positions by January 15, 1988. Late applications will be considered until the positions are filled.

Iowa State is an Affirmative Action/Equal Opportunity Employer.

PUC/RJ - RIO DE JANEIRO, BRAZIL

The Department of Mathematics of the Pontificia Universidade Católica do Rio de Janeiro, situated in one of the main scientific centers of Latin America, seeks applicants for visiting, tenure track, and tenure positions on its research faculty, starting March and August 1988. Prior knowledge of Portuguese is not essential. Main research areas of present Faculty are: Differential and Algebraic Topology, Foliation Theory, Partial Differential Equations, Numerical Analysis. Other research areas include: Computer Graphics, Riemannian Geometry, Dynamical Systems, Algebraic Number Theory, Mathematical Economics, Foundations of Physics.

Send current curriculum vitae and names of three references to: Paul Schweitzer, S. J., Chair, Mathematics Department, PUC/RJ 22453 Rio de Janeiro, Brazil. Telephone: 55/21/259-5495.

Mathematics Department
California State University
Northridge, California 91330

Two tenure track positions are available. Requirements are a Ph.D. in Mathematics, evidence of teaching excellence, and research activity in one of the following fields: applied mathematics, foundations of mathematics, or mathematics education. Applications will be considered for appointment at the assistant professor rank. Salary range: $30,248 to $33,186. Starting date for all positions is August 29, 1988. Send a cover letter and resume by February 1, 1988 to D. H. Potts, Chair, Department of Mathematics, California State University, Northridge, California 91330. California State University is an Equal Opportunity, Affirmative-Action, Handicapped Title IX Employer.

UNIVERSITY OF UTAH
DEPARTMENT OF MATHEMATICS
invites applications for the following positions:

1. Three full time tenure track appointments are available. Two of these are to be at the Assistant Professor or Associate Professor rank and one is to be at the
Associate Professor or Professor rank. Selection will be based on research expertise and teaching ability. Applications will be accepted until January 31, 1988 or until all three positions are filled.

2. One tenure track position of one-third full time at the rank of Associate Professor or Professor. Selection as above. Applications will be accepted until the position is filled.

3. Two or more nonrenewable three-year instructorships. Persons of any age receiving Ph.D. degrees in 1987 or 1988 are eligible. Applicants will be selected on the basis of ability and potential in teaching and research. Starting salary this academic year is $27,000 and cost of living increases are contingent on action by the State Legislature. Duties consist of teaching two courses through the academic year. Applications will be accepted until February 28, 1988 or until the positions are filled.

4. One or more visiting positions of one year or less. Selection criteria are teaching ability and potential contribution to our research environment. Applications will be accepted until February 28, 1988 or until the positions are filled.

Applications must include curriculum vita, bibliography and three letters of reference. (Instructorship applications must also include an abstract of thesis and a list of graduate courses completed or transcripts.)

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.

SOUTHERN CONNECTICUT STATE UNIVERSITY DEPARTMENT OF MATHEMATICS

MATHEMATICS, tenure-track position, assistant/associate professor level, to teach undergraduate and graduate mathematics beginning August 22, 1988.

Qualifications: Ph.D. in mathematics or related area or Ph.D. must be completed by June 1, 1988; expertise in applications of mathematics, and a demonstrated commitment to teaching required. Salary and rank commensurate with experience and qualifications.

Submit a letter of application, resume, three letters of recommendation and transcripts by February 15, 1988 to
Michael Meck,
Search Committee Chairman,
Department of Mathematics,
Southern Connecticut State University,
New Haven, CT 06515.
AA/EOE

STATE UNIVERSITY OF NEW YORK AT BINGHAMTON

Department of Mathematical Sciences
invites applications at all levels for several openings. Senior applicants must have an outstanding research record. Junior applicants must show great promise. All areas, including mathematical computer science and statistics, will be considered. The department has a healthy doctoral program and an attractive future. Vita and letters of recommendation should be sent to: David L. Hanson, Chairman, Dept. of Math. Sciences., SUNY-Binghamton, Binghamton, NY 13901. An AA/EOE.

