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Spiral Wave in an Ecological Model (See page 1429)
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New Titles from the AMS

The Classification of the Finite Simple Groups, Number 3
Daniel Gorenstein, Richard Lyons, Rutgers University, New Brunswick, NJ, and Ronald Solomon, Ohio State University, Columbus

This book offers a single source of basic facts about the structure of the finite simple groups with emphasis on a detailed description of their local subgroup structure, conjugacy classes, and automorphisms. The method is by examination of the specific groups, rather than by the development of an abstract theory of simple groups. While the purpose of the book is to provide the background for the proof of the classification of the finite simple groups—dictating the choice of topics—the subject matter is covered in such depth and detail that the book should be of interest to anyone seeking information about the structure of the finite simple groups.

Discrete Mathematics in the Schools
Joseph G. Rosenstein, Rutgers University, New Brunswick, NJ, Deborah S. Franzblau, City University of New York (CUNY), Staten Island, and Fred S. Roberts, Rutgers University, New Brunswick, NJ, Editors

This volume is a collection of articles written by experienced primary, secondary, and collegiate educators. The book explains why discrete mathematics should be taught in K-12 classrooms and offers practical guidance on how to do so.

Features:
- Classroom activities and an annotated list of resources.
- Authors who are directors of innovative programs and who are well known for their work.
- A description of discrete mathematics providing the opportunity for a fresh start for students who have been previously unsuccessful in mathematics.
- Discussion on discrete mathematics as it is used to achieve the goals of the current effort to improve mathematics education.
- Guidance on topics, resources and teaching; a valuable guide for both pre-service and in-service professional development.

This volume is co-published with the National Council of Teachers of Mathematics (NCTM), Reston, VA.

Homeomorphisms in Analysis
Casper Goffman, Purdue University, West Lafayette, IN, Togo Nishiura, Wayne State University, Detroit, MI, and Daniel Waterman, Syracuse University, NY

The book is well written, packed with information and makes a novel contribution to the literature. Much of what is in the book is important material that is new for the first time readily accessible ... readers will appreciate the many comments that provide historical or motivational perspectives.

—Professor Andrew Bruckner, University of California, Santa Barbara

This book features the interplay of two main branches of mathematics: topology and real analysis. The material of the book is largely contained in the research publications of the authors and their students from the past 50 years. Parts of analysis are touched upon in a unique way, for example, Lebesgue measurability, Baire classes of functions, differentiability, and C^k and C^0 functions, the Blumberg theorem, bounded variation in the sense of Cesari, and various theorems on Fourier series and generalized bounded variation of a function.

Supplementary Reading

Knotted Surfaces and Their Diagrams
J. Scott Carter, University of South Alabama, Mobile, and Masahico Saito, University of South Florida, Tampa

In this book the authors develop the theory of knotted surfaces in analogy with the classical case of knotted curves in 3-dimensional space.

The book contains over 200 illustrations that illuminate the text. Examples are worked out in detail, and readers have the opportunity to learn first-hand a series of remarkable geometric techniques.

Mathematical Surveys and Monographs, Volume 55; 1998; 258 pages; Hardcover; ISBN 0-8218-0593-2; List $69; Individual member $41; Order code SURV/55NT712

Mathematical Hierarchies and Biology
Boris Mirkovic, DIMACS, Rutgers University, Piscataway, NJ, F. R. McMorris, University of Louisville, KY, Fred S. Roberts, Rutgers University, New Brunswick, NJ, and Andrey Ryzhov, Columbia University, New York, NY, Editors

The mathematical approach to the study of hierarchies presents the theoretical framework for much of the current scientific investigation. Biology has benefited from this research and has also stimulated the study of mathematical hierarchies. The papers in this volume provide a contemporary sample of many new results in hierarchy theory with applications in biology, psychology, data analysis, and systems engineering.


Proceedings of the Ashkelon Workshop on Complex Function Theory (May 1996)
Lawrence Zalcman, Bar-Ilan University, Ramat-Canaan, Israel, Editor

This volume of proceedings presents a snapshot view of current Israeli activity in complex function theory and provides impressive evidence of the vigor, enthusiasm, and success with which classical complex analysis is cultivated in Israel today.

Israel Mathematical Conference Proceedings, Volume 11; 1997; 245 pages; Softcover; List $39; Individual member $35; Order code IM/C/P/11NT712

Second Order Equations of Elliptic and Parabolic Type
E. M. Landis, Moscow State University, Russia

Most books on elliptic and parabolic equations emphasize existence and uniqueness of solutions. By contrast, this book focuses on the qualitative properties of solutions. In addition to the discussion of classical results for equations with smooth coefficients (Schauder estimates and the solvability of the Dirichlet problem for elliptic equations; the Dirichlet problem for the heat equation), the book describes properties of solutions to second order elliptic and parabolic equations with measurable coefficients near the boundary and at infinity.

The book presents a fine elementary introduction to the theory of elliptic and parabolic equations of second order. The precise and clear exposition is suitable for graduate students as well as for research mathematicians who want to get acquainted with this area of the theory of partial differential equations.

Translations of Mathematical Monographs, Volume 171; 1997; 203 pages; Hardcover; ISBN 0-8218-0587-5; List $69; Individual member $59; Order code Mmono/171NT712
Local Conformal Kähler Geometry
S. Dragomir, Università degli Studi della Basilicata, Italy & L. Ornea, University of Bucharest, Romania

This unique monograph is a differential geometric study of l.c.K.
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criterion) and their submanifolds. While the latest results on
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Hopf manifolds, harmonic and holomorphic forms of l.c.K.
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• Submanifolds • Extrinsic spheres • Real hypersurfaces
• Complex submanifolds • Integral formulas • Miscellaneous
• A. Boothby-Wang fibrations • B. Riemannian submersions


Princeton in Mathematics, Volume 155

Foliations on Riemannian Manifolds and Submanifolds
Y. Voskod, Topological Institute, Russia

This volume focuses on the role of a Riemannian
curvature in studies of foliations on manifolds and submanifolds.

The book focuses on the author’s own investigations in the
Riemannian geometry of foliations and submanifolds with
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• Part II: Applications to Submanifolds
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• Appendix A. Great sphere foliations and manifolds with
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Advances in Ring Theory
S.K. Jain, Ohio University, Athens, Ohio & S.T. Rizvi, Ohio State
University at Lima, Lima, Ohio (Eds.)

This invaluable, informative volume examines wide-
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Finite Type Dimension


Topics in Mathematics

Metric Structures for
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Revised and Updated from the French by M. Gromov, I.H.E.S., France
Edited by J. Lafontain & P. Pansu; Translated from French by S. Bates; With appendices by M. Katz, P. Pansu & S. Semmes

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Princeton in Mathematics

Fatou Type Theorems
Maximal Functions and Approach Regions
F. Di Giuse, Princeton University, NJ & University of Roma, Italy

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1997 160 pp., 30 illus. Hardcover 444.50 (Italy) ISBN 0-8176-5976-4

Problems in Mathematics, Volume 141

Global Aspects of Classical
Integrable Systems
R.H. Cushman, Univ. of Utrecht & L.M. Bates, Univ. of Calgary

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S^3, the Euler top, the spherical pendulum and the Lagrange top. It presents for the
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obstruction to the existence of global action angle
coordinates is calculated for the spherical pendulum and the
Lagrange top.

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## Articles

**The Football Player and the Infinite Series**

*Harold P. Boas*

On Dirichlet series, the Riemann zeta function, and a famous early twentieth century mathematician who studied them.

**A Generalization of Fermat's Last Theorem:**

*The Beal Conjecture and Prize Problem*

*R. Daniel Mauldin*

A Dallas banker and mathematical amateur has formulated a conjecture in number theory and established a prize for its solution.

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A Community in Crisis

As I write this, the revitalizing effect of a summer of travel and research is fading in the face of disquieting memos, messages, and news reports. Despite numerous retirements, our department has neither new faculty nor authorization to recruit. N sections of courses are being taught by engineering faculty, while even more are staffed by part-time adjuncts. The underfunding of state-supported higher education is now accompanied by proposals that would shift students from state universities to two-year colleges. Many serving mathematicians were unable to obtain NSF grants, while those of us who did had budgets cut to the bone. And far too many good young mathematicians are unable to find secure employment in which their talents can flourish.

The mathematics community is in a state of crisis. The success of the heroic efforts to restore the Rochester Ph.D. program should not obscure the fact that many issues continue to threaten mathematics departments across the country. The underfunding of scientific research and of higher education also affects other groups. Rather than squabble over pieces of a shrinking pie, we must collaborate with other departments and disciplines to create a climate in which investments in research and in education are each valued enough to make the necessary funding a political necessity as well. Within the mathematics community we must recognize the need to support a variety of research and educational activities so that we can present a united front in Washington—not a false facade that masks dissension, but the result of healthy professional debate in which differences are sorted out to achieve a consensus position that benefits the entire community.

Although the problems are pervasive, some especially threaten the mathematics community. A shift in calculus enrollment from four-year to two-year institutions, or to technology-based "distance-learning", changes both the character and number of positions. The position of mathematics as the foundation of science and engineering has been turned on its head as administrators switch to viewing it as an essential discipline to a superfluous one which is implicit in others. How shall we respond? Not by acting as if mathematics Ph.D.s are the anointed ones in whom the ability to teach calculus is exclusively invested. How can we make such a claim when, for many years, some of the top mathematics research departments at institutions with prestigious undergraduate programs employed people with master's degrees to teach and/or coordinate calculus? Is viewing a lecture on a remote screen worse than doing so in a large room with 500 students? Nor can we fail to recognize that many faculty in engineering, physics, economics, and other disciplines are also doing good mathematics.

Why do universities have separate departments when there is so much overlap? Physics, chemistry, and mathematics were once grouped together under the rubric "natural philosophy". Now, some institutions even have departments for biophysics, statistics, operations research, etc. The departmental divisions necessitated by growth and specialization also create artificial boundaries. I would argue that educational quality demands that one group, the "mathematics faculty", be entrusted with the responsibility for mathematics instruction. It is far too important to be taught as a sideline by those committed to other disciplines.

No one can argue that educational quality demands that one group, the "mathematics faculty", be entrusted with the responsibility for mathematics instruction. It is far too important to be taught as a sideline by those committed to other disciplines. However, as articulated in Richard Maher's letter in the August 1997 Notices, we must take this responsibility seriously enough to replace the name-calling of the calculus reform debate by thoughtful curriculum development and evaluation.

One politician, instead of delineating the role of two-year colleges within a comprehensive educational system, argued for free tuition by asserting that community colleges primarily served poor and immigrant students. This attitude only extends the gap between elite high schools which offer calculus and those from which some graduates didn’t learn to add fractions. There is more to a college education than an accumulation of course credits. Opportunities to interact with upper-division students, with research faculty, and with specialists in fields not represented at two-year colleges are valuable. Such benefits of a four-year educational experience should not be reserved for the affluent. These are difficult problems. They will not be resolved by a "business as usual" or "we need better P.R." attitude. Only if we provide a quality mathematics education, whether to aspiring mathematicians or to students from other fields, can we hope to convince administrators, politicians, and tuition-paying parents that mathematics faculty are a necessity, not a luxury.

—Mary Beth Ruskai
Letters to the Editor

Objection to “Hoax” Accusation

I am writing to express my dismay at the use of the word hoax in Shlomo Sternberg's "Comments on the Bible Code" in the September 1997 Notices. According to my dictionary a hoax is a type of deception and to deceive is to deliberately mislead. One could argue that accusations of hoax never belong in the Notices, but even if one believes that such accusations may appear, one must demand they be accompanied by compelling evidence that the accused have indeed intended deliberate deception.

But in this case not a shred of evidence is provided that any deception was intended. Rather, Professor Sternberg gives us strong arguments that the accused (Professor Rips and Mr. Witztum) are wrong in their various publications on the subject. To be wrong is not to be guilty of perpetrating a hoax.

In connection with writing a piece for Jewish Action (the magazine of the OU, the largest Orthodox Jewish organization in the United States) entitled "A Skeptical Look at the Codes", I have looked at the Statistical Science article and many commentaries on the subject and had discussions with Professor Rips and some of the authors of the code-debunking papers. I share Professor Sternberg's opinion as to the correctness of the arguments of Professor Rips and Mr. Witztum, but I have not seen any convincing evidence of deliberate doctoring.

I might add that having had the pleasure of spending time with Professor Rips, I was struck by his gentleness and decency, and I find it impossible to conceive of his presenting any ideas that he doesn't believe in himself.

An accusation this serious without any proof is irresponsible. I believe both Professor Sternberg and the Notices owe Professor Rips and Mr. Witztum an apology.

Barry Simon
California Institute of Technology
(Received August 25, 1997)

In Praise of Epsilon/Delta

The epsilon-delta definition of the limit is one of the greatest achievements of the human mind. It provides the answers to ancient paradoxes involving infinity, it allows us to discover which analytical ideas are true and which are false, and it gives us reliable methods of knowing what control over an input will produce the desired accuracy in the output.

The Greek letters epsilon and delta are better than the Latin letters e and d because (1) e and d are busy representing other things and (2) epsilon and delta have entered our common language. "We are within epsilon of solving the problem." "Houston, what's our delta v?" (In the latter example, the delta is a capital delta, but lowercase delta is just an upper bound on capital delta.)

Like the Hollywood screenwriters who attempt to rewrite Hamlet (to make it easier), all attempts I have seen to rewrite the epsilon-delta definition of the limit make things more confusing. "We get really, really, really very, very close." The original is crystal clear and in plain language says exactly this: A function has a limit at an input number x if and only if for any positive epsilon there is a delta that allows us to control the output of the function. Keeping the input within delta of x but not allowing the input to equal x forces the output to be within epsilon of the limit.

Students easily understand why it is a good thing to control output. A few examples show them why we sometimes want to avoid inputting x itself. A function is continuous at exactly those inputs where inputting x gives us the limit.

Most of the trouble my students have with epsilon-delta does not arise from not understanding what epsilon and delta are. They even appreciate the mathematical shorthand. The biggest problem they have is that they don't really understand subtraction and have never been told what the absolute value function is good for. Once they understand that a distance is the absolute value of a difference (highway mileage signs are a good way to make that clear), epsilon-delta is smooth sailing.

Rick Norwood
East Tennessee State University
(Received August 26, 1997)

About the Cover

The figure shows a simulation of a three-species competition system with a cyclic relationship: 1 > 2, 2 > 3, and 3 > 1 where > is short for outcompetes. The underlying model takes place on a 300 x 300 grid with each site being in state 1, 2, or 3. In the image the height represents the density of type 1 and the color the density of type 2 in an 11 x 11 window centered at the point. The initial state of the simulation consisted of three sectors, each occupied by one of the types. This spiral wave forms in the early stages of convergence to a spatially structured equilibrium state.

A report on this joint research of Richard Durrett, a Cornell mathematician, and Simon Levin, a Princeton mathematician biologist, can be found in J. Theor. Biol. 185 (1997), 165-171, or at http://math.cornell.edu/~durrett/. Linda Buttell performed the simulations on the Cornell supercomputer. The visualization using Data Explorer was done by Catherine Devine, a former employee of the now defunct Cornell National Supercomputer Facility.
The Football Player

The air buzzed with anticipation as the football team crowded excitedly into the lecture hall. The country's top halfback was about to defend his Ph.D. thesis in mathematics! It soon became apparent that the proceedings were a mere formality, as the candidate's dissertation on summability methods for divergent Dirichlet series was a masterful piece of work. This scenario is no fantasy from a 1990s television sitcom; it is a true story. The place was Copenhagen, the year was 1910, and the sport was "football" as the word is understood internationally ("soccer" in American lingo). The star halfback played in the 1908 Olympics on Denmark's silver-medal football team, a team that is still in the record books [21, p. 172] for the most goals scored in a single game. (Denmark defeated France by the lopsided score of 17 to 1.)

The dissertation title was Contributions to the Theory of Dirichlet Series (well, actually Bidrag til de Dirichlet'ske Rækkers Theori), and the candidate's name was Harald Bohr.

Harald Bohr

Like many others before and after him, Harald Bohr wanted to decide the truth or falsity of the Riemann hypothesis, one of the most famous unsolved problems of mathematics. Bohr was unsuccessful, but much of his mathematical work was motivated by trying to understand the Riemann zeta-function \( \zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s}, \) \( \text{Re } s > 1. \)

It is easy to see that the infinite series on the right-hand side converges absolutely in the half-plane where the real part of the complex variable \( s \) exceeds 1, for \( |1/n^s| = 1/n^{\text{Re } s}, \) and \( \sum_{n=1}^{\infty} 1/n^x \) converges when \( x > 1. \) On the other hand, there is no
larger open half-plane where the series converges (even conditionally), because when $s = 1$ the series reduces to the divergent harmonic series.

It is a natural idea to try to understand the Riemann $\zeta$-function by studying the more general Dirichlet series of the form $\sum_{n=1}^{\infty} a_n/n^s$, the coefficients $a_n$ being complex constants. (These are ordinary Dirichlet series; for a wider class see, for example, [2, 16].) A simple example of a Dirichlet series is $\sum_{n=1}^{\infty} (-1)^{n+1}/n^s$, which is the $\zeta$-function series with alternating signs. Evidently this series converges absolutely in exactly the same half-plane as the $\zeta$-function series does: $\Re s > 1$.

However, this new series converges conditionally (but not absolutely) in the larger half-plane where $\Re s > 0$. The convergence follows from the Abel-Dirichlet-Dedekind generalization of the alternating series test (see, for example, [15, §143], [20, §5.5]), which implies that if $\{b_n\}$ is a sequence tending to $0$ and of bounded variation (meaning that $\sum_{n} |b_n - b_{n+1}|$ converges), then $\sum_{n} (-1)^n b_n$ converges. The sequence $\{1/n^s\}$ has bounded variation when $\Re s > 0$ since $|1/n^2 - 1/(n+1)^2| = O(1/n^{1+\Re s})$.

This phenomenon of conditional convergence is contrary to our experience with ordinary power series $\sum_{n=1}^{\infty} a_n z^n$, for a power series converges absolutely at all points of its open disk of convergence. A Dirichlet series can converge nonabsolutely (that is, conditionally) in a vertical strip, and the above example shows that the width of such a strip can be as large as $1$. The width of the strip of conditional, nonabsolute convergence cannot, however, exceed $1$. Indeed, if the Dirichlet series $\sum_{n=1}^{\infty} a_n/n^s$ converges for a certain $s$, then the individual terms tend to $0$ and in particular are bounded in absolute value by some constant $M$; now if $z$ is a complex number such that $\Re z > 1 + \Re s$, then $\sum_{n=1}^{\infty} |a_n/n^s| \leq M\sum_{n=1}^{\infty} 1/n^{\Re (z - s)} < \infty$.

Incidentally, the series $\sum_{n=1}^{\infty} (-1)^{n+1}/n^s$ is closely related to the $\zeta$-function. When $\Re s > 1$, we can rearrange the terms of the absolutely convergent series however we like, so by separating the sum over odd integers from the sum over even integers, we find that

$$\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^s} = \sum_{n=1}^{\infty} \frac{1}{n^s} - 2 \sum_{k=1}^{\infty} \frac{1}{(2k)^s} = \zeta(s)(1 - 2^{1-s}).$$

Thus, the function $(1 - 2^{1-s})^{-1}\sum_{n=1}^{\infty} (-1)^{n+1}/n^s$ serves to extend the definition of the $\zeta$-function from the half-plane where $\Re s > 1$ to the half-plane where $\Re s > 0$. Bohr observed in [6] that one way to extend the $\zeta$-function to the whole plane is to take iterated Cesaro averages of the series $\sum_{n=1}^{\infty} (-1)^{n+1}/n^s$, thereby producing equivalent series that converge in progressively larger half-planes.

The Question

What about uniform convergence of Dirichlet series? An ordinary power series converges uniformly on each closed disk inside its open disk of convergence, but this gives no hint about what might be true for Dirichlet series (as we have already seen in the case of conditional convergence).

Since $|1/n^s|$ does not depend on the imaginary part of $s$, it is clear that if a Dirichlet series $\sum_{n=1}^{\infty} a_n/n^s$ converges absolutely in a half-plane where $\Re s > A$, then it converges uniformly in each closed half-plane $\{s : \Re s \geq A + \epsilon\}$, where $\epsilon$ can be any positive number. Having just seen that there may be an abscissa $C$ to the left of $A$ such that the series converges conditionally when $\Re s > C$, we might anticipate that there is an intermediate abscissa $B$, as indicated in Figure 1, such that the Dirichlet series converges uniformly in each closed half-plane $\{s : \Re s \geq B + \epsilon\}$, where $\epsilon > 0$. Harald Bohr introduced this notion of a line of uniform convergence in [7].

In [8, p. 446] Bohr asked, What is the maximal possible width $A-B$ of the vertical strip of uniform, but not absolute, convergence of a Dirichlet series? We saw above that $A - C \leq 1$, so certainly $A - B$ cannot exceed $1$. It turns out that $A - B$ cannot exceed $1/2$, and this value is sharp.

Although Bohr knew that $A - B \leq 1/2$, he could not produce a single example of a Dirichlet series for which $A - B > 0$. In a companion paper [26] in the same volume, Otto Toeplitz gave examples showing that the upper cutoff for $A - B$ is no smaller than $1/4$. It was nearly two decades later that H. F. Bohnenblust and Einar Hille finally proved $1/2$ to be the right value in an article [5] that Henry Nelson, commenting in a collection of Hille’s papers, termed “a re-
The Lower Bound

I will construct a Dirichlet series \( \sum_{n=1}^{\infty} a_n / n^s \) that converges uniformly in every half-plane \( \{ s : \text{Re } s \geq \delta + 1/2 \} \), where \( \delta > 0 \), but that does not converge absolutely when \( \text{Re } s < 1 \). This example demonstrates that no number smaller than 1/2 will serve as a cutoff for the maximal width of the strip of uniform nonabsolute convergence of Dirichlet series.

Tools

The construction uses off-the-shelf technology: elementary counting, the prime number theorem, and the theory of random Fourier series. There is enough slack in the method that I do not need particularly sharp implementations of these tools. The theory of analytic functions of an infinite number of variables, central to Harald Bohr's approach, is hiding in the background, but I shall not need to make explicit reference to it.

Nonetheless, the philosophy of the construction is very much that of Bohr. Namely, I choose to view an object such as \( 1/45^s \), not as the reciprocal of a power of an integer, but as the value of the monomial \( z_1^s z_2^{45} \) when \( z_1 = 1/3^s \) and \( z_2 = 1/5^s \). Thus, the problem becomes separated from number theory and turns into a problem about polynomials.

The prime number theorem

The most familiar version of the prime number theorem says that the number of primes less than \( x \) is asymptotic to \( x / \log x \) when \( x \to \infty \). An equivalent statement is that if the prime numbers are arranged in increasing order \( (p_1 = 2, p_2 = 3, p_3 = 5, \text{ and so on}) \), then the size of the \( n \)th prime \( p_n \) is asymptotic to \( n \log n \). I need only the weaker statement that there is a constant \( c_1 \) such that \( 1/c_1 < p_n / (n \log n) < c_1 \) when \( n > 1 \); this is rather easier to prove than the full-blown prime number theorem (see, for example, [1, §4.5]).

Counting monomials

I need simple bounds on the number of monomials of degree \( m \) in \( n \) variables: objects of the form \( z_1^{a_1} z_2^{a_2} \ldots z_n^{a_n} \), where the \( a_i \) are nonnegative integers whose sum is \( m \). Viewing such a monomial as a product of \( m \) nontrivial factors, where there are \( n \) choices for each factor, gives a count of \( n^m \), but this count is too big, since it takes account of the order of the terms. No particular product of terms has more than \( m! \) rearrangements, and some products have fewer rearrangements, so \( n^m / m! \) is an undercount. Thus the number of distinct monomials of degree \( m \) in \( n \) variables is between \( n^m / m! \) and \( n^m \). It is easy to show that the precise count is the binomial coefficient \( \binom{n^m}{m} \), but I shall not need this exact value.

Random polynomials

Consider a homogeneous polynomial of degree \( m \) in \( n \) complex variables with coefficients \( \pm 1 \), that is, an object of the form

\[ a_1 z_1 + a_2 z_2 + \ldots + a_n z_n \]

where the \( a_i \) are \( \pm 1 \). The number of such polynomials is \( 2^n \) because the coefficients can be either 1 or -1.
To avoid trivialities, I assume that $m$ and $n$ are both at least 2. What can be said about the supremum of the modulus of such a polynomial when every coordinate $z_j$ lies in the unit disk? Since each term has modulus at most 1, the maximum modulus is certainly no more than the total number of terms, which according to the preceding paragraph is at least $2^m$. What can be said about the supremum of the modulus of such a polynomial when every variable has modulus 1; by orthogonality, this average equals the square-root of the total number of terms and thus exceeds $n^{m/2}/\sqrt{m}$ (again, by the count in the preceding paragraph). What will be significant below is the exponent of $n$.

It turns out that typically the maximum modulus of such a polynomial is nearly as small as it can be. According to the theory of random trigonometric polynomials (see, for example, [17, Theorem 4 of Chapter 6]) there is a constant $c_2$ such that if the signs are assigned at random, then with high probability the maximum modulus of the resulting polynomial is less than $c_2 n^{m+1)/2}/\sqrt{\log m}$. Although there consequently are many polynomials satisfying this bound, all I need is the existence of one for each $m$ and $n$.

**The Construction**

I will construct a Dirichlet series $\sum_{n=1}^{\infty} a_n/n^s$ for which every coefficient $a_n$ is either 0, $+1$, or $-1$, and I will show that for every positive $\delta$ this Dirichlet series converges uniformly when $\text{Re } s \geq \delta + \frac{1}{2}$, yet the series does not converge absolutely when $\text{Re } s < 1$.

I construct the terms of the series in groups. To build the $k$th group (starting with $k = 2$), choose a random homogeneous polynomial of degree $k$ in $2^k$ variables with coefficients $\pm 1$ (as described above). List the $2^k$ consecutive prime numbers starting with the $2^k$th prime, and for each such prime $p$ substitute $1/p^s$ for the corresponding variable in the polynomial. This converts the sum of monomials $\pm z_1^{a_1} z_2^{a_2} \cdots z_{2^k}^{a_{2^k}}$ into a sum of terms $\pm 1/n^s$, where each integer $n$ is the product of exactly $k$ primes (counting repeated factors with their multiplicities) from the block of $2^k$ primes starting at the $2^k$th prime. The uniqueness of prime factorization implies that no integer $n$ appears more than once.

For every integer $n$ not arising in the above process, I set $a_n = 0$. The first integer $n$ for which $a_n \neq 0$ is 49, for this is the smallest integer that is the product of two primes taken from the set of $2^2$ consecutive primes starting with $p_1 = 7$.

Now I verify that the constructed Dirichlet series has the required properties. First consider the question of absolute convergence of $\sum_{n=49}^{\infty} a_n/n^s$. The counting argument above implies that the number of integers $n$ formed from products of $k$ primes in the block from the $2^k$th prime to the $2^{k+1}$th prime exceeds $2^k/k^k$. By the prime number theorem the $2^{k+1}$th prime is bounded above by $3c_1 k^{2k}$, so such integers $n$ are bounded above by $(3c_1 k^{1/2})^k$. Hence

$$\sum_{n=49}^{\infty} |a_n/n^s|$$

exceeds

$$\sum_{k=2}^{2k} 2^{k(1-\text{Re } s)}/(3c_1 k^{1(1+\text{Re } s)})$$

Evidently the latter sum diverges when $\text{Re } s < 1$, so our Dirichlet series fails to converge absolutely when $\text{Re } s < 1$. (On the other hand, since the coefficients $a_n$ are bounded, it is evident that our Dirichlet series does converge absolutely when $\text{Re } s > 1$.)

Next consider the question of uniform convergence of our Dirichlet series. I wish to estimate the modulus of the sum of the terms in the $k$th block. This piece of the Dirichlet series equals the value of our random polynomial when we substitute for each variable the reciprocal of the corresponding prime number raised to the power $s$. Since the polynomial is homogeneous of degree $k$, the supremum of its modulus when the variables have modulus at most $1/p^s$ is $1/p \text{Re } s$ times the bound $c_2 2^{k(k+1)/2} / \sqrt{\log k}$ coming from the paragraph "Random polynomials". Since the $2^k$th prime is bounded below by $2^{k^2/2}$, this chunk of the Dirichlet series is bounded above by $c_2 2^{k(k+1)/2} \sqrt{\log (k^{2k}/2c_1)}$. The Weierstrass M-test and the root test now imply that the series of blocks converges uniformly when $\text{Re } s > 1/2$.

The proof is now finished modulo a technical (but nontrivial) point. I have showed that the constructed Dirichlet series converges uniformly for $\text{Re } s > 1/2$ if the series is summed in appropriate blocks; however, I need to show that the Dirichlet series converges uniformly when summed in its natural order, without grouping. (That there truly is something to check here is indicated already by the alternating version of the $\zeta$-function series $\sum_{n=1}^{\infty} (-1)^{n+1}/n^s$, which when $s = 0$ converges if summed by pairs of terms, yet diverges when summed in the ordinary way.) The convergence we need follows from a general lemma, essentially due to Bohr [9, Hilfssatz 2].

**Lemma.** Suppose that a Dirichlet series $\sum_{n=1}^{\infty} b_n/n^s$ converges absolutely when $\text{Re } s > a$ and that the analytic function $f(s)$ which it represents continues analytically to the half-plane where $\text{Re } s > a$. If $c < b < a$, and if $f$ is bounded on the half-plane where $\text{Re } s > b$, then for every positive $\delta$ the Dirichlet series converges uniformly on the half-plane where $\text{Re } s > b + \delta$.

In our situation the series summed in blocks converges uniformly in the closed half-plane where $\text{Re } s > \frac{1}{2}$ to a bounded function $f$ that is analytic in the open half-plane. When $\text{Re } s > 1$, this function $f$ does equal the sum of the Dirichlet series (summed in any order, since in that region the series converges absolutely). Consequently, the lemma implies that the Dirichlet series converges uniformly to $f$ in each half-plane where $\text{Re } s > \delta + \frac{1}{2}$. 
Proof of the Lemma
The lemma follows from a technique that Bohr attributed to his contemporary W. Schnee, who wrote his dissertation in Berlin in 1908 under the influence (although not the formal tutelage) of the famous Edmund Landau. Soon after receiving his master’s degree in 1909 Bohr himself began a collaboration with Landau, who had just been appointed Minkowski’s successor at the University of Göttingen. In his reminiscences [11, p. xxvi] Bohr remarked on Landau’s unequalled zeal:

When Landau and I thought that an oral conference on our work was needed, I caught the train to Göttingen for a few days’ stay. No one could be in such an excellent mood for work as Landau, and his speed and perseverance were sometimes quite breathtaking. In order to show me at once that the time had come for serious work, he had instituted the tradition of ringing the bell immediately, as soon as I had arrived at his house after the long and somewhat tiring journey and had set foot inside his study, and of requesting the entering maid to inform the kitchen that “tonight at 2 AM a very strong cup of coffee is to be served to both of us.”

The idea of the proof is easier to describe than to implement: integrate over a vertical contour, and use Cauchy’s integral formula to push the contour to the right into the region where the Dirichlet series is already known to converge uniformly. The technique is still the standard one employed to derive Perron’s formula for the partial sums of Dirichlet series (see, for example, [1, §11.12], [25, §9.42]). This shows that contour integration remains useful, even though symbolic computation software packages such as Mathematica and Maple can now calculate all the real integrals that are given in complex analysis textbooks as the main applications of contour integration.

To begin the proof, let \( K \) denote an upper bound for \( f(z) \) in the half-plane where \( \Re s \geq b \), and fix a positive \( \delta \) (which we may as well assume is less than 1). I aim to show that if \( \Re s \geq b + \delta \), then \( |f(s) - \sum_{n=1}^{M} b_n/n^n| \) is bounded by a constant times \( M^{-\delta} \log M \), where the constant depends on \( K \) and \( \delta \) but is independent of \( s \) and \( M \). Consequently, the Dirichlet series will converge uniformly to \( f(z) \) in the half-plane where \( \Re s \geq b + \delta \), as claimed.

Viewing \( s \) and \( M \) as fixed for the moment, with \( \Re s \geq b + \delta \), consider \( f(z)M^{1/2}e^{s\log z}/(z - s) \) as a function of \( z \) around the rectangular contour shown in Figure 2 with vertices at \( s - \delta - iM^{a-b}z, \ s + a - b - iM^{a-b}z, \ s + a - b + iM^{a-b}z, \ s + b - iM^{a-b}z \), and \( s - \delta + iM^{a-b}z \). By Cauchy’s integral formula this integral equals \( 2\pi i f(s) \). The integral over the left-hand edge of the rectangle has modulus bounded by \( KM^{-\delta} \int_{M^{a-b}z}^{M^{a-b}z}(\delta^2 + y^2)^{-1/2} \, dy \), and hence by a constant (depending on \( \delta \) and \( K \) times \( M^{-\delta} \log M \). The integrals over the top and bottom edges of the rectangle are each bounded by

\[
KM^{-(a-b+2)} \int_{-\delta s}^{a-b+s} (M + 1/2)^{s - \Re s} \, dx,
\]

and hence by a constant times \( M^{-2} \). Consequently, \( 2\pi i f(s) \) differs by \( O(M^{-\delta} \log M) \) from the integral over the right-hand edge of the rectangle.

Since the right-hand edge of the contour is in the region where the Dirichlet series is known to converge uniformly to \( f(z) \), we may replace \( f(z) \) by \( \sum_{n=1}^{\infty} b_n/n^n \) in the remaining integral and interchange the order of summation and integration. We now have that \( 2\pi i f(s) \) differs from

\[
\sum_{n=1}^{\infty} b_n/n^s \int_{s-a+b-1}^{s+a-b+1} \left( \frac{M + 1/2}{n} \right)^{z-s} \frac{1}{z-s} \, dz
\]

by \( O(M^{-\delta} \log M) \). To evaluate the integrals in this sum, we must distinguish between the cases \( n \geq M + 1 \) and \( n \leq M \).

When \( n \geq M + 1 \), build a new rectangular contour whose left-hand edge is the given vertical line segment with abscissa \( a - b + \Re s \) and whose right-hand edge has very large abscissa. The integrand has no singularities inside this contour, so the integral over the left-hand side equals the negative of the sum of the integrals over the other three sides. Since \( ((M + 1/2)/n)^{z-s} \) is decaying exponentially when \( \Re z \) becomes large, we may push the right-hand edge of the contour off to \( +\infty \). The integrals over the top and bottom sides are each bounded by \( M^{-(a-b+2)} \int_{a-b}^{(M + 1/2)/n} d\xi \). Hence the terms for which \( n \geq M + 1 \) make a total contribution to the sum in (1) not exceeding twice...
\[ \sum_{n \geq M+1} \left| \frac{b_n}{n^{\Re s}} M^{-(a-b+\varepsilon)} \right| \left( \frac{M + \frac{1}{2}}{n} \right)^{a-b} \times \left| \log \frac{M + \frac{1}{2}}{n} \right|^{-1} \]

Observe that \( \log(M + \frac{1}{2})/n \) is smallest when \((M + \frac{1}{2})/n \) is closest to 1, which happens when \( n = M + 1 \). In this case, the absolute value of the logarithm is

\[ -\log 2M - \frac{1}{2} \]
\[ -\log \left( 1 - \frac{1}{2M+2} \right) > \frac{1}{2M+2} . \]

Since the series \( \sum_{n=1}^{\infty} \left| b_n \right|/n^{a-b+\Re s} \) is uniformly bounded above by \( \sum_{n=1}^{\infty} \left| b_n \right|/n^{a+\delta} \), which converges by hypothesis, it follows that the terms in (1) with \( n \geq M + 1 \) have a sum bounded by a constant times \( 1/M \).