POTSDAM COLLEGE OF THE STATE UNIVERSITY OF NEW YORK

The Department of Mathematics invites applicants for a full time tenure track position as Assistant Professor commencing September 1, 1988 to teach at most twelve semester hours of undergraduate (lower and upper division) and beginning graduate courses. Salary will be competitive. The mathematics offerings at Potsdam College include a strong undergraduate major elected by approximately 20% of the student body; during the last five years, an average of 54% of the graduating math majors have been women. The department also has a four-year B.A./M.A. program, an M. A. program, and serves a growing number of students seeking teacher certification. It also participates in the general education curriculum of the college. Potsdam College of the State University of New York is a liberal arts college with an undergraduate enrollment of 3,800 nestled between the St. Lawrence Seaway and the foothills of the Adirondacks. The department seeks applicants with a Ph.D. in any area of mathematics (ABD's will receive consideration). Excellent teaching skills or excellent promise as a teacher are expected.

Pending final approval, we will also consider applications for one or two temporary one-year appointments to replace faculty on leave during the academic year 1988-89.

Send letter of application, resume, graduate transcripts and at least three professional letters of reference to C. L. Smith, Chair of Search Committee, Department of Mathematics, Potsdam College, Potsdam, New York, 13676. The search committee will begin reviewing applications on January 1, 1988, and will continue to do so until the position is filled. Potsdam College is committed to providing opportunities for women and minorities and actively seeks these candidates.

University of North Carolina at Greensboro

Applications are invited for a nine-month tenure track assistant professor position in Mathematics to begin August 1, 1988.

Applicants should have a Ph.D. in Mathematics and a strong commitment to both teaching and research. Preference will be given to candidates whose research interests are in combinatorics or discrete mathematics. Salary is competitive.

Applicants should send a resume and arrange for three letters of recommendation to be sent to: Search Committee, Mathematics Department, UNCG, Greensboro, NC 27412. For full consideration, applications should be received by February 1, 1988. UNCG is an Equal Opportunity/Affirmative Action employer and specifically invites applications from women and minorities.

The Department of Mathematics at the University of Wisconsin Oshkosh anticipates having one or more entry level tenure track positions beginning September 1988.

The primary responsibility is undergraduate teaching with the usual teaching load being 12 credits per semester. Scholarly activity is required and, where appropriate, pursuit of extramural funding is expected. Good teaching is essential.

Candidates should have a Ph.D. or anticipate completing a Ph.D. by September 1988. All areas of specialization will be considered with some preference given to persons knowledgeable in discrete mathematics and to those interested in teaching geometry and/or mathematics for prospective teachers. Send application letter, vita, a complete set of transcripts and three letters of recommendation to: Dr. Norbert J.
WASHINGTON STATE UNIVERSITY
PURE AND APPLIED
MATHEMATICS
PULLMAN, WA 99164-2930

The Department of Pure and Applied Mathematics has at least one tenure-track position starting August 1988. Applicants must have demonstrated research competence in COMPUTATIONAL MATHEMATICS, NUMERICAL ANALYSIS OR OPERATIONS RESEARCH/COMBINATORIAL OPTIMIZATION, and have the potential to supervise doctoral dissertations. The position requires a Ph.D. with competence in teaching relevant graduate and undergraduate courses. The appointment is planned at the Assistant Professor level, but outstanding senior applicants will also be considered. WSU is an EO/AA educator and employer. Protected group members are encouraged to apply and to identify their status. Applications will be accepted through February 1, 1988, or until the position is filled. Vitae and three (3) letters of reference should be sent to: Professor William A. Webb, Chairman, Search Committee.

UNIVERSITY OF MISSOURI
ST. LOUIS
JOINT POSITION IN MATHEMATICS AND EDUCATION

Tenure track joint position for Fall 1988 in Mathematics and Secondary Education. Ph.D. in Mathematics or Mathematics Education required, with experience in Education. Send resume, transcripts and three letters of recommendation by February 15, 1988 to Richard Friedlander, Mathematics Education Search Committee, Department of Mathematics and Computer Science, University of Missouri-St. Louis, St. Louis, MO 63121. AA/EOE.