For the terms with \( n \leq M \), we may similarly build a rectangular contour whose right-end edge is the vertical line with abscissa \( a - b + \Re s \) and which extends to the left toward \(-\infty\). The integral over this contour picks up a contribution \( 2\pi i \) from the simple pole at \( z = s \) with residue 1, while the integrals over the top and bottom edges admit estimates analogous to the previous case. Consequently,

\[ \left| f(s) - \sum_{n=1}^{M} \frac{b_n}{n^{\delta}} \right| = O(M^{-\delta} \log M) \]

uniformly with respect to \( s \) when \( \Re s \geq b+\delta \). This completes the proof of the lemma.

**Envoi**

We have seen an example of a Dirichlet series \( f(s) \) whose strip of uniform, but not absolute, convergence attains the maximal possible width of \( 1/2 \). On the other hand, for the Riemann zeta function \( \zeta \), the width of this strip is 0. Bohnenblust and Hille went to some trouble in \([5, pp. 618-620]\) to demonstrate that if \( \lambda \) is any real number between 0 and 1/2, then there is a Dirichlet series whose strip of uniform, nonabsolute convergence has width precisely \( \lambda \). Harald Bohr \([5, p. 622 \text{ footnote}] \) cut through this problem with a knife: the Dirichlet series for \( f(s) + \zeta(s+\lambda) \) does the job.

**References**


[22] **Jack Olsen, Dr. Ryan of the Browns: How smart is too smart?**, Sports Illustrated 23 (1965), no. 13, 64–76.


A Generalization of Fermat's Last Theorem: The Beal Conjecture and Prize Problem

R. Daniel Mauldin

Andrew Beal is a Dallas banker who has a general interest in mathematics and its status within our culture. He also has a personal interest in the discipline. In fact, he has formulated a conjecture in number theory on which he has been working for several years. It is remarkable that occasionally someone working in isolation and with no connections to the mathematical world formulates a problem so close to current research activity.

The Beal Conjecture

Let $A, B, C, x, y, z$ be positive integers with $x, y, z > 2$. If $A^x + B^y = C^z$, then $A, B,$ and $C$ have a common factor.

Or, slightly restated:

The equation $A^x + B^y = C^z$ has no solution in positive integers $A, B, C, x, y, z$ with $x, y, z$ at least 3 and $A, B,$ and $C$ coprime.

It turns out that very similar conjectures have been made over the years. In fact, Brun in his 1914 paper states several similar problems [1]. However, it is very timely that this problem be raised now, since Fermat's Last Theorem has just recently been proved (or re-proved) by Wiles [6]. Some of the significant advances made on some problems closely related to the prize problem by Darmon and Granville [2] are indicated below. Darmon and Granville in their article also discuss some related conjectures along this line and provide many relevant references.

The prize. Andrew Beal is very generously offering a prize of $5,000 for the solution of this problem. The value of the prize will increase by $5,000 per year up to $50,000 until it is solved. The prize committee consists of Charles Fefferman, Ron Graham, and R. Daniel Mauldin, who will act as the chair of the committee. All proposed solutions and inquiries about the prize should be sent to Mauldin.

The abc conjecture. During the 1980s a conjectured diophantine inequality, the "abc conjecture", with many applications was formulated by Masser, Oesterle, and Szpiro. A survey of this idea has been given by Lang [5] and an elementary discussion by Goldfeld [4]. This inequality can be stated in very simple terms, and it can be applied to Beal's problem. To state the abc conjecture, let us say that if $a, b, c$ are positive integers, then $N(a,b,c)$ denotes the square free part of the product $abc$. In other words, $N(a,b,c)$ is the product of the prime divisors of $a, b,$ and $c$ with each divisor counted only once. The abc conjecture can be formulated as follows:

For each $\epsilon > 0$, there is a constant $\mu > 1$ such that if $a$ and $b$ are relatively prime (or coprime) and $c = a+b$, then

$$\max(|a|, |b|, |c|) \leq \mu N(a, b, c)^{1+\epsilon}.$$ 

Now let us show that if the abc conjecture holds, then there are no solutions to the prize problem when the exponents are large enough.

Let $k = \log\mu/\log 2 + (3 + 3\epsilon)$. Let $\min(x, y, z) > k$. Assume $A, B,$ and $C$ are positive integers with $A$ and $B$ relatively prime and such that $A^x + B^y = C^z$. Setting $a = A^x$ and $b = B^y$, we have

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\(c = a + b = C^2\). From the abc conjecture and the fact that \(N(A^x, B^y, C^z) \leq ABC\), we have
\[
\text{max}(A^x, B^y, C^z) \leq \mu(ABC)^{1+\varepsilon}.
\]
If \(\text{max}(A, B, C) = A\), then we would have
\[
A^x \leq \mu A^{3+3\varepsilon}
\]
or
\[
x \leq \frac{\log \mu}{\log A} + 3 + 3\varepsilon \leq k,
\]
which is not the case. A similar argument for the other two possibilities for the maximum shows that our original assumption is impossible.

Next let us give an explicit version of the abc conjecture: If \(a\) and \(b\) are coprime positive integers and \(c = a + b\), then \(c \leq (N(a, b, c))^2\). Let us see what this implies for the prize problem. Suppose \(A^x + B^y = C^z\), with \(x \leq y \leq z\). Again, since \(A^x\) and \(B^y\) are coprime,
\[
C^z \leq (N(A^x B^y C^z))^2 \leq (ABC)^2 < C^{2(\frac{x}{x} + \frac{y}{y} + \frac{z}{z} + 1)}.
\]
So \(\frac{1}{2} < 1\) or \(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}\). Since \(x, y,\) and \(z\) are greater than 2, we have the following possibilities for \((x, y, z)\): \((3, 3, z > 3), (3, 4, z \geq 4), (3, 5, z \geq 5), (3, 6, z \geq 7), (4, 4, z \geq 5),\) and a finite list of other cases.

There are only finitely many possible solutions. In 1995 Darmon and Granville [2] showed that if the positive integers \(x, y,\) and \(z\) are such that \(1/x + 1/y + 1/z < 1\), then there are only finitely many triples of coprime integers \(A, B, C\) satisfying \(A^x + B^y = C^z\). Since each of \(x, y,\) and \(z\) is greater than 2, then \(1/x + 1/y + 1/z < 1\) unless \(x = y = z = 3\). But Euler and possibly Fermat knew there are no solutions in this case. So for each triple \(x, y,\) and \(z,\) all greater than 2, there can be only finitely many solutions to the diophantine equation \(A^x + B^y = C^z\).

Related problems. What happens if it is only required that \(x, y,\) and \(z\) be \(\geq 2\) and at least one of them is greater than 2 and \(A, B,\) and \(C\) are coprime? There is a detailed analysis in [2] of those cases where \(x, y, z \geq 2\) and \(1/x + 1/y + 1/z > 1\).

What happens if we require only that \(1/x + 1/y + 1/z < 1\) and \(A, B,\) and \(C\) are coprime? This problem is also discussed by Darmon and Granville. In fact, they have formulated

The Fermat-Catalan Conjecture. There are only finitely many triples of coprime integer powers \(x^p, y^q, z^r\) for which
\[
x^p + y^q = z^r\text{ with }\frac{1}{p} + \frac{1}{q} + \frac{1}{r} < 1.
\]
So far, as mentioned in [2], ten solutions have been found. The first five are small solutions. They are
\(1 + 23^3 = 3^2, 2^7 + 7^2 = 3^4, 7^3 + 13^2 = 2^9, 2^7 + 17^2 = 71^2, 3^5 + 11^4 = 122^2\). Also five large solutions have been found:
\(17^7 + 76271^3 = 21063928^2, 1414^3 + 2213459^2 = 657, 9262^3 + 15312283^2 = 1137, 43^8 + 96222^3 = 30042907^2, 33^8 + 1549034^2 = 15613^3\). The last five big solutions were found by Beukers and Zagier.

Recently Darmon and Merel have shown that there are no coprime solutions with exponents \((x, x, 3)\) with \(x \geq 3\) [3].

Acknowledgment. Since I am not an expert in this field, I would like to thank Andrew Granville and Richard Guy for their expert help in preparing this note.

References

Andrew Beal is a number theory enthusiast residing in Dallas, Texas. He grew up in Lansing, Michigan, and attended Michigan State University. He has a particular interest in some of Fermat's work and has spent many, many hours thinking about Fermat's Last Theorem. He believes that Fermat did possess a relatively simple non-geometry-based proof for FLT, and he continues to search for it. He also believes that Fermat had a method of solution for Pell's equation that remains unknown and that was a function of the squares whose sum equals the coefficient.

Andrew is forty-four years old. He and his wife, Simona, have five children. He is the founder/chairman/owner of Beal Bank, Dallas's largest locally owned bank. He is also the recent founder/CEO/owner of Beal Aerospace, which is designing and building a next-generation rocket for launching satellites into earth orbits.

Beal Bank, Toyota, and the Dallas Morning News are the primary sponsors of the Dallas Regional Science and Engineering Fair. Beal Bank is also a primary sponsor of the Dallas Area Odyssey of the Mind Competition. Andrew Beal has been a major benefactor for the mathematics program at the University of North Texas through his substantial scholarships for graduate students and for students in the Texas Academy of Mathematics and Science.
Garrett Birkhoff became fascinated with finite groups when he was an undergraduate major in mathematics at Harvard. Upon graduation in 1932, at the age of nineteen, he traveled in Europe with a Hemy fellowship. There he studied Speiser's book on group theory and van der Waerden on modern algebra. At Cambridge University he was impressed by the elegant group theoretic ideas of Philip Hall. Then Garrett also discovered the idea of a lattice—a poset with both lower and upper bounds (only later did it turn out that this structure had been found by Dedekind, in a little noted study of what he called a “dual group”). While in Cambridge, Garrett also conceived the idea that there could be a real “universal algebra” and realized this idea by proving what is now known as Birkhoff’s theorem, characterizing varieties of algebras.

He considered algebras given by a set with specified operations (unary, binary, etc.) which satisfy a given list of identities. All such constitute a “variety”. Birkhoff’s theorem states that a class of algebras is such a variety if and only if it is closed under the formation of subalgebras, direct products, and homomorphic images. This result became the starting point for the subsequent active development of universal algebra.

After holding a Junior Fellowship at Harvard 1933–36, Garrett became an instructor in 1936. At that time Harvard provided a full year undergraduate course in geometry; Garrett advocated the establishment of a corresponding full year course in algebra, to be called Mathematics 6. He taught the first version of this course in 1937–38, emphasizing Boolean algebra, set theory, vectors and group theory; he prepared notes of his course. I taught a somewhat different version of Mathematics 6 in the next year, 1939–40, after I joined the Harvard faculty in 1938; I also provided typed notes of my version of the course. In the subsequent years Garrett and I combined our preliminary notes to publish with MacMillan in 1941 our joint book, Survey of Modern Algebra. It provided a clear and enthusiastic emphasis on the then new modern and axiomatic view of algebra, as advocated by Emmy Noether, Emil Artin, van der Waerden, and Philip Hall. We aimed to combine the abstract ideas with suitable emphasis on examples and illustrations. Groups were started by examples such as the group of symmetries of the square. Vector spaces were introduced by axioms, but with \( n \)-tuples of numbers as illustrations. The chapter on matrices began with linear transformations and explained matrix multiplication in terms of the composition of the corresponding linear transformations. The Galois theory was presented with the conceptual ideas of Emil Artin, which made the Galois correspondence (subgroups to subfields) vivid. In brief, the emphasis was axiomatic and abstract, but built on examples.

At that time one of my good midwestern friends told me that our survey “would not fly beyond the Charles River.” For a year or two this was perhaps so. But American mathematics, spurred by the in-

**Editor’s Note:** Garrett Birkhoff passed away on November 11, 1996, at the age of 85.
fluence of refugees from Europe and the urgent needs of war research, was rapidly developing. Throughout mathematics, ideas in their abstract form mattered. Our Survey was at hand and provided these ideas with examples. It soon became, and was for many years, the text of choice for an undergraduate course in algebra. We were fortunate to be there, young and enthusiastic, at the time when new views of algebra came to fruition. And these ideas are still there; Garrett and I were both pleased with the recent publication of the fifth edition of Survey (A. K. Peters, 1996).

We enjoyed teaching and writing algebra because it was clear, exciting, and fun to present. The book was prepared at a time when both of us were assistant professors, so without tenure. Yes, we did know then that research mattered for tenure, but our joy in teaching was somehow connected with our respective research. Also, the mathematics department at Harvard both emphasized research and expected all faculty members to be steadily active in teaching undergraduates. These responsibilities were in effect combined in our activity. Then and later we took part in the flow of new ideas from discovery to use and to present to students.

Garrett's own research was involved. It was then primarily in lattice theory and universal algebra. His original slim colloquium volume on lattice theory was later expanded to a much more comprehensive version, reflecting the growth in this field. During the war Garrett's interests grew to include hydrodynamics and other applied mathematics—with an occasional pause to prepare revised editions of Survey. On the fiftieth anniversary of its publication, the Mathematical Intelligencer, in its column "Years Ago", edited by Karen V. H. Parshall, gave a description of Survey, complete with pictures of the authors (vol. 14, no. 1, 1992, 26-31 pp.).

References
Introduction

Never in the history of mathematics has a mathematical theory been the object of such vociferous vituperation as lattice theory. Dedekind, Jonsson, Kurosh, Malcev, Ore, von Neumann, Tarski, and most prominently Garrett Birkhoff have contributed a new vision of mathematics, a vision that has been cursed by a conjunction of misunderstandings, resentment, and raw prejudice.

The hostility towards lattice theory began when Dedekind published the two fundamental papers that brought the theory to life well over one hundred years ago. Kronecker in one of his letters accused Dedekind of "losing his mind in abstractions," or something to that effect.

I took a course in lattice theory from Oystein Ore while a graduate student at Yale in the fall of 1954. The lectures were scheduled at 8 a.m., and only one other student attended besides me—María Wonenburger. It is the only course I have ever attended that met at 8 o'clock in the morning. The first lecture was somewhat of a letdown, beginning with the words: "I think lattice theory is played out" (Ore's words have remained imprinted in my mind).

For some years I did not come back to lattice theory. In 1963, when I taught my first course in combinatorics, I was amazed to find that lattice theory fit combinatorics like a shoe. The temptation is strong to spend the next fifty minutes on the mutual stimulation of lattice theory and combinatorics of the last thirty-five years. I will, however, deal with other aspects of lattice theory, those that were dear to Garrett Birkhoff and which bring together ideas from different areas of mathematics.

Lattices are partially ordered sets in which least upper bounds and greatest lower bounds of any two elements exist. Dedekind discovered that this property may be axiomatized by identities. A lattice is a set on which two operations are defined, called join and meet and denoted by ∨ and ∧, which satisfy the idempotent, commutative and associative laws, as well as the absorption laws:

\[ a \lor (b \land a) = a \]
\[ a \land (b \lor a) = a. \]

Lattices are better behaved than partially ordered sets lacking upper or lower bounds. The contrast is evident in the examples of the lattice of partitions of a set and the partially ordered set of partitions of a number. The family of all partitions of a set (also called equivalence relations) is a lattice when partitions are ordered by refinement. The lattice of partitions of a set remains to this day rich in pleasant surprises. On the other hand, the partially ordered set of partitions of an integer, ordered by refinement, is not a lattice and is fraught with pathological properties.

Distributive Lattices

A distributive lattice is a lattice that satisfies the distributive law:

\[ a \lor (b \land c) = (a \lor b) \land (a \lor c). \]
For a long time many people believed that every lattice is distributive. This misunderstanding was finally cleared up when Garrett Birkhoff, in the early thirties, proved a fundamental theorem, which we summarize next.

There is a standard way of constructing distributive lattices. One takes all the order ideals of a partially ordered set \( P \). An order ideal is a subset of \( P \) with the property that if \( x \in P \) and \( y \leq x \), then \( y \in P \). Union and intersection of order ideals are order ideals. In other words, the set of all order ideals of a partially ordered set is a distributive lattice.

Garrett Birkhoff proved the converse of this statement: every finite distributive lattice is isomorphic to the lattice of order ideals of some partially ordered set. The resulting contravariant functor from the category of partially ordered sets to the category of distributive lattices, known as the "Birkhoff transform," provides a systematic and useful translation of the combinatorics of partially ordered sets into the algebra of distributive lattices.

The definitive generalization of Birkhoff's theorem to arbitrary distributive lattices was obtained in the sixties by Ann Priestley. Briefly, there is a nontrivial extension of the notion of topological space that takes order into account, defined by Leopoldo Nachbin in his thesis. Distributive lattices are represented as lattices of closed order ideals on such ordered topological spaces. Point set topology has been nontrivially extended to ordered topological spaces, but this extension has remained largely unknown. Dieudonné was taken with it in the sixties by Ann Priestley. Briefly, there is a useful translation of the combinatorics of partially ordered sets into the algebra of distributive lattices.

The synthetic presentation of geometry has become in the latter half of this century a curiosity, cultivated by Italians and by Professor Coxeter. Modular lattices were dismissed without a hearing as a curious outgrowth of a curiosity.

Garrett once described to me his first meeting with von Neumann. After exchanging a few words they quickly got down to their common interest in lattice theory, and von Neumann asked Garrett, "Do you know how many subspaces you get when you take all joins and meets of three subspaces of a vector space in general position?" Garrett immediately answered, "Twenty-eight!", and their collaboration began at that moment.

The free modular lattice with three generators, which indeed has twenty-eight elements, is a beautiful construct that is presently exiled from textbooks in linear algebra. Too bad, because the elements of this lattice explicitly describe all projective invariants of three subspaces.

One of Garrett's theorems on modular lattices states that the free modular lattice generated by two linearly ordered sets (or chains) is distributive. This result has been shamelessly restated without credit in disparate mathematical languages.

The core of the theory of modular lattices is the generalization of the theory of linear dependence of sets of vectors in a vector space to sets of linear subspaces of any dimension. Dilworth, Kurosh, Ore, and several others defined an extended concept of basis, and they established invariance of dimension and exchange properties of bases. The translation of their results into coordinate language is only now being carried out.

Two recent developments in modular lattices are:

First, the discovery of 2-distributive lattices by the Hungarian mathematician Andras Huhn. A 2-distributive lattice is a lattice that satisfies the identity

\[
(a \vee (x \wedge y \wedge z)) = (a \wedge (x \vee y)) \vee (a \wedge (x \vee y)) \vee (a \vee (y \wedge z)).
\]

This improbable identity implies that the lattice is modular and much more. It has been shown by Bjarni Jónsson, J. B. Nation, and several others that 2-distributive lattices are precisely those lattices that are isomorphically embeddable into the lattice of subspaces of a vector space over any...
field whatsoever, subject only to cardinality restrictions. Thus, 2-distributive lattices come close to realizing the ideal of a universal synthetic geometry, at least for linear varieties. They have a rich combinatorial structure.

Second, the theory of semiprimary lattices. These lattices were given their unfortunate name by Reinhold Baer, but, again, only recently has their importance been realized in the work of such young mathematicians as Franco Regonati and Glenn Tesler. Examples of semiprimary lattices are the lattice of subgroups of a finite Abelian group and the lattice of invariant subspaces of a nilpotent matrix. Semiprimary lattices are modular, and hence every element is endowed with a rank or dimension. However, the elements of semiprimary lattices are additionally endowed with a finer type of rank, which is a partition of an integer, or a Young shape, as we say in combinatorics. For the lattice of subgroups of an Abelian group such a partition comes from the structure theorem for finite Abelian groups; for the invariant subspaces of nilpotent matrices the partition comes from the Jordan canonical form.

This finer notion of dimension leads to a refinement of the theory of linear dependence. One major result, due to Robert Steinberg, is the following. Consider a complete chain in a semi-primary lattice. Two successive elements of the chain differ by one dimension, but much more is true. As we wind up the chain, we fill a Young shape with integers corresponding to the positions of each element of the chain, and thus every complete chain is made to correspond to a standard Young tableau.

Now take two complete chains in a semiprimary lattice. It is easy to see that a pair of complete chains in a modular lattice determines a permutation of basis vectors. In a semiprimary lattice each of the two chains is associated with a standard Young tableau, hence we obtain the statement and proof of the Schensted algorithm, which precisely associates a pair of standard Young tableaux to every permutation.

Lattice of Ideals

Dedekind outlined the program of studying the ideals of a commutative ring by lattice-theoretic methods, but the relevance of lattice theory in commutative algebra was not appreciated by algebraists until the sixties, when Grothendieck demanded that the prime ideals of a ring should be granted equal rights with maximal ideals. Those mathematicians who knew some latent theory watched with amazement as the algebraic geometers of the Grothendieck school clumsily reinvented the rudiments of lattice theory in their own language. To this day lattice theory has not made much of a dent in the sect of algebraic geometers; if ever it does, it will contribute new insights. One elementary instance: the Chinese remainder theorem. Necessary and sufficient conditions on a commutative ring are known that insure the validity of the Chinese remainder theorem. There is, however, one necessary and sufficient condition that places the theorem in proper perspective. It states that the Chinese remainder theorem holds in a commutative ring if and only if the lattice of ideals of the ring is distributive.

The theory of ideals in polynomial rings was given an abstract setting by Emmy Noether and her school. Noetherian rings were defined, together with prime and primary ideals, and fundamental factorization theorems for ideals were proved. It does not seem outrageous to go one step further in Dedekind's footsteps and extend these theorems to modular lattices. This program was initiated by Oystein Ore and developed by Morgan Ward of Caltech and by his student, Bob Dilworth. Dilworth worked at this program on and off all his life, and in his last paper on the subject, published in 1961, he finally obtained a lattice theoretic formulation of the Noetherian theory of ideals. I quote from the introduction of Dilworth's paper:

The difficulty [of the lattice theory of ideals] occurred in treating the Noether theorem on decomposition into primary ideals. ... In this paper, I give a new and stronger formulation for the notion of a "principal element" and... prove a [lattice theoretic] version of the Krull Principal Ideal Theorem. Since there are generally many non-principal ideals of a commutative ring which are "principal elements" in the lattice of ideals, the [lattice theoretic] theorem represents a considerable strengthening of the classical Krull result.

Forgive my presumptuousness for making a prediction about the future of the theory of commutative rings, a subject in which I have never worked. The theory of commutative rings has been torn by two customers: number theory and geometry.

Our concern here is the relationship between commutative rings and geometry, not number theory. In the latter part of this century algebra has so overwhelmed geometry that geometry has come to be viewed as a mere "facade de parler". Sooner or later geometry in the synthetic vein will reassert its rights, and the lattice theory of ideals will be its venue. We intuitively feel that there is a geometry, projective, algebraic, or whatever, whose statements hold independently of the choice of a base field. Desargues's theorem is the simplest theorem of such a "universal" geometry. A new class of commutative rings remains to be discovered that will be completely determined by their lattice of ideals. Von Neumann found a class of noncom-
mutative rings that are determined by their lattices of ideals, as we will shortly see, but the problem for commutative rings seems more difficult. A first step in this direction was taken by Hochster. Algebraic geometry done with such rings might be a candidate for "universal geometry".

Commutative rings set the pace for a wide class of algebraic systems in the sense of Garrett Birkhoff's universal algebra. The lattice of congruences of an algebraic system generalizes the lattice of ideals, and this analogy allows us to translate facts about commutative rings into facts about more general algebraic systems. An example of successful translation is the Chinese remainder theorem in its lattice theoretic formulation, which has been proved for general algebras. The work of Richard Herrmann and his school has gone far in this direction. In view of the abundance of new algebraic structures that are being born out of wedlock in computer science, this translation is likely to bear fruit.

**Linear Lattices**

Having argued for modular lattices, let me now argue against them.

It turns out that all modular lattices that occur in algebra are endowed with a richer structure. They are lattices of commuting equivalence relations. What are commuting equivalence relations?

Two equivalence relations on a set are said to be independent when every equivalence class of the first meets every equivalence class of the second. This notion of independence originated in information theory and has the following intuitive interpretation. In the problem of searching for an unknown element, an equivalence relation can be viewed as a question whose answer will tell to which equivalence class the unknown element belongs. Two equivalence relations are independent when the answer to either question gives no information on the possible answer to the other question.

Philosophers have gone wild over the mathematical definition of independence. Unfortunately, in mathematics philosophy is permanently condemned to play second fiddle to algebra. The pairs of equivalence relations that occur in algebra are seldom independent; instead, they satisfy a sophisticated variant of independence that has yet to be philosophically understood—they commute.

Two equivalence relations are said to commute when the underlying set may be partitioned into disjoint blocks and the restriction of the pair of equivalence relations to each of these blocks is a pair of independent equivalence relations. In other words, two equivalence relations commute when they are isomorphic to disjoint sums of independent equivalence relations on disjoint sets.

Mme. Dubreil found in her 1939 thesis an elegant characterization of commuting equivalence relations. Two equivalence relations on the same set commute whenever they commute in the sense of composition of relations, hence the name.

The lattice of subspaces of a vector space is an example of a lattice that is naturally isomorphic to a lattice of commuting equivalence relations on the underlying vector space viewed as a mere set. Indeed, if $W$ is a subspace of a vector space $V$, one defines an equivalence relation on the set of vectors in $V$ by setting $x \equiv_W y$ whenever $x - y \in W$. Meet and join of subspaces are isomorphic to meet and join of the corresponding equivalence relations in the lattice of all equivalence relations on the set $V$. The lattice of subspaces of a vector space $V$ is isomorphic to a sublattice of the lattice of all equivalence relations on the set $V$, in which any two equivalence relations commute.

Similar mappings into lattices of commuting equivalence relations exist for the lattice of all ideals of a ring and the lattice of all submodules of a module. Mark Haiman has proposed the term "linear lattice" for lattices of commuting equivalence relations.

Schützenberger found an identity satisfied in certain modular lattices that is equivalent to Desargues's theorem. Not long afterwards, Bjarni Jónsson proved that every linear lattice satisfies Schützenberger's identity. At that time the problem arose of characterizing linear lattices by identities. This brings us to two notable theorems Garrett proved in universal algebra.

The first of Birkhoff's theorems characterizes categories of algebraic systems which can be defined by identities. These are precisely those categories of algebraic systems that are closed under the three operations of products, subalgebras, and homomorphic images. For example, groups and rings can be characterized by identities, but fields cannot, because the product of two fields is not a field. There are algebraic systems which are known to be definable by identities because they have been shown to satisfy the three Birkhoff conditions but for which the actual identities are not known.

The second of Birkhoff's theorems states that a category of algebraic systems is endowed with "free algebras" if and only if it is closed under products and subalgebras.

The category of linear lattices is closed under products and sublattices, so that the free linear lattice on any set of generators exists. A thorough study of free linear lattices, revealing their rich structure, was carried out by Gelfand and Ponomarev in a remarkable series of papers. Their results are so stated as to apply both to modular and to linear lattices. The free linear lattice in $n$ generators is intimately related to the ring of invariants of a set of $n$ subspaces in general position in projective space. Gelfand has conjectured that the free linear lattice in four generators is decidable. Recently an explicit set of generators for the ring...
of invariants of a set of four subspaces in projective space has been given by Howe and Huang; Gelfand's conjecture is the lattice theoretic analog and is thus probably true.

It is not known whether linear lattices may be characterized by identities. Haiman has proved that linear lattices satisfy most of the classical theorems of projective geometry, such as various generalizations of Desargues's theorem, and he proved that not even these generalized Desarguian conditions suffice to characterize linear lattices.

The deepest results to date on linear lattices are due to Haiman, who in his thesis developed a proof theory for linear lattices. What does such a proof theory consist of? It is an iterative algorithm performed on a lattice inequality that splits the inequality into subinequalities by a tree-like procedure and eventually establishes that the inequality is true in all linear lattices, or else it automatically provides a counterexample. A proof theoretic algorithm is at least as significant as a decision procedure, since a decision procedure is merely an assurance that the proof theoretic algorithm will eventually stop.

Haiman's proof theory for linear lattices brings to fruition the program that was set forth in the celebrated paper "The logic of quantum mechanics", by Birkhoff and von Neumann. This paper argues that modular lattices provide a new logic suited to quantum mechanics. The authors did not know that the modular lattices of quantum mechanics are linear lattices. In light of Haiman's proof theory, we may now confidently assert that Birkhoff and von Neumann's logic of quantum mechanics is indeed the long-awaited new "logic" where meet and join are endowed with a logical meaning that is a direct descendant of "and" and "or" of propositional logic.

**Lattice Theory and Probability**

One of the dramas of present-day mathematics is the advent of noncommutative probability. Lattice theoretically, this drama is a game played with three lattices: the lattice of equivalence relations, Boolean algebras, and various linear lattices that are threatening to replace the first two.

Classical probability is a game of two lattices defined on a sample space: the Boolean $\sigma$-algebra of events and the lattice of Boolean $\sigma$-subalgebras.

A $\sigma$-subalgebra of a sample space is a generalized equivalence relation on the sample points. In a sample space the Boolean $\sigma$-algebra of events and the lattice of $\sigma$-subalgebras are dual notions, but whereas the Boolean $\sigma$-algebra of events has a simple structure, the same cannot be said of the lattice of $\sigma$-subalgebras. For example, we understand fairly well measures on a Boolean $\sigma$-algebra, but the analogous notion for the lattice of $\sigma$-subalgebras—namely, entropy—is poorly understood.

Stochastic independence of two Boolean $\sigma$-subalgebras is a strengthening of the notion of independence of equivalence relations. Commuting equivalence relations also have a stochastic analog, which is best expressed in terms of random variables. We say that two $\sigma$-subalgebras, $\Sigma_1$ and $\Sigma_2$, commute when any two random variables $X_1$ and $X_2$ defining the $\sigma$-subalgebras $\Sigma_1$ and $\Sigma_2$ are conditionally independent. Catherine Yan has studied the probabilistic analog of a lattice of commuting equivalence relations: namely, lattices of nonatomic $\sigma$-subalgebras, any two of which are stochastically commuting. There are stochastic processes where all associated $\sigma$-subalgebras are commuting in Yan's sense, for example, Gaussian processes.

In a strenuous tour de force, Catherine Yan has developed a proof theory for lattices of nonatomic commuting $\sigma$-subalgebras. Her theory casts new light on probability. It is also a vindication of Dorothy Maharam's pioneering work in the classification of Boolean $\sigma$-algebras.

The portrait of noncommutative probability is at present far from complete. Von Neumann worked hard at a probabilistic setting for quantum mechanics. His search for a quantum analog of a sample space led him to the discovery of continuous geometries. These geometries are similar to projective spaces, except that the dimension function takes all real values between zero and one. Von Neumann characterized continuous geometries as modular lattices and showed that noncommutative rings can be associated with continuous geometries which share properties of rings of random variables, in particular that there is the analog of a probability distribution.

Sadly the applications of continuous geometries have hardly been explored; allow me to stick my neck out and mention one possible such application. It is probable that some of the attractive $q$-identities that are now being proved by representation theoretic methods can be given a "bijective" interpretation in continuous geometries over finite fields. I have checked this conjecture only for the simplest $q$-identities.

The triumph of von Neumann's ideas on quantum probability is his hyperfinite factor, which unlike Hilbert space has a modular lattice of closed subspaces. For a long time I have wondered why quantum mechanics is not done in the hyperfinite factor rather than in Hilbert space. Philosophically, probability in a hyperfinite factor is more attractive than ordinary probability, since the duality between events and $\sigma$-subalgebras is replaced by a single modular lattice that plays the role of both. On several occasions I have asked experts in quantum mechanics why the hyperfinite factor has been quietly left aside, and invariably I received evasive answers. Most likely, physicists and mathematicians needed some fifty years of train-
ing to grow accustomed to noncommutative proba-
ability, and only now are the tables beginning to
turn after the brilliant contributions to noncom-
mutative geometry and noncommutative proba-
bility by Alain Connes and Dan Virgil Voiculescu.

Other Directions
It is heartening to watch every nook and cranny of
lattice theory coming back to the fore after a long
period of neglect. One recent instance: MacNelle,
a student of Garrett’s, developed a theory of com-
pletion by cuts of partially ordered sets, analogous
to Dedekind’s construction of the real numbers. His
work was viewed as a dead end until last year, when
Lascoux and Schützenberger, in their last joint
paper, showed that MacNelle’s completion neatly
explains the heretofore mysterious Bruhat orders
of representation theory.

Two new structures that generalize the concept
of a lattice should be mentioned in closing. First,
Tits buildings. It is unfortunate that presentations
of buildings avoid the lattice theoretic examples,
which would display the continuity of thought
that leads from lattices to buildings.

Second, Δ-matroids, due to Kung, and developed
by Dress, Wentzel, and several others. Garrett Birk-
hoff realized that Whitney’s matroids could be
cast in the language of geometric lattices, which
Garrett first defined in a paper that appeared right
after Whitney’s paper in the same issue of the
American Journal. Roughly, Δ-matroids are to Praf-
fians as matroids are to determinants. Δ-matroids
call for a generalization of lattices that remains to
be explored.

These developments, and several others that I
have not mentioned, are a belated validation of Gar-
rett Birkhoff’s vision, which we learned in three edi-
tions of his Lattice Theory, and they betoken Pro-
fessor Gelfand’s oft-repeated prediction that lattice
theory will play a leading role in the mathematics
of the twenty-first century.

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Introduction
Garrett Birkhoff contributed to many areas of mathematics during his long and distinguished career. He is, of course, very well known for his work in algebra and lattice theory. However, in this article we will focus on his work in applied mathematics, including the numerical solution of elliptic partial differential equations, reactor calculations and nuclear power, and spline approximations. We will also give a very brief discussion of his work on fluid dynamics. Additional information on Birkhoff's work in applied mathematics can be found in many of the publications listed below; see especially [11].

The author gratefully acknowledges the contributions of Richard Varga and Carl de Boor. Varga contributed the section entitled "Reactor Calculations and Nuclear Power", and de Boor contributed the section entitled "Spline Approximations".

The Numerical Solution of Elliptic Partial Differential Equations
In this section we describe two aspects of Birkhoff's work on the numerical solution of elliptic partial differential equations (PDE), his role in the automation of "relaxation methods", and his work on the dissemination of information on the numerical selection of elliptic PDE. Additional work of Birkhoff in this area is described in the section entitled "Reactor Calculations and Nuclear Power".

The Automation of Relaxation Methods
With the advent of high-speed computers in the 1940s Birkhoff became very interested in their possible use for obtaining numerical solutions to problems involving elliptic PDE. Many such problems could be "reduced", by the use of finite difference methods, to the solution of a (usually) large system of linear algebraic equations where the matrix was very sparse. However, because of the relatively low speeds and the very limited memory sizes of computers which were then available, the direct solution of such systems was usually out of the question.

On the other hand, many such large linear systems were actually being solved by R. V. Southwell and his associates in England using relaxation methods and without using computers; see [39]. Relaxation methods involve first choosing an initial guess for the unknown solution, \( u \), at each grid point and then computing at each point the "residual", i.e., a number which measures the amount by which the linear equation for that point fails to be satisfied. One can eliminate, or "relax", the residual at a given grid point by suitably modifying the value of \( u \) at that point. (If one "overcorrects" or "overrelaxes", then the sign of the residual is changed.) Of course the residuals at nearby grid points are also changed when the value of \( u \) at a particular grid point is changed. By repeated use of relaxation a skilled person could soon achieve a situation where all of the residuals were very small and where the values of \( u \) at the grid points provided a satisfactory solution to the problem.

In the late 1940s when I asked Birkhoff for a thesis topic, he suggested that I work on the
"automation" of relaxation methods. Actually there was already a systematic iteration procedure available, namely, the "Liebmann method" [34] (which is a special case of the Gauss-Seidel method). However, the Liebmann method is often exceedingly slow. Another method that was available at the time was Richardson's method [36]. This method involves the use of a number of parameters. However, at the time it was not obvious how the parameters should be chosen. (It was discovered later that by a suitable choice of the parameters, which could be found using Chebyshev polynomials, one could obtain very rapid convergence; see, e.g., [38] and [43].)

Largely as a result of the stimulus, encouragement, and many useful suggestions provided by Birkhoff, I was able to develop a method which is now called the "successive overrelaxation" (SOR) method and which is described in [41, 42]. (The SOR method was developed independently by Frankel [31], who called it the "extrapolated Liebmann" method.) The SOR method provides an order-of-magnitude improvement in convergence as compared to the Gauss-Seidel method for many linear systems corresponding to the numerical solution of elliptic PDE. Thus, for a class of problems corresponding to the Dirichlet problem the number of iterations required for convergence with the SOR method is proportional to $h^4$, where $h$ is the grid size, as compared with $h^2$ as required with the Gauss-Seidel method.

The SOR method, with generalizations, modifications, and extensions (see, e.g., Varga [40]), was used extensively for engineering and scientific computations for many years. Eventually it was superseded by other methods, such as preconditioned conjugate gradient methods and methods based on the use of Chebyshev polynomials.

Further discussion of Birkhoff's role in the automation of relaxation methods can be found in [11].

Dissemination of Information on the Numerical Solution of Elliptic PDE

Birkhoff was very active in the dissemination of information on the numerical solution of elliptic PDE. This activity included the preparation of a book with Robert Lynch (see [16]) and playing a leading role in the arranging of two conferences on "Elliptic Problem Solvers". The first of these conferences was held in Santa Fe in 1980 and led to a publication; see [37]. The second conference was held in Monterey in 1982 and also led to a publication; see [20].

The book with Lynch provides an excellent survey of many topics, including formulations of typical elliptic problems and classical analysis, difference approximations, direct and iterative methods, variational methods, finite element methods, integral equation methods, and a description of the ELLPACK software package. The book contains a wealth of information and is recommended reading for anyone interested in working in this area.

The two conferences provided, among other things, forums for discussions about the ELLPACK software package that was being developed at Purdue University by John Rice and his associates. Contributions to ELLPACK were made by a number of other institutions. For example, several iterative programs were contributed by The University of Texas.

David Kincaid and David Young, who directed the development at The University of Texas of the ITPACK software package for solving large sparse linear systems by iterative methods, regard Birkhoff as the "godfather" of the project. For several years he had been patiently but seriously suggesting that such a package be developed. The implementation of his idea was delayed in part by uncertainty as to how to choose the iteration parameters, such as omega for the SOR method, and how to decide when to terminate the iteration process. Eventually, as described in the book by Hageman and Young [32] and in the paper by Kincaid et al. [33], these and other obstacles were largely overcome and the ITPACK software package was completed.

Reactor Calculations and Nuclear Power

Garrett Birkhoff was intimately associated with reactor computations which played an essential role in the design of nuclear power reactors. This arose primarily from his role as a consultant to the Bettis Atomic Power Laboratory from 1955 through the early 1960s.

As a brief background, analytical models of nuclear reactors were brand new in the early 1950s, unlike the case of analytical fluid dynamics, which had enjoyed two hundred years of development. Fortuitously, high-powered digital computers were also making their appearance in the early 1950s. Because building full-scale nuclear reactors was both expensive and very time consuming, it was prudent and farsighted then to look to digital computers to numerically solve the associated nuclear reactor models. Even more fortuitous was the simultaneous emergence in 1950 of David M. Young's thesis [41], which contained an analytic treatment of the SOR iterative method for numerically solving second-order elliptic boundary problems.

In that exciting period when nuclear reactors were first being considered for naval ships, Bettis hired in 1954 five new Ph.D.s—Harvey Amster, Elis Gelbard, and Stanley Stein in physics, and Jerome Spanier and Richard Varga in mathematics—all of whom made contributions to various aspects of nuclear reactor theory. There is no doubt that detailed discussions with the energetic consultant, Garrett Birkhoff, helped solidify many of their emerging ideas. Garrett loved the challenge...
of working in new research areas, and his enthusiasm was infectious!

But Garrett’s contributions to reactor theory and reactor computations were much more than just the random discussions of a consultant with Bettis people. Three solid contributions of his stand out. Early on he saw the relevance of non-negative matrices (or, more generally, operators which leave a cone invariant) to nuclear reactor theory, and this can be seen in his publications [3] and [21]. In the latter paper the now well-known terms essentially nonnegative and essentially positive matrices, as well as supercritical, critical, and subcritical multiplicative processes, were first introduced. Second, while SOR-type iterative methods were being used for solving reactor problems at Bettis, alternating-direction (implicit), or ADI, iterative methods were similarly used for solving reactor problems at the Knolls Atomic Power Laboratory. The superiority of ADI iterative methods over the SOR method had been shown by Peaceman and Rachford [35] and by Douglas and Rachford [30], both for special Laplace-type problems in a rectangle. Garrett observed, in a classroom lecture at Harvard University, that the commuting nature of certain matrices may not hold in regions other than a rectangle, a property implicitly used in [30] and in [35]. This observation was the impetus for two research papers, [22] and [28], where many positive and negative results for such ADI schemes were presented.

Garrett was also very much interested in semi-discrete approximations of time-dependent problems, such as the heat-conduction equation; here “semi-discrete” means that time remains a continuous variable while other variables, usually the space variables, are discretized. This was researched in his paper [28], where Padé approximations to the function exp(z) were connected with time-stepping schemes for parabolic-like partial differential equations.

In no uncertain terms, Garrett Birkhoff, through his own research and his collaboration with others, left an indelible mark on nuclear reactor theory.

**Spline Approximation**

Birkhoff materially influenced the early development of spline theory and practice through his consulting work for General Motors Research. This work started in 1959 when General Motors decided that perhaps widespread use of nuclear energy was not just around the corner and needed some other useful problems for some of the members of its Nuclear Engineering Department to work on. One of the problems posed was the mathematical representation of automobile surfaces in order to exploit the recently developed numerically controlled milling machines for the cutting of dies needed for the stamping of outer and inner panels. The idea was to determine the free parameters in a suitably flexible mathematical model so as to fit closely to measurements taken from the finished physical model of the car. There was also the hope that eventually the design process itself could be carried out entirely on computers.

Birkhoff was quick to recommend the use of cubic splines (i.e., piecewise cubic polynomial functions with two continuous derivatives) for the representation of smooth curves. He was familiar with their use in naval design through his contact with the David Taylor Model Basin, and he also knew of their use at Boeing through a report written by MacLaren. Furthermore, in joint work with Henry Garabedian (see [14]) he developed what we would now call a four-mode, twelve-parameter $C^1$ macro finite element consisting of eight harmonic polynomial pieces, as a bivariate generalization of cubic spline interpolation, capable of interpolating a $C^1$ surface to a given rectangular mesh of cubic splines. This method eventually led de Boor to the now standard method of bicubic spline interpolation.

Subsequently, W. J. Gordon of General Motors Research developed the technique of spline blending for fitting smooth surfaces to an arbitrary (rectangular) smooth mesh of curves. This method too has become standard. Some mathematical aspects of blending are taken up in [15].

Birkhoff observed that the cubic spline is a good approximation to the draftsman’s (physical) spline only when the latter is nearly flat. He contributed to the mathematical understanding of a more accurate model of the latter; see [26]. His insight into mechanics also made it obvious to him that a cubic spline which vanishes at all its modes must necessarily have exponential growth in at least one direction. The resulting paper [12] on the error in cubic spline interpolation was the first one to demonstrate and make use of the exponential decay of the fundamental functions of spline interpolation for “reasonable” breakpoint sequences.

The survey paper [13] provides a very good record for the many and wide-ranging suggestions concerning interpolation and approximation to univariate and bivariate data which Birkhoff made in those early days.

Somewhat later, in [4], a paper on local spline approximation by moments, Birkhoff proposed what is probably the first spline quasi-interpolant, i.e., a method of approximation that is local, stable, and aims only at reproducing all polynomials of a certain degree (rather than at matching function values).

Birkhoff’s method is now treated as a special case of the de Boor-Fix quasi-interpolant. Already the above-mentioned survey contains detailed ideas about the use of splines in the numerical solution of integral and differential equations. The case of eigenvalue calculations for second-order
ordinary differential equations via the Rayleigh-Ritz method is worked out in detail in [27], while the use of tensor-product splines in the numerical solution of partial differential equations is examined in [29] and in other work by Schultz. Since rectangular meshes cannot handle all practically important situations, Birkhoff also investigated splines on triangular meshes in [8, 1, 17]. The theme of multivariate interpolation was taken up one more time, but this time by Birkhoff the algebraist in [9].

**Numerical Fluid Dynamics**

In this section a very brief discussion of Birkhoff's work in numerical fluid dynamics will be given. For additional information the reader should see his two books, which are cited below, as well as his survey article [10].

Birkhoff worked extensively in numerical fluid dynamics, especially from the middle 1940s to the late 1950s. He was greatly influenced by the work of John von Neumann in fluid dynamics and in the then-emerging field of high-speed computing.

In 1981 Birkhoff was invited to give the John von Neumann lecture at the SIAM meeting in Troy, New York. This lecture led to the publication of a very informative survey article in numerical fluid dynamics; see [10].

It seems truly unfortunate that Birkhoff will not be around to witness the many advances in numerical fluid dynamics which will undoubtedly take place in the next twenty-five to fifty years and which in many cases will benefit from his ideas.

**References**


Applications are invited for the above position, tenable for ten months commencing fall of 1998.

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Brian White

Frederick Justin Almgren Jr., one of the world’s leading geometric analysts and a pioneer in the geometric calculus of variations, began his graduate work at Brown in 1958. It was a very exciting place and time for geometric measure theory. Wendell Fleming had just arrived and begun his collaboration with Herbert Federer, leading to their seminal paper “Normal and Integral Currents” in 1960. Among the major results in “Normal and Integral Currents” was a compactness theorem which implied existence of k-dimensional rectifiable area minimizing varieties with prescribed boundaries in \( \mathbb{R}^n \). (Similar existence theorems were proved independently by Reifenberg and, in case \( n = k + 1 \), by De Giorgi.) Shortly afterward, Fleming (using earlier work of Reifenberg) proved that if \( k = 2 \) and \( n = 3 \), then the varieties are in fact smooth surfaces. Meanwhile De Giorgi (and subsequently, by a different argument, Reifenberg) did work implying that the varieties were smooth almost everywhere when \( n = k + 1 \), the case of hypersurfaces.

Fred came to Brown with an unusual background. He had just spent three years as a Navy pilot, and before that his undergraduate degree at Princeton had been not in mathematics but in engineering. In fact, as an undergraduate he took only three math courses: two semesters of honors calculus and one semester of differential equations and infinite series. Later he would jokingly accuse various mathematicians at Brown of calling him “the most ignorant person” that they had ever met.

“It was clear that he had great raw talent and good intuition,” says Federer, “but indeed he knew very little mathematics then. There were even basic things in group theory, for example, that he had never heard of. When he asked me to be his advisor, I suggested the problem I did because he didn’t know enough analysis for most problems in geometric measure theory.”

Federer suggested a problem that was as much topological as measure theoretic. Four years earlier Dold and Thom had shown that there was a natural isomorphism between the homology groups of a compact manifold \( M \) and the homotopy groups of their associated symmetric product spaces. Federer realized that this could be interpreted as a statement about the homotopy groups of the space of 0-dimensional integral cycles of \( M \). He conjectured a generalization to \( k \)-dimensional cycles, namely, that the \( m \)th homotopy group of the space of integral \( k \)-cycles in \( M \) is naturally isomorphic to the \( (m + k) \)th homology group of \( M \). Almgren’s thesis, published in the first volume of the journal Topology[2], proved that this was indeed the case.

Oddly enough, its publication caused trouble. Almgren was supposed to sign the copyright of his thesis over to Brown University, but could not since he had already signed it over to Topology. To the dean that meant Almgren could not graduate.

Brian White, the eighth of Fred Almgren’s doctoral students, received his Ph.D. in 1982. After a two-year postdoctoral fellowship at the Courant Institute in New York he went to Stanford University, where he is a professor of mathematics. His e-mail address is white@math.stanford.edu.

This article is excerpted from a more complete article, to be published in the Journal of Geometric Analysis.
Federer actually had to go before the graduate council to have the dean overruled.

After his Ph.D., Almgren took a position at Princeton University. There he remained for the rest of his life, even taking most of his leaves of absence at the Princeton Institute for Advanced Study, though he attended conferences and made summer visits to institutes throughout the world.

After Almgren finished his thesis Federer suggested that he develop a Morse theory for minimal varieties, analogous to the well-developed theory of closed geodesics. In particular, although the Federer-Fleming paper proved existence of area-minimizing varieties (integral currents) in homology classes of compact Riemannian manifolds, there were no theorems asserting the existence of unstable minimal varieties.

Almgren's *Topology* result was a step in that direction, but it was not sufficient. Although the integral currents introduced by Federer and Fleming had proved to be ideally suited to the problem of minimizing area, they were not so suitable for problems in which the solutions are unstable critical points of the area functional. This is, in part, because the area functional is not continuous, but merely lower-semicontinuous on the space of integral currents. To prove the existence of a minimum, lower-semicontinuity suffices. But if one wishes to prove existence of a critical point by a mountain pass lemma, having only lower semicontinuity poses difficulties.

To handle these difficulties, Almgren turned to the class of surfaces that he called integral varifolds.1 The area functional is continuous (with respect to weak convergence) on the space of integral varifolds, and he was able to carry out a Morse theory with them. In particular, he proved that every compact m-manifold contains stationary integral varifolds of each dimension less than m. He also proved a compactness theorem for integral varifolds. (The Banach-Alaoglu theorem trivially implies a compactness theorem for all varifolds, but the compactness for integral varifolds is quite subtle.) He also proved a striking isoperimetric inequality for stationary integral varifolds. All this was done in Almgren's 1965 *Theory of Varifolds*, mimeographed lecture notes that amazingly were never published. The work, extended and streamlined by Allard, was—with Almgren's encouragement—eventually published together with Allard's celebrated regularity theorem for integral stationary varifolds in [1].

So far the tremendous advances that had been made in the higher-dimensional calculus of variations had been limited to the area functional. In his 1968 paper [4] Almgren introduced the class of parametric elliptic functionals and (extending the techniques pioneered by De Giorgi) proved the fundamental regularity theorem: if a minimizing surface is weakly close to a multiplicity one disk, then it is smooth near the center of the disk. This implies that minimizing surfaces are smooth almost everywhere (if multiplicity is not counted) or on an open dense set (if multiplicity is counted).

Robert Hardt proved the analog of Almgren's theorem for boundary points [21]. Many years later, Bombieri [12] and Schoen and Simon [24] gave different proofs of Almgren's theorem, replacing some of Almgren's barehanded geometric constructions by more standard PDE techniques. However, the later proofs are limited to oriented surfaces, whereas Almgren's is not. Almgren's regularity theorem is used in almost all subsequent work on parametric elliptic functionals.

**Soap-Film-Like Surfaces**

Almgren's next major work on regularity was his 1975 monograph, *Existence and regularity almost everywhere of solutions to elliptic variational problems with constraints* [5]. There were two major new features.

The first was that it developed a regularity theory for sets rather than currents. The theory of integral currents, as well as the classical theory of Douglas and Rado, can be regarded as providing solutions to Plateau's problem. But neither theory very accurately models soap films and soap bubbles, which were what Plateau actually studied. For example, the classical Douglas-Rado solutions are sometimes immersed, which real soap films never are. Conversely, soap films display types of singularities that are present neither in the Douglas-Rado minimal surfaces nor in mass-minimizing integral currents. (Reifenberg's theory modeled soap films rather well, but Almgren wanted to handle soap bubbles as well as films and arbitrary elliptic functionals, not just the area functional.)

The difficulty with currents, as Almgren saw it, was that they had structure that the physical surfaces did not. "In this paper," he wrote, "we do not wish to assume the existence of a boundary operator...because in many of the geometric, physical, and biological phenomena to which the results and methods [of this paper] are applicable there seems to be no natural notion of such a boundary operator."

The lack of a boundary operator meant that comparison surfaces could no longer be constructed by cut-and-paste operations. Instead, all comparison surfaces had to be obtained by (not necessarily one-to-one) Lipschitz deformations of the original surface. This limitation meant that

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1Essentially the same class of surfaces had been introduced in 1951 by L. C. Young under the name "generalized surfaces" [30]. That term is perhaps confusing since there are many other generalizations of the familiar notion of surface: integral currents, integral flat chains, normal currents, real flat chains, flat chains mod p, and so on. Indeed, Young himself had first used the term "generalized surface" in a somewhat different context [29].
pros were rather cumbersome compared to those in Almgren's earlier work on elliptic regularity.

The second major new feature of the paper is the extremely useful idea of surfaces that "almost" minimize a functional. Given an elliptic functional $F$, in addition to the basic problem of finding a surface that minimizes $F$, there are many closely related problems of interest: minimize $F$ among surfaces enclosing a specified volume, or among surfaces in a Riemannian manifold (rather than in $\mathbb{R}^N$), or among surfaces that avoid a specified smooth obstacle, etc. Almgren realized that a solution surface $S$ to any one of these problems must be what he called "$(F, \epsilon, \delta)$-minimizing". Roughly speaking, the portion of $S$ in a small ball has $F$-energy close to the smallest possible $F$-energy (ignoring volume constraints, obstacles, etc.); the smaller the ball, the closer the $F$-energy to the minimum possible.

Consider, for example, a circle and the length functional: a small arc of the circle comes close to the chord is only slightly greater than one, and indeed the ratio tends to one as the length tends to 0.

It turns out that the fundamental regularity theorem (a minimizing surface weakly near a multiplicity one disk is regular near the center of the disk) for minimizing surfaces is also true and only slightly more difficult to prove for $(F, \epsilon, \delta)$-minimizing surfaces. (Here regular means $C^{1,1}$ for a suitable $\alpha > 0$.) Thus Almgren simultaneously handled the various problems mentioned above.

A special case of the results in Almgren's monograph is the existence and almost-everywhere regularity of surfaces in $\mathbb{R}^3$ that accurately model physical soap films and soap bubble clusters. Jean Taylor wrote a thesis [25] leading to her celebrated 1976 theorem [26] that Almgren's soap-bubble-like surfaces do indeed have exactly the structure described by Plateau: they consist of smooth surfaces which meet in threes along smooth curves, which in turn meet in fours at isolated points. Almgren and Taylor described their work in a beautiful Scientific American article [9] on the physics and mathematics of soap films.

**Surfaces of Higher Codimension**

In the early 1970s very little was known about regularity of mass-minimizing surfaces of codimension greater than one. The singular set of such an $m$-dimensional surface was known to be closed and nowhere dense, but it was not known to have $m$-dimensional measure 0. Around 1974 Almgren started on what would become his most massive project, culminating ten years later in a three-volume, 1,700-page proof that the singular set not only has $m$-dimensional measure 0 but in fact has dimension at most $(m - 2)$ [6]. This dimension is optimal, since by an earlier result of Federer there are many examples in which the dimension of the singular set is exactly $(m - 2)$. Sheldon Chang, Almgren's eleventh Ph.D. student, proved in his 1986 thesis that for the case $m = 2$ the singular set is not only 0-dimensional (which some cantor sets are) but is locally finite away from the boundary [15].

The reader may wonder why Almgren's theorem is so much more complicated than all the regularity results that preceded it. Perhaps the most fundamental difference is the following. For the various surfaces (e.g., mass-minimizing hypersurfaces, size-minimizing surfaces, mass-minimizing surfaces mod 2) in which almost everywhere regularity was already known, one can determine whether a point is a regular point just by examining its tangent cone: the point is regular if and only if it has a plane as a tangent cone.

For mass-minimizing surfaces of higher codimension, this is no longer true. Suppose, for example, that a two-dimensional mass-minimizing surface has as a tangent cone (at a certain point) a plane with multiplicity 2. The point could be a regular point, namely, part of a smooth multiplicity 2 surface, or it could be a singular branch point (such as the origin in the surface $\{(z^2, z^3): z \in C\} \subset C^2 \cong \mathbb{R}^4$).

Thus the problem is multiplicity. If a tangent cone is a plane with multiplicity one, the standard regularity theory applies. In codimension 1, multiplicity is not a problem: an integral current weakly close to a multiplicity $k$ disk can be decomposed into layers (from top to bottom), each of which is close to the same disk with multiplicity 1. But in codimension greater than 1, such decomposition is impossible because there is no appropriate analog of "top" and "bottom".

To get an idea of how subtle Almgren's theorem is, imagine an $m$-dimensional mass-minimizing surface consisting of two distinct smooth pieces which intersect and are tangent to each other along a set $S$. Almgren's theorem asserts in this case that the set $S$ has dimension $\leq (m - 2)$, and thus it can be regarded as a delicate unique continuation theorem. Now imagine that the two pieces are actually joined by infinitely many little handles near $S$. The surface can no longer be locally represented by graphs of functions solving a PDE, but the same conclusion about $S$ has to be reached.

The enormity of Almgren's paper has deterred all but a few people from reading very much of it. Nevertheless, some ideas from it have begun to have an impact. For a description of some of those ideas, see [28]. See [16] for a short overview of the proof.

**The Isoperimetric Inequality**

Almgren discovered several beautiful theorems relating to the classical isoperimetric inequality. The classical inequality states that if $S$ is a closed
k-dimensional surface in $\mathbb{R}^{k+1}$ and if $M$ is the region bounded by $S$, then

$$ \mathcal{H}^{k+1}(M) \leq c_k \mathcal{H}^k(S)^{1+\frac{1}{k}} $$

with the constant $c_k$ chosen so that equality holds if $S$ is a sphere. (Here $\mathcal{H}^k$ denotes $k$-dimensional Hausdorff measure: length if $k = 1$, area if $k = 2$, and so on.)

In their 1960 paper "Normal and Integral Currents" [19] Federer and Fleming proved a beautiful generalization to $k$-dimensional surfaces in $\mathbb{R}^n$. Of course, if $n > k + 1$, there will be many $(k + 1)$-dimensional surfaces bounded by $S$. Federer and Fleming proved that for any $S$ there exists a surface $M$ bounded by $S$ for which essentially the same inequality still holds, though their proof did not give the best constant $c_k$. Of course, one may as well take $M$ to be the least area surface with boundary $S$. Thus their isoperimetric inequality can be stated as follows: if $M$ is a $(k + 1)$-dimensional mass-minimizing integral current in $\mathbb{R}^n$ with boundary $S$, then

$$ \text{mass}(M) \leq c_{k,n}(\text{mass}(S))^{1+\frac{1}{k}}. $$

Almgren's first discovery along these lines was his beautiful 1965 proof ([3], [1], §7) that (2) is true (possibly with a worse constant) not only for minimizing surfaces $M$ but also for surfaces that are merely stationary for the area functional. (To say that $M$ is stationary means that it satisfies the first-derivative test for minima: if we deform $M$, then the initial derivative of area is 0.) In particular, it applies to any smooth surface $M$ whose mean curvature is 0 at every point.

The value of the best constants in these isoperimetric inequalities remained open for sixteen years after the Federer-Fleming paper was published. Then in 1986 Almgren published a beautiful proof [7] that the best constant for the Federer-Fleming inequality (2) is the same as for the classical isoperimetric inequality. Thus among all $(k + 1)$-dimensional mass-minimizing integral currents of a given mass, a ball in $\mathbb{R}^{k+1}$ of the appropriate radius has the smallest possible boundary mass.

One ingredient of Almgren's proof is the following fact (which is quite interesting in its own right, even for smooth surfaces): if $S$ is any closed $k$-dimensional surface with mean curvature everywhere bounded above by $k$, then the area of $S$ is greater than or equal to the area of the unit $k$-sphere $\partial B^{k+1}$, with equality if and only if $S$ is isometric to $\partial B^{k+1}$.

Almgren's proof of this fact is typical of his geometric ingenuity and ability to look at problems from an unusual point of view. First he takes the convex hull $C$ of $S$. Then he thickens it a little to get a convex body $C'$ with a well-defined unit normal at every boundary point. Let $R$ be the set of points $x$ in $\partial C'$ such that the point in $C$ nearest to $x$ belongs to $S$. Of course, the image of $\partial C'$ under the Gauss map is the unit sphere $\partial B^n$. Now Almgren proves that the image of $\partial C'\setminus R$ has area 0, and he bounds the area of the image of $R$ (by a straightforward calculation of the Jacobian determinants) in terms of the area of $S$ and the given bound on mean curvature of $S$. Putting these together gives the inequality.

(See [27] for a more detailed expository account of Almgren's proof.)

Almgren's optimal isoperimetric inequalities paper applies only to minimizing surfaces. Whether his inequality for stationary (but not necessarily minimizing) surfaces is true with the same constant is still not known (though there are some results in this direction: [17, 18, 22, 23]).

**Curvature Flows**

In recent years Almgren was very interested in dynamic problems in which surfaces move through space with velocities related to their curvatures. His first major contribution to this field was not a paper but a graduate student: in 1975, Ken Brakke wrote a remarkable thesis on mean-curvature flow for varifolds [13]. However, the thesis was ahead of its time and had little impact for many years. After Richard Hamilton's stunning success with the Ricci curvature flow in 1982 [20], Gerhardt Huisken, Mike Gage, Matt Grayson, and Hamilton himself began obtaining striking theorems about mean curvature flow using methods of classical PDE and differential geometry rather than geometric measure theory. The field became a large and active one, as it continues to be. After a few years researchers in the field became aware of Brakke's thesis and were amazed by the wealth of insights it contained. Meanwhile, Brakke had also become interested in numerical work, and today he is even more widely known for his extremely powerful Surface Evolver software for simulating geometric flows [14].

Smooth surfaces evolving under curvature flows typically become singular at a finite time, after which it is not clear even how to define the flow with classical PDE and differential geometry. Thus, people have proposed various notions of weak or generalized solutions to geometric evolution equations.

These notions allow one to prove existence of solutions for all time. Typically it is relatively easy to prove that the generalized solutions agree with the classical ones as long as the surfaces are smooth. It is rather difficult to prove partial regularity results for solutions after singularities form. (Indeed, I believe that Brakke's regularity theorem is the only such result known. That is, the various partial regularity theorems all use Brakke's.)

Almgren and his collaborators Jean Taylor and Lihe Wang wanted a model that would apply to many kinds of geometric evolutions occurring in nature. Brakke's mean curvature flow models mo-
tion of grain interfaces in annealing metals, but
mean-curvature flows in general are relevant only
when the physical surface energies are isotropic.
Almgren, Taylor, and Wang also wanted to model
crystal growth, in which the surfaces energies are
highly nonisotropic; indeed, for crystals the sur-
face energy density typically depends in a non-
differentiable way on the unit normal.

They proposed such a model in [10]. The idea
was to replace the parabolic problem by a series
of minimization problems at discrete time steps.
The flow is then the limit (as the time step size goes
to 0) of the minimization problem. More precisely,
at each time one chooses a surface that minimizes
the sum of two quantities: the surface energy and
a term that measures how far the surface is from
where it was at the previous time step.

The main theorem of [10] asserts that a region
bounded by the evolving surface is a Holder-con-
tinuous function of time. The authors also prove
that for smooth initial surfaces and smooth elliptic
surface energy density functions their flow agrees
with the classical one until singularities ap-
pear.

In [11] Almgren and Wang incorporated tem-
perature into the model so that one could, for ex-
ample, model melting or freezing ice. Thus, in ad-
tion to a moving region (the “ice”) there is a
temperature function. Both in the region and in its
complement, the temperature should satisfy a heat
equation. Whereas mathematicians studying this
problem routinely use the same heat equation in
both regions, Almgren characteristically does not,
since (as he points out elsewhere [8]) the heat ca-
pacity of water is twice that of ice. Furthermore,
within the crystal the model allows heat to flow
more easily in some directions than in others.
Naively one might define the ice region to be the
set of points at which the temperature is below
freezing, but this neglects (among other things) the
“Gibbs-Thomson effect”, that is, the dependence of
the local freezing temperature (along an inter-
face) on curvature (of that interface). As Almgren
explains, “Small crystals with high curvatures melt
even though the temperature of the surrounding
liquid is slightly below the freezing temperature
given in handbooks.” [8]

Almgren and Wang [11] define a kind of evolu-
tion that includes these many physical effects,
they prove existence for all time, and they prove
(among other results) that temperature depends
Holder-continuously on time.

When illness struck in the summer of 1996,
Almgren was busy with a number of projects. One
of his main goals was to prove regularity theorems
for the Almgren-Taylor and Almgren-Taylor-Wang
curvature flows.

Other Works
Almgren wrote a great many other papers, in-
cluding important work with Schoen and Simon on
elliptic regularity, with Allard on uniqueness of tan-
genent cones, with Lieb on liquid crystals and on
spherical symmetrization of functions, and with
Thurston on the “convex hull genus” of space
curves. See [28] for descriptions of some of this
work and for fuller accounts of some of the work
described here.

References
of Math. 95 (1972), 417–491.
[2] F. J. ALMGREN JR., The homotopy groups of the integ-
ral cycle groups, Topology 1 (1962), 257–299.
[3] ———, The theory of varifolds: A variational calcul-
us in the large for the k-dimensional area inte-
[4] ———, Existence and regularity almost everywhere
of solutions to elliptic variational problems among sur-
faces of varying topological type and singularity
[5] ———, Existence and regularity almost everywhere
of solutions to elliptic variational problems with con-
[6] ———, Q.-valued functions minimizing Dirichlet’s in-
tegral and the regularity of area minimizing rec-
tifiable currents up to codimension two, preprint.
[7] ———, Optimal isoperimetric inequalities, Indiana
[8] ———, Questions and answers about geometric evolu-
tion processes and crystal growth, The Gelfand
Mathematical Seminars, 1993–1995 (J. Lepowsky
and M. M. Smirnov, eds.), Birkhäuser, Boston, 1996,
pp. 1–9.
films and soap bubbles, Sci. Amer. (July 1976), 82–93.
[10] F. J. ALMGREN JR., J. TAYLOR, and L. WANG, Curva-
ture driven flows: A variational approach, SIAM J.
tence of crystal growth with Gibbs-Thomson curva-
[12] E. BOMBIERI, Regularity theory for almost minimal cur-
[13] K. BRANKE, The motion of a surface by its mean cur-
[14] ———, The surface evolver, Experimental Math. 1
(1992), 141–165.
[15] S. CHANG, Two dimensional area minimizing integral
curves are classical minimal surfaces, J. Amer.
to appear).
[17] J. CHOE, The isoperimetric inequality for a minimal sur-
face with radially connected boundary, Ann.
[18] ———, Three sharp isoperimetric inequalities for sta-
tionary varifolds and area minimizing flat chains mod
[19] H. FEDERER and W. FLEMMING, Normal and integral cur-
Number Theory

Exercices Corrigés de Théorie Analytique et Probabiliste des Nombres
Gérald Tenenbaum

This volume provides solutions to the exercises in the book *Introduction à la théorie analytique et probabiliste des nombres*, which is the first volume of the series, *Cours Spécialisés*. The subjects included are essentially of two types: those designed to put into practice the fundamental concepts introduced in the lectures, and those designed to introduce readers to research in analytic number theory. The latter category of exercises contains numerous original and unpublished results, and the corresponding solutions are written up in detail.

This work will be useful both to students of number theory, by familiarizing them through practice with the specific notions of the discipline and to the specialist, who will find complete proofs both of new and previous results. Text is in French.

Titles in this series are published by the Société Mathématiques de France and distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 20% discount from list.

Cours Spécialisés — Collection SMF, Number 2; 1996; 250 pages; Softcover; ISBN 2-85629-045-0; List $40; Individual member $36; Order code COSP/2NA

Number Theory

V. Kumar Murty, University of Toronto, ON, Canada, and Michel Waldschmidt, Université Pierre et Marie Curie, Paris, France, Editors

To observe the tenth anniversary of the founding of the Ramanujan Mathematical Society, an international conference on Discrete Mathematics and Number Theory was held in Trichirapalli, India. This volume contains proceedings from the number theory component of that conference. Papers are divided into four groups: arithmetic algebraic geometry, automorphic forms, elementary and analytic number theory and transcendental number theory. This work deals with recent progress in current aspects of number theory and covers a wide variety of topics.

Contemporary Mathematics, Volume 210; 1997; 398 pages; Softcover; ISBN 0-8218-0606-8; List $69; Individual member $54; Order code CONM/210NA

Anthony W. Knapp of the State University of New York, Stony Brook, will begin a three-year term as editor of the Notices, starting January 1, 1998. A prominent researcher in representation theory of semisimple Lie groups, Knapp is also well known for his mathematical expositions. This year he won the AMS Steele Prize for mathematical exposition for his book *Representation Theory of Semisimple Groups* (An overview based on examples) (Princeton University Press, 1986).

Knapp will succeed Hugo Rossi of the University of Utah, who was editor from January 1995 until August 1997, when he took the position of deputy director at the Mathematical Sciences Research Institute in Berkeley. Notices Editorial Board member Andy Magid of the University of Oklahoma has been serving as acting editor until Knapp's term begins.

As an undergraduate at Dartmouth College, Knapp was part of a mathematical milieu where many people were at work on books. While a graduate student at Princeton University, he collaborated with Dartmouth mathematicians John G. Kemeny and J. Laurie Snell on the book *Denumerable Markov Chains*, which was based on an undergraduate course Knapp had taken. The book appeared in 1966, the year after Knapp received his Ph.D. from Princeton University, under the direction of Salomon Bochner. Knapp was a Moore Instructor at the Massachusetts Institute of Technology (1965–67) before joining the faculty at Cornell University. Starting in 1986, he began to spend time at SUNY Stony Brook and moved there permanently in 1990. He presented an invited address at the International Congress of Mathematicians in Vancouver in 1974. In 1982–83 he held a John Simon Guggenheim Memorial Fellowship.

In 1968 Knapp began a fifteen-year collaboration with Elias Stein of Princeton, during which they made the theory of intertwining operators into a powerful tool for constructing unitary representations by deformation arguments. Around 1975, with Gregg Zuckerman, Knapp completed the classification of “tempered” unitary representations, which appear in Harish-Chandra’s Plancherel formula. In the 1980s came results in complementary series representations, some in joint work with Birgit Speh and with M. W. Baldoni-Silva. Knapp has also worked on cohomological induction constructions of representations with L. Barchini, David Vogan, and Roger Zeilman and has used cohomological induction to describe exotic unitary representations. The book by Knapp and Vogan, *Cohomological Induction and Unitary Representations* (Princeton University Press, 1995), received an award from the Association of American Publishers.

The book for which Knapp received the Steele Prize brings readers from the level of a second-year graduate student up to current research. The citation for the prize calls it “a beautifully written book which starts from scratch but takes the reader far into a highly developed subject.” His other expository works include *Elliptic Curves* (Mathematical Notes, Princeton University Press, 1992), which received especially wide attention because it appeared close to the time of Andrew Wiles’s announcement of his proof of Fermat’s Last Theorem, in which elliptic curves play a central role. Knapp’s most recent book is the basic graduate text *Lie Groups beyond an Introduction* (Birkhäuser, 1996).
Over the years Knapp’s interest in exposition has been fueled in part by contacts with some of the masters of the art, such as Sigurdur Helgason and Elias Stein, both fellow Steele Prize winners. But it was also fueled by the belief that expository writing is important to the development of the field. “Mathematics advances not just by research alone,” Knapp notes. “There is a process of distillation that is necessary.” The work of the most prominent mathematicians is usually accessible, chiefly through collected works, “but apart from that, unless mathematics gets into some other form—a book form or expository article form—my sense is that it tends to get lost,” he remarks. “So exposition is a way of collecting, from the vast amount of research done, the mathematics that survives… Collectively, mathematicians have this responsibility.”