University of California, Irvine

The School of Social Sciences has a tenure track Assistant Professor position in mathematical social science to begin July 1988. Requires Ph.D. in some field of the social or mathematical sciences, an exceptionally strong research potential, and an interest and ability in a broad range of methodological and formal modeling techniques in the social sciences. Candidate will join a unit with faculty formally trained in anthropology, economics, geography, psychology, and sociology. Teaching will be at both the graduate and undergraduate levels including courses in quantitative and computer methods and undergraduate courses in some social science major. Applicants should submit letter of interest, resume, publications, and the names of three references by February 1, 1988. An equal opportunity/affirmative action employer. Contact Ms. Dee Yox, School of Social Sciences, University of California, Irvine, CA 92717.

CHAIR OF THE DEPARTMENT OF MATHEMATICS
ROSE-HULMAN INSTITUTE OF TECHNOLOGY
POSITION AVAILABLE BEGINNING JULY 1, 1988

Applications and nominations are invited for the position of Chair of the Department of Mathematics at Rose-Hulman Institute of Technology. Candidates should have a Ph.D. degree, administrative potential, a record of scholarly activity and excellence in teaching. Responsibilities include scheduling classes, budgeting, recruiting, making promotion, tenure and retention recommendations and teaching one course per quarter.

Rose-Hulman is a small (1300 students) science and engineering college noted for its well-qualified and highly motivated undergraduates. The median SAT scores for the 1991 class are 660 in mathematics and 540 in verbal. There are no remedial courses and mathematics students are encouraged to present papers at undergraduate conferences and to compete in mathematical contests.

The mathematics department consists of twelve active (writing, research, consulting) full time faculty members with interests and expertise in mathematics, operations research and statistics.

Fringe benefits include TIAA-CREF, health and life insurance, tuition benefit for children, and a personal computer in each faculty member’s office.

To apply, send a letter of application, a curriculum vita and the names and addresses and telephone numbers of at least three people who are willing to serve as references for you, to Mathematics Chair Search Committee Department of Mathematics Rose-Hulman Institute of Technology Terre Haute, IN 47803

Rose-Hulman Institute of Technology is an equal opportunity employer.
ROSE-HULMAN INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MATHEMATICS

A tenure-track assistant or associate professorship will be available September 1, 1988. Applicants should have a Ph.D. in mathematics or statistics and a strong commitment to teaching and scholarly activity. Send letter of application, resume, three letters of recommendation and graduate transcripts to Roger Lautzerheiser, Chairman, Department of Mathematics, Rose-Hulman Institute of Technology, Terre Haute, IN 47803.

Rose-Hulman Institute of Technology is an Equal Opportunity Employer.

University of Missouri-Rolla
Chair-Department of Mathematics and Statistics

The Department invites applications for the position of Department Chair to begin September 1, 1988. The Rolla campus is one of four within the University of Missouri system, has an enrollment of about 5500, and emphasizes engineering and science. The Department has 22 faculty and offers bachelor, master, and doctoral programs in mathematics and statistics. Candidates should have a strong research record and a commitment to excellent teaching. The review of applications will begin October 1, 1987, and will continue until the position is filled. A vita and at least three references should be sent to Professor Glen Haddock, Department of Mathematics and Statistics, University of Missouri-Rolla, Rolla, MO 65401. Applications by minorities are encouraged. AA/EOE.

WESLEYAN UNIVERSITY
DEPARTMENT OF MATHEMATICS

Tenure-track assistant professorship, with initial appointment for four years beginning academic year 1988-89. Preferred specialty is algebra, including algebraic geometry, group theory and algebraic number theory; outstanding applicants from all fields welcome. Six hours teaching weekly, in undergraduate and graduate programs. Candidates should have a serious interest in teaching and an ongoing research program. Send vita and three letters of recommendation to: Search Committee, Department of Mathematics, Wesleyan University, Middletown, CT 06457. Wesleyan University is an Equal Opportunity Affirmative Action Employer.