His wife, Susan Knapp, will serve as editorial assistant for the Notices. This arrangement has its clear advantages, she notes: “We can talk about the Notices at breakfast.” Her background in mathematics—she has a bachelor's degree in the subject—will be a useful resource. She has had experience working with mathematics publications, having served as an editorial assistant for the SIAM Journal on Computing. She also worked for a brief stint as a secretary for another AMS publication, Journal of the AMS.

Anthony Knapp wrote a two-part article for the Notices entitled “Group Representations and Harmonic Analysis from Euler to Langlands” (April 1996, pages 410-415, and May 1996, pages 537-549). As editor he is interested, as Hugo Rossi was, “in articles that cut across fields and show connections and possible connections among areas of mathematics.” Knapp would like the articles to be akin to excellent colloquia that Notices readers can “attend” each month. “I’m constantly on the lookout for possibilities for good mathematics articles,” Knapp says. “I’m interested in hearing from people that they heard someone give a wonderful talk that might be converted into a good Notices article. I’ll do my best to pursue those and persuade people to write them up.”

Those with ideas for articles are encouraged to contact Knapp by e-mail at notices@math.sunysb.edu or by regular mail at this address: Anthony W. Knapp, Editor, Notices of the AMS, P.O. Box 333, East Setauket, NY 11733.
Mathematics: An Interview with AMS President Arthur Jaffe

The following interview was conducted by Notices Senior Writer Allyn Jackson.

Notices: You have been very active in national issues since you were elected president of the AMS. What do you see as ways that the AMS president can help the mathematics community?

Jaffe: I have been fortunate to be elected at a time when several opportunities arose right away to do things that affect the way the world thinks about our profession. There is a paradox: we are living in a golden age of mathematics research, yet our infrastructure is in danger of total collapse. So at the moment I am focusing on two special issues. The first concerns public support of science, and mathematics in particular. The second revolves around public awareness. These two focal points are intimately connected. In the long run, success with the former relies on the latter.

Notices: In fact, your national activities started in late 1995, before you formally began your term, when you became involved in the effort to restore the mathematics graduate program at the University of Rochester.

Jaffe: Yes. Everything I have been doing today at the national level is based on principles I learned from Rochester. One major thing I learned was the importance, value, and necessity of collaborating with our colleagues in other disciplines. At the same time we must preserve our view of mathematics. If anybody is going to make the case for mathematics, it has to begin with us. But we require help from others.

I firmly believe that progress toward our major goals can be made only when the public has a positive attitude toward science as a whole. We have to see mathematics as part of the whole, and that is why I have put so much effort into working for science. As mathematicians we do many things differently, and we contribute in different ways to society, but the goals of our community overlap with those of other sciences. And the general public will not single us out—except when some unusual problem, like Fermat's, both can be explained and does get solved.

Returning to the subject of the University of Rochester, let me emphasize a couple of points about the university's attempt to downgrade the mathematics department. First, the mathematicians expressed surprise at the decision, while some people from other disciplines saw it coming. It is very important that we talk to our colleagues outside our immediate circle and learn what people are thinking about matters of importance.

Second, the general public often has standard misconceptions about the value of mathematics and stereotypes of mathematicians. The initial reactions of the Rochester administration reinforced these, and I believe unfairly to a large extent. Let me give one example: at every university I know there is an extraordinary effort to teach mathematics well and to strive constantly to improve. Still, at these same universities mathematics teaching tends to be criticized. Judging from teaching evaluations, mathematics teaching at Rochester appeared to be as good as or better than that in

Arthur Jaffe is the Landon T. Clay Professor of Mathematics and Theoretical Science at Harvard University and the president of the American Mathematical Society. His e-mail address is jaffe@math.harvard.edu.

1 See “Whatever Happened to Rochester?” in this issue of the Notices, page 1463.
most of the other science departments. The level of criticism was not justified by the facts.

I believe that one of the main problems at Rochester was that mathematicians were "out of the loop". Fortunately, Rochester mathematicians are now "in the loop". In fact, when I met with President Thomas Jackson of the University of Rochester last April, he commented that mathematics might now be the best-connected department in the university. That is quite a statement to make. But now he knows Rochester mathematicians, and he appreciates them.

Notices: Do you think that his reactions are connected to the broader question of public views of mathematics?

Jaffe: Yes. But even more generally I would say that we are going through a period in which the national perception of science and of scientists is very negative. For fifteen to twenty years the press has focused on how developments in science adversely affect the environment, on how science is elitist, on how scientists sometimes falsify or misinterpret data, and in general on how science represents not truth, but merely a parochial viewpoint, as valid as any other. These attitudes affect mathematics too, if only indirectly, because we get lumped in with the rest of science. We need to try to turn these attitudes around. We need to focus attention on the multitudinous positive aspects of science. This is no easy task, but I believe that a positive public perception of science and of mathematics is the key to our future.

Furthermore, mathematics is the least understood and most difficult to explain of all the sciences. Most people think that mathematics is handed down on a stone tablet and do not think it is possible, much less fundamentally important, to discover new mathematics. Despite these difficulties, we have to do our best to communicate and to explain our subject to those outside our discipline.

Notices: What is the AMS doing to promote public awareness of mathematics?

Jaffe: At the moment we are taking small but important steps. After our very successful (and, I believe, first-time) mathematical briefing in the Rayburn Office Building on Capitol Hill, we are planning another briefing on mathematics next spring, probably in the first week in March. In a different venue, I've just become co-chair with Paul Anderson of the Public Awareness Forum of the Council of Scientific Society Presidents. Here the role of mathematics will be folded into the question of the awareness of science in general. I believe it is important that mathematicians take a visible part in the efforts to bring science to the public. On the Web we have instituted an information page oriented toward nonmathematicians called "What's New in Mathematics", under the auspices of the Working Group on Public Awareness of Mathematics, begun within the Committee on the Profession by Steve Weintraub.

Notices: You have been especially active in science policy affairs in Washington. Can you talk about what the AMS has been doing in this arena?

Jaffe: First of all, we have worked hard on unifying the leadership of a number of professional scientific organizations to work toward common goals. As I mentioned, unless there is an environment sympathetic to science as a whole, it is very difficult to have an environment sympathetic to mathematics. One common long-range goal that was easy to agree upon is the importance of positive public perception of science. Of course we would like every person in the government to understand the importance to our country of maintaining our position of scientific leadership. And this means the support of science across the board.

Much of our federal budget is spent on the present or makes up for deficiencies in the past. Science is different. It is an investment in the future of our country. The future outweighs the past, and we cannot emphasize this point too often. We should continue until our public accepts this fact, as the public does in many other countries (especially in Europe and in the Pacific Rim).

The AMS began working together with the American Physical Society, the American Chemical Society, and also with some biologists from the Federation of American Societies in Experimental Biology. Of course we have also been partners in these efforts with the other mathematics societies: the Association for Women in Mathematics, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

By this spring our informal coalition had expanded to include forty-six presidents of scientific societies, who endorsed a statement in support of strong funding for science. The statement points out the importance to the country of federal investment in scientific research and also the interdependence of scientific disciplines. It calls for increases for 1998 in the range of 7 percent in the research budgets of agencies that fund science. It was mailed to every member of the House and of the Senate and was given quite a lot of attention in the press, with supporting stories and editorials appearing in the New York Times, the Washington Post, U.S. News and World Report, and the Wall Street Journal, among other publications. In addition, I was part of a small group of presidents that paid visits to a number of key legislators and their staffs in order to emphasize our views and

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to offer assistance with their implementation. At the same time, a group of about ten Washington representatives of science organizations—including Sam Rankin of the AMS Washington Office—began to meet regularly to plan special projects.

It has been wonderful to see how rapidly opinions changed.

**Notices:** What exactly did you observe?

**Jaffe:** For example, the day after the press conference in which we presented the statement, we held the briefing about mathematics on Capitol Hill that I mentioned earlier. In his introduction the chair of the House Science Committee, Congressman James Sensenbrenner, gave quite a negative prognosis for the support of science in the 1998 budget. Just two weeks later he changed his opinion and proposed a 3 percent increase in the science budgets under the auspices of his committee. And then, a few weeks after that, his committee actually voted an authorization bill with a 7.2 percent increase! The Appropriations Committee cut this back to 6.8 percent, but it was still more than double the increase that the president had requested and far beyond any prediction at the beginning of the year. Later, the Senate authorization bill was similar, but the appropriations bill cut the increase back to 3.3 percent (an unusual reversal of roles in the Senate and House). During August we did a good deal of work to encourage mathematicians and others to speak to the twelve senators on the conference committee in their local districts and to urge their support of the House version of the bill. In September the final figures will be decided in Senate/House conference.

Whenever we go to Washington, we hear the same story: Scientists are not very visible. And as mathematicians, we're invisible! However, I think that's changing, and an appreciation is building for the fact that the sciences are interdependent—you can't really study, say, medical imaging without using physics, chemistry, mathematics. Furthermore, it is impossible for the federal government to predict which areas of basic science will yield the most important and revolutionary advances. I believe that the best method to ensure success in mathematics is to encourage bright students to pursue mathematics as a career. We then need to support them, both as students and as active mathematicians, for as long as they are successful.
Our natural allies come not only from universities, but also from industry, business, and the financial community, for the future prosperity of our country depends on our scientific strength. A large problem is that science needs more powerful advocates in Congress, persons who put science on the top of their agenda. But few people in government have scientific training, and many do not understand the way that scientific discovery comes about. We have worked with and are grateful to James Sensenbrenner, the current chair, and to George Brown, longtime former chair of the House committee, and to Vernon Ehlers, a distinguished vice chair. There are some active persons in the Senate, including two with whom we have had recent contact, Senators William Frist and Joseph Lieberman. Senator Phil Gramm has put forward a bill, S124, which advocates doubling the nondefense science budget over ten years.

**Notices:** What is the next step in these efforts?

**Jaffe:** We have met with Senators Gramm and Lieberman and have worked over the year with their staffs to encourage bipartisan support for science. We hope that these two senators will introduce a new joint bill this fall to replace S124.

We are planning a second statement of the ad hoc coalition of presidents of scientific societies and umbrella organizations this fall. Our aim, rather than focusing on a one-year plan, is to formulate a long-range goal for our country concerning the necessity to increase our investment in basic scientific research. We have increased the size of our coalition from forty-six this spring to over ninety presidents currently on board, and we hope that over one hundred will sign by the time of our announcement.

We are building bridges with various leaders in industry and in business, and we hope that they will coalesce into powerful outside support for our position. We are also working in parallel with certain universities and with the Science Coalition, which is a Washington-based organization of universities, professional societies (including the AMS), and a few individuals. Through the AMS Washington Office and JPBM (the Joint Policy Board on Mathematics) we also are active within the Coalition for the National Science Foundation.

Don Lewis, the director of the Division of Mathematical Sciences at the NSF, has provided a strong voice for mathematics. Don plans to retire this academic year, and a big problem for the community will be how to fill his shoes. The person in that position sets the tone for the visibility of mathematics within the Foundation, as well as ensures that our research funds are well spent.

Much of what I have talked about concerns activities in Washington. However, ultimately the long-term success of science must be based on support from the public, and this means throughout the country. Mathematicians should know who their local representatives are and try to meet them. The members of Congress should know that they can call on a constituent in case they need some advice of a technical nature. It is generally much easier and more relaxed to establish a relationship in a person's local district than in Washington.

**Notices:** What about the longer term?

**Jaffe:** Most important of all, we want to see all these individual actions grow into a “grass roots” movement. Scientists and mathematicians need to take the message to our students, to our schools, to our communities, as well as to our local representatives. Only through the efforts of many people locally can we hope to reach the numbers and the variety of persons needed in order to have a long-term effect. Once the message is sufficiently widespread, it will be taken up by the media.

We are trying to develop models for how this can be done. For example, on October 15 the AMS held a town meeting at its headquarters in Providence. State government officials and local scientists and mathematicians came together to discuss the importance of science.

The AMS Washington Office is working on ways to spawn these kinds of efforts around the country. An ideal setting would be to bring together at a university a group consisting of, say, a couple of mathematicians, a chemist, a physicist, a biologist. The group can invite a local delegation to the university and describe what is going on in different areas of science and explain why it is good for the community. While a few such events have already been held, I hope that in the future mathematicians will play a central role.

I would like to see the AMS and the scientific community set in motion a new passion for science. If we are successful in sparking a grass roots movement, then I believe it can be sustained over the long term.

**At press time,** the House and Senate conferees had agreed on a final version for the 1998 VA, HUD, and Independent Agencies Appropriations Bill, including an increase in funding for the National Science Foundation of nearly 5 percent above the 1997 level, and nearly 2 percent more than the agency requested.
Whatever Happened to Rochester? Two Years Later, Mathematics Is Getting Accolades

Two years ago the mathematics department at the University of Rochester made national headlines as it battled a move by the university administration to eliminate the department's graduate program. After the crisis was resolved in March 1996 and the administration reversed its decision, the Rochester mathematicians made efforts to improve undergraduate instruction and establish stronger ties to other disciplines. Now, a year and a half later, a remarkable turnaround is in evidence, with the mathematics department enjoying the strong support of the administration and drawing praise—and even prizes—for its work. Says William Green, professor of religion and dean of the college, "It's got to be one of the great success stories of higher education."

Emblem of Departmental Woes

The crisis at the University of Rochester has become emblematic of many of the problems facing mathematics departments in this era of shrinking higher education budgets. It was in November 1995 that the university announced the "Rochester Renaissance Plan", which described a host of measures designed to improve the university's financial position and its attractiveness to undergraduates. The plan called for a reduction of 10% in the number of professors and the elimination of four graduate programs (chemical engineering, comparative literature, linguistics, and mathematics). Mathematics was one of the departments hardest hit, with a reduction in faculty slated for close to 50%.

Shortly after the plan was announced, the AMS dispatched a small group to Rochester to offer assistance in helping the department and the administration resolve their differences. When these meetings did not prove fruitful, a number of AMS representatives—including Salah Baouendi, member of the AMS Committee on the Profession, and Arthur Jaffe, who was then AMS president-elect—orchestrated a campaign to get people outside Rochester to write in support of the mathematics department. The campaign was quite successful, drawing a total of over one hundred letters, many of them from prominent scholars outside of mathematics, including a number of Nobel laureates.

All along the biggest sticking point at Rochester was the elimination of the mathematics graduate program, which the mathematics faculty believed would drain the lifeblood from its research effort and eventually undermine the intellectual tone of the university. When, after nineteen weeks of internal negotiation and pressure from the letter writers, the administration agreed to reinstate the graduate program, the landscape suddenly changed. "I think that at that moment everybody realized that we were all on the same team," says Douglas Ravenel, who became chair of the mathematics department. The department was able to breathe a sigh of relief and address the very real problems the administration had pointed out, and the administration now had an interest in strengthening the mathematics department.

With Ravenel as chair, the mathematics department has been working hard to improve its undergraduate teaching and to reach out to other departments. Because Ravenel is one of the most highly regarded researchers in the department, the fact that he took an active interest in the department's fate was important in bringing about the turnaround. "This is a group of leaders, strong
mathematicians who stepped up” to the challenge, says Thomas LeBlanc, professor of computer science and dean of the faculty. “They are intellectual leaders, not political leaders.” That the change came so quickly is quite remarkable. “When you tell people this happened in a year and a half, it seems like we're trying to put a happy face on a bad situation,” LeBlanc remarks. “But that's not the case.”

**Improvements in Teaching**

The mathematics department started making improvements in the area that had drawn the most complaints: lower-level teaching. One of the most visible manifestations is WebWorK, an Internet tool developed by Michael Gage and Arnold Pizer. (Ironically, WebWorK was under development even before the crisis broke at Rochester.) Earlier this year Gage received a regional prize from the Mathematical Association of America for his role in developing WebWorK, and he has also received an on-campus teaching award.

WebWorK supplies students with homework problems in such a way that they all have the same problems, but each has slightly different numbers. Therefore, the correct answers are different for each student. When the student keys an answer into WebWorK, he or she is told immediately whether or not the answer is right. No hints are given, but with the immediate feedback the students become quite persistent: Eventually, 80 percent of them get all of the answers right. In addition, when a student does come to the professor with questions, he or she has usually thought about the problem quite a bit. “So the direct communication between student and professor is much more specific, much more focused, than student questions are in a traditional course,” Ravenel explains.

WebWorK was introduced in a new course called “Calculus with Foundations”, which is aimed at precalculus students. The department found that these students, who tend not to be highly motivated in mathematics, responded well to WebWorK. “They say that the immediate feedback is a huge asset,” says Ravenel, noting that the students also seemed to work a lot harder at the course. This fall the department is expanding the use of WebWorK into its slower-paced calculus course, which has an enrollment of about 170 students.

The reasons for developing "Calculus with Foundations" provide a good example of the problems the department faced. At Rochester—as on many campuses nationwide—freshmen have been arriving with steadily declining mathematical backgrounds. “There was a widening gap between what incoming freshmen knew about mathematics and what other departments expected them to know as sophomores, and we were expected to fill this ever-widening gap,” says Ravenel. With precalculus the situation was even worse, because other departments would steer their students from the course because it offered so few credits. Predictably, these students would flounder in calculus. “Calculus with Foundations” addresses these problems by filling in holes in the students’ background while introducing them to ideas from calculus and offering them more credits.

Another new course developed by the department is “Calculus for Understanding”. It is tougher than the regular calculus course for science and engineering majors but less theoretical than honors calculus. The hallmark of the new course is the use of two-hour workshops—in which students collaborate on the homework, with a teaching assistant roaming around the room to provide help—rather than traditional recitation sections. The new course is one of a group of “Quest” courses on the Rochester campus, which are designed for highly motivated freshman students and which provide a setting where students work in groups on problems and get a taste of what real research is like. Enrollments in the mathematics department’s Quest courses far exceed those of any other department. The department’s success with precalculus and calculus courses has resulted in articles in the Rochester alumni magazine as well as in the local newspaper, the Rochester Democrat and Chronicle, which on September 27 ran a story entitled “UR Tries to Cure Calculus Fear”.

One factor that has buoyed the fortunes of the mathematics department is that the Renaissance Plan’s aim to improve the academic preparation of the student body has paid off: the average SAT score for this and last year’s incoming classes is just shy of 1300, the highest it has been in twenty years. The mathematics department is seeing the change firsthand, says Ravenel. “We see more people enrolled in these very challenging courses, and this is very encouraging.” Thirty-three students made it through honors calculus in the fall semester of 1996, “a huge enrollment,” according to Ravenel. What is perhaps even more striking is the half dozen freshmen who enrolled in and succeeded at sophomore-level honors calculus. “Nothing like this has ever happened before,” Ravenel remarks, noting that in the past at most one or two freshmen might enroll in that course. And generally the courses in the mathematics department just seem to be popular. Ravenel says nobody knows why last semester a dozen economics graduate students showed up for a graduate course in measure theory. Although the economics department at Rochester has a mathematical bent, having so many economics students in such a theoretical mathematics course is unusual.

At the time the Renaissance Plan was announced many departments had complaints about the teaching in the mathematics department, and relations with engineering were especially strained. The en-
engineers' frustration was compounded by the fact that one of their own faculty, Al Clark, has a doctorate in applied mathematics and is an excellent mathematics teacher. To the dismay of the mathematics department, the engineering school began offering its own versions of some upper-level mathematics courses. Two initiatives have calmed these troubled waters. First, discussions between mathematics and other departments led to the development in the mathematics department of a new differential equations course that better addressed what other departments said their students need. And second, the mathematics department extended a joint appointment to Al Clark. (A joint appointment between mathematics and physics is also in the works.)

The mathematics department has not only reached out to other departments to address teaching concerns but has also made scholarly connections. There is now a joint mathematics-physics colloquium attended by members of both departments. In addition, an applied mathematics seminar was started last year that brings in speakers from a variety of other departments to talk about the use of mathematics in their own subjects. "There is a lot of mathematics being done outside the mathematics department," says Ravenel, "and this is a very good way to get people together." There have been talks on DNA computing and chemical reactions—and even one that used flag manifolds to help explain the dance language of honeybees. When the speaker suggested a connection between this dance and quantum mechanics, "the physicists went ballistic," Ravenel reports. The speaker "set a new standard for intellectual provocation," he says, and the discussion went on for about half an hour after the talk had ended. (The work of the speaker, mathematician Barbara Shipman, is described in the article "Quantum Honeybees", Discover magazine, November 1997.)

One dark cloud looming over the Rochester mathematics department is the administration's insistence that the number of mathematics faculty be reduced to 15. Mathematics faculty member Michael Cranston says that the reduction would make it "impossible" for the department to meet its teaching responsibilities. Since the time the Renaissance Plan was announced the department has lost three faculty: one moved to the University of Iowa when the turmoil erupted, and two others have accepted early retirement packages. With one of the retirees working half-time, the faculty now numbers 18 1/2 full-time members. In addition, the graduate program is currently limited to twenty students, down from a steady-state of the low thirties before the Renaissance Plan. "The size restrictions on the faculty and the graduate program put constraints on our ability to cover the teaching that needs to be done," Cranston says.

Advice for Other Departments

The turnaround in the mathematics department at Rochester can provide lessons for other institutions. For example, "communication with other departments is vital," Ravenel observes. "Mathematicians have a tendency to be politically aloof and not to get involved in the politics of their institutions and not to interact with other departments. This makes us very vulnerable. I think that when you meet with other departments one-on-one and discuss issues related to mathematics, it can be very beneficial." His department has met with almost every other department that has a mathematics requirement to discuss what the other departments want their students to know about mathematics. As a result of these meetings, says Ravenel, "I think there's a feeling around the university that the math department is very approachable and responsive to the needs of other departments."

These meetings also revealed some misconceptions on the part of other departments. For example, many believed that mathematics courses were taught too abstractly or too theoretically. "On the other hand, they admit that mathematical maturity is a very valuable commodity and it's something that they want all their students to have," Ravenel notes. Bringing such contradictions to light helps the two sides understand better the problems that need to be addressed. Another misconception, says Ravenel, is that professors in other departments tend to believe that calculus is taught in the same way as when they were in college. "They are oblivious to the changes that have been made in the way that calculus has been taught in the last twenty years," he notes. "The more you can communicate with them about these things, the better off you'll be."

In addition to discussing mathematics instruction, it is also important to forge scholarly connections to other departments through such activities as joint seminars. Asked which was more important, Ravenel says, "If you do it right, these things can reinforce each other." In particular, he believes that having lively interactions with other departments makes the mathematics major more appealing to undergraduates. "Every math department needs to have an attractive major so that they can get more students, and that will improve the health of the department," he notes. In this way
the scholarly and teaching missions are drawn closer together.

**Ingredients in the Resolution**

According to Paul Slattery, chair of the Rochester physics department, the key ingredient in the solution of the crisis at Rochester was the internal response of the mathematics department. Another important factor, he notes, was the support of physics. “Physicists nationwide had rallied to the support of the math department in significant numbers,” says Slattery, “and physicists at Rochester were certainly no exception. Some wrote semipublic letters and some chose to proceed more discreetly, but all fully understood the obvious fact that we would not long continue to be a top quartile department in association with a completely dysfunctional math department.” The support of the physics department for strengthening ties to mathematics, through joint appointments and other mechanisms, increased the receptiveness of the administration to reversing its decision.

How important were the letters from well-known scholars and Nobel laureates outside Rochester, who took the administration to task for its demotion of the mathematics department? Views on this question vary. Certainly, many in the mathematics department believe the letter-writing campaign was critical. “It made it impossible for the administration to ignore, and also for other departments to ignore,” says Cranston. That many of the letters came from outside mathematics made them especially influential. It was not just the AMS functioning as “a guild protecting its own members,” he notes.

Others see the letters as less important. In fact, Slattery points out that the very intensity of the protest made it especially difficult for the administration to consider reversing itself, “lest it appear to be irresolute in the face of outside criticism.” Dean LeBlanc says the letters “raised the temperature” but were not a critical factor. The idea that the administration changed its mind under the pressure of opinion outside Rochester is “wrong,” he says, “because without the leadership in the math department coming forward, the letter-writing campaign would not have had an effect.” LeBlanc worries that the mathematics community might see Rochester entirely as a political battle, with the lesson being that mathematics must be vigilant and defend itself against its enemies. Instead, he says, mathematicians should recognize that there are real problems in higher education that they need to work on. If they become “part of the solution to those problems, it will be good for mathematics.”

Asked about the letter campaign, Dean Green replies that change came not as a reaction to pressure but “through quiet, intelligent negotiation and diplomacy.” He credits Rochester president Thomas Jackson with having the courage to reverse a decision to which he had made a substantial commitment. Jackson could have stuck to his decision, for he had the support of the Rochester Board of Trustees (in fact, he took some heat afterwards from supporters of departments in which the decision to eliminate the graduate programs was not reversed). For its part the mathematics department could have retreated into itself and become “bitter and self-righteous,” says Green. “But they turned around, looked at the problems, and saw what they needed to do. There was real leadership from the department and from the president.”

Many of the letter writers from outside Rochester focused on the central role of mathematics in the scholarly and academic world. In this the letter writers were correct, Green believes, but mathematicians must take this centrality seriously. “The message to mathematicians is that, because your subject is essential to so much, you cannot afford to be anything but powerfully engaged in thinking through the future of your own institutions,” he says. “Not all fields have that obligation, but mathematics really does.” The centrality of mathematics “does not give you entitlements; it gives you responsibilities.”

—Allyn Jackson
Mathematicians are frequently called upon to write and talk about their work to a general audience in order to convince those who pay our salaries and (if we are lucky) support our research activity that the research we do is worthwhile and interesting. Indeed, the editorial column in these Notices has itself urged just this on more than one occasion. Most of us find this task such a daunting challenge that we put it aside for a rainy day, only to find that there are always more pressing things to be done, whether it is writing up a new piece of research or preparing a new course. There is a small but significant number of mathematicians, however, who succeed in this task and produce a (seemingly) constant stream of entertaining (and informative) books about mathematics for a “general audience”. Ian Stewart is one of these, and one of the most successful.

Nature’s Numbers is the sixth in a series of fairly short books called The Science Masters, in which leading scientists communicate their ideas to general readers. As far as I know (from the list of current and planned future contributors on the back cover) Stewart is the only mathematician currently on the list. Having read two or three of the books in the series, I would say that the format is very successful. The books are short enough to be read in one or two sittings and are very accessible to their intended audience. At least that is true of the other books in the series; it is rather dangerous for a mathematician to judge what is or is not accessible to nonmathematicians.

The starting point for Nature’s Numbers is that there are many patterns to be found in nature, including numerical patterns (such as Fibonacci numbers in sunflowers) and shape patterns (such as in snowflakes). The first chapter already seeks to define what we actually mean by “a pattern”, coming to the conclusion that we see a pattern in something that has symmetry, but not too much symmetry — that is, broken symmetry. We do not see a pattern in the still surface of a pond, as there is too much symmetry. If we then toss the traditional pebble into the pond, however, the perfect symmetry is broken: we lose all but the symmetries which fix the point where the pebble strikes the surface in the resulting pattern of concentric circles. This theme of broken symmetry is a recurring one in the book, particularly in Chapter 6. The

“Mathematical Recreations” column in Scientific American each month? Are they mathematics graduates in nonmathematical careers who like to keep their mathematical hand in? Or people who always wanted to be able to understand mathematics better but left it behind at an earlier age?

Nature’s Numbers is the sixth in a series of fairly short books called The Science Masters, in which leading scientists communicate their ideas to general readers. As far as I know (from the list of current and planned future contributors on the back cover) Stewart is the only mathematician currently on the list. Having read two or three of the books in the series, I would say that the format is very successful. The books are short enough to be read in one or two sittings and are very accessible to their intended audience. At least that is true of the other books in the series; it is rather dangerous for a mathematician to judge what is or is not accessible to nonmathematicians.

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ideathatsymmetriesareoperationsthataremaybe combinedtogether,ratherthansтратproperties ofashape,isoroughtout.Naturehassymmetries atevenscale,fromelementaryparticlealandatom rightuptogalaxies.Theroleofmathematicsis todescribe symmetry-breaking processes inorderto explaininunifiedwaythefactthatthepatterns weseseinandunesandzebras'sstripesarecaused byprocesseswhich,whaphysicallydifferent,are mathematicallyverysimilar.

In the early chapters of the book there is an excellent attempt to answer the questions What is mathematics for? and What is mathematics about? For the former, the answers given includesolving puzzlesinnature(suchaswhyplanetsmovethewaythattheydo),describingchangingquantities via calculus, modeling change (such as the evolution of the eye), and the prediction and control of physical systems. The useful point is made that there is often a very long time lag between the original, "pure" mathematical work and the eventual application, so that purely goal-directed research is often inappropriate in mathematics. I hope that the grant-awarding bodies read as far as this (page 29)!

Under the heading "What Mathematics Is About" Stewart emphasizes that it is not just about numbers, but also about operations (also known as functions or transformations), about the logical relationships between facts, and about proof. He gives a good example of the process of finding a proof. There is also an interesting section on the "thingification of processes" as a basic mathematical process. I have previously read about this (using the more standard word "reification", which Stewart says sounds pretentious) only in articles on mathematics education; here it is made clear what a universal abstraction process this is, not just in mathematics.

There is not space here to describe the contents of each of the book's nine chapters in detail: the pace is fast, and hence a lot of ground is covered quickly. I must confess that when I started to read it, I was expecting more of a bias towards nonlinear dynamics and chaos, but this does not appear (except briefly) until the last two or three chapters. Prospective readers who have not been prepared to tackle a whole book on these topics (such as Stewart’s own Does God Play Dice?) could do a lot worse than to read Chapters 8 and 9 of this book for an entertaining and readable account. In the last chapter, entitled "Drops, Dynamics and Daisies", there are three examples of "simplicity emerging from complexity": the formation of water droplets, population dynamics, and Fibonacci numbers cropping up in the formation of daisy petals. I found it particularly surprising to learn that it was not until 1993 that the latter phenomenon was given a satisfactory dynamical explanation. In each of the three examples the case is made that nonlinear dynamics provides a better insight and explanation into what happens than earlier attempts, which were either purely descriptive or overly formula-bound.

The epilogue to the book is entitled "Morphomatics". It appears to be a kind of manifesto for a new mathematical theory of that name, or even for a new kind of mathematics that will complement rather than replace current scientific thinking. This new theory does not currently exist, but Stewart sees its creation as a necessary way forward in the use of mathematics to understand the natural world. Not all mathematicians will necessarily agree with this manifesto, but it should certainly stimulate an interesting debate. It is a little puzzling, however, for such a manifesto to appear in the epilogue of a book that is not aimed at mathematicians!

Finally, there are several dozen references for further reading, divided up by chapter. These are mostly articles and books published within the last ten years, but include a few earlier items such as the classic On Growth and Form by D'Arcy Thompson (originally published in 1917, and still in print). I would like to add one title: Patterns in Nature by Peter S. Stevens (Little, Brown & Co., 1974) is a beautifully illustrated account covering some of the same ground.

This book claims it will equip its readers with a mathematician's eyes and hence change the way they see the world. In this aim it stands a good chance of succeeding—provided that they are not already mathematicians, of course.
Libraries are special resources in mathematics, and their health is a matter of concern not only to librarians but also to mathematicians. Spiraling journal costs, budget problems, space problems, and the increasing role of electronic media continue to require decisions that affect every aspect of the operation.

In the late 1980s the AMS became interested in collecting data on mathematics research libraries to replace anecdotal information. The overall purpose is to assist librarians and mathematicians to build and maintain the best possible mathematics research libraries in academic institutions. The first AMS survey of mathematics research libraries was conducted in the fall of 1990 (Notices of the AMS, December 1991, 1258-1262). As in 1990 the goal of the 1996 survey was to document the state of the system.

The 1996 survey was run in the fall of 1996 and extended into February 1997. As in 1990 the questionnaire was sent to all institutions granting the doctorate in mathematics in the U.S. and Canada. The questionnaire was designed to be filled out by the librarian in charge of the mathematics library, which is defined as the main mathematics collection used by the mathematics faculty and graduate students, whether this collection is housed in a general library or some other structure such as a science library or branch library. In some institutions there is more than one collection that is important to mathematicians, and rather than combine data it was requested that these collections should be reported separately. The focus, however, is on the main collection in each institution.

The questionnaire was sent to 25 institutions in AMS Group I public, 23 in Group I private, 56 in Group II, 72 in Group III, and to 29 Canadian doctoral-granting departments. The U.S. peer groups are determined by "scholarly quality of program faculty," as reported in the 1995 publication Research-Doctorate Programs in the United States: Continuity and Change. Group I is composed of 48 departments with scores in the 3.00-5.00 range and is further divided into public and private institutions. Group II is composed of 56 departments with scores in the 2.00-2.99 range. Group III contains the remaining U.S. departments with doctoral programs and includes a number of departments that were not part of the 1995 ranking. The response rates were:

- Group I public: 23 libraries in 22 institutions; 22/25 or 88% of institutions responded (1990, 85% for all of Group I)
- Group I private: 22 libraries in 21 institutions; 21/23 or 91% of institutions responded (1990, 85% for all of Group I)
- Group II: 37 libraries in 35 institutions; 35/56 or 63% of institutions responded (1990, 74%)
- Group III: 48 libraries in 48 institutions; 48/72 or 67% of institutions responded (1990, 66%)
- Canadian: 26 libraries in 25 institutions; 25/29 or 86% of institutions responded (1990, 48%)

In all, this amounts to responses from 156 libraries in 151 institutions, that is, 151/205 or 74% of all
1996 AMS-IMS-MAA Library Survey

The Canadian Mathematical Society participated in the 1996 survey. The questionnaire was written by the AMS Library Committee. Current (*) and participating retired (†) librarian members are: Nancy D. Anderson (co-chair), Carol Hutchins*, Dorothy McGarry*, Mary Ann Southern †, Martha Tucker*, John W. Weigel II †. Mathematician members are: George E. Andrews †, Bruce Berndt† (co-chair), Felix Browder †, Lawrence S. Husch†, James Rovnyak †, James J. Tattersall†, Hung-Hsi Wu*. Karl Dilcher served as the Canadian liaison.

A copy of the full report on the 1996 AMS-IMS-MAA library survey may be obtained from the Web site: http://wsv.class.virginia.edu/~jlr5m/survey/survey.html.

mental reading rooms (1 in Group I public, 2 in Group II, 2 in Group III, and 1 in Canada). An effort was made to get more responses from reading rooms, but we regret that the numbers are too small to report them as a separate group. Reading rooms nonetheless play a very important role in many departments.

The size of the mathematics literature is also a factor in interpretation of results. Compared to the humanities, the mathematics literature is relatively compact and monolithic. Its size and diversity nevertheless come as a surprise to many people.

- In 1996 Mathematical Reviews selected articles from 1,629 journals (in 1990, about 1,400), and of these it indexed cover-to-cover about 600 (in 1990, about 400).
- In 1997 there are about 29 purely electronic journals in mathematics or closely related areas. Of these, 22 are indexed cover-to-cover. About 123 journals are offered in both paper and electronic format, and this number appears to be rising rapidly.

The authors thank B. TePaske-King and P. Shanks of Mathematical Reviews for supplying these figures.

Some of the ground covered in the 1990 survey was not duplicated in 1996. In 1990 there were questions probing characteristics that make a good library. These are the same today. The ideal mathematics library has a deep and broad collection including older and historical materials and complete runs of journals. Mathematicians prize ease of access, ability to browse, and a pleasant environment. Professionalism in the staff and good service are also frequently named by mathematicians as important characteristics of a good library.

In the 1996 survey we have been especially interested in comparisons with 1990. Direct comparisons are complicated by the fact that the Group I population has been enlarged from 39 in 1990 to 48 in 1996. Group I is also newly divided into two subgroups, Group I public and Group I private. In some cases Group I public and Group I private were combined for the purpose of comparison with 1990.

These conclusions stand out.

- Significant numbers of journals are being cancelled (Table 1), and some added. Since the questionnaire did not ask the respondents to note if domestic titles were replacing foreign ones or if titles were replaced with those of equal value, we cannot state the extent to which this trend is deleterious. However, a major reshaping of journal collections is under way, from broadly based collections to those which more closely reflect the specific research interests of various departments. Market forces and inflation are driving cancellations. This is shown most strikingly in Group I public universities and Canadian universities: the former with a net change of -22, due to a decrease in state funding, and the latter with a net change of -46, partly due to the decline of the Canadian dollar. Subscriptions of paper journals in 1996 are down about a quarter from 1990.
  These data are consistent with data published by Chrzaszowski and Schmidt (Library Acquisitions: Practice and Theory, 1997), which show an overall drop of 18% in domestic science serial holdings in a national aggregate serial collection between 1992 and 1994.

- Serials budgets are up sharply, but they cannot compensate for price increases. The median for Group I rose 58% from 1990 to 1996. Group II rose 32%, Group III rose 20%, and the Canadians rose only 11% in U.S. dollars. Canadian serials budgets increased 30% in Canadian dollars, but a strong decrease in exchange rates for Canadian currency negated much of the budget increase. Spiraling journal costs have hit smaller libraries especially hard, and a growing gap between budgets of large and small libraries may be a byproduct of the journal cost crisis.

- Demand for electronic journals is modest thus far. There is interest in receiving journals in both paper and electronic format. The numbers for purely electronic journals obtained by subscription, or free but cataloged, are very small. At the same time, 60% of all libraries provide access to free electronic preprints, journals, and other mathematical resources such as e-MATH (Table 2, column (H)).

- The Web-based MathSciNet is popular: after only a little more than a year, already 69% of all libraries report that they have subscribed.

- The median for total number of volumes is up 15%. In terms of numbers reporting space problems, this issue seems to take second place to budget shortfalls. The problem is very
serious for those who have it. Space problems affect about 29% of all libraries: 20% have less than a quarter of their books in other locations, 9% a quarter or more. In a subject that has so much emphasis on browsing and the older literature, a badly split collection threatens productivity and quality of scholarship.

- There is an increase in the number of mathematics libraries that are part of a general library or a science and engineering library. The increase appears across all groups. In Group I this is due to at least one change from a departmental library to a science library, but another effect is the change of population by the 25% enlargement of Group I from 1990. We also note erosion of the numbers of mathematics libraries located in the same building as the mathematics faculty. There remains, however, a strong correlation of location in the same building with the top-ranked departments: the figure drops from 73% in Group I to 17% in Group III.

- Oversight by a professional librarian remains strong in 1996 as in 1990. There is an increase from 77% to 91% in Group I. Group III also shows an increase, while Group II is down slightly. The decrease from 75% to 65% in the Canadian group must be read in light of the fact that the 1996 population of the Canadian group is significantly larger than in 1990.

Table 1 shows the net change in number of journals from reported cancellations and additions. The median for the Canadian group is particularly striking when total holdings are taken into account. In Group I about twice as many show a negative net change as positive. Group III stands out in a table not included here for the very small number of additions to replace cancellations; whereas the other groups are reshaping their collections, Group III appears to be mainly reducing.

The next table shows electronic products available in the library:

### Table 1
Net change in number of journals: number added minus number cancelled (numbers in parentheses show response rates)

<table>
<thead>
<tr>
<th></th>
<th>Group I public</th>
<th>Group I private</th>
<th>Group II</th>
<th>Group III</th>
<th>Canadian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(20/23)</td>
<td>(18/22)</td>
<td>(25/37)</td>
<td>(39/48)</td>
<td>(21/26)</td>
<td>(123/156)</td>
</tr>
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<td>80 to 89</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>70 to 79</td>
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<td>60 to 69</td>
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<td>1</td>
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</tr>
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<td>50 to 59</td>
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<td>0</td>
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</tr>
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<td>6</td>
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<td>18</td>
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<td>10</td>
<td>2</td>
<td>22</td>
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<td>−10 to −19</td>
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<td>4</td>
<td>4</td>
<td>9</td>
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<td>22</td>
</tr>
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<td>3</td>
<td></td>
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<td>−90 to −99</td>
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<td>−18</td>
<td>−10</td>
<td>−46</td>
<td>−16</td>
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### Table 2
Electronic products

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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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<td>5</td>
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<tr>
<td>Group I private</td>
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<td>11</td>
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</tr>
<tr>
<td>Group II</td>
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<td>5</td>
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<td>3</td>
<td>23</td>
</tr>
<tr>
<td>Canadian</td>
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<td>8</td>
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<td>3</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
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<td>58</td>
<td>30</td>
<td>60</td>
<td>6</td>
<td>18</td>
<td>93</td>
</tr>
</tbody>
</table>
The American Mathematical Society is pleased to announce the new AMS VISA® Card. This credit card offer is available to all AMS members and carries no annual fee. The offer is the result of a signed agreement between MBNA America Bank, N. A.® and the AMS. The AMS will receive a percentage of all purchases made by members on the AMS card and for each new account that remains open for 90 days.

You will receive information in the mail from MBNA describing the credit card option and benefits. Please examine this offer and choose the card that works both for you and for the AMS!

*MBNA America and MBNA are federally registered service marks of MBNA America Bank, N.A., and VISA is a federally registered service mark of VISA U.S.A., Inc., respectively; each is used pursuant to license.

Over all groups, 69% report use of (A) MathSciNet (Web version) as compared to 37% for (C) the CD-ROM version; 11% have (B) the online version through a site-load or consortium. Only 3% subscribe to (E) CompactMath.

Group III and Canadian institutions are most affected by lack of electronic access; an exception is that the larger libraries in Group III are more likely to have products like (D) and (E).

Comparisons with 1990 are not so easy to make, because the electronic scene has been in such a state of change.

- Already in 1990 most libraries had their catalogs online; asking this question in 1996 did not seem worthwhile, as the practice now is essentially universal.
- Availability of electronic media from faculty offices was an issue in 1990. We conjecture that the nonresponse to our questions in this area means that this is not an issue in 1996; that is, access is widely available to faculty who desire it.
- MathSciNet did not exist in 1990. In 1990 only 28% reported some version of MathSci available in-house in the library; 62% had MathSci available via a vendor. Today having some version of MathSci is on its way to becoming universal in Group I and the Canadian institutions, but Groups II and III lag in this area. The full report on the survey includes many additional tables and should be consulted for detailed information.

**Note:** A version of this report is also being published in the November 1997 *CMS Notes*.
MAA Prizes Presented in Atlanta

At the MAA Mathfest in Atlanta in August 1997 the Mathematical Association of America presented a number of prizes.

The Carl B. Allendoerfer Award was established in 1976 to honor articles of expository excellence in the Mathematics Magazine. In 1997 the award went to COLM MULCAHY of Spelman College for his article "Plotting and Scheming with Wavelets", Mathematics Magazine, December 1996; and to LIN TAN of West Chester University for his article "The Group of Rational Points on the Unit Circle", Mathematics Magazine, June 1996.

The Trevor Evans Award, established in 1992, recognizes authors of exceptional articles that are accessible to undergraduates and published in Math Horizons. The 1997 award went to WILLIAM DUNHAM of Muhlenberg College for his article "1996—A Triple Anniversary", Math Horizons, September 1996; and to DAN KALMAN of American University for his article "A Perfectly Odd Encounter in a Reno Cafe", Math Horizons, April 1996.


The Merten M. Hasse Award is intended to encourage young mathematicians to take up the challenge of exposition and communication. Presented in alternate years, the prize recognizes a noteworthy expository paper appearing in an MAA publication where at least one of the authors is less than forty years old at the time of the paper's acceptance. The 1997 Hasse award was presented to JONATHAN KING of the University of Florida for his paper "Three Problems in Search of a Measure", The American Mathematical Monthly, August-September 1994.


— Allyn Jackson
On Issues of Immigration and Employment For Mathematicians

Cora Sadosky

The major political and economic changes that shook the world during the last decade led to population displacements. The simultaneous globalization of the economy produced complex effects on unemployment resulting in confusion, exasperation, and despair. Such a reaction is being felt in the U.S. mathematical community, which has faced an unexpected and sustained scarcity of jobs. Issues pertaining to immigration have come before the Society a number of times in the past few years. In view of this I accepted an invitation from the editors of the Notices to write on this subject.

Mathematics (Universal Science) in the U.S. (an Immigrant Nation)

Mathematics is the universal science par excellence, with no language or national barriers. This constitutes one of its great traditions. The validity of the same theorems in Chicago, Jerusalem, Beijing, Cape Town, Paris, Rio, Cairo, or Tokyo is one of the few things still beyond doubt—ours is an international enterprise.

"Throughout its history, the United States has been a nation of immigrants" reads the first sentence of "The New Americans," the monumental new report produced by the National Research Council on "Economic, Demographic and Fiscal Effects of Immigration" [9]. It concludes that "immigration produces substantial economic benefits to the U.S. as a whole," yet recalls that "the current debate over... immigration is not new; it stretches back even to colonial times. There are concerns about the effects of immigration on the economic prospects of native-born residents." On scientific immigration there is little, and all is praise.

In fact, there is not one significant aspect of American life that has not gained through immigration, from music to modern art and architecture, to sports, to medicine, and—paramount to all—to science. "The emergence of American research mathematics coincides with the founding of Johns Hopkins University and the hiring of the British Algebriast J. J. Sylvester in 1876" [5], while modern medicine began when the new Johns Hopkins School of Medicine brought Sir William Osler from Oxford.

Many of the immigrant scientists arrived already famous, as did Albert Einstein and Emmy Noether, and became the teachers to many of the more senior AMS members. But many others—refugees from Nazism also among them—developed brilliant careers here, building in the process renowned schools in U.S. institutions. The contribution of immigrants to the formation and consolidation of the American mathematical community is well known (see, e.g., [2] and [5]).

In the mathematics departments of many U.S. universities a substantial percentage of professors—in particular, of mathematicians—are foreign born. This would be unthinkable in Europe! It is a sign of how more socially open this country is with respect to the rest of the world. We should be collectively proud of the U.S. openness, which underlines an extraordinary social dynamism. The enlightened acceptance foreigners receive at our universities ought to be promoted as an example to follow.

Shortage of Professional Employment for Mathematicians

All this being widely acknowledged, there is a shortage of mathematical jobs in the United States of unprecedented proportions. Although
many causes coalesce to produce this problem, some voices are turning to a not-so-new approach: curtail immigration to protect jobs for U.S. nationals.

The problem of finding employment for graduating and recently graduated mathematicians is real and severe. Much has been said about how responsible institutions (like the National Science Foundation or the National Academy of Sciences) have made wrong predictions on the issue in the recent past (see, e.g., [1]).

This appalling situation is not unique to mathematics, but widespread in all academia, worse in the humanities than in the sciences. Many of its causes are common to the problems created by an increasingly global economy, but some are peculiar to the academic environment. Among the latter are declining overall federal funding for basic research, declining states' funding for higher education, and university administrations applying corporate methods to handle the educational boom, which has made colleges and universities into a $180 billion industry, nearly 3 percent of the total U.S. economy (New York Times, August 31, 1997).

Under this plight, and finding it plausible that immigration has played a part in the high unemployment figures, a few mathematicians have gone to the public (see, e.g., articles in the Wall Street Journal, September 4, 1996, and in the Boston Globe, March 17, 1997) and to Congress, urging that the immigration of research scientists and university professors be restricted.

**Traditional Scapegoat: The Alien**

"2,000,000 chomeurs = 2,000,000 arabes" was Le Pen's slogan for the French National Party last fall. ("Chomeurs" translates as unemployed.) The FNP had to do away with this one xenophobic slogan when it was pointed out in the press as a carbon copy of the anti-Semitic slogan of the Vichy Government during WWII: "200,000 chomeurs = 200,000 juifs". ("Juifs" translates to Jews.) The public found it a bit too much to swallow, even with the high rates of unemployment that exist in France.

But if this happens in France, the cradle of rationalism and once a traditional refuge from persecution, what can one expect from the rest of the world? Elsewhere immigrants are often held responsible for social ills such as epidemics, housing shortages, lower economic standards, and unemployment.

Study after study has failed to substantiate these perceptions, but they still are used to create a scapegoat to explain every evil people suffer from. No need to look for real causes then, much less for solutions.

In the early 1990s at the start of the current job shortage in mathematics the easy explanation was "women are getting all the jobs". Although AMS data provided the basis for an effective early refutation [3, 7], it helped spread stereotypes while diverting attention from the search for solutions.

Now some would make foreigners rather than women the scapegoats. *It is imperative that the xenophobic "foreigners are getting all the jobs" does not become a rallying cry for inaction on the real causes of the problem.*

**"Do Baptist Preachers Cause Public Drunkenness?"**

I raise this unlikely inquiry because an old and famous tabulation clearly shows a strong positive correlation between the number of preachers and the frequency of arrests for inebriation during the second half of the nineteenth century in America.

"You don't need a Ph.D. in logic to spot the fallacy in my first sentence. Correlation is not causality. The undeniable association of preachers and drunks might mean that hellfire inspires imbibing, but the same correlation could also (and more reasonably) suggest the opposite causal hypothesis that the rise in public drinking promotes the hiring of more preachers.

Yet another possibility—almost surely correct in this particular case—holds that preaching and drinking may have no causal relationship, while their simultaneous increase only records a common link to a third, truly determining factor. The steady rise of the American population during the late nineteenth century promoted an increase in thousands of phenomena linked to total numbers, but otherwise unrelated—arrests for drinking and hiring of clergy among them.

This tale has long served as the standard textbook example for illustrating the difference between correlation and causality" [4, p. 296].

Surely mathematicians know better than to mistake correlation with causality in their efforts to deal with the current job crisis.

**Enrollments Decline and Part-Timers Are the Cheap Solution**

Recent data suggest that we ought to be paying more attention to other factors in mathematical unemployment in addition to those stemming from the global economy and from changes in government funding. From 1990 to 1995 enrollment in calculus decreased by over 100,000 students at all four-year institutions according to [6, Table 1]. During the same time period calculus enrollment at two-year community colleges increased by 5,000. Both the net enrollment decrease and the shift between institutions represent a significant number of positions [8]. Assuming full-time faculty normally teach 100 students of calculus per semester, this can add up...
to a loss of 1,000 full-time faculty positions. Not a figure to disregard.

Worse, as new enrollments increase again the positions lost will probably not be replaced in kind, but by part-time, low-paying, no-benefits, heavy-teaching, nonpermanent jobs.

The Size of Graduate Programs and Chinese Students Who Stayed

Under the (debatable) assumption that "we are producing too many Ph.D.s," there is talk of the need to downsize graduate output. It is easy to err with such a policy—we have seen how predictions made twelve years ago were flawed. It is also hard to implement, since it is usually somebody else's graduate program that we would agree to cut. Professors need the graduate programs to justify their research as part of their thesis advising, and chairmen need graduate students as teaching assistants to sustain their undergraduate programs.

When the number of graduate students began to decrease in the 1980s, the Chinese were welcomed. But the influx of Chinese students was not purely spontaneous. The visits of prestigious mathematicians to Beijing were followed by the appearance in their institutions of talented and extremely hard-working students, without whom entire programs would have disappeared. And after graduation they went home. Everybody was happy. Then came the massacre at Tiananmen Square, the Chinese students started to remain in the U.S., and they needed jobs. Even now the U.S. graduates from China face an employment problem far worse than any other group of mathematicians in the U.S., so grave that it has created a racist atmosphere damaging even U.S.-born citizens bearing a Chinese name.

A steady flow of foreign students has come to this country since the 1960s when it became clear that the U.S. had the best graduate education in the world. After a postdoctoral period, most foreign graduates yearn to go home. But it is not always easy or possible to do so. The worst-case scenario is when returning may mean the loss of freedom or life. This is but one more reason why the American mathematical community should care about the human rights situation in China and elsewhere.

Perceptions, Competition, and the American Way

This is not the first time that historical events led to an influx of foreign scientists, as did racist persecution and war in the 1930s and 1940s. Yet it has been repeatedly claimed in the press and in [1] that the current increase in scientific immigration transcends the historical events of the last decade, such as the massacre at Tiananmen Square and the demise of the Soviet Union.

However, a recent NSF study shows that this perception is false. In 1993 the number of people in all fields of science and engineering admitted to the U.S. on permanent visas peaked at 23,534. But in 1994 the number of these immigrants admitted had dropped to 17,403, or a decline of 26 percent. "The number of immigrant scientists and engineers entering the United States each year was stable throughout the 1980s, rose in the early 1990s, and then declined dramatically in 1994 back toward 1980s levels. The latest data indicates that what observers thought was a major, long-term rise in skilled immigrants was only a temporary surge"[10].

The increased influx of mathematicians associated with the dissolution of the Soviet Union coincided with the onset of employment problems. Many of the incoming mathematicians were already very accomplished, while most of the rest had training both broad and deep. Some decried this as unfair competition. Why unfair?

Is it the American Way to give preference to less-qualified U.S. citizens? While the true American Way would be to improve the U.S. educational system to train our graduates so as to ensure their competitiveness, is barring competitive foreigners a New American Way of Affirmative Action?

This would be a perverse caricature—one all too common and responsible for much current backlash. Affirmative action is not about closing doors for those who are able and well trained in favor of those who are not. It is about opening opportunities to all those who are able to become well trained and to compete as such.

Let us work to eliminate the stereotype of foreigners as smart but unable to teach simply because they have accents. Both U.S. nationals and immigrants should be judged on their true mathematical and pedagogical talents when they seek opportunities to flourish.

Who Wants to Be a Mathematician? How to Remain One?

"There is considerable evidence that labor market considerations play a strong role in determining educational and career choices for young people" [1]. This seems to be so and is an important factor in the sharply declining number of U.S. nationals that pursue Ph.D.s in mathematics. "To our most talented students, the mere $6,000 difference in starting salary over that for mathematics bachelor's degree holders does not make a strong economic case for years of intensive postbaccalaureate training amidst deteriorating employment conditions" [1]. But
since when are mathematicians selected on their ambition to make money?

Mathematics is hard. The training requires a lifetime of work; it brings usually less money than corporate law, surgery, or really good computer wizardry; and job security is dependent on circumstances and economics. Those who opt out of mathematics on the basis of economics have made the right choice. There is no way we can attract them—much less keep them—with mere economic incentives. Nor should we want to.

If we are talking about how to attract and keep in the profession all those with strong inclination for the unique pleasures of mathematics, that is another question. At the very least they need to be able to make a decent living and to work under conditions conducive to doing mathematics.

Many young mathematicians are trying to develop research careers in difficult circumstances. Research mathematicians in nonresearch environments, including those at nondoctoral institutions, need support. For ages many women have faced these difficulties without help, and some have survived as mathematicians. Their experiences could help others, and their losses should not be repeated. Now some see promising young mathematicians take positions at nonresearch institutions, and they cry foul. Instead, we should help devise support systems to make small-college positions compatible with research.

Conclusion
The employment problem in mathematics exists and is very serious, warping the lives of many people. It is not clear what the future will bring, yet we have to oppose measures that carry a terrible social cost. It is morally imperative to seek rational and democratic solutions—nonexclusive, embracing all ethnic groups—in keeping with America's tradition of openness.

Banning immigrant mathematicians would, at best, make a few positions available without going to the roots of the problem yet creating others.

The American Mathematical Society has gone on record deploring restrictions in the new immigration law\(^1\), signaling that a significant segment of the community does not see foreign mathematicians as the problem.

Finding ways to support an active research population in the U.S. will become increasingly difficult in an era of globalization of the world economy, where the competition is fierce and international.

As an organized community we have to react positively to the challenge, not by asserting supposed birth rights of the U.S.-born in divisive chauvinist quests, or with anti-immigration nuendo, but with constructive proposals to improve the teaching of mathematics at all levels throughout America and to ensure the possibility of doing research outside the top institutions.

We can and must defend the profession and all of its members, and we will succeed only if we act in concert.

References

\(^1\)At its meeting in April 1996, the AMS Council expressed alarm at then-pending federal legislation to restrict visits and immigration by academic scholars [11]. Despite the concerns voiced by the AMS and other groups, the bill was enacted into law in September 1996. At its meeting in January 1997, the AMS Council passed a resolution deploring provisions of the bill [12]. In April 1997 the Council approved, so as to speak in the name of the Society, the first four paragraphs of that resolution [13].
American Mathematical Society

Recently Published Titles from the AMS

Advances in Mathematical Sciences: CRM's 25 Years
Luc Vinet, Centre de Recherches Mathématiques, Université de Montréal, PQ, Canada, Editor
This volume commemorates the 25th anniversary of the Centre de Recherches Mathématiques (CRM)—a national institute for research in the mathematical sciences in Canada. It includes contributions by eminent scientists who have been closely involved with the CRM. Various topics in pure and applied mathematics, statistics, theoretical physics, and mathematical biology are covered. Original research papers, reviews, as well as historical notes and reminiscences are included in the volume.

Applications of Computational Algebraic Geometry
David A. Cox, Amherst College, MA, and Bernd Sturmfels, University of California, Berkeley, Editors
This book introduces readers to key ideas and applications of computational algebraic geometry. Beginning with the discovery of Gröbner bases and fueled by the advent of modern computers and the rediscovery of resultants, computational algebraic geometry has grown rapidly in importance. The fact that "crunching equations" is now so easy as "crunching numbers" has had a profound impact in recent years. At the same time, the mathematics used in computational algebraic geometry is unusually elegant and accessible, which makes the subject easy to learn and easy to apply.

Featured Reviews in Mathematical Reviews 1995–1996
Donald G. Babbitt, Publisher, American Mathematical Society, Providence, RI, and Jane E. Kister, Associate Executive Editor, Mathematical Reviews, Ann Arbor, MI, Editors
This collection of reprinted Featured Reviews published in Mathematical Reviews (MR) in 1995 in the makes widely available informed reviews of some of the best mathematics published recently.

Mathematics and Mathematicians
Mathematics in Sweden before 1950
Lars Gårding, Lund University, Sweden
This book is about mathematics in Sweden between 1639 and 1950—from S. Klingenstierna to M. Riesz, T. Carleman, and A. Beurling. It tells the story of how continental mathematics came to Sweden, how it was received, and how it inspired new results. The book contains a biography of Otto Mittag-Leffler, the father of Swedish mathematics, and introduced Weierstrassian theory of analytic functions and dominated a golden age from 1880 to 1910.

Important results are analyzed and re-proved in modern notation, with explanations of their relations to mathematics at the time. The book treats Bäcklund transforms, Mittag-Leffler's theorem, the Fréchet-Lindelöf theorem and Carleman's contributions to the spectral theorem, quantum mechanics, and the asymptotics of eigenvalues and eigensubspaces. Other important features include sketches of personalities and university life.

Co-published with the London Mathematical Society. Members of the LMS may order directly from the AMS at the member price. The LMS is registered with the Charity Commissioners.

History of Mathematics, Volume 13; 1997; 268 pages; Hardcover; ISBN 0-8218-0612-2; List $75; Individual member $45; Order code HMAA/13NA

Number Theory
V. Kumar Murty, University of Toronto, ON, Canada, and Michel Waldschmidt, Université Pierre et Marie Curie, Paris, France, Editors
To observe the tenth anniversary of the founding of the Ramanujan Mathematical Society, an international conference on Discrete Mathematics and Number Theory was held in January 1996 in Tiruchirappalli, India. This volume contains proceedings from the number theory component of that conference. Papers are divided into four groups: transcendental number theory, computational algebraic geometry, arithmetic forms, elementary and analytic number theory, and transcendental number theory. This work deals with recent progress in current aspects of number theory and covers a wide variety of topics.

Contemporary Mathematics, Volume 210; 1997; 399 pages; Hardcover; ISBN 0-8218-0606-8; List $69; Individual member $41; Order code CONM/210NA

Partial Differential Equations
Harold Levine, Stanford University, CA
The subject matter partial differential equations (PDEs) has a long history dating from the 18th century and an active contemporary phase. An early phase (with a separate focus on taut string vibrations and heat flow through solid bodies) stimulated developments of great importance in the classical areas and the subject was in a state of maturity by 1830. The second phase, beginning with recent progress in current aspects of number theory and covering a wide variety of topics.

Contemporary Mathematics, Volume 210; 1997; 706 pages; Hardcover; ISBN 0-8218-0775-7; List $69; All AMS members $55; Order code CONM/210NA

Studies on Composition Operators
Farhad Jafari, University of Wyoming, Laramie, Barbara D. MacCluer, University of Virginia, Charlottesville, Carl C. Cowen, Purdue University, West Lafayette, IN, and A. Duane Porter, University of Wyoming, Laramie, Editors
This book reflects the proceedings of the 1996 Rocky Mountain Mathematics Consortium conference on "Composition Operators on Spaces of Analytic Functions" held at the University of Wyoming. Readers will find here a collection of high-quality research and expository articles on composition operators and related fields covered in this volume.

Contemporary Mathematics, Volume 213; 1997; 252 pages; Softcover; ISBN 0-8218-0768-4; List $35; All AMS members $28; Order code CONM/213NA

All prices subject to change. Charges for delivery are $3.00 per order. For optional air delivery outside of the continental U.S., please include $6.50 per item. Payment required. Order from: American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248, USA. For credit card orders, fax (401) 455-4066 or call toll free 800-321-4AMS (4267) in the U.S. and Canada, (401) 455-4000 worldwide. Or place your order through the AMS bookstore at http://www.ams.org/bookstore/. Residents of Canada, please include 7% GST.
Coxeter Receives Sylvester Medal

H. S. M. COXETER, Professor Emeritus of Mathematics at the University of Toronto, has been awarded the Sylvester Medal of the Royal Society. He received the honor "in recognition of his achievements in geometry, notably projective geometry, non-euclidean geometry and the analysis of spatial shapes and patterns, and for his substantial contributions to practical group theory which pervade much modern mathematics."

— Royal Society

Loïc Merel Receives Blumenthal Prize

The Leonard M. and Eleanor B. Blumenthal Award for the Advancement of Research in Pure Mathematics has been awarded to Loïc MEREL of Université Denis Diderot, Paris VII. The award was presented at the AMS meeting in Montreal, Canada, on September 27, 1997, where Merel also presented a lecture entitled "Rational Points: The Case of Elliptic Curves".

Merel was born in Carhaix-Plouguer, Brittany, France, on August 13, 1965. In 1986 he became a student at the École Normale Supérieure, where his interest in number theory was kindled. In 1989 he began a thesis on modular symbols under the supervision of Joseph Oesterlé of the Université Pierre et Marie Curie, Paris VI. Merel took inspiration from the work of Y. Manin and B. Mazur from the 1970s. After a year of military service at the École Polytechnique, Merel completed his Ph.D. in 1993. He then took a CNRS position in the team Problèmes Diophantiens at the Université Pierre et Marie Curie. By combining the techniques developed in his thesis with work of other people, Merel proved that the torsion of elliptic curves over number fields is uniformly bounded. On the basis of that result, he obtained his habilitation in 1994. He held a Miller Professorship at the University of California, Berkeley from 1995 to 1997. He is currently a professor at the Université Denis Diderot.


The Leonard M. and Eleanor B. Blumenthal Trust for the Advancement of Mathematics was created for the purpose of assisting the Department of Mathematics of the University of Missouri at Columbia, where Leonard Blumenthal served as professor for many years. Its second purpose is to recognize distinguished achievements in the field of mathematics through the Leonard M. and Eleanor B. Blumenthal Award for the Advancement of Research in Pure Mathematics, which was originally funded from the Eleanor B. Blumenthal Trust (dated September 24, 1984) upon Mrs. Blumenthal’s death on July 12, 1987.

The Trust, which is administered by the Financial Management and Trust Services Division of Boone County National Bank in Columbia, Missouri, pays its net income to the recipient of the award each year for four years. The recipient is selected by a committee of five members, each of whom has made notable contributions to mathematics. On the committee are Hendrik Lenstra (chair), University of California, Berkeley; Ronald Coifman, Yale University; Benedict Gross, Harvard University; Thomas C. Spencer, Institute for Advanced Study; and Robert J. Zimmer, University of Chicago.

The recipient accepts the award in person and immediately following the formal presentation of the award gives an address on the research for which the award was given. The recipient also presents his or her current research...
in an address to at least one meeting of an academy or mathematical society over the next four years.

— AMS Announcement

Nomizu Receives Blaschke Medal

The Wilhelm Blaschke Memorial Foundation of Hamburg has awarded the Blaschke Medal to KATSUMI NOMIZU of Brown University. A Festkolloquium in honor of Nomizu was held in Hamburg in October and featured several lectures on modern developments in affine differential geometry as well as the medal presentation ceremony.

Nomizu was born in Osaka, Japan, and was educated in Japan and the United States. He received his Ph.D. from the University of Chicago in 1953 and worked in Japan and France before going to Brown University in 1960. A prominent differential geometer, Nomizu has lectured widely in the United States and Europe and is the author of over 85 scientific papers and 7 books. His most widely known work is the two-volume *Foundations of Differential Geometry*, which he wrote with S. Kobayashi of the University of California, Berkeley. It became the standard reference text for a generation of differential geometers. A theme running through Nomizu’s mathematical career has been affine differential geometry, starting with his Ph.D. thesis and continuing through his most recent mathematical papers. While maintaining his active research career, Nomizu retired from Brown University in 1995 as the Florence Pierce Grant University Professor and Professor of Mathematics.

Wilhelm Blaschke (1885–1962) was a prominent geometer and professor of mathematics at the Universität Hamburg from 1919 through his retirement in 1953. He worked in the area of differential geometry and is known for his geometrical intuition and his use of analytic techniques. His major work, the three volumes of *Vorlesungen über Differentialgeometrie* (1921–1929), was influential in the modern development of the field. Volume 2 of this work is dedicated in particular to the exposition of affine differential geometry. Under his influence the Universität Hamburg became a prominent center for mathematics, and Blaschke attracted there the well-known mathematicians E. Artin, E. Hecke, and H. Hasse.

— Walter Craig, Chair, Mathematics Department, Brown University

Presidential Awards for Mentoring

Ten individuals and nine institutions have been named winners of the 1997 Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. This is the second year of the award, administered and funded through the National Science Foundation (NSF). The awards recognize outstanding individual efforts and organizational programs to increase the participation of underrepresented groups in science, mathematics, and engineering at the K–12 through graduate level. Up to ten individuals and ten institutions annually may qualify for the award, which includes a $10,000 grant and a commemorative presidential certificate.

Among the individual awardees were four in the mathematical sciences: CARLOS CASTILLO-CHAVEZ, Cornell University; DAVID FERGUSON, State University of New York, Stony Brook; ROBERT MEGGINSON, University of Michigan; and WILLIAM Y. VELEZ, University of Arizona. Among the institutions receiving the awards is University of Texas, San Antonio, which was honored for the Pre-Freshmen Engineering Program (PREP), directed by mathematician Manuel Berriozabal.

— from NSF News Release

Deaths

RODERICK P. C. CALDWELL, associate professor at the University of Rhode Island, died on September 8, 1997. Born on March 18, 1915, he was a member of the Society for 43 years.

LOUIS HERMAN, associate professor at Kansas State University, died on August 19, 1997. Born on June 25, 1942, he was a member of the Society for 31 years.

ANDREY MALISHEVSKI, senior resident fellow at the Institute of Control Sciences, Moscow, died on September 4, 1997. Born on March 17, 1943, he was a member of the Society for 2 years.

MASAMI OKADA, professor at Tohoku University, Japan, died on August 11, 1997. Born on February 11, 1951, he was a member of the Society for 13 years.

CHARLES L. RIGGS, of Lubbock, Texas, died on November 30, 1996. Born on August 13, 1923, he was a member of the Society for 47 years.
Mathematics Opportunities

News from DIMACS

DIMACS, the Center for Discrete Mathematics and Theoretical Computer Sciences, will hold its 1998-1999 Special Year on Large Scale Discrete Optimization.

This special year is motivated by developments in the past ten years. There have been three simultaneous advances: at the algorithmic level, with new and interesting algorithms for solving large scale discrete problems both exactly and approximately; at the implementation level, providing codes and systems for solving such problems; and at the practical level, with interests in the fast solution of real world problems. Examples of such applications include airline crew scheduling, chemical process design, and telecommunication network design. The goal in this year is to unite these groups. The confluence of exciting recent work on approximation and other algorithms and greatly improved software/hardware for optimization makes large scale discrete optimization a practical, useful approach to solving problems of practical interest.

The special year organizers hope to provide forums to increase research contacts between groups not frequently in contact—for example, practitioners and academics, operations research and computer science researchers, theoretically oriented researchers (in areas such as interior point IP methods, combinatorial geometry approaches, approximation methods, and group formulations) and computationally oriented researchers, including those interested in AI techniques such as constraint programming.

A variety of workshop and mini-workshop topics are under consideration. A pre-special-year workshop on Large Scale Discrete Optimization organized by R. Ravi and Vijay Vazirani is already planned for May 27-29, 1998. Among the topics under consideration are large scale discrete optimization in engineering, in production and scheduling, in transportation, in robotics and vision, and in data mining, as well as algorithms for large scale discrete optimization, semidefinite programming, and constraint programming. In addition, there will be at least one Computational Challenge, addressing one or more problems in large scale discrete optimization. Those with suggestions for workshops or who are interested in aiding the organization of workshops should contact the organizing committee.

Applications for research and graduate student visits to the center are invited. Some funds are available for travel and local support. Two postdoctoral positions will be offered in this area.

Organizers for the special year are: Endre Boros (Rutgers/DIMACS) (local chair), William Pulleyblank (IBM), Michael Trick (Carnegie Mellon) (general chair), Bob Vanderbei (Princeton/DIMACS), and Vijay Vazirani (Georgia Tech). Researchers interested in early discussions about visiting are encouraged to contact the organizing committee by sending e-mail to dimacs98@mat.gsia.cmu.edu. Information about workshops and other activities will be made available on the DIMACS Web site at http://dimacs.rutgers.edu/. The mailing address is DIMACS Center, Rutgers University, P.O. Box 1179, Piscataway, NJ 08855-1179. The telephone number is 732-445-5928.

—from DIMACS Announcement
ICM-98 Grants for Mature Mathematicians from Developing Countries

The International Congress of Mathematicians will be held August 17–27, 1998, in Berlin, Germany. The Organizing Committee of ICM-98 has set up programs whereby young mathematicians from developing countries and mathematicians from Eastern Europe can attend ICM-98. The Organizing Committee has received a number of requests for support for mature mathematicians (age 35 or older) from developing countries who are not eligible for support under the other ICM-98 grant programs. To meet this need, the ICM-98 Committee for Support of Mathematicians from Developing Countries (CSMDC) was established.

This committee will consider applications from mature mathematicians (older than 35 years of age at the occasion of the Congress) with residence in developing countries for grants to attend ICM-98. The funds for financial support are very limited. To secure the participation of as many persons as possible, only local costs in Berlin (registration, board and lodging) will be supported. Travel grants can only be provided in exceptional cases.

The deadline for the submission of applications is January 1, 1998. All applications will be reviewed and all applicants will be informed about the result immediately after May 1, 1998.

For further information and application forms, visit the ICM-98 Web site at http://elib.zib.de/ICM98/. There is a mirror site at the AMS at http://www.emis.ams.org/mirror/ICM98/. One may also write to: Freie Universität Berlin, Fachbereich Mathematik und Informatik, ICM-CSMDC, Arnimallee 2-6, 14195 Berlin, Germany. E-mail requests may be directed to Gerhard Berendt, berendt@math.fu-berlin.de, or to Eberhard Letzner, letzner@math.fu-berlin.de.