INDIANA UNIVERSITY-PURDUE UNIVERSITY AT INDIANAPOLIS
DEPARTMENT OF MATHEMATICAL SCIENCES

The Department of Mathematical Sciences at IUPUI is seeking applicants for two tenure-track positions to begin in August, 1988. Applicants must have an earned doctorate, research record, and excellent potential. Some preference will be given to applicants in computational and applied mathematics, applied geometry, functional analysis and operator algebras. However, strong applicants from other areas of pure and applied mathematics will also be considered.

IUPUI is a comprehensive urban university with over 23,000 students. The department offers B.S., M.S., and Ph.D. degrees from Purdue University. The normal teaching load is two courses per semester. The University offers excellent fringe benefits and competitive salaries. Send resume and three letters of recommendation to Professor Bart Ng, Chairman, Department of Mathematical Sciences, IUPUI, 1125 East 38th Street, P.O. Box 647, Indianapolis, IN 46223. Closing date: January 15, 1988. Late applications will be considered until positions are filled. IUPUI is an Affirmative Action/Equal Opportunity Employer.

LAKE FOREST COLLEGE
Department of Mathematics & Computer Studies

Applications are invited for a continuing appointment in Mathematics at the Assistant Professor level, starting in the Fall of 1988. We seek candidates with a Ph.D., a commitment to excellent teaching in a quality liberal arts environment, and an active interest in mathematical research. The teaching load is three courses per semester.

Candidates should send a Curriculum Vitae and arrange to have three letters of reference and a graduate transcript sent by February 15, 1988 to:
Edward W. Packel, Chairperson
Department of Mathematics & Computer Studies
Lake Forest College
Lake Forest, IL 60045

Applications from minorities and women are actively encouraged.

COLLEGE OF ST. THOMAS

Tenure-track and non-tenure track positions in Mathematics to begin in September 1988. Applicants should hold a Ph.D. in Mathematics, be committed to first-rate teaching, and have an active scholarly agenda along with the desire to contribute in the environment of a private, Catholic liberal arts college. The College of St. Thomas, the largest private college in Minnesota, is located one block from the Mississippi River in the heart of the attractive and dynamic Twin Cities' metropolitan area. Application materials, including a letter of interest, C.V., graduate and undergraduate transcripts and three letters of recommendation (including comments on the applicant's prospects for success as a teacher and scholar) will be accepted until January 15, 1988 and, thereafter, until the positions are filled. Atlanta interviews are available by arrangement or through the Employment Register. Candidates will be considered for all available positions unless they specify otherwise. Applications and inquiries should be sent to John T. Kemper, Chair, Dept. of Math., College of St. Thomas, St. Paul, MN 55105. The College of St. Thomas is an equal opportunity/affirmative action employer.

THE UNIVERSITY OF TEXAS AT SAN ANTONIO

The Division of Mathematics, Computer Science and Systems Design invites applications for tenure-track positions in applied mathematics and mathematics education in the fall of 1988 at the level of assistant or associate professor. Strong candidates who can interact with local research laboratories are encouraged to apply. Preference will be given to candidates whose research complements the interests of current faculty. A PhD. is required.

Send vita and 3 letters of recommendation to: Dr. Neal Wagner, Search Committee, Division of Mathematics, Computer Science and Systems Design, The University of Texas at San Antonio, San Antonio, TX 78285-0664.

UTSA is an Equal Opportunity/Affirmative Action Employer.
DEPARTMENT OF MATHEMATICS
CALIFORNIA STATE UNIVERSITY, CHICO
Assistant Professor of Mathematics

The Department of Mathematics is seeking mathematicians or statisticians for one or more full-time, tenure-track positions, beginning Fall, 1988. A Ph.D. in Mathematics or Statistics, and an interest in teaching excellence, are required. The salary is $25,812-$35,676. Duties include teaching 12 units of undergraduate mathematics per semester, and carrying out scholarly research.