— from ICM-98 Announcement

Society of Women Engineers

The Society of Women Engineers is seeking applicants for 56 scholarships in amounts varying from $1,000 to $5,000 and totaling more than $75,000. Scholarships are available for reentry, undergraduate, and graduate students. While none of the scholarships is for mathematics students, mathematics faculty may wish to refer mathematically inclined computer science and engineering students to this program. The deadline to apply is February 1, 1998.

For further information, contact: Society of Women Engineers, 120 Wall Street, 11th Floor, New York, NY 10005-3902; telephone 212-509-9577; fax 212-509-0224; e-mail hq@swe.org.

— Allyn Jackson

NRC-Ford Foundation Postdoctoral Fellowships for Minorities

The National Research Council (NRC) administers the Ford Foundation Postdoctoral Fellowships for Minorities. This program enables teacher-scholars to engage in postdoctoral research and scholarship in an environment free from the interference of their normal professional duties and helps them to achieve greater recognition in their respective fields and to develop the professional associations that will make them more effective and productive in academic employment.

To be eligible, applicants must be U.S. citizens or nationals who are members of one of the following ethnic minority groups: Alaskan Natives (Eskimo or Aleut), Black/African Americans, Mexican Americans/Chicanas/Chicanos, Native American Indians, Native Pacific Islanders (Polynesian or Micronesian), or Puerto Ricans. Applicants are required to have earned the Ph.D. or Sc.D. degree by March 10, 1998, from a U.S. educational institution and may not have held the degree for more than seven years as of the deadline date.

Approximately 25 one-year postdoctoral fellowships are given each year. The total amount of the fellowship is $35,000, which includes a $25,000 stipend. The deadline to apply is January 5, 1998, and awards will be announced in early April 1998.

For further information, consult the NRC Web site http://www2.nas.edu/fo/ or contact: Fellowship Office, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418; telephone 202-334-2860.

— from NRC Announcement
BMS Workshop Report Available

The Board on Mathematical Sciences (BMS) of the National Research Council (NRC) has issued the report *Preserving Strength While Meeting Challenges*. The product of a workshop held in May 1996, the 83-page report contains papers on a range of issues facing the mathematical sciences community.

The last section of the report contains a summary of the proceedings of the workshop. "The summary was prepared by the BMS and reviewed by the NRC in accordance with the usual NRC report reviewing procedures," writes workshop chair Avner Friedman in the report's preface. "The BMS believes that the views expressed at the workshop should be seen by the mathematical sciences community at large." What follows is from the "Closing Observations" section of the summary.

**Closing Observations**

- To preserve the discipline's strengths while meeting challenges posed by a changed environment, the U.S. mathematical sciences community's major national responsibilities include:
  1. Promoting research and discovery in all areas of the mathematical sciences so that the U.S. will continue to maintain preeminence in these powerful, innovative endeavors;
  2. Supporting the use of mathematical results and acumen in order to increase the capabilities of the various scientific and engineering disciplines and to help advance science and technology in the United States; and
  3. Providing top-quality education and skills in the mathematical sciences at all levels and for all members of the student population to ensure that the United States will continue to have a scientifically and technically trained work force and an informed citizenry.
- Fulfilling these responsibilities is doubly challenging in the current changed environment. The end of the cold war has increased the national emphasis on economic competitiveness and pressing social concerns, health care issues, and environmental needs. One consequence of this shift in national priorities is that a strong scientific base, as an end in itself, is not as high a priority as it was. Another change affecting the environment for science, and for the mathematical sciences, involves the national resolve to balance the federal budget and to cut government spending.
- There are several implications of these changes. In the near future there may be less public money (in constant dollars) for support of universities and of scientific research. Also, the scientific community may have to justify much of its research as contributing to societal goals. For example, quality education, especially K-12 education, for all segments of society remains high on the national agenda and is a goal to which the scientific community is expected to contribute. What support—both political and financial—there now is for the mathematical sciences may well diminish if the community's responsibilities are not met. On the other hand, efforts to meet those responsibilities can provide opportunities for additional resources.
- Action might be taken by different cohorts within the mathematical sciences community on various fronts. For example, it is clear that much of the educated public, including the scientifically educated public, is unaware of new discoveries in the mathematical sciences and their importance. The general public also is not made aware of the fundamental contributions of the mathematical sciences to many advances in science and technology. In the general technical community, there is a sense that the mathematical sciences community could do more to accelerate
the impact of mathematical sciences research on science, technology, and society in general.

• The mathematical sciences community has not been very successful in the important area of attracting underrepresented minority groups, and the disproportionately small number of women at many levels in the mathematical sciences is self-evident. By identifying broader career opportunities in the mathematical sciences, some of the obstacles to attracting these groups to the mathematical sciences might be overcome.

• A further area where mathematical sciences involvement could be increased is in the education of all undergraduates. It is important for mathematical sciences departments to strengthen their scientific and educational ties with the university community at large. It is also important that the full mathematical sciences community enhance its scientific and educational ties with the general scientific and technological community. The pervasiveness of the mathematical sciences in those diverse areas makes this both a responsibility and an opportunity.

• In light of the present environment for science and the direction that continuing change in that environment will likely take, how the mathematical sciences community now acts could be crucial to its future strength and health and so deserves urgent attention. The mathematical sciences community now faces serious challenges in a changing and demanding environment that warrant quick and effective responses. The health of the mathematical sciences community and how well it fulfills its national responsibilities depend on its ability to resolve these issues.

• Clearly a successful resolution of these issues requires the active participation of mathematical sciences departments, the professional societies, and the community as a whole.

For Information
For further information on this and other BMS reports, consult the BMS Web site at http://www2.nas.edu/bms/.
Or contact: Board on Mathematical Sciences, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418; telephone 202-334-2421; e-mail: bms@nas.edu.

—Allyn Jackson

B. N. Prasad Centenary Commemoration


Contributions for the commemorative volumes should reach the editors preferably by August 1998; those received after December 1998 may have to be shifted to a later volume. For further information, contact Pramila Srivastava, Chair, Committee for Publications, Allahabad Mathematical Society, 10, C.S.P. Singh Marg, Allahabad 211 001, India; e-mail: pramila@almas.ali.in.

—Pramila Srivastava

Members Dues Information

The Internal Revenue Code requires that not-for-profit organizations advise their members of the amount of their dues which is tax deductible as a charitable contribution. The determination of this amount must reduce the dues payment by the “fair value” of the benefits received as a member. When journals or magazines are privileges of membership, the “fair value” of membership rights includes the price that nonmembers would have to pay for the journals or magazines. Other benefits of membership are less easily quantified, and include such items as the availability of discounts on publications and meeting registration fees.

Staff of the Society have studied these issues and consulted with other professionals, and have concluded that no portion of a member's dues to the AMS is tax deductible as a charitable contribution. However, a member's dues payment to the AMS may be tax deductible under other provisions of the Internal Revenue Code, such as those addressing professional expenses. Members should consult with their personal tax advisors.

—AMS Fiscal Department

Statistics Teachers Group

In the summer of 1991 a group now known as the Isolated Statisticians met for the first time at the Joint Statistics Meetings. These individuals were largely from departments in which they were the only statistician. They found they had no one with whom to exchange ideas about picking a statistics textbook, trying a new teaching technique for statistics, or incorporating technology into their statistics courses. Starting with 15 participants in 1991, the informal "Isostat" meeting has become a yearly event. The group has held its own national meeting in 1995 and eleven regional workshops in 1996 and 1997 and also has an e-mail network of 150 people.

The group will meet for an informal discussion on Friday, January 9, from 7-9 p.m. at the Joint Mathematics Meetings in Baltimore. For further information, contact: Dexter Whittinghill, Department of Mathematics, Rowan University, Glassboro, NJ 08028; e-mail whittinghill@rowan.edu.

—Dexter Whittinghill, Rowan University
### Honorary Members of the AMS

Listed below are the Honorary Members of the American Mathematical Society, those who have been members for fifty years or more.

The American Mathematical Society offers congratulations to all its Honorary Members on their longstanding affiliation with the AMS and extends appreciation for their continued commitment to the mathematics profession.

<table>
<thead>
<tr>
<th>James C. Abbott</th>
<th>William M. Boothby</th>
<th>Charles A. Cole</th>
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<tr>
<td>Clarence M. Ablow</td>
<td>Truman A. Botts</td>
<td>A. John Coleman</td>
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<td>H. L. Alder</td>
<td>Julia W. Bower</td>
<td>Myron A. Coler</td>
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<tr>
<td>Franz L. Alt</td>
<td>Harold E. Bowie</td>
<td>Henry D. Colson</td>
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<td>German Ancochea</td>
<td>Evelyn Hull Boyle</td>
<td>E. Allen Cook Jr.</td>
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<td>R. Lucile Anderson</td>
<td>Wray G. Brady</td>
<td>H. S. MacDonald Coxeter</td>
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<td>Richard D. Anderson</td>
<td>Joel L. Brenner</td>
<td>Stephen H. Crandall</td>
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<td>Theodore W. Anderson</td>
<td>Nelson A. Brigham</td>
<td>Franklyn G. Creese</td>
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<td>Thomas B. Andrews Jr.</td>
<td>Foster Brooks</td>
<td>Florence G. Critchlow</td>
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<td>Tom M. Apostol</td>
<td>Arthur A. Brown</td>
<td>Edwin L. Crow</td>
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<td>Richard F. Arens</td>
<td>Arthur B. Brown</td>
<td>Herbert J. Curtis</td>
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<td>Bradford H. Arnold</td>
<td>Richard H. Brown</td>
<td>John M. Danksin</td>
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<td>Winifred A. Asprey</td>
<td>Hugh D. Brunck</td>
<td>George B. Dantzig</td>
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<td>Silvio Aurora</td>
<td>Mildred C. Brunschwig</td>
<td>Donald A. Darling</td>
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<tr>
<td>Christine W. Ayoub</td>
<td>Ellen F. Buck</td>
<td>Martin D. Davis</td>
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<td>Edward G. Baker</td>
<td>R. Creighton Buck</td>
<td>Hubert Delange</td>
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<td>George A. Baker Sr.</td>
<td>Royce E. Buehler</td>
<td>Douglas Derry</td>
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<td>Richard W. Ball</td>
<td>Winifred K. Burroughs</td>
<td>Ainsley H. Diamond</td>
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<td>Donald H. Ballou</td>
<td>Leonard P. Burton</td>
<td>Bernard Dimsdale</td>
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<td>S. F. Barber</td>
<td>John H. Butchart</td>
<td>Joseph L. Doob</td>
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<td>William J. Barr</td>
<td>Leonard Carlitz</td>
<td>Harold L. Dorwart</td>
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<td>Robert C. F. Bartels</td>
<td>Bengt G. Carlson</td>
<td>Francis G. Dressel</td>
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<td>Paul T. Bateman</td>
<td>Charles L. Carroll Jr.</td>
<td>Daniel M. Dribin</td>
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<td>Helen P. Beard</td>
<td>C. Ronald Cassity</td>
<td>Roy Dubisch</td>
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<td>K. Chandrasekharan</td>
<td>William H. Durfee</td>
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<td>Janie L. Bell</td>
<td>Y. W. Chen</td>
<td>Lincoln K. Durst</td>
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<td>Philip O. Bell</td>
<td>Shing S. Chern</td>
<td>Jacques Dutka</td>
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<td>Theodore J. Benac</td>
<td>Herman Chernoff</td>
<td>Julius S. Dwork</td>
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<td>Agnes Berger</td>
<td>Kai Lai Chung</td>
<td>Leaman A. Dye</td>
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<td>Peter G. Bergmann</td>
<td>Paul Civin</td>
<td>John Dyer-Bennett</td>
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<tr>
<td>Salvatore D. Bernardi</td>
<td>Charles L. Clark</td>
<td>J. J. Echus</td>
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<td>Ebon E. Betz</td>
<td>F. Eugene Clark</td>
<td>Madeline L. Early</td>
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<td>Z. William Birnbaum</td>
<td>Robert A. Clark</td>
<td>Beno Eckmann</td>
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<tr>
<td>Clair J. Blackall</td>
<td>Helen E. Clarkson</td>
<td>Robert P. Eddy</td>
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<td>David Blackwell</td>
<td>Mary Dean Clement</td>
<td>Anthony J. Eiardi</td>
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<td>Charles Blanc</td>
<td>Haskell Cohen</td>
<td>Samuel Ellenberg</td>
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<td>Albert A. Blank</td>
<td>Herman J. Cohen</td>
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<td>William A. Blankinship</td>
<td>Harvey Cohn</td>
<td>Benjamin Epstein</td>
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<td>Joseph Blum</td>
<td>Richard M. Cohn</td>
<td>Bernard Epstein</td>
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Add this Cover Sheet to all of your Academic Job Applications

How to use this form

1. Using the facing page or a photocopy, (or a TeX version which can be downloaded from the e-math "Employment Information" menu, [http://www.ams.org/profession/employ.html](http://www.ams.org/profession/employ.html)), fill in the answers which apply to all of your academic applications. Make photocopies.

2. As you mail each application, fill in the remaining questions neatly on one cover sheet and include it on top of your application materials.

The Joint Committee on Employment Opportunities has adopted the cover sheet on the facing page as an aid to job applicants and prospective employers. The form is now available on e-math in a TeX format which can be downloaded and edited. The purpose of the cover form is to aid department staff in tracking and responding to each application.

Mathematics Departments in Bachelor's, Master's and Doctorate granting institutions have been contacted and are expecting to receive the form from each applicant, along with any other application materials they require. Obviously, not all departments will utilize the cover form information in the same manner. Please direct all general questions and comments about the form to:

emp-info@ams.org
or call the Professional Programs and Services Department, AMS, at 800-321-4267 extension 4105.

JCEO Recommendations for Professional Standards in Hiring Practices

The JCEO believes that every applicant is entitled to the courtesy of a prompt and accurate response that provides timely information about his/her status. Specifically, the JCEO urges all institutions to do the following after receiving an application:

(1) Acknowledge receipt of the application—immediately; and
(2) Provide information as to the current status of the application, as soon as possible.

The JCEO recommends a triage-based response, informing the applicant that he/she
(a) is not being considered further;
(b) is not among the top candidates; or
(c) is a strong match for the position.
**Academic Employment in Mathematics**

**AMS STANDARD COVER SHEET**

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>Middle Names</th>
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<tr>
<th>Address through June 1998</th>
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<thead>
<tr>
<th>Highest Degree and Source</th>
<th>Year of Ph.D. (optional)</th>
<th>Ph.D. Advisor</th>
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If the Ph.D. is not presently held, date on which you expect to receive ____________

Indicate the mathematical subject area(s) in which you have done research using, if applicable, the 1991 Mathematics Subject Classification printed on the back of this form. If listing more than one number, list first the one number which best describes your current primary interest.

<table>
<thead>
<tr>
<th>Primary Interest</th>
<th>Secondary Interests optional</th>
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<tbody>
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Give a brief synopsis of your current research interests (e.g., finite group actions on four-manifolds). Avoid special mathematical symbols and please do not write outside of the boxed area.

Give a brief synopsis ____________________________ ___________________________________________________________ __

Most recent, if any, position held post Ph.D.

<table>
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<tr>
<th>University or Company</th>
<th>Position Title</th>
<th>Dates</th>
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Indicate the position for which you are applying and position posting code, if applicable

If unsuccessful for this position, would you like to be considered for a temporary position?

☐ Yes  ☐ No  If yes, please check the appropriate boxes.

☐ Postdoctoral Position  ☐ 2+ Year Position  ☐ 1 Year Position

List the names, affiliations, and e-mail addresses of up to four individuals who will provide letters of recommendation if asked. Mark the box provided for each individual whom you have already asked to send a letter.

☐

☐

☐

☐
1991
Mathematics Subject Classification

00 General
01 History and biography
03 Logic and foundations
04 Set theory
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General mathematical systems
11 Number theory
12 Field theory and polynomials
13 Commutative rings and algebras
14 Algebraic geometry
15 Linear and multilinear algebra, matrix theory
16 Associative rings and algebras
17 Nonassociative rings and algebras
18 Category theory, homological algebra
19 K-theory
20 Group theory and generalizations
22 Topological groups, Lie groups
26 Real functions
28 Measure and integration
30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytic spaces
33 Special functions
34 Ordinary differential equations
35 Partial differential equations
39 Finite differences and functional equations
40 Sequences, series, summability
41 Approximations and expansions
42 Fourier analysis
43 Abstract harmonic analysis
44 Integral transforms, operational calculus
45 Integral equations
46 Functional analysis
47 Operator theory
49 Calculus of variations, optimal control
51 Geometry
52 Convex and discrete geometry
53 Differential geometry
54 General topology
55 Algebraic topology
57 Manifolds and cell complexes
58 Global analysis, analysis on manifolds
60 Probability theory and stochastic processes
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
73 Mechanics of solids
76 Fluid mechanics
78 Optics, electromagnetic theory
80 Classical thermodynamics, heat transfer
81 Quantum theory
82 Statistical mechanics, structure of matter
83 Relativity and gravitational theory
85 Astronomy and astrophysics
86 Geophysics
90 Economics, operations research, programming, games
92 Biology and other natural sciences, behavioral sciences
93 Systems theory, control
94 Information and communication, circuits
Statistics on Women Mathematicians Compiled by the AMS

At its August 1985 meeting, the Council of the AMS approved a motion to regularly assemble and report in the Notices information on the relative numbers of men versus women in at least the following categories: membership in the AMS, invited hour addresses at AMS meetings, speakers at special sessions at AMS meetings, percentage of women speakers in AMS Special Sessions by gender of organizers, and members of editorial boards of AMS journals.

It was subsequently decided that this information would be gathered by determining the sex of the individuals in the above categories based on name identification and that additional information on the number of Ph.D.s granted to women would also be collected using the AMS-IMS-MAA Annual Survey. Since name identification was used, the information for some categories necessitated the use of three classifications:

Male: names that were obviously male;  
Female: names that were obviously female;  
Unknown: names that could not be identified as clearly male or female (e.g., only initials given, non-gender-specific names, etc.)

The following is the twelfth reporting of this information. Updated reports will appear annually in the Notices.

<table>
<thead>
<tr>
<th>Invited Hour Address Speakers at AMS Meetings (1987–1996)</th>
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<tbody>
<tr>
<td>Male: 396 85%</td>
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<tr>
<td>Female: 63 14%</td>
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<td>Unknown: 4 1%</td>
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<td>Total checked: 463</td>
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<table>
<thead>
<tr>
<th>Speakers at Special Sessions at AMS Meetings (1992–1996)</th>
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<td>Male: 7,030 81%</td>
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<td>Female: 1,081 12%</td>
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<tr>
<td>Unknown: 647 7%</td>
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<table>
<thead>
<tr>
<th>Percentage of Women Speakers in AMS Special Sessions by Gender of Organizers (1996)</th>
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<tbody>
<tr>
<td>Special Sessions with at Least One Woman Organizer</td>
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<tr>
<td>Total number of speakers: 411</td>
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<tr>
<td>Male: 306 75%</td>
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<tr>
<td>Female: 75 18%</td>
</tr>
<tr>
<td>Unknown: 30 7%</td>
</tr>
<tr>
<td>Special Sessions with No Women Organizers</td>
</tr>
<tr>
<td>Total number of speakers: 1,420</td>
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<tr>
<td>Male: 1,146 81%</td>
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<tr>
<td>Female: 184 13%</td>
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<tr>
<td>Unknown: 90 6%</td>
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<table>
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<tr>
<th>Members of the AMS Residing in the U.S.</th>
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<tr>
<td>Male: 13,609 70%</td>
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<td>Female: 3,519 18%</td>
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<td>Unknown: 2,237 12%</td>
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<td>Total: 48</td>
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<tr>
<td>Male: 36 75%</td>
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<tr>
<td>Female: 12 25%</td>
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<tr>
<td>Unknown: 90 6%</td>
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<tr>
<th>Members of Editorial Boards of AMS Journals</th>
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<td>Total: 198</td>
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<tr>
<td>Male: 177 89%</td>
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<tr>
<td>Female: 21 11%</td>
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<table>
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<tr>
<th>Ph.D.s Granted to U.S. Citizens</th>
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<tbody>
<tr>
<td>Total: 493</td>
</tr>
<tr>
<td>Male: 377 76%</td>
</tr>
<tr>
<td>Female: 116 24%</td>
</tr>
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</table>
Reference

The Reference section of the Notices is intended to provide the reader with frequently sought information in an easily accessible manner. New information is printed as it becomes available and is referenced after the first printing. As soon as information is updated or otherwise changed, it will be noted in this section.

Upcoming Deadlines


National Science Board

The National Science Board (NSB) serves as a national science policy advisor to the president and the Congress and as the governing body for the National Science Foundation. The term of service on the NSB is six years.

The following lists the names, titles, and affiliations of current NSB members.

John A. Armstrong, IBM Vice President for Science and Technology (retired).
F. Albert Cotton, Distinguished Professor of Chemistry, Texas A & M University.
Mary K. Gaillard, Professor of Physics, University of California, Berkeley.
Sanford D. Greenberg, Chairman and CEO, TEI Industries, Inc.
M. R. C. Greenwood, Chancellor, University of California, Santa Cruz.
Charles E. Hess, Director of International Programs, University of California, Davis.
John E. Hopcroft, Joseph Silbert Dean of Engineering, Cornell University.
Stanley V. Jaskolski, Vice President, Eaton Corporation.
Eamon M. Kelly, President, Tulane University.
Neal F. Lane, Director, National Science Foundation (ex officio).
Jane Lubchenco, Wayne and Gladys Valley Professor of Marine Biology and Distinguished Professor of Zoology, Oregon State University, Corvallis.
Shirley M. Malcom, Head, Director for Education and Human Resources Programs, American Association for the Advancement of Science.
Eve L. Menger, Director, Characterization Science and Services, Corning, Inc.

Claudia I. Mitchell-Kernan, Vice Chancellor, Academic Affairs, and Dean, Graduate Division, University of California, Los Angeles.
Diana Natalicio, President, University of Texas at El Paso (vice chair).
James L. Powell, President and Director, Los Angeles County Museum of Natural History.
Frank H. T. Rhodes, President Emeritus, Cornell University.
Ian M. Ross, President Emeritus, AT&T Bell Laboratories, Holmdel, New Jersey.
Vera C. Rubin, Staff Member, Department of Terrestrial Magnetism, Carnegie Institution of Washington, DC.
Robert M. Solow, Institute Professor Emeritus of Economics, Massachusetts Institute of Technology.
Bob H. Suzuki, President, California State Polytechnic University, Pomona.
Richard Tapia, Professor, Department of Computational and Applied Mathematics, Rice University.
Warren M. Washington, Senior Scientist and Head, Climate Change Research Section, National Center for Atmospheric Research.
John A. White Jr., Chancellor, University of Arkansas, Fayetteville.
Richard N. Zare, Professor of Chemistry, Stanford University (chair).
Discrete Mathematics and Combinatorics

Progress in Algebraic Combinatorics
E. Bannai and A. Munemasa, Kyushu University, Fukuoka, Japan
This volume consists of thirteen papers on algebraic combinatorics and related areas written by leading experts around the world. There are four surveys by papers illustrating the following currently active branches of algebraic combinatorics: vertex operator algebras, spherical designs, KerDock codes and related combinatorial objects, and geometry of matrices. The remaining nine papers are original research articles covering a wide range of disciplines, from classical topics such as permutation groups and finite geometry, to modern topics such as spin models and invariants of 3-manifolds. Two papers occupy nearly half the volume and present a comprehensive account of new concepts: "Combinatorial Cell Complexes" by M. Aschbacher and "Quantum Matroids" by P. Terwilliger.

Advanced Studies in Pure Mathematics is published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

Advanced Studies in Pure Mathematics, Volume 24; 1996; 453 pages; Hardcover; ISBN 4-314-10119-9; List $88; Individual member $55; Order code ASPM/24

Supplementary reading

Qualitative Topics in Integer Linear Programming
V. N. Shevchenko, Nizhni Novgorod, Russia
Integer solutions for systems of linear inequalities, equations, and congruences are considered along with the construction and theoretical analysis of integer programming algorithms. The complexity of algorithms is analyzed dependent upon two parameters: the dimension, and the maximal modulus of the coefficients describing the conditions of the problem. The analysis is based on a thorough treatment of the qualitative and quantitative aspects of integer programming, in particular on bounds obtained by the author for the number of extreme points. This permits progress in many cases in which the traditional approach—which regards complexity as a function only of the length of the input—leads to a negative result.

Translations of Mathematical Monographs, Volume 156; 1996; 146 pages; Hardcover; ISBN 0-8218-0535-5; List $69; Individual member $41; Order code MMONO/156/NA

Stable Marriage and Its Relation to Other Combinatorial Problems
Donald E. Knuth, Stanford University, CA
This short book will provide extremely enjoyable reading to anyone with an interest in discrete mathematics and algorithm design.

-Mathematical Reviews
This book is an excellent (and enjoyable) means of sketching a large area of computer science for specialists in other fields: It requires little previous knowledge, but expects of the reader a degree of mathematical facility and a willingness to participate. It is really neither a survey nor an introduction; rather, it is a paradigm, a fairly complete treatment of a single example used as a synopsis of a larger subject.

-SIGACT News
Anyone would enjoy reading this book. If one had to learn French first, it would be worth the effort.

-Computing Reviews
The above citations are taken from reviews of the initial French version of this text—a series of seven expository lectures that were given at the University of Montreal in November of 1975. The book uses the appealing theory of stable marriage to introduce and illustrate a variety of important concepts and techniques of computer science and mathematics: data structures, control structures, combinatorics, probability, analysis, algebra, and especially the analysis of algorithms. The presentation is elementary, and the topics are interesting to nonspecialists. The theory is quite beautiful and developing rapidly. Exercises with answers, an annotated bibliography, and research problems are included.

CRM Proceedings & Lecture Notes, Volume 10; 1997; 74 pages; Softcover; ISBN 0-8218-0603-3; List $19; All AMS members $15; Order code CRM/P/10NA

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Vyjayanthi Chari and Andrew Pressley
December 1997

December International Symposium on Mathematical Physics in Memory of S. Chandrasekhar, Calcutta, India. (Mar. 1997, p. 380)


*3-4 Fourth CANT Conference -Number Theory and Cryptography, University of Sydney, Sydney, Australia.

Aim: The conference aims to provide an overview of recent developments in computational number theory, with an emphasis on areas that are applicable to public-key cryptography.


4-7 3rd Joint Meeting of the AMS and the Sociedad Mathematica Mexicana, Oaxaca, Mexico. (Dec. 1996, p. 1560)

8-9 Workshop on Quantum Coherence and Information Processing, Adelaide, South Australia. (Sept. 1997, p. 1024)


8-12 International Conference on Scientific Computing and Math Modelling, New Delhi, India. (Oct. 1997, p. 1156)


13-17 8th Meeting of European Women in Mathematics, Trieste, Italy. (Mar. 1997, p. 380)

13-17 AMAST'97 Sixth International Conference on Algebraic Methodology and Software Technology, Macquarie University, Sydney, Australia. (Sept. 1997, p. 1024)


28-January 1 International Symposium on Mathematical Physics in Memory of S. Chandrasekhar with Special Session on Abdus Salam, Calcutta, India. (Aug. 1997, p. 845)

January 1998

3-6 Ninth International Conference on Approximation Theory, Nashville, TN. (June/July 1997, p. 731)

4-5 Fifth International Symposium on Artificial Intelligence and Mathematics, Fort Lauderdale, Florida. (Sept. 1997, p. 1025)


7-10 Joint Mathematics Meetings, Baltimore, Maryland (including the annual meetings of the AMS, AWM, MAA, and NAM). (Dec. 1995, p. 1570)

*9 Isolated Teachers of Statistics Meeting, Baltimore, Maryland.

Description: This year at the Joint Mathematics Meetings in Baltimore, there will be an informal meeting of "isolated teachers should be sent to the Editor of the Notices in care of the American Mathematical Society in Providence or electronically to notices@ams.org or mathcal@ams.org.

In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the Notices prior to the meeting in question. To achieve this, listings should be received in Providence six months prior to the scheduled date of the meeting.

The complete listing of the Mathematics Calendar will be published only in the September issue of the Notices. The March, June, and December issues will include, along with new announcements, references to any previously announced meetings and conferences occurring within the twelve-month period following the month of those issues. New information about meetings and conferences that will occur later than the twelve-month period will be announced once in full and will not be repeated until the date of the conference or meeting falls within the twelve-month period.

The Mathematics Calendar, as well as Meetings and Conferences of the AMS, is now available electronically through e-MATH on the World Wide Web. To access e-MATH, use the URL: http://e-math.ams.org/ (or http://www.ams.org/). (For those with VT100-type terminals or for those without WWW browsing software, connect to e-MATH via Telnet (telnet e-math.ams.org/login and password e-math) and use the Lynx option from the main menu.)
of statistics' on Friday night, from 7-9 pm, in the Convention Center (room TBA). The ASA/MAA Joint Committee on Undergraduate Statistics is inviting those of you who teach all or most of the statistics in your department. At this first meeting there will be an informal discussion where you can raise (and discuss?) issues that are important or significant to you. The intent is that the meeting will become a yearly exchange of ideas among the isolated teachers of statistics, and possibly the beginning of a network. See the MAA Online Web page for a detailed announcement.

**Information:** D. Whittinghill, Department of Mathematics, Rowan University, Glassboro, NJ 08028. E-mail: whittingh@rowan.edu.


12-16 Introductory Workshop on Model Theory of Fields, Mathematical Sciences Research Institute, Berkeley, CA. (June/July 1997, p. 731)

12-23 Emerging Applications of Dynamical Systems, University of Minnesota, Minneapolis, Minnesota. (Sept. 1997, p. 1025)


19-23 First Pacific Rim Conference on Mathematics, City University of Hong Kong, Hong Kong. (Apr. 1997, p. 481)


**February 1998**

2-4 33 Years of Gröbner Bases, Risc-Linz, Hagenberg, Austria. (Apr. 1997, p. 481)

5-6 Emerging Applications of Dynamical Systems, University of Minnesota, Minneapolis, Minnesota. (Sept. 1997, p. 1026)

9-13 Emerging Applications of Dynamical Systems, University of Minnesota, Minneapolis, Minnesota. (Sept. 1997, p. 1026)

9-13 Seventh International Conference on Hyperbolic Problems Theory, Numerics, Applications, ETH Zürich, Switzerland. (Oct. 1997, p. 1156)


11-14 Xth National Conference of Finsler and Lagranges Spaces and Applications, Craiova, Romania. (Nov. 1997, p. 1362)

18-20 Seventeenth IASTED International Conference on Modelling, Identification and Control, Grindelwald, Switzerland. **Topics:** Modelling, identification, control, systems, technology, applications.

**Organizers:** The International Association of Science and Technology for Development (IASTED); e-mail: iasted@iasted.com; Web site: http://www.iasted.com.

*20-21 Fourteenth Conference on Applied Mathematics, University of Central Oklahoma, Edmond, Oklahoma. **Program:** An interdisciplinary conference on mathematics with applications, this year's CAM will feature Nobel laureate H. Hauptman (Director of the Hauptman-Woodward Medical Research Foundation), who will speak on "A Minimal Principle in the Phase Probe of X-Ray Crystallography," Also featured will be P. D' Oell (Baylor Univ., Dept. of Mathematics), who will give a talk on "Solving Matrix Equations Using Generalized Inverses of Matrices." A MATLAB workshop will be available for participants.

**Call for Papers:** Abstracts should be post-marked by December 16, 1997, and mailed to the address below. There will be a special session on Differential Equations and Dynamical Systems.

**Information:** Conference on Applied Mathematics, College of Mathematics and Science, University of Central Oklahoma, 100 N. University, Edmond, OK 73034; tel: 405-341-2980, ext. 5381; fax: 405-330-3824; e-mail: cam@aiei.ucok.edu.

*20-22 8th Annual Conference of the Jammu Mathematical Society: Seminar on Recent Trends in Geometry, Operator Theory and Complex Dynamics, University of Jammu, Jammu, India. **Call for Papers:** Mathematicians interested in participating in the conference should contact R. K. Singh, Dept. of Mathematics, Univ. of Jammu, Jammu-4, India and send title of their articles/talks.

*27-28 The 14th Annual Southeastern Analysis Meeting (SEAM 14), The University of Alabama, Tuscaloosa, Alabama. **Main Speakers:** M. Aabbaugh (Univ. of Missouri); R. V. Kadison (Univ. of Pennsylvania); R. Rochberg (Washington Univ.); J. Werner (Brown Univ.).

**Organizers:** R. Brown, A. Hoppenwasser, R. Moore, T. Trent, J. Wang, Z. Wu; e-mail: cconf@euler.math.ua.edu.

**March 1998**

*9-13 Twenty-ninth Southeastern International Conference on Combinatorics, Graph Theory and Computing, Florida Atlantic University, Boca Raton, Florida.

9-14 Emerging Applications of Dynamical Systems, University of Minnesota, Minneapolis, Minnesota. (Sept. 1997, p. 1026)

12-14 Spring Topology and Dynamics Conference, George Mason University, Fairfax, Virginia. (Sept. 1997, p. 1026)


16-18 Conference on Complex Hyperbolic Geometry and Discrete Groups, Okayama University of Science, Okayama, Japan. (Oct. 1997, p. 1056)

20-21 AMS Southeastern Sectional Meeting, University of Louisville, Louisville, Kentucky. (Dec. 1996, p. 1560)

**Information:** R. Cascella, rge@ams.org.

23-25 DIMACS Workshop on Discrete Mathematical Chemistry, DIMACS Center, Rutgers University, Piscataway, New Jersey. (Sept. 1997, p. 1026)


23-29 Japan-U.S. Mathematics Institute Conference and Workshop on Meromorphic Mappings and Intrinsic Metrics in Complex Geometry, Johns Hopkins University, Baltimore, Maryland. (Nov. 1997, p. 1362)

25-28 Global Analysis 30 Years Later, University of Cincinnati, Cincinnati, Ohio. (Nov. 1996, p. 1384)

27-28 AMS Central Section Meeting, Kansas State University, Manhattan, KS. (Sept. 1997, p. 1027)

**Information:** W. Drady, AMS, P.O. Box 6887, Providence, RI 02940; e-mail: wad@math.ams.org.

30-April 3 European Joint Conferences on Theory and Practice of Software (ETAPS), Preliminary announcement and call for satellite events, Lisbon, Portugal. (Nov. 1996, p. 1385)

**April 1998**


**Information:** R. Cascella, rge@ams.org.

16-18 Twenty-Second Arkansas Spring Lectures in the Mathematical Sciences, Fayetteville, Arkansas. (Sept. 1997, p. 1027)

19-22 Supporting Educational, Faculty & TADevelopment Within Departments and Disciplines, Austin, Texas. (Nov. 1997, p. 1362)

20-23 International Conference on Interval Methods and their Application in Global Optimization (INTERVAL '98), Nanjing, China. (Oct. 1997, p. 1156)

*20-24 Workshop on Probability; Theory and Applications, Nottingham Trent University, Nottingham, England."
Mathematics Calendar

DECEMBER 1997
NOTICES OF THE AMS

Aim: The aim of the workshop is to encourage interaction between pure and applied probabilists on topics of mutual interest. One day will be devoted to each of the following areas: (1) probability in finance; (2) probability in information science; (3) probability in biology; (4) probability in physics; (5) probabilistic methods and modelling.

Plenary Talks: The following have accepted invitations to give plenary talks: D. Aldous (Berkeley), A. Barbour (Zurich), J. Chayes (Microsoft), M. Davis (Mitsubishi), A. Dorlas (Swansea), T. Gowers (Cambridge), L. Hughston (Merrill Lynch), C. Pfister (Lausanne), S. Tavare (USC) and J. Ziv (Haifa). Other speakers will include B. Derrida (Paris), P. Donnelly (Oxford) and J. Rosenthal (Toronto).

Hotel Accommodation: As hotel accommodation in Nottingham is limited, prospective participants are advised to register their intention to attend by contacting the workshop administrator D. Jones as soon as possible (e-mail: ces3jones@ntu.ac.uk; tel: 0115-9418418, ext. 2249, fax: 0115-9486536). Participants wishing to give short talks should send an e-mail giving the title and a short abstract to pconf@maths.ntu.ac.uk.

Information: This meeting is partially funded by EPSRC. All non-EPSRC funded participants will be required to pay a workshop fee of 100 pounds (this does not include accommodation and subsistence). Nottingham Trent Univ. will make available 20 workshop fellowships of up to 300 pounds each to cover travel and subsistence for young research-active participants under the age of 30. To apply for one of these, please send a short (one page) cv and an estimate of your travel expenses by e-mail to pconf as above.

Scientific Committee: D. Applebaum (NTU); main organizer, F. Ball (Nottingham), A. Etheridge (QM), C. Goldie (Sussex), J. Lewis (Dublin), G. Roberts (Cambridge), D. Williams (Bath).

Information: WWW page: http://euler.ntu.ac.uk/pconf/html/.

25-26 AMS Western Sectional Meeting, University of California-Davis, CA. (Apr. 1997, p. 481)

Information: W. Drady; vad@ams.org.

27-29 Conference on Real Numbers and Computers, Pierre et Marie Curie University, Paris, France. (Sept. 1997, p. 1027)

27-May 1 Emerging Applications of Dynamical Systems, University of Minnesota, Minneapolis, Minnesota. (Sept. 1997, p. 1028)

29-May 1 Nonlinear Problems in Aviation and Aerospace, Daytona Beach, Florida. (Sept. 1997, p. 1028)

May 1998

* 1-3 Conference on Algebraic Combinatorics and Applications, Oakland University, Rochester, Michigan.

Speakers: Invited one-hour speakers include: A. Bjorner (Royal Institute of Technology, Stockholm), R. Calderbank (AT&T Research), P. Cameron (Queen Mary College, London), J. Chayes (Microsoft), P. Frajoler (INRIA), R. Graham (AT&T Research), D. Jackson (University of Waterloo), R. Stanley (MIT). There will also be sessions for invited half-hour talks.

Participation: Persons in academia or industry interested in exploring this fertile and evolving area of mathematics and its interactions with and applications to other areas are encouraged to participate. Some support will be available to assist graduate students in attending the conference.

Sponsors: Sponsors include the National Science Foundation, the National Security Agency, Oakland University, the Oakland University Foundation, and others still pending.

Information: Anyone interested in further information should send name, institution, e-mail address, and current estimated probability of attending, to the organizers by e-mail or snail-mail. Conference e-mail address: calca@oakland.edu; World Wide Web home page: http://www.oakland.edu/~calca/.


11-15 Emerging Applications of Dynamical Systems, University of Minnesota, Minneapolis, Minnesota. (Sept. 1997, p. 1028)


*24-31 International Algebraic Conference (Dedicated to the Memory of A. Kurosh), Department of Algebra, Faculty of Mechanics and Mathematics, Moscow State University, Moscow, Russia. (Sept. 1997, p. 1028)

Topics: Group theory, rings and modules, homological algebra, algebraic K-theory, Lie groups and algebras, algebraic geometry, algebraic number theory, commutative algebra, algebraic geometry, computer algebra, algorithmic problems.

Organizing Committee: P. M. Cohn, O. H. Kegel, A. I. Kostrikin, M. Suzuki, E. I. Zelmanov, and others.


Information: Contact the organizing committee at Dept. of Algebra, Faculty of Mechanics and Mathematics, Moscow State University, 119899, Moscow, Russia; fax: 095-9392090; e-mail: artamon@msn.math. msu.su; http://www.math.msu/users/artamon/kurosh.html.

26-29 ICDCS'98, the 18th International Conference on Distributed Computing Systems, Center of Mathematics and Computer Science (CWI), Amsterdam, The Netherlands. (Oct. 1997, p. 1157)

27-29 Joint DIMACS-CMU-Georgia Tech Workshop on Large Scale Discrete Optimization, DIMACS Center, Rutgers University, Piscataway, New Jersey. (Oct. 1997, p. 1157)

28-31 19th Annual Meeting of Canadian Applied Mathematics Society (CAMS/SCMA) and 13th Canadian Symposium on Fluid Dynamics, Simon Fraser University, Burnaby, British Columbia, Canada. (Sept. 1997, p. 1028)

31-June 6 Sixth International Spring School "Nonlinear Analysis, Function Spaces and Applications", Prague, Czech Republic. (Sept. 1997, p. 1028)

June 1998


* 1-4 IASTED International Conference on Computer Graphics and Imaging, Halifax, Canada.

Organizer: The International Association of Science and Technology for Development (IASTED); e-mail: iasted@cadvision.com; Web site: http://www.iasted.com.

Scope: Rendering, image processing, modeling, animation, visualization, applications.

Deadline: Submission deadline for abstracts and tutorial proposals - November 15, 1997.


Deadline: For abstracts: November 15.

Topics: Computer design, mathematical modelling, visualization and system media design, computational geometry, art and mathematics.


1-5 Emerging Applications of Dynamical Systems, University of Minnesota, Minneapolis, Minnesota. (Sept. 1997, p. 1028)

1-5 Fifth International Conference on p-Adic Functional Analysis, A. Mickiewicz University of Poznań, Poland. (Sept. 1997, p. 1028)


1-5 Model Theory, Algebra and Arithmetic, Mathematical Sciences Research Institute, Berkeley, CA. (Sept. 1997, p. 1028)


15-20 Second International Conference on Differential Equations and Applications, St. Petersburg State Technical University, St. Petersburg, Russia. (Oct. 1997, p. 1157)


29-July 3 Second International Conference on Bifurcation Theory and Its Numerical Analysis, Xian Jiaotong University, Xi'an, P.R. China.

Purpose: The aim of this conference is to bring together active researchers with different backgrounds to discuss recent and prospective advances in the bifurcation theory and its numerical analysis.

Call for Papers: Prospective authors are invited to submit 500 word abstracts of their papers by Feb. 1, 1998, to H. Y. Yang, Research Center for Applied Mathematics, Xian Jiaotong Univ., Xian, 710049, P. R. China; e-mail: kli@xjtu.edu.cn.

July 1998


6-10 Twenty-Third Australasian Conference on Combinatorial Mathematics and Combinatorial Computing, The University of Queensland, Brisbane, Australia. (Sept. 1997, p. 1029)

7-9 Thirteenth International Conference on Artificial Intelligence in Engineering (AIENG 98), Galway, Ireland.

Organized by: Wessex Institute of Technology, UK University College Galway, Ireland.

Contact: S. Radford, AIENG 98 Conference Secretariat, Wessex Institute of Technology, Ashurst Lodge, Ashhurst, Southampton SO40 7AA UK; tel: 44-1703-293-223; fax: 44-1703-292-855; e-mail: radford@wessex.ac.uk; URL: http://www.wessex.ac.uk.


7-17 Emerging Applications of Dynamical Systems, University of Minnesota, Minneapolis, Minnesota. (Sept. 1997, p. 1029)

8-10 4th International Conference on Lattice Paths Combinatorics and Applications, University of Vienna, Vienna, Austria. Topics: Lattice paths and boundaries; plane partitions; Young tableaux; q-calculus; orthogonal polynomials; random walk problems; non-parametric statistical inference; discretizations and urn models; queueing theory; analysis of algorithms.

Deadlines: Authors are invited to submit abstracts of at most four pages before February 1, 1998. Preferred way of submission is by sending ONE postscript file by email to boehm@isiis.wu-wien.ac.at. If an author is not able to submit a postscript version of her/his extended abstract, four copies of the extended abstract should be mailed to Walter Boehm, Department of Statistics, University of Economics and Business Administration, Auguste 2-6, A-1091 Vienna, Austria. Authors are also requested to indicate how much time they will need to present their talks.

Organizers: W. Boehm, Department of Statistics, Univ. of Economics and Business Administration, Vienna; C. Krattenthaler, Department of Mathematics, Univ. of Vienna.

Information: e-mail: boehm@isiis.wu-wien.ac.at; http://www.wu-wien.ac.at/www/institute/stat/1p/1p.html.


19-August 2 7th Workshop on Stochastic Analysis, Didim, Turkey. (Sept. 1997, p. 1029)


*27-August 7 SMS-NATO ASI: Nonlinear Analysis, Differential Equations, and Control, Universite de Montreal, Montreal, Canada. Program: The main topics to be discussed in this summer school are nonlinear analysis, differential equations, control theory, and functional analysis.


August 1998

August-December The Fields Institute for Research in Mathematical Sciences Program in Probability and Its Applications; The Fields Institute, Toronto, Ontario, Canada. (Sept. 1997, p. 1029)

3-7 Conference on Lattices and Universal Algebra, JATE Bolyai Institute, Szeged, Hungary. (Oct. 1997, p. 1158)

3-7 XI - Brazilian Meeting of Topology, Departamento de Matematica do Instituto de Geociencias e Ciencias Exatas da UNESP - Rio Claro, Sao Paulo, Brazil.


Scientific Committee: J. P. Brasselet (Luminy), D. L. Goncalves (IME-USP), U. Koshkorev (Siegen), O. Saeki (Hiroshima), P. Schwartz (PUC-Rio).

Information: e-mail: topxi@igce.unesp.br.

9-15 Conference on Geometry and Topology, University of Aarhus, Aarhus, Denmark.

Emphasis: This is the 5th in a series of topology conferences hosted by Aarhus Univ. The week prior to the ICM, when located in Europe. The tradition started in 1962 with a conference on algebraic topology, but over the years, the emphasis has moved more toward manifold theory and geometry.

Sponsor: Danish Science Council and Univ. of Aarhus.

Organizing Committee: K. Grove, J. Madsen and E. K. Pedersen.

Program: All lectures will take place in the Mathematics Department, where lunch as well as breakfast are also available.

Social Program: Monday, August 10, 5:30 p.m.: Banquet at City Hall; Wednesday, August 12: Dinner and guided tour at the Steno museum (235 DKK); Friday, August 14: Conference dinner. Daily lunch and conference dinner are free for participants.

Accommodations: Help will be provided in finding accommodations. Registration fee: 500 DKK (≈ $70).

Information: A second announcement will be sent out in January 1998 with information on hotel reservations and registration. For further information see the home page at http://www.ml.au.dk/~top98/.


Chair: Conference Chairman: C. Constanda (U.K.). Chairman of the Local Organizing Committee: B. Bertram (USA).

Invited Speakers: G. Beylkin (Univ. of Colorado, Boulder); A. G. Gibson (Univ. of New Mexico); C. G. Jerley (Scripps, Univ. of California, San Diego); S. Kim (Univ. of Wisconsin, Madison); M. Z. Nashed (Univ. of Delaware); J. C. Nedelec (Ecole Polytechnique, Palaiseau, France); B. D. Sleeman, (Univ. of Leeds, England).

Participation: Participation is open to all scientists and engineers whose work makes use of analytic and numerical methods, integral equations, ordinary and partial differential equations, finite element methods, conservation laws, hybrid approaches, vortex methods, etc. A second announcement will be sent to all prospective participants who indicate their interest to the Chairman of the Local Organizing Committee before November 1, 1997.

Contributed Papers: The authors of contributed papers are requested to submit an abstract containing the topic of the talk, a summary (not exceeding 300 words), and the full institutional address, including telephone and fax numbers and e-mail address.


Information: B. Bertram, IMSE98, Departament of Mathematical Sciences, Michigan Technological University, Houghton, Michigan; tel: 906-487-2111; fax: 906-487-3133; e-mail: imse@mtu.edu; Website access through http://www.math.mtu.edu.

10-14 From Individuals to Populations, Ceske Budejovice, Czech Republic. (Sept. 1997, p. 1030)

13-17 Seventh International Colloquium on Numerical Analysis and Computer Science with Applications, Plovdiv, Bulgaria. (Sept. 1997, p. 1030)


18-23 Ninth International Colloquium on Differential Equations, Plovdiv, Bulgaria. (Sept. 1997, p. 1030)

18-27 International Congress of Mathematicians (ICM98), Berlin, Germany. (June 1996, p. 702)

*19-21 20th Anniversary of Boundary Elements Conference (BEM 20), University of Central Florida, Orlando, Florida.

Purpose: BEM 20 will bring together researchers from industry and academia who are involved with the use of the method. This conference is internationally recognized as the forum for boundary element research and always attracts a large number of well established practitioners and leading researchers in the field. The meeting also holds a special appeal for young researchers who are actively involved in advances of boundary elements; the meeting provides a unique forum in which they can present and discuss their ideas with their colleagues. Exhibitors wishing to display products, services, hardware, software, or literature relating to the theme of the conference are also welcome.

Call for Papers: Papers are invited on the topics indicated and others falling within the scope of the conference. An abstract of no more than 300 words, clearly stating the purpose, results, and conclusion of the work to be described in the final paper should be submitted to the Conference Secretariat as soon as possible and no later than January 2, 1998. The camera-ready manuscript of the final full-length paper must be received by April 15, 1998. Final acceptance will depend on the full-length paper.

Information: For more information on the conference go to Web page http://www.wessex.ac.uk/ and click on the conference information link, or contact the conference secretariat, L. Kerr, at Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, UK; tel: 44-1703-293-223; fax: 44-1703-292-853; e-mail: ik@wessex.ac.uk.

*19-23 4th International Conference on Numerical Methods and Applications, Sofia, Bulgaria.

Purpose: NMA’98 is the 4th in a row International Conference in the broad field of numerical methods and their applications in mathematical modeling and aims at providing forum for exchange of ideas between scientists who develop and study numerical methods, and researcher who apply them for solving real-life problems.

Topics: Finite difference methods; finite element methods; finite volume methods; boundary element methods; Monte Carlo methods; numerical linear algebra; parallel computing; numerical methods for non-linear problems; numerical methods for multiscale problems; multigrid and domain decomposition; computational fluid dynamics; structural mechanics modeling; environmental modeling; engineering applications; minisymposia.

Contributions: Minisymposia (proposals due by November 30, 1997); paper (due by February 15, 1998). Submit two hard copies of the paper (up to 8 pages).

Organizers: The Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, in cooperation with Central Laboratory for Parallel Processing, Bulgarian Academy of Sciences, Faculty of Mathematics and Informatics, University of Sofia, and the Society for Industrial and Applied Mathematics (SIAM).

Confirmed Key and Invited Speakers: O. Axelsson (The Netherlands), J. H. Bramble (USA), B. N. Chetverushkin (Russia), R. E. Ewing (USA), R. P. Fedorenko (Russia).
**Mathematics Calendar**

November 1998

14–15 AMS Western Sectional Meeting, University of Arizona, Tucson, AZ. (Sept. 1997, p. 1031)

Information: W. Drady, wsd@ams.org.

The following new announcements will not be repeated until the criteria in the next to the last paragraph at the bottom of the first page of this section are met.

February 1999


Purpose: This conference, traditionally held at a summer holiday resort, covers a broad spectrum of applied mathematics, strongly encouraging lectures on concrete applications. Areas include engineering and industrial mathematics, fluid and solid mechanics, mathematical modelling, numerical mathematics, operations research, financial mathematics, and solution methods for partial differential equations.


Information: Secretary, ANZIAM'99, School of Mathematics and Applied Statistics, University of Wollongong, NSW 2522, Australia; fax: 61-2-42214845; e-mail: Tim_Marchant@uow.edu.au.

July 1999


Program: The congress will focus worldwide attention on the importance of mathematical and computational methods in the solution of real world problems. The program consists of invited and contributed lectures, minisymposia, poster presentations, and an exhibition.

Topics: Presentations are welcome in all areas of applied and computational mathematics, computer science, applied probability and statistics, scientific computing and applications of mathematics to industrial, financial, medical, environmental, and other related fields.

Information: Details of the conference are available by accessing the conference Web page: http://www.maths.ed.ac.uk/conferences/iciam99/, or by writing/telephoning/faxing/e-mailing ICIAM '99 Congress Secretariat, c/o Meeting Makers, 50 George Street, Glasgow G1 1QE, UK; tel: +44 0 141 553 1930; e-mail: geninfo.iciam99@meetingmakers.co.uk; fax: +44 0 141 552 0511.

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sia), S. K. Godunov (Russia), M. Griebel (Germany), P. Hemker (The Netherlands), U. Jankel (Germany), Z. Kamont (Poland), S. P. Kuryumov (Russia), Yu. A. Kuznetsov (USA/Russia), R. Lazarov (USA/Bulgaria), H. Niederreiter (Austria), L. Perkins (USA), B. Philippe (France), Yu. P. Popov (Russia), I. V. Puzynin (Russia), S. Rjasanow (Germany), A. A. Samarskii (Russia), M. Schaefer (Germany), V. Thomee (Sweden), P. N. Vabishchevich (Russia), H. A. van der Vorst (The Netherlands), M. E. Wheeler (USA), L. Xanthis (UK), Z. Zlatev (Denmark).

**Call for Organizing Minisymposia:** To organize a minisymposium provide: name and address of the organizer; minisymposium title and abstract; titles and authors of a minimum of four presentations; abstracts of presentations (optional).

**Call for Papers:** To present a paper, submit by e-mail a LaTeX file. Two hard copies of the paper will also be required by February 15, 1998. The final version of the papers should not exceed 12 pages for key and invited lectures, and 8 pages for contributed talks. Notification of acceptance and mandatory format of the final manuscript will be sent by May 1, 1998.

**Conference Proceedings:** Proceedings (in a book form) of refereed and presented papers will be published.

**Abstracts:** Abstracts of a maximum of 1 page are required from all participants wishing to present a talk at the conference. Abstracts have to be sent as ASCII files via e-mail. The deadline is February 15, 1998.

**Information:** Submit papers to: NMA & Oth'L98, c/o O. Iliev, Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., B18, 1113 Sofia, Bulgaria; e-mail: Nic98@math.acad.bg; URL: http://orca.st.uam.es/marcin/np/cfp/sofia.html or http://banamplc.math.acad.bg/#/nma98/.

30-September 5 Algebraic Number Theory and Diphantine Analysis, Graz, Austria. (Sept. 1997, p. 1030)


Information: WWW: http://www.math.uni-rostock.de/math/events/

31-September 6 International Conference on Mathematics and Applications Dedicated to the 90th Anniversary of L. S. Pontryagin, St. Petersburg Mathematical Institute and Moscow State (Lomonosov) University, Moscow, Russia. (Sept. 1997, p. 1030)

September 1998

1-9 Fourth International Conference on Complex Structures and Vector Fields, St. Constantine resort (near Varna), Bulgaria. (Sept. 1997, p. 1031)

12-13 Central Sectional Meeting, DePaul University, Chicago, IL. (Sept. 1997, p. 1031)

*16-18 Seventh International Conference on Hydraulic Engineering Software (HYDROSOFT '98), Centro di in Como, Italy.

Contact: L. Kerr, HYDROSOFT 98 conference secretariat, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton SO4 7AA UK; tel: 44-1703-293-223; fax: 44-1703-292-853; e-mail: liz@wessex.ac.uk; Web: http://www.wessex.ac.uk.


28-30 International Conference on Ordinary and Symbolic Data Analysis (OSDA98), University of Massachusetts, Lincoln Campus Center, Amherst, Massachusetts.

Theme: The theme of the conference is motivated by the fact that ordinal and symbolic data occur quite frequently, but theoretical tools for handling ordinal and symbolic data are not sufficiently developed. The layout of the conference will involve a nominal registration fee. Courses on conceptual data analysis and on conceptual knowledge processing will be offered immediately before the conference at the University of Massachusetts.

**Deadline:** The deadline for applications and abstracts is July 1, 1998. If possible the abstract should be submitted in Latex, and should not consist of more than a single page. A template for the abstracts is available on request.

**Information:** Inquiries, applications, and abstracts should be sent to: M. F. Janowitz, Dept. of Mathematics and Statistics, Univ. of Massachusetts, Lederle Graduate Research Tower, Box 34515, Amherst, MA 01003-4515, or preferably by e-mail to: OSDA98@math.umass.edu. (Oct. 1997, p. 1158)

October 1998

9-10 AMS Southeastern Sectional Meeting, Wake Forest University, Winston-Salem, North Carolina. (Sept. 1997, p. 1031)

24-25 AMS Eastern Sectional Meeting, Pennsylvania State University, State College, PA. (Sept. 1997, p. 1031)

Information: R. Cascella, rgc@ams.org.

*25-28 Fractal 98, Complexity and Fractals in the Sciences, Valletta, Malta.

Information: Further details on http://www.kingston.ac.uk/fractal/.
New Publications Offered by the AMS

General and Interdisciplinary

Jacques Hadamard, A Universal Mathematician
Vladimir Maz'ya and Tatyana Shaposhnikova, Linköping University, Sweden

This book presents a fascinating story of the long life and great accomplishments of Jacques Hadamard (1865-1963), who was once called "the living legend of mathematics". As one of the last universal mathematicians, Hadamard's contributions to mathematics are landmarks in various fields. His life is linked with world history of the 20th century in a dramatic way. This work provides an inspiring view of the development of various branches of mathematics during the 19th and 20th centuries.

Part I of the book portrays Hadamard's family, childhood and student years, scientific triumphs, and his personal life and trials during the first two world wars. The story is told of his involvement in the Dreyfus affair and his subsequent fight for justice and human rights. Also recounted are Hadamard's worldwide travels, his famous seminar, his passion for botany, his home orchestra, where he played the violin with Einstein, and his interest in the psychology of mathematical creativity.

Hadamard's life is described in a readable and inviting way. The authors humorously weave throughout his jokes and the myths about him. They also movingly recount the tragic side of his life. Stories about his relatives and friends, and old letters and documents create an authentic and colorful picture. The book contains over 300 photographs and illustrations.

Part II of the book includes a lucid overview of Hadamard's enormous work, spanning over six decades. The authors do an excellent job of connecting his results to current concerns. While the book is accessible to beginners, it also provides rich information of interest to experts.

Contents: Part I, Hadamard's Life: Prologue; The beginning; The turn of the century; Mature years; After the Great War; Le Maitre; In the thirties; World War II; After eighty; Part II, Hadamard's Mathematics: Analytic function theory; Number theory; Analytical mechanics and geometry; Calculus of variations and functionals; Miscellaneous topics; Elasticity and hydrodynamics; Partial differential equations; Hadamard's last works; Epilogue; Principal dates in Hadamard's life; A Hadamard collection; Bibliography of Jacques Hadamard; Publications about Jacques Hadamard and his work; General bibliography; Archival material; Index.

History of Mathematics, Volume 14
February 1998, approximately 507 pages, Hardcover, ISBN 0-8218-0841-9, LC 97-36357, 1991 Mathematics Subject Classification: 01-02, 01A70, 01A99; 11-03, 26-03, 30-03, 35-03, 46-03, 53-03, 73-03, 76-03, Individual member $47, List $79, Institutional member $83, Order code HMAI/14N

Mathematical Sciences Professional Directory

This annual directory provides a handy reference to various organizations in the mathematical sciences community. Listed in the directory are: officers and committee members of over thirty professional mathematical organizations (terms of office and other pertinent information are also provided in some cases); key mathematical sciences personnel of selected government agencies; academic departments in the mathematical sciences; mathematical units in nonacademic organizations; and alphabetic listings of colleges and universities. Current addresses, telephone numbers, and electronic addresses for individuals are listed in the directory when provided.

Number Theory

Reviews in Number Theory 1984–96

These six volumes include approximately 20,000 reviews of items in number theory that appeared in Mathematical Reviews (MR) between 1984 and 1996. This is the third such set of volumes in number theory: The first was edited by W. J. LeVeque and included reviews from 1940–1972; the second was edited by R. K. Guy and appeared in 1984.

With the publication of the new review volumes, readers now have available reviews in number theory covering more than half a century.

Contents: Volume 1B: Elementary number theory; Sequences and sets; Polynomials and matrices; Volume 2B: Diophantine equations; Forms and linear algebraic groups; Discontinuous groups and automorphic forms; Arithmetic algebraic geometry (Diophantine geometry); Volume 3B: Geometry of numbers; Diophantine approximation, transcendental number theory; Probabilistic theory: distribution modulo 1; metric theory of Diophantine approximation, transcendental number theory; Analytic number theory: zeta functions, exponential sums, character sums; Volume 4B: Exponential sums and character sums; Zeta functions and L-functions: analytic theory; Multiplicative number theory; Additive number theory; Partitions; Other arithmetic-analytic topics; Volume 5B: Algebraic number theory: global fields; Algebraic number theory: local and p-adic fields; Finite fields and commutative rings (number-theoretic aspects); Connections with logic; Computational number theory; Volume 6B: Preface; Chapter 1: General; Classification scheme; Subject word index; Author index; Key index; MR number list; Cyrillic table.


Algebra and Algebraic Geometry

Characters of Finite Groups. Part I

Ya. G. Berkovich, University of Haifa, Israel, and E. M. Zhmud', Kharkov University, Ukraine

This book discusses character theory and its applications to finite groups. The work places the subject within the reach of people with a relatively modest mathematical background. The necessary background exceeds the standard algebra course with respect only to finite groups.

Starting with basic notions and theorems in character theory, the authors present a variety of results on the properties of complex-valued characters and applications to finite groups. The main themes are degrees and kernels of irreducible characters, the class number and the number of nonlinear irreducible characters, values of irreducible characters, characterizations and generalizations of Frobenius groups, and generalizations and applications of monomial groups. The presentation is detailed, and many proofs of known results are new. Most of the results in the book are presented in monograph form for the first time. Numerous exercises offer additional information on the topics and help readers to understand the main concepts and results.

Contents: Basic concepts; Characters: On arithmetical properties of characters; Products of characters; Induced characters and representations; Projective representations; Clifford theory; Brauer's induction theorems; Faithful representations; Existence of normal subgroups; On sums of degrees of irreducible characters; Groups of relatively small height; The Brauer-Suzuki theorem; Appendices; Notes on the bibliography; Bibliography; Author index; Subject index.


Quantum Groups and Knot Invariants

Christian Kassel, Marc Rosso, and Valadimir Turaev, CNRS, Strasbourg, France

This book provides a concise introduction to quantum groups, braided monoidal categories and quantum invariants of knots and of three-dimensional manifolds. The exposition emphasizes the newly discovered deep relationships between these areas.

1502 Notices of the AMS Volume 44, Number 11
Symmetric Functions and Orthogonal Polynomials

I. G. Macdonald, Queen Mary College, University of London, England

One of the most classical areas of algebra, the theory of symmetric functions and orthogonal polynomials, has long been known to be connected to combinatorics, representation theory, and other branches of mathematics. Written by perhaps the most famous author on the topic, this volume explains some of the current developments regarding these connections. It is based on lectures presented by the author at Rutgers University. Specifically, he gives recent results on orthogonal polynomials associated with affine Hecke algebras, surveying the proofs of certain famous combinatorial conjectures.

This text will also be of interest to those working in discrete mathematics and combinatorics and analysis.

Contents: Symmetric functions; Orthogonal polynomials; Postscript; References.

University Lecture Series, Volume 12

Trends in Ring Theory

Vlastimil Dlab, Carleton University, Ottawa, ON, Canada, and László Márki, Hungarian Academy of Sciences, Budapest, Editors

The Ring Theory Conference (University of Miskolc, Hungary) successfully accomplished its two goals: 1) to reflect contemporary trends in the subject area and 2) to offer a meeting place for a large number of Eastern European algebrists and their colleagues from around the world. Particular emphasis was placed on recent developments in the following four areas: representation theory, group algebras, PI algebras and general ring theory. This book presents 13 of the invited lectures.

Members of the Canadian Mathematical Society may order at the AMS member price.

algebras; K. W. Roggenkamp, Problems on group rings; A. Skowroński, Tame module categories of finite dimensional algebras; A. E. Zalesskii, Direct limits of finite dimensional algebras and finite groups.

Conference Proceedings, Canadian Mathematical Society, Volume 22


Discrete Mathematics and Combinatorics

The Classification of Countable Homogeneous Directed Graphs and Countable Homogeneous n-tournaments

Gregory L. Cherlin, Rutgers University, New Brunswick, NJ

In this book, Ramsey theoretic methods introduced by Lachlan are applied to classify the countable homogeneous directed graphs. This is an uncountable collection, and this book presents the first explicit classification result covering an uncountable family. The author's aim is to demonstrate the potential of Lachlan's method for systematic use.

Features:
- Interface between combinatorics and model theory
- Unusual use of Ramsey's theorem to classify structures
- An extension of an already elaborate branch of model theory
- The first monograph on Lachlan's method

Contents: Results and open problems; Homogeneous 2-tournaments; Homogeneous n-tournaments; Homogeneous symmetric graphs; Homogeneous directed graphs omitting I_n; Propositions 16 to 20 and MT 2.2; Homogeneous directed graphs embedding I_n; Theorems 7.6-7.9; Appendix: Examples for richer languages; Bibliography; Index of Notation; Index.

Memoirs of the American Mathematical Society, Volume 131, Number 621


Network Threats

Rebecca N. Wright, AT&T Labs Research, Florham Park, NJ, and Peter G. Neumann, SRI International, Menlo Park, CA, Editors

This volume presents papers from a DIMACS workshop on network threats. The workshop brought together computer scientists (theorists and practitioners) working in this area to discuss topics such as network security, prevention and detection of security attacks, modeling threats, risk management, threats to individual privacy, and methods of security analysis. The book demonstrates the wide and diverse range of topics involved in electronic interactions and transactions—including the less desirable aspects: security breaches. The volume offers a timely assessment of avoiding or minimizing network threats. Presented here is an interdisciplinary, system-oriented approach that encompasses security requirements, specifications, protocols, and algorithms. The text includes implementation and development strategies using real-world applications that are reliable, fault-tolerant, and performance oriented. The book would be suitable for a graduate seminar on computer security.

Features:
- Discussion of Internet, Web and Java security
- Information on new attacks and weaknesses
- Formal and informal analysis methods to identify, quantify, and combat security threats

This text will also be of interest to those working in general interest and interdisciplinary areas.

Contents: C. Meadows, A representation of protocol attacks for risk assessment; D. Zhou and S.-K. Chin, Verifying enhanced mail functions with higher order logic; M. Joyce and J.-J. Quisquater, Cryptanalysis of RSA-type cryptosystems: A visit; S. Patel, Information leakage in encrypted key exchange; A. Shostack, Observed weaknesses in security dynamics' client/server protocol; D. Dean, Web security: A high level view; D. S. Wallach, J. A. Roskind, and E. W. Felten, Flexible, extensible Java security using digital signatures; M. Burmester, Y. Desmedt, and G. Kabatianski, Trust and security: A new look at the Byzantine generals problem; R. J. Hall, Channels: Avoiding unwanted electronic mail; C. Cullen, Demonstration of hacker techniques.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 38

In this book, the authors treat the full Hodge theory for the de Rham complex when calculated in the Sobolev topology rather than in the $L^2$ topology. The use of the Sobolev topology strikingly alters the problem from the classical setup and gives rise to a new class of elliptic boundary value problems. The study takes place on both the upper half space and on a smoothly bounded domain.

Features:
- A good introduction to elliptic theory, pseudo-differential operators, and boundary value problems
- Theorems completely explained and proved
- New geometric tools for differential analysis on domains and manifolds

Contents: Preliminaries; The problem on the half space; The case of smoothly bounded domains.

Memoirs of the American Mathematical Society, Volume 131, Number 622


Differential Equations

Elliptic Boundary Value Problems in Domains with Point Singularities
V. A. Kozlov and V. G. Maz'ya, Linköping University, Sweden, and J. Rossmann, Rostock University, Germany

This monograph systematically treats a theory of elliptic boundary value problems in domains without singularities and in domains with conical or cuspidal points. This exposition is self-contained and a priori requires only basic knowledge of functional analysis. Restricting to boundary value problems formed by differential operators and avoiding the use of pseudo-differential operators makes the book accessible for a wider readership.

The authors concentrate on fundamental results of the theory: estimates for solutions in different function spaces, the Fredholm property of the operator of the boundary value problem, regularity assertions and asymptotic formulas for the solutions near singular points. A special feature of the book is that the solutions of the boundary value problems are considered in Sobolev spaces of both positive and negative orders. Results of the general theory are illustrated by concrete examples. The book may be used for courses in partial differential equations.

Contents: Introduction; Part 1: Boundary value problems for ordinary differential equations on the half-axis; Elliptic boundary value problems in the half-space; Elliptic boundary value problems in smooth domains; Variants and extensions; Part 2: Elliptic boundary value problems in an infinite cylinder; Elliptic boundary value problems in domains with conical points; Elliptic boundary value problems in weighted Sobolev spaces with nonhomogeneous norms; Variants and extensions; Part 3: Elliptic boundary value problems in domains with exterior cusps; Elliptic boundary value problems in domains with inside cusps; Bibliography; Index; List of symbols.
Recent Advances in Partial Differential Equations, Venice 1996

Renato Spigler, University of Padova, Italy, and
Stephanos Venakides, Duke University, Durham, NC, Editors

Lax and Nirenberg are two of the most distinguished mathematicians of our times. Their work on partial differential equations (PDEs) over the last half-century has dramatically advanced the subject and has profoundly influenced the course of mathematics. A huge part of the development in PDEs during this period has either been through their work, motivated by it or achieved by their postdocs and students.

A large number of mathematicians honored these two exceptional scientists in a week-long conference in Venice (June, 1996) on the occasion of their 70th birthdays.

This volume contains the proceedings of the conference, which focused on the modern theory of nonlinear PDEs and their applications. Among the topics treated are turbulence, kinetic models of a rarefied gas, vortex filaments, dispersive waves, singular limits and blow-up of solutions, conservation laws, Hamiltonian systems and others. The conference served as a forum for the dissemination of new scientific ideas and discoveries and enhanced scientific communication by bringing together such a large number of scientists working in related fields. The event allowed the international mathematics community to honor two of its outstanding members.

This text will also be of interest to those working in mathematical physics.


Proceedings of Symposia in Applied Mathematics, Volume 54

Geometry and Topology

Confoliations

Yakov M. Eliashberg, Stanford University, CA, and
William P. Thurston, University of California, Davis

This book presents the first steps of a theory of confoliations designed to link the geometry and topology of three-dimensional contact structures with the geometry and topology of codimension-one foliations on three-dimensional manifolds. Developing almost independently, these theories at first glance belonged to two different worlds: The theory of foliations is part of topology and dynamical systems, while contact geometry is the odd-dimensional "brother" of symplectic geometry.

However, both theories have developed a number of striking similarities. Confoliations—which interpolate between contact structures and codimension-one foliations—should help us to understand better links between the two theories. These links provide tools for transporting results from one field to the other.

Features:
- A unified approach to the topology of codimension-one foliations and contact geometry.
- Insight on the geometric nature of integrability.
- New results, in particular on the perturbation of confoliations into contact structures.

Contents: Geometric nature of integrability; Perturbation of confoliations into contact structures; Taut vs. tight; Bibliography.

University Lecture Series, Volume 13

Topological Dynamics and Applications

M. G. Nerurkar, Rutgers University, Camden, NJ, and D. B. Ellis, Beloit College, WI, Editors

This book is a very readable exposition of the modern theory of topological dynamics and presents diverse applications to such
areas as ergodic theory, combinatorial number theory and differential equations. There are three parts: 1) The abstract theory of topological dynamics is discussed, including a comprehensive survey by Furstenberg and Glasner on the work and influence of R. Ellis. Presented in book form for the first time are new topics in the theory of dynamical systems, such as weak almost-periodicity, hidden eigenvalues, a natural family of factors and topological analogues of ergodic decomposition. 2) The power of abstract techniques is demonstrated by giving a very wide range of applications to areas of ergodic theory, combinatorial number theory, random walks on groups and others. 3) Applications to non-autonomous linear differential equations are shown. Exposition on recent results about Floquet theory, bifurcation theory and Lyapunov exponents is given.