Qualified candidates should submit a resume, graduate transcripts, supporting documents, and at least three letters of recommendation to:

Thomas A. McCready, Chair
Department of Mathematics
California State University, Chico
Chico, CA 95929-0525

The closing date for applications is February 1, 1988. CSU, Chico is an Equal Opportunity/ Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA AT
DAVIS
Department of Mathematics

Applications are invited for two or more anticipated tenure track positions in the Department of Mathematics, University of California, Davis, effective 7/1/88. Appointments will be made at rank and salary commensurate with qualifications. Duties include teaching at all levels. We are particularly interested in applicants with a distinguished research record in Applied Analysis, Mathematical Physics, or Mathematical Biology, but outstanding candidates in other fields will be given full consideration. Postmarked deadline for applications is 2/16/88. Application consists of curriculum vitae, list of publications, and names of three references—we shall solicit letters of reference—sent to: Chair of Search Committee, Department of Mathematics, University of California, Davis, CA 95616. The University of California is an Equal Opportunity/Affirmative Action Employer.

KEENE STATE COLLEGE
Keene, New Hampshire 03431

Fall 1988. Applications are invited for at least one tenure-track position at the assistant/associate professor level. Applicants must have a clear commitment to excellence in teaching and hold a Ph.D. in mathematics. Candidates who are in the late stages of their dissertation will be considered. Prior full-time college teaching experience preferred. The selection procedure will begin January 20 and continue until position(s) are filled. Representatives will be at the AMS/MAA meeting in Atlanta, January, 1988.

Applicants should submit a current resume and three letters of reference to:
Gaynelle Pratt
Personnel Office
Keene State College
Keene, NH 03431
An EOE employer.

SOUTHWESTERN UNIVERSITY

Applications are invited for a tenure-track position in Mathematics and a tenure-track position in Computer Science at the Assistant Professor level beginning Fall semester, 1988. Successful candidates will have a strong commitment to teaching excellence at the undergraduate level, to maintain an active interest in scholarly pursuits, and to possess an appreciation for the role of liberal arts education. Ph.D. required.
The Department of Mathematics and Computer Science, which offers a major in computer science, has seven full-time and several adjunct members. The University has a Sequantial 8000 computer designed for parallel processing available for use, as well as direct access to the University of Texas computer system. The position in Computer Science is supported through an endowment provided by Mr. Grogan Lord.

Send letter of application, vita, and three letters of reference to: Dr. Theodore D. Lucas, Associate Provost, Southwestern University, Georgetown, Texas 78626. Southwestern University is an Affirmative Action/Equal Opportunity Employer.

NORTHEAST MISSOURI STATE UNIVERSITY
DIVISION OF MATHEMATICS AND COMPUTER SCIENCE

The division seeks applicants for four or more tenure-track positions available August, 1988. Candidates in the areas of algebra, analysis, applied mathematics (especially modeling) and statistics are of particular interest. Teaching loads for faculty engaged in research average 9 hours per semester. A successful candidate must be able to contribute significantly to the division's teaching and research program including substantial interaction with undergraduate majors and graduate students. Northeast is a public, liberal arts and sciences university with selective admissions and an enrollment of over 6,000. Applications will also be accepted for about four renewable, temporary instructorships. Candidates for these positions are not required to hold a Ph.D. Teaching load averages 12 hours per semester.

A complete application consists of a letter, resume, transcripts of all undergraduate and graduate study and three letters of reference. These should be sent to:

Dr. Lanny Morley, Head
Division of Mathematics and Computer Science
Northeast Missouri State University
Kirksville, MO 63501

EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER
THE VIRGINIA MILITARY INSTITUTE  
Mathematics/Computer Science

Applications are invited for a tenure-track position in the Mathematics and Computer Science Department beginning August, 1988. The applicant should have a strong interest in teaching and participating in the development of the computer science degree program. VMI began offering a B.S. in computer science this year with 38 students either as majors or minors (VMI's total enrollment is 1300). The computer science laboratory contains a Data General MV/7800 with 20 terminals. VMI also has a Burroughs A9 and approximately 200 IBM PC's for student and faculty use.

Preference will be given to an applicant with a Ph.D. in a computer-related field such as Computer Science, Management Information Systems, Mathematics, or Operations Research. If the degree is not in Computer Science, the applicant must have significant formal education or experience in Computer Science. Duties include teaching both mathematics and computer science courses. Salary and rank are commensurate with degrees, qualifications, and experience.

VMI is a quality undergraduate military college of engineering, liberal arts, and science, located in an attractive college town. Faculty wear uniforms but have no other assigned military duties.

The deadline for applications is January 1, 1988. Send vita, three letters of reference and transcripts to: Dr. Veril L. Phillips, Chair, Department of Mathematics and Computer Science, San Jose State University, San Jose, CA 95192-0103. EEO/AAPA VPIN-FPS 88-2

WILKES COLLEGE  
Faculty Position

The Department of Mathematics and Computer Science invites applications for a tenure-track position beginning fall 1988. The position is open to candidates with a Ph.D. in mathematics or computer science or with a mix of teaching and research experience. Teaching responsibilities include a mix of mathematics and computer science, both undergraduate and graduate. Duties include teaching, research, and service.

The college has 750 undergraduates; the department has 13 full-time faculty and 160 majors. The department contains a Data General MV10000, an HP3000-6800, and about 100 microcomputers. Send resume and three letters of recommendation to: Mathematics Department, Wilkes College, Wilkes-Barre, PA 18766. Wilkes College is an Affirmative Action/Equal Opportunity Employer.

GETTYSBURG COLLEGE  
Computer Science/Mathematics

Applications are invited for a tenure-track, assistant professor position beginning September, 1988. Candidates must have a master's degree in computer science and a Ph.D. in mathematics. The normal teaching load will be two CS courses and one mathematics course each semester. Excellence in teaching and ongoing research are essential. There will be an opportunity to help develop an evolving computer science program. Salary is competitive.

Gettysburg College is a selective college offering liberal arts degrees with approximately 1800 students and a 13:1 student-faculty ratio. Extensive computing facilities include a Burroughs 5920 and a microcomputer laboratory. The department has 13 full-time faculty and 20 majors. Computer science students are urged to develop an interest in mathematics, engineering, chemistry, and physics. The faculty and computer scientists at the five Claremont Colleges and the Claremont Graduate School together with the site in Southern California provide an attractive professional setting. There are strong active research groups in several areas of pure and applied mathematics, especially, Differential Equations, Algebra, and Functional Analysis. The computer facilities at the college are outstanding and the mathematics department operates its own Computer Laboratory.

Send resume and three letters of reference to: L. Carl Leinbach, Department of Mathematics, Gettysburg College, Gettysburg, PA 17325. Consideration of applications will begin Feb. 15, 1988. Gettysburg College is an Equal Opportunity/Affirmative Action Employer. Women and minority candidates are especially urged to apply.

SLIPPERY ROCK UNIVERSITY  
MATHEMATICS POSITIONS

Pending final budgetary approval, the Department of Mathematics invites applications for one tenure-track position. Salary competitive, rank commensurate with degree and experience. A Ph.D. in mathematics required. Minorities and women are especially encouraged to apply.

Applicants should send their vita, transcripts and at least three letters of recommendation to: Mathematics Search Committee, Slippery Rock University, Slippery Rock, PA 16057. Applications received by February 15, 1988 are assured consideration. EO/AAE.

HARVEY MUDD COLLEGE  
DEPARTMENT OF MATHEMATICS

A tenure track position in the mathematics department is available at the Assistant Professor level. Qualifications include a Ph.D. in mathematics and a strong interest in research and undergraduate teaching. Responsibilities include teaching, research, curriculum development, and possibly supervision of industrially-sponsored projects in the Mathematics Clinic program pioneered by the college. Harvey Mudd College, one of the nation's most selective undergraduate colleges, offers degrees in mathematics, engineering, chemistry, and physics. The forty mathematicians and computer scientists at the five Claremont Colleges and the Claremont Graduate School together with the site in Southern California provide an attractive professional setting. There are strong active research groups in several areas of pure and applied mathematics, especially, Differential Equations, Algebra, and Functional Analysis. The computer facilities at the college are outstanding and the mathematics department operates its own Computer Laboratory.

Send letter of application, vita, and three letters of recommendation to: Robert L. Borrelli, Mathematics Department, Harvey Mudd College, Claremont, CA 91711, 714-621-8023. An equal opportunity/affirmative action employer.
MATH TEACHER QUALIFIED ETHNIC MINORITIES ARE ENCOURAGED TO APPLY

SUNY Plattsburgh has a vacancy in the Math Department for September 1988. The position is full-time tenure-track at ranks of all levels.

Primary responsibility is undergraduate teaching, research and service to the College.

Qualifications: Ph.D. in mathematics or statistics required.

SUNY Plattsburgh is a public four-year college with approximately 5600 undergraduates and 110 math majors.

We will start to consider applications on January 20, 1988 and will accept applications until position is filled.

Submit letter of application, current resume and three current letters of reference to:
Chairman, Search Committee
Department of Mathematics
SUNY Plattsburgh
Box 1494
Plattsburgh, New York 12901

SUNY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

Three tenure-track positions at the assistant professor level. A candidate for position one should have a doctorate (or near doctorate) in mathematics education with teaching experience in K-12, the ability to teach undergraduate mathematics courses and do research in mathematics education. A candidate for position two should have a Ph.D. in mathematics with research interest in combinatorial designs or approximation theory/applied mathematics. Priority will be given to candidates in combinatorial designs. A candidate for position three should have a Ph.D. in statistics. Candidates for all positions should show promise of excellence in teaching and research. Salaries are competitive and benefits include university paid TIAA, medical, dental, group life. Send resume, transcripts and three letters of recommendation to R. J. Fleming, Department of Mathematics, Central Michigan University, Mt. Pleasant, MI 48859 by Feb. 15, 1988. Late applications will be received until the positions are filled. CMU is an Affirmative Action/Equal Opportunity Institution.

NORTH TEXAS STATE UNIVERSITY (THE UNIVERSITY OF NORTH TEXAS)

The Mathematics Department anticipates authorization to make several new faculty appointments for 1988-89. Salary and rank will be commensurate with qualifications and experience. The focus of the department is on pure and applicable mathematics. Hence we seek to appoint mathematical research scholars of the highest possible caliber who will also be very good teachers.

North Texas State University has been designated by the State Legislature as an emerging national research university, and its name will become the University of North Texas in May, 1988. Interested persons are asked to see our full page ad in the December issue of the Notices for additional information about the department and the University.

Applicants should submit a vita and letter of reference to Dr. John Ed Allen, Chairman, Department of Mathematics, North Texas State University, Denton, Texas 76203-5116.

NTSU IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

TEMPLE UNIVERSITY Department of Mathematics Assistant Professorships

The Mathematics Department expects to have, pending final budgetary approval, three tenure-track positions at the assistant professor level beginning Fall 1988. Preferred specialties: Applied Math/Analysis, Computational Math/Combinatorics, Algebra/Geometry. Outstanding research potential and serious commitment to teaching required. Competitive salaries and excellent fringe benefits. Vita and three letters of reference should be sent by January 15, 1988 to Louis Raymon, Chairman, Box N, 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.

PORTLAND STATE UNIVERSITY Department of Mathematical Sciences

The Department of Mathematical Sciences at Portland State University invites applications for a tenure track position at the assistant professor level to begin fall 1988. Candidates must have a doctoral degree in mathematics or a related field and show both a research potential and a commitment to good teaching. The salary will depend on the applicant's qualifications. Priority will be given to applicants whose research interests are in applied mathematics or statistics although other areas of specialty will be considered.

The department has bachelors and masters level programs and has been newly authorized to offer a PhD in System Science/Mathematics. Applicants are sought who will participate in the further development of the graduate program. Consideration of applications will begin on February 15, 1988, but applications will be accepted until the position is filled.

Applicants should send vita (including a list of publications) and have at least three letters of recommendation sent directly to
Bruce A Jensen, Head
Mathematical Sciences
Portland State University
P.O. Box 751
Portland, OR 97207

Portland State University is an Equal Opportunity Affirmative Action Employer. Minorities, women, and members of other protected groups are encouraged to apply.

UNIVERSITY OF COLORADO AT COLORADO SPRINGS, DEPT. OF MATH.
COLORADO SPRINGS, CO 80933-7150

Applications invited for three tenure-track positions starting Fall 1988. Preferred areas: Algebra, Diff. Equations, Harmonic Analysis, Probability and Statistics. Candidates with other research interests are also encouraged to apply. Applicants should have significant research accomplishments or exceptional research promise and evidence of good teaching ability. Salary and rank negotiable. The normal teaching load is 6-9 credit hours per semester (15 per academic year). Generous support for faculty development like conference travel, teaching off-loads and summer research. arrange to send resume and 3 letters of reference to Dr. K. M. Rangaswamy, Chair, by 1 Feb. 1988. UCPCS is an Equal Opportunity/Affirmative Action Employer.
Applications are requested for anticipated tenure-track positions at all ranks beginning August, 1988. Candidates should possess the Ph.D. degree, have a strong commitment to teaching, and have research expertise in algebra, combinatorics, analysis, computational mathematics, operations research or statistics. Desirable attributes for candidates include an interdisciplinary orientation in research, an interest in innovative applications, or an interest in the computational aspects of the mathematical sciences. All of the areas of algebra/combinatorics, analysis, computational mathematics, operations research, and statistics are integrated into the BA, BS, MS, and PhD programs of the Department. The Department jointly administers a PhD program in Management Science with the University Management Department.

The award of a long term ONR University Research Initiative contract and Departmental resources open the possibility of summer research support of outstanding new faculty. A sixteen node FPS hypercube parallel processor and conventional facilities (including NAS mainframe with vector processor) provide excellent computational facilities.

Applications will be accepted until all approved positions are filled. Vitae (with names and telephone numbers of three references), nominations, and requests for further information should be sent to:

Professor John D. Fulton, Head Department of Mathematical Sciences
Clemson, SC 29634-1907

Clemson University is an AA/EO Employer

POHANG INST OF SCIENCE AND TECH

Department of Mathematics
Pohang, 680 Korea

The department invites applications for both junior and senior positions with rank and salary depending on qualifications.

We are in the process of establishing a new educational institution. Our goal is to build up the best research-oriented educational institution in Korea with 300 faculty members in 11 departments and 2000 students, 800 graduates and 1200 undergraduates combined. We aim at excellence in research and teaching. We already have our first group of students selected from the top few percentiles of high school graduates in the country, and most of our faculty members are recruited from best institutions in the United States. Our graduate program will start from the next spring.

We are interested in applicants majored in algebraic geometry, several complex variables, global analysis, ODE, PDE, differential geometry (especially physics oriented), probability, combinatorics, graph theory, or numerical analysis. Applicants must have a PhD, be able to teach in Korean (or English for a visiting position), and preferably have a few papers accepted in international journals. We will also consider visiting positions depending on the person’s qualifications.

Interested persons should write to professor C. N. Lee at the above address, or call him for more information before the end of March. (Tel: 011-82-562-71-5140 from the United States.) Application should include a resume, 3 reference letters sent directly from the writers, academic record of the last graduate school attended, and a brief statement about his/her research plan.
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Linda Keen, Editor

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The academic year 1985-86 marked the 15th anniversary of the Association for Women in Mathematics and the 25th anniversary of the Mary Ingraham Bunting Institute of Radcliffe College, Harvard University—both organizations that have enhanced women’s role in mathematics. These two occasions provided a framework for a Kovalevskaya celebration, which included a symposium at Radcliffe College, and special sessions at the the AMS meeting in Amherst, Massachusetts, both in October 1985. The papers in this collection were drawn from those two events.

The first group of papers contains background material about Kovalevskaya’s life and work, including a discussion of how she has been perceived by the mathematical community over the last century. The rest of the papers contain new mathematics and cover a wide variety of subjects in geometry, analysis, dynamical systems and applied mathematics. They all involve in one form or another Kovalevskaya’s main areas of interest, differential equations and mathematical questions arising from physical phenomena.

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