This text will also be of interest to those working in analysis.

Contents: Part I: H. Furstenberg and E. Glasner, Robert Ellis and the algebra of dynamical systems; J. Auslander, Weak mixing and pure weak mixing minimal flows; E. Glasner, M. Mentzen, and A. Siemaszko, A natural family of factors for minimal flows; E. Akin and E. Glasner, Topological ergodic decomposition and homogeneous flows; D. Penazzi, On the proximal and regionally proximal relation of an extension between minimal flows; E. Akin, J. Auslander, and K. Berg, Almost equicontinuity and the enveloping semigroup; V. Pestov, Some universal constructions in abstract topological dynamics; T. Downarowicz, Weakly almost periodic flows and hidden eigenvalues; E. Akin, Enveloping linear maps; H. Keynes, K. Madden, N. Markley, and M. Sears, An overview of the construction of suspension flows using continuous cocycles; D. Ellis, Suspensions, inheritance, and flows on homogeneous spaces; H. Ikeshoji and T. Wu, On the lifting of transformation semigroups; Part II: D. Dokken, Idempotent measures associated to a locally compact topological group; S. Adams, Another proof of Moore's ergodicity theorem for $SL(2, \mathbb{R})$; B. Weiss, Multiple recurrence and doubly minimal systems; H. Furstenberg and E. Glasner, Subset dynamics and van der Waerden's theorem; V. Bergelson and R. McCutcheon, Recurrence for semigroup actions and a noncommutative Schur theorem; Z. Coelho, W. Parry, and R. Williams, A note on Livšic's periodic point theorem; E. Glasner and J. King, A zero-one law for dynamical properties; D. Rudolph, Residuality and orbit equivalence; J. Feldman, Uncountably many Vershik-inequivalent group actions of equal entropy; Part III: M. Nerurkar, Positive Lyapunov exponents for a dense set of continuous $SL(2, \mathbb{R})$ valued cocycles which arise as solutions to strongly accessible linear differential systems; G. Sell, W. Shen, and Y. Yi, Topological dynamics and differential equations; S. Novo and R. Obaya, An ergodic and topological approach to almost periodic bidimensional linear systems; R. Johnson, An application of topological dynamics to bifurcation theory.

Contemporary Mathematics, Volume 215


Mathematical Physics

A Continuum Limit of the Toda Lattice

P. Deift, New York University-Courant Institute, NY, and K. T-R McLaughlin, Ohio State University, Columbus

In this book, the authors describe a continuum limit of the Toda ODE system, obtained by taking as initial data for the finite lattice successively finer discretizations of two smooth functions. Using the integrability of the finite Toda lattice, the authors adapt the method introduced by Lax and Levermore for the study of the small dispersion limit of the Korteweg de Vries equations to the case of the Toda lattice. A general class of initial data is considered which permits, in particular, the formation of shocks. A novel feature of the analysis in this book is an extensive use of techniques from the theory of Riemann-Hilbert problems.

This text will also be of interest to those working in analysis.

Contents: Introduction; Analysis of Log formula; An example; Monotone initial data; Shock 1; Shock 2; Shock 3; Shock 4; Symmetric data; Global description; Large time calculations; Appendix I—WKB; Appendix II—Bibliography.

Memoirs of the American Mathematical Society, Volume 131, Number 624


Nonlinear Waves and Weak Turbulence

V. E. Zakharov, Landau Institute for Theoretical Physics, Moscow, Russia, Editor

This book is a collection of papers on dynamical and statistical theory of nonlinear wave propagation in dispersive conservative media. Emphasis is on waves on the surface of an ideal fluid and on Rossby waves in the atmosphere. Although the book deals mainly with weakly nonlinear waves, it is more than simply a description of standard perturbation techniques. The goal is to show that the theory of weakly interacting waves is naturally related to such areas of mathematics as Diophantine equations, differential geometry of waves, Poincaré normal forms and the inverse scattering method.

Contents: A. M. Balk and E. V. Ferapontov, Invariants of wave systems and web geometry; A. M. Balk and V. E. Zakharov, Stability of weak-turbulence Kolmogorov spectra; V. A. Kalmykov, Energy transfer in the spectrum of surface gravity waves by resonence five wave-wave interactions; E. Kartashova, Wave resonances in systems with discrete
New Publications Offered by the AMS

spectra; L. I. Piterbarg, Hamiltonian formalism for Rossby waves; V. E. Zakharov, Weakly nonlinear waves on the surface of an ideal finite depth fluid.

American Mathematical Society Translations—Series 2, Advances in the Mathematical Sciences, Volume 182


Perspectives on Quantization

Lewis A. Coburn, State University of New York at Buffalo, and Marc A. Rieffel, University of California, Berkeley, Editors

This book presents the proceedings of a 1996 Joint Summer Research Conference sponsored by AMS-IMS-SIAM on “Quantization” held at Mount Holyoke College (Northampton, MA). The purpose of the conference was to bring together researchers focusing on various mathematical aspects of quantization.

In the early work of Weyl and von Neumann at the beginning of the quantum era, the setting for this enterprise was operators on Hilbert space. This setting has been expanded, especially over the past decade, to involve C*-algebras—noncommutative differential geometry and noncommutative harmonic analysis—as well as more general algebras and infinite-dimensional manifolds. The applications now include quantum field theory, notable conformal and topological field theories related to quantization of moduli spaces, and constructive quantum field theory of supersymmetric models and condensed matter physics (the fractional quantum Hall effect in particular).

The spectrum of research interests which significantly intersects the topic of quantization is unusually broad, including, for example, pseudodifferential analysis, the representation theory of Lie groups and algebras (including infinite-dimensional ones), operator algebras and algebraic deformation theory. The papers in this collection originated with talks by the authors at the conference and represent a strong cross-section of the interests described above.

This text will also be of interest to those working in analysis.

Contents: J. Arazy and H. Upmeier, Discrete series representations and integration over boundary orbits of symmetric domains; D. Borthwick, Microlocal techniques for semiclassical problems in geometric quantization; J. Dimock, A non-Gaussian fixed point for the renormalization group; B. C. Hall, Quantum mechanics in phase space; T. J. Hodges, Nonstandard quantum groups associated to certain Belavin-Drinfeld triples; S. Klimek and A. Leśniewski, Ergodic theorems for quantum Kronecker flows; S. Klimek and A. Leśniewski, Quantum maps; G. W. Mackey, The relationship between classical mechanics and quantum mechanics; G. Nagy, Deformation quantization and K-theory; J. H. Przytycki, A q-analogue of the first homology group of a 3-manifold; I. Segal, Constructive non-linear quantum field theory in four space-time dimensions; A. J. L. Sheu, Groupoids and quantization; A. Unterberger, Quantization, symmetries, and relativity; A. A. Voronov, Quantizing Poisson manifolds.

Contemporary Mathematics, Volume 214

Recent Reviews of AMS Publications

These publications recently were peer-reviewed within the scholarly community. It is our pleasure to share with you some of that feedback. These selections, which include books for specialists and nonspecialists, recommended textbooks, independent study volumes and more, offer valuable contributions to the field of mathematics. Browse this list or visit the AMS Bookstore at www.ams.org/bookstore to purchase these or any of our other highly praised publications.

C*-Algebras by Example
Kenneth R. Davidson, University of Waterloo, ON, Canada

The writing is clear and easy to follow ... an outstanding book that should be on every operator algebraists bookshelf.

—Mathematical Reviews

Categorical and Co-rings in Differential Graded Rings
George M. Bergman, University of California, Berkeley, and Adam O. Hausknecht, University of Massachusetts at Darmouth

Indispensably, Bergman and Hausknecht have done a remarkable job of surveying a broad range of territories ... there is no comparable book.

—Bulletin of the American Mathematical Society

Gröbner Bases and Convex Polytopes
Bernd Sturmfels, University of California, Berkeley

Material is presented in a concise way ... lots of motivating examples ... not only of interest for mathematicians studying Gröbner bases, but also for researchers working on the mathematical aspects of integer programming and computational statistics.

—Newsletter on Computational and Applied Mathematics

Lectures on Entire Functions
B. Ya. Levin, Institute of Low Temperature Physics and Engineering, Kharkov, Ukraine

Readers with some previous knowledge will experience pleasant surprises at the deft way in which the material is presented. David Drasin's excellent translation is smooth and idiomatic. It reads like a book written in English by a gifted expositor.

—Zentralblatt für Mathematik

Mathematics 1: Japanese Grade 10
Kunihiko Kodaira, Gakushuin University, Tokyo, Japan, Editor

Covers a wealth of material ... clearly, matter-of-facty written, has many demonstrations of proofs, and many examples. A lot of trees and minds would be saved if this book were to replace typical American Algebra 1 texts. I applaud UCSMP and AMS for their valuable work on making some of the world's better textbooks available to an English-reading audience.

—Zentralblatt für Mathematik

Mixed Problem for Partial Differential Equations with Quasihomogeneous Principal Part
S. G. Gindikin and L. R. Volevich, Rutgers University, New Brunswick, NJ

The book ... has advantages which make it distinctive ... gives a good introduction to the subject, and can be understood by undergraduate students ... an expert may well find many useful technical results and observations that were previously unknown.

—Bulletin of the London Mathematical Society

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ARIZONA

ARIZONA STATE UNIVERSITY
Department of Mathematics

The Department of Mathematics at Arizona State University invites applications for several tenure-track and visiting positions at the assistant and associate professor levels, pending budgetary approval, commencing fall 1998. All candidates must have a Ph.D. in mathematics, statistics, or a closely related area and demonstrated potential for excellence in research and teaching at the undergraduate level. For candidates at the associate professor level, additional requirements include an outstanding research record and proven commitment to excellence and innovation in teaching at all levels.

Tenure-track candidates must have research strengths in one or more of the following areas: i) applied and theoretical statistics, ii) computationally oriented applied mathematics, iii) differential equations (ordinary and/or stochastic), or iv) operator algebras. Candidates in the first three areas should also have experience in modeling and computation, encompassing applications from industry, the life sciences or engineering, and expect to participate fully in a cross-disciplinary environment.

Applications for visiting positions are invited from candidates who must have research strengths in applied mathematics or discrete mathematics and interests in modeling, computation, and participation in multidisciplinary activities.

The main campus of Arizona State University has approximately 43,000 students and is located in the rapidly growing metropolitan Phoenix area, which provides a wide variety of recreational and cultural opportunities. The Department of Mathematics currently has 58 full-time faculty members, 27 lecturers, and over 70 supported graduate students. Departmental computing facilities include networked clusters of high-end workstations as well as several graphics computers and access to the university’s central computing facilities.

Applicants must send i) their résumé, ii) an AMS Cover Sheet, iii) a letter stating for which position they wish to be considered and addressing their research agenda, iv) a statement of teaching philosophy, and v) at least three letters of recommendation by the deadline to: R. A. Renaut, Chair, Department of Mathematics, P. O. Box 871804, Arizona State University, Tempe, AZ 85287-1804.

Review of the applications will begin on November 30, 1997, and will continue weekly until the positions are filled.

ARIZONA STATE UNIVERSITY
Senior Joint Positions: (i) Departments of Mathematics and Chemical, Bio and Materials Engineering; (ii) Departments of Mathematics and Electrical Engineering.

We invite applications for two associate or full professor positions commencing fall, 1998.

One is to be jointly appointed in the mathematics and chemical, bio and materials engineering departments. Candidates must have a Ph.D. degree in mathematics, materials science or engineering, or a closely related degree; experience in mathematical modeling and simulation of semiconductor materials processing, computation, and contact with applications from industry.

One is to be jointly appointed in the mathematics and electrical engineering departments. Candidates must have a Ph.D. degree in mathematics, electrical engineering, or a closely related degree. Candidates must have expertise in control systems and in differential equations. Experience in modeling of complex dynamical systems and computation, encompassing applications from industry or the life sciences, desired.

All candidates must have an outstanding research record, an established record of research funding, and a proven commitment to excellence and innovation in teaching. Candidates are expected to participate fully in cross-disciplinary programs, teaching, research, and professional service.

The main campus of Arizona State University has approximately 43,000 students and is located in the rapidly growing metropolitan Phoenix area, which provides a wide variety of recreational and cultural opportunities. The Phoenix area supports a high concentration of high technology industries. The Department of Mathematics has 58 full-time faculty; the Department of Chemical, Bio and Materials Engineering has 26 full-time faculty; and the Department of Chemical, Bio and Materials Engineering has approximately 70 supported graduate students. Departmental computing facilities include networked clusters of high-end workstations as well as several graphics computers and access to the university’s central computing facilities.

Suggested uses for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

The 1997 rate is $100 per inch or fraction thereof on a single column (one-inch minimum), calculated from top of headline. Any fractional text of 1/2 inch or more will be charged at the next inch rate. No discounts for multiple ads or the same ad in consecutive issues. For an additional $10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Headlines will be centered in boldface at no extra charge. Ads will appear in the language in which they are submitted. There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified advertising.


U.S. laws prohibit discrimination in employment on the basis of color, age, sex, race, religion, or national origin. "Positions Available" advertisements from institutions outside the U.S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U.S. laws. Details and specific wording may be found on page 1373 (vol. 44).

Situations wanted advertisements from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4367) in the U.S. and Canada, or 401-455-4084 worldwide, for further information.

Submission: Promotions Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940, or via fax, 401-331-3842, or send e-mail to classads@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02944. Advertisers will be billed upon publication.

DECEMBER 1997
NOTICES OF THE AMS

1511
Candidates for associate professor must have a demonstrated record of superior teaching and an established research program. Preference will be given to applicants in applied mathematics, especially in the areas of applied analysis, PDEs, ODEs, continuous dynamical systems, or integral equations. Applicants should also have wide mathematical interests and be able to teach across the undergraduate mathematics curriculum. Candidates must be willing to supervise undergraduate research and work with others in the development of departmental programs.

Harvey Mudd College is a highly selective undergraduate institution of science and engineering. One year of high school calculus is required for admission to HMCC. More than one-third of the student body are National Merit Scholarship finalists. The college enrolls about 630 students and is associated with four other undergraduate colleges and the Claremont Graduate University, forming together an academic community of about 5,000 students. There are over 40 mathematicians in Claremont. Applicants should send a curriculum vitae, a description of their teaching philosophy and accomplishments, and a description of their current research and research goals. Applicants should also arrange to have three letters of reference sent directly to the address that appears below.

Review of the applications will begin on December 31, 1997, and will continue weekly until the positions are filled.

AA/EOE.

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CALIFORNIA

CALIFORNIA STATE UNIVERSITY, NORTHridge

The Department of Mathematics invites applications for a tenure-track appointment at the assistant professor level effective fall 1998, although in exceptional cases a more advanced appointment may be considered. Since about half of our majors graduate with a secondary teaching option and the department has recently instituted a graduate option in applied mathematics, candidates with specialties in teacher education or applied mathematics will be given particular consideration. Excellence in teaching, research, and a willingness to participate in departmental and University affairs, in addition to a Ph.D. in the mathematical sciences, are required. Please send a vita, the AMS Standard Cover Sheet, and three letters of recommendation, one of which addresses the candidate's teaching abilities, to the Hiring Committee, Department of Mathematics, CSUN, Northridge, CA 91330-8313, by January 15, 1998. CSU Northridge is an Equal Opportunity/Affirmative Action Employer.

HARVEY MUDD COLLEGE

Associate or Assistant Professor of Mathematics

Harvey Mudd College invites applications for one tenure-track position in mathematics at the associate professor or assistant professor level. Excellence in teaching is absolutely essential, as is evidence of a strong and ongoing research program.

normal teaching schedule is the equivalent of five semester courses per year. A one-year leave is granted every four years. The College is located in Los Angeles County with easy access to a number of research institutions. For more information visit our departmental home page, http://www.oxy.edu/departments/math/.

Salary is competitive. The benefits package includes a mortgage subsidy program, on-campus child care, tuition grants for children of faculty, and a choice of health care plans.

Candidates must submit a current résumé and three letters of recommendation, at least one of which evaluates teaching experience, performance, and potential. In addition, candidates must submit a statement of professional plans, interests, and goals. The statement should address teaching and curriculum for undergraduate mathematics at a liberal arts college, as well as mathematical interests and research plans.

All materials must be received by February 13, 1998. Address all materials to: Faculty Search Committee, Department of Mathematics, Occidental College, 1600 Campus Road, Los Angeles, CA 90041-3314.

Members of the department will be attending the Annual Joint Meetings in Baltimore. Occidental College is committed to equity and excellence in education and strongly encourages applications from women and minorities.

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UNIVERSITY OF CALIFORNIA, BERKELEY

Department of Statistics

Pending final budgetary approval, applications are invited for a special full-time Neyman Visiting Assistant Professor position, beginning fall 1998 or spring 1999. The appointment is of a two-year duration (but can be shorter by mutual agreement) and is not renewable. Applicants should have exhibited exceptional research potential in any of the following areas: theoretical or applied statistics, computational statistics, probability theory, applied probability. Appointees will be expected to teach effectively as well as carry out a vigorous program of research. Minimum salary $39,000; salary commensurate with experience. Apply, including résumé, names, and (preferably e-mail) addresses of three references, by January 20, 1998, to: Chair, Department of Statistics, #3860, University of California, Berkeley, CA 94720; fax 510-642-7892; e-mail: recruit@stat.berkeley.edu. The University of California is an Equal Opportunity/Affirmative Action Employer.

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UNIVERSITY OF CALIFORNIA, IRVINE

Department of Mathematics

Irvine, CA 92697-3875

Applications are invited for several one- or two-year Visiting Assistant Professor positions in the following areas of research: 1)
The University of California, Los Angeles Department of Mathematics

Temporary Positions

Subject to availability of resources and administrative approval: (1) Three E. R. Hedrick Assistant Professorships. Applicants must show very strong promise in research and teaching. Salary $45,000. Three-year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by January 6, 1998.

(2) One or two Research Assistant Professorships in Computational and Applied Mathematics. Applicants must show very strong promise in research and teaching. Salary $45,000. One-year appointment, probably renewable up to two times. Teaching load: at most four quarter courses per year, which may include one advanced course in the candidate’s field. Preference will be given to applications completed by January 6, 1998.

(3) One Adjunct Assistant Professorship or Lectureship in the Program in Computer Science (PIC). Applicants for the adjunct position must show very strong promise in teaching and research in an area related to programming. Teaching load: four quarter programming courses and one more advanced quarter course per year. One-year appointment, probably renewable once. Salary $48,400. Applicants for the lectureship must show very strong promise in the teaching of programming. An M.S. in computer science or equivalent degree is preferred. Teaching load: six quarter programming courses per year. One-year appointment, probably renewable one or more times depending on the needs of the program. Salary is $40,656 or more depending on experience. Preference will be given to applications completed by February 1, 1998.

(4) An Adjunct Assistant Professorship. One-year appointment, probably renewable once. Strong research and teaching background required. Salary $41,900-$43,900. Teaching load: five quarter courses per year.

(5) Possibly one or more positions for visitors.

To apply, send electronic mail to: search@math.ucla.edu, or open http://www.math.ucla.edu/~search on the World Wide Web, or write to Tony Chan, Chair, Department of Mathematics, University of California, Los Angeles, CA 90095-1555. Attn: Staff Search. UCLA is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA, SANTA CRUZ
Mathematics Department

The Mathematics Department at the University of California, Santa Cruz, is recruiting for one or more tenure-track assistant professors Step I-III in the areas of algebra and number theory, Position #510. The position(s) would be effective July 1, 1998, contingent on budgetary approval. The teaching load is one-quarter courses per year. Minimum qualifications: Ph.D. (or equivalent) in mathematics and demonstrated achievements or potential for excellence in research, teaching, and professional service. Step commensurate with experience. Salary Range: $36,900-$43,900. Application deadline: January 16, 1998. Please refer to position number indicated above in your correspondence. Applicants should send a curriculum vitae, a summary of their research and teaching experience, and four confidential letters of recommendation (at least one letter addressing teaching experience and ability) to: Recruitment Committee, Mathematics Department, University of California, Santa Cruz, CA 95064. Inquiries (only) can be sent to mathcrccats.ucsc.edu.

UNIVERSITY OF CALIFORNIA, SANTA CRUZ
Applied Mathematics and Statistics

The Santa Cruz campus of the Univer-
The University of California invites applications for outstanding faculty members in applied mathematics and statistics. Successful candidates at the senior level will be expected to play a leadership role in the development of this new academic program. We are particularly, but not exclusively, interested in the following areas: 1) scientific computing and numerical methods, mechanics and dynamics, applied dynamical systems, and control theory; 2) applied probability, statistics, and stochastic processes; 3) discrete mathematics and related areas.

Rank: Assistant to full professor.

Position available: Fall 1998, contingent upon final budgetary approval.

Minimum qualifications: Ph.D. or equivalent in applied mathematics or related field. Outstanding record as researcher and educator, appropriate to the level of appointment.

Closing date: Nominations and applications received by January 15, 1998, will be assured of receiving full consideration.

For assistant professor applicants, refer to Position #442. For associate to full professor applicants, refer to Position #443.

For additional information on this position, see http://www.cse.ucsc.edu/events/ams-recruit.html.

UCSC is an EEO/AA/IRCA Employer.

STANFORD UNIVERSITY
Department of Mathematics
Assistant Professorships in Honor of Gabor Szego

The department expects to make one or more appointments in 1998-99 for these special three-year positions. Applicants are expected to show outstanding promise in research and clear evidence of achievement. They should have received the Ph.D. prior to the start of the appointment, but not before 1986. Stanford is committed to excellence in teaching, and applicants should count this as one of their goals.

Candidates should send a letter of application with a curriculum vitae, a list of publications, information concerning teaching experience, and three letters of recommendation to Prof. Gunnar Carlsson, Chairman, Department of Mathematics, Stanford University, Stanford, CA 94305-2125, by December 15, 1997. Stanford is an Affirmative Action/Equal Opportunity Employer and welcomes applications from women and minorities.

COLORADO
UNIVERSITY OF COLORADO AT BOULDER
Department of Mathematics

Applications are invited for two tenure-track faculty positions at the assistant professor level beginning in the fall of 1998, one in probability and one in classical analysis. Candidates should have earned a Ph.D. in mathematics by August 1998, have demonstrated interest and ability in teaching, and have experience in and commitment to mathematical research.

These positions require teaching at various levels, mathematical research, and service.

Applications, including a résumé and four letters of reference, should be sent to: Search Committee, Department of Mathematics, Campus Box 395, University of Colorado, Boulder, CO 80309-0395. Review of applications will begin December 15, 1997, and will continue until the positions are filled.

The University of Colorado at Boulder strongly supports the principle of diversity in all its forms. We are interested in receiving applications from women, ethnic minorities, persons with disabilities, veterans, and veterans of the Vietnam era.

FLORIDA
FLORIDA ATLANTIC UNIVERSITY
Department of Mathematics

The department invites applications for a tenure-track faculty position beginning in the fall of 1998, in the area of computational PDE/ODE and related numerical analysis. Applicants must have a Ph.D. in mathematics or an equivalent discipline. Demonstrated potential for quality research and teaching is essential. Preference will be given to candidates whose work has an applied component that can be related to industrial applications and/or other sciences.

Applicants should send a curriculum vitae, including a list of publications and a statement of research and teaching interests, and three letters of recommendation to: Hiring Committee, Department of Mathematical Sciences, Florida Atlantic University, Boca Raton, FL 33431. Applications received before January 31, 1998, will receive full consideration. For more information visit http://www.math.fau.edu/.

Florida Atlantic University is an Affirmative Action/Equal Opportunity Employer. Women and minorities are strongly encouraged to apply.

GEORGIA
GEORGIA INSTITUTE OF TECHNOLOGY

The School of Mathematics expects to have visiting and tenure-track positions at various levels in pure and applied mathematics and statistics, beginning in fall 1998. The School intends to expand its areas of expertise and foresees the potential for 10-15 new appointments in the next five years. Candidates with strong research and teaching records or potential should arrange for a résumé, at least three letters of reference, and a summary of future research plans to be sent to The Hiring Committee, School of Mathematics, Georgia Institute of Technology, Atlanta, GA 30332-0160. Georgia Tech, an institution of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

GEORGIA SOUTHERN UNIVERSITY
Department of Mathematics and Computer Science

Two tenure-track positions starting August 1, 1998. Salary dependent upon qualifications. Indicated degrees are required by the position starting date. All deadlines are postmark deadlines. Commitment to excellence in teaching and scholarly activity, as well as excellent command of written and spoken English, are required. College teaching experience is desirable.

Departmental representatives will be available at the national AMS/MAA meeting in Baltimore in January 1998 to discuss these positions with interested parties. Send letter of application indicating position desired, curriculum vitae, unofficial transcripts of all college work, evidence of commitment to excellence in teaching and scholarship, a brief description of planned scholarly activities, and a letter of reference from each of three references by the
indicated deadline to appropriate search chair (Applied Math or Math Ed.), [search number, see below], Department of Mathematics and Computer Science, Post Office Box 8093, Georgia Southern University, Statesboro, GA, 30460-8093.

The names of applicants and nominees, résumés, and other general nonevaluative information are subject to public inspection under the Georgia Open Records Act. Georgia Southern is an Equal Opportunity/Affirmative Action Institution. Persons who need accommodation(s) in the application process under the Americans with Disabilities Act should notify the search chair.

Applied Mathematics, Assistant Professor, Ph.D. in an applied math area required. Preference will be given to applicants in the areas of discrete math, numerical analysis, scientific computing, modeling, and differential equations, but consideration will be given to applicants in all areas of applied math. At least one year of experience with the use of computational packages (such as Mathematica, Maple, or Matlab) is required. Interest in teaching freshman/sophomore-level mathematics courses required. Three years' college teaching experience preferred. Send applications and supporting materials to Applied Math Search Chair. Search # 34925. Deadline: January 16, 1998.

Mathematics Education, Assistant Professor. Doctorate in a mathematical science required; Ph.D. or Ed.D. in mathematics education preferred. Must be broadly trained in mathematics with at least 24 semester hours of graduate level courses in pure or applied mathematics. Must exhibit evidence of a strong commitment to excellence in teaching and continued scholarly activity and have familiarity with current directions in mathematics education, including the use of technology in the classroom. Primary interest in mathematics education required; experience in working with K-12 mathematics teachers preferred. At least three years' teaching experience preferred. Candidates must be able to work effectively with professional and community groups. Duties include teaching undergraduate mathematics courses and undergraduate/graduate mathematics courses for mathematics education majors; and supporting materials to Math Ed. Search Chair. Search # 34927. Deadline: January 16, 1998.

Georgia Southern University, a unit of the University System of Georgia, was founded in 1906 and became a regional university in 1990. The 601-acre campus is located in Statesboro, a community of approximately 30,000 residents fifty miles northwest of historic Savannah and two hundred miles southeast of Atlanta. Anticipated fall quarter 1997 headcount of over 14,000 reflects a 115% enrollment growth since the fall of 1984, resulting in the addition of over 200 faculty positions. The university offers 23 baccalaureate degrees in 81 major fields of study, 10 master's degrees in 40 fields, the Education Specialist degree with 16 majors, and Ed.D. programs in Educational Administration and Curriculum Studies.

GEORGIA STATE UNIVERSITY
Department of Mathematics and Computer Science

Two anticipated tenure-track positions for Ph.D.s beginning August 1998, Department of Mathematics and Computer Science, Georgia State University. One position is in mathematics education for an assistant or associate professor. Another position is in applied statistics for an assistant professor. Ph.D. and excellent record in publications are required with preference for extramural funding. Applications should include a letter of application, a vita without birthdate but including citizenship status, three letters of reference, and transcripts of all graduate and undergraduate work. Applicants should have letters of reference and other materials sent to: Chair, Department of Mathematics and Computer Science, Georgia State University, University Plaza, Atlanta, GA 30303-3083. Applications must be postmarked no later than 1/16/98. Georgia State University, a unit of the University System of Georgia, is an Equal Opportunity Educational Institution and an EEO/AA employer.

ILLINOIS
ELMHURT COLLEGE
Mathematics Department

Tenure-track position beginning fall 1998 (pending approval of the Board of Trustees), qualifications desired: Ph.D. in mathematics at time of hire, interest in continued scholarship, and a strong commitment to undergraduate teaching in a liberal arts college. Teaching load: 6 courses per year. Elmhurst College is a four-year private institution located in the western suburbs of Chicago. Applications should include a curriculum vitae and three letters of reference. Please send to Prof. Jon L. Johnson, Dept. of Mathematics, Elmhurst College, 190 Paul Card Ave., Elmhurst, IL 60126, by February 1, 1998. Minority and women candidates are strongly urged to apply. EOE.

ILLINOIS WESLEYAN UNIVERSITY
Bloomington, Illinois 61702
Department of Mathematics

The Department of Mathematics of Illinois Wesleyan University invites applications for one tenure-track position and one or more one-year visiting positions. Employment would begin in August 1998, and the teaching load would be six courses per year. All candidates should possess a Ph.D. in mathematics and a dedication to quality teaching in an independent liberal arts university. For any position, preference may be given to those candidates having experience in the integration of technology into undergraduate instruction. Candidates for the tenure-track position must have a Ph.D. with research specialty in either probability or mathematical statistics. The successful candidate will be expected to work closely with undergraduates in mathematics majors who are planning careers in actuarial science. In particular, candidates for this position should be interested in directing undergraduate research projects. Preference may be given to candidates who have passed actuarial exams and to candidates who are willing to develop upper-level special topics courses in mathematics for these students. Candidates for this position should submit transcripts of all graduate work.

For a visiting position, preference may be given to those candidates who have good teaching credentials. Preference may also be given to those candidates who have special qualifications to address curricular needs in our department for the 1998-99 academic year.

Illinois Wesleyan University has approximately 1,900 undergraduate students. It is a highly selective university. For example, in 1994 the average ACT for Illinois Wesleyan's entering class of freshmen was 27.9, while the average ACT for freshman mathematics majors was 30.6. In past years over 4 percent of the undergraduate population at Illinois Wesleyan have declared majors in mathematics. Our mathematics faculty possesses a healthy balance between applied and pure mathematics. Our current areas of professional expertise include algebra, approximation theory, differential equations, dynamical systems, electrical engineering, linear algebra, logic, operations research, operator theory, topology, topological analysis. We encourage our majors to complete undergraduate research projects. Our department is also actively involved in the integration of technology into many of our courses. For example, we have four different ways to complete freshman calculus, one of which is a three-course sequence in calculus/Mathematics taught in an NSF-sponsored Sun/Spark computer lab. We also maintain a Sun/Spark computer lab for mathematical modeling and one other Unix-based computer lab.

Candidates for any of the positions should submit a letter of application, a vita, an AMS Standard Cover Sheet, and three letters of recommendation to Melvin W. Jeter, Head, Department of Mathematics, Illinois Wesleyan University, P. O. Box 2900, Bloomington, IL 61702-2900. Candidates who submit their applications after January 30, 1998, may not receive full consideration. Applications before December 30, 1997, are encouraged. Women and minorities are encouraged to apply. Illi-


**UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN**

**Postdoctoral Positions**  
**J. L. Doob Research Assistant Professor**

The Department of Mathematics of the University of Illinois at Urbana-Champaign is soliciting applications for postdoctoral positions. Two appointments will be made starting August 21, 1998; each appointment is for three years and is not renewable. The positions are for recent Ph.D. recipients (with a strong preference for those not more than one year past the Ph.D. degree). The Department of Mathematics will provide an excellent scientific environment to pursue research in pure and applied mathematics. The position carries a salary of $39,000 per year.

Applications should include a curriculum vitae and a brief statement of research interests and activities. The use of the AMS Cover Sheet will be appreciated.

Applications should be sent by regular mail to the Postdoctoral Search Committee, Department of Mathematics, University of Illinois at Urbana-Champaign, 1409 W. Green St., Urbana, Illinois 61801-2975.

Applicants should arrange for at least three letters of recommendation to be sent to the same address.

For more information visit our Web page at [http://www.math.uiuc.edu/](http://www.math.uiuc.edu/).

Inquiries may be sent to: postdocs@math.uiuc.edu.

For full consideration the application must be received by December 7, 1997.

The University of Illinois is an Affirmative Action/Equal Opportunity Employer. Women and minorities are strongly encouraged to apply.

**NORTHEASTERN UNIVERSITY**

**Department of Mathematics**

Applications are invited for anticipated tenure-track or tenured positions starting September 1998. Priority will be given to exceptionally promising researchers in mathematics. Fields of interest within the department include algebra, algebraic geometry, analysis, dynamical systems, probability, partial differential equations, and topology.

Candidates should arrange to have their application materials sent to Chairperson, Personnel Committee, Department of Mathematics. Applications should include: (1) the American Mathematical Society's Application Cover Sheet for Academic Employment in Mathematics, (2) a curriculum vitae, and (3) at least four letters of recommendation, including one which discusses in some detail the candidate's teaching qualifications. Inquiries may be sent via e-mail to hiring@math.nwu.edu. In order to receive full consideration, applications should be received by November 15, 1997.

Northwestern is an Affirmative Action/Equal Opportunity Employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply.

**SOUTHERN ILLINOIS UNIVERSITY AT EDWARDSVILLE**

**Mathematics Department**

Southern Illinois University at Edwardsville, a comprehensive state university located 20 miles from downtown St. Louis, Missouri, invites applications for a tenure-track position in mathematics at the rank of assistant professor beginning August 1998. Higher ranks may be considered for outstanding candidates. Applicants should have a Ph.D. in an area of mathematics, a strong commitment to teaching, and a demonstrated capacity to perform research. The successful candidate will teach calculus, differential equations, and some upper-level courses in mathematics, applied mathematics, and numerical analysis. The Department of Mathematics and Statistics has 17 full-time faculty members and offers undergraduate programs in mathematics, applied mathematics, statistics, actuarial science, and secondary education, and master's programs in mathematics, statistics, and operations research, and computational mathematics. Send a letter of application, curriculum vitae, transcripts (unofficial transcripts are acceptable for now), and three letters of recommendation to Chair of Search Committee, Department of Mathematics and Statistics, Campus Box 1653N, Southern Illinois University at Edwardsville, Edwardsville, IL 62026-1653. Review of applications will begin on January 1, 1998, and will continue until the position is filled. Please use the AMS Standard Cover Sheet. As an Affirmative Action Employer, SIUE offers equal opportunity without regard to race, color, creed or religion, age, sex, national origin, or handicap.

**INDIANA**

**Purdue University**

**Professor of Mathematics and Director, Center of Applied Mathematics**  
**Department of Mathematics**

Since Purdue is Indiana's state-supported land-grant university and has a world-class engineering school and widely recognized departments in science, management, and agriculture, Purdue's mathematics department has the opportunity—indeed, the obligation—to have a strong and influential group in applied mathematics with strong ties to the rest of the University.

Purdue's Center for Applied Mathematics (CAM) was started in 1985 under the directorship of Avner Friedman and has been led by Jim Douglas Jr. since 1987. CAM provides an umbrella for the activities of faculty, postdoctoral staff, graduate students, and long- and short-term visitors in applied mathematics. Currently there are a dozen mathematics faculty who identify themselves as applied mathematicians and several other faculty in and out of the department who work in applied areas and are loosely associated with CAM. The Purdue mathematics department is committed to deepening and expanding its contributions to research and education in applied mathematics. Because of its solid foundation and the support of the school and university administrations, the department is well positioned to achieve its goals in this area.

The director should be a senior full professor or distinguished professor of mathematics with the stature and experience to lead outstanding research and educational programs in applied mathematics. In addition to carrying on a strong research program in her or his own area, the director will be expected to coordinate the development of other applied areas in the department, facilitate research contacts between mathematics faculty and faculty in other departments, oversee the applied mathematics visitor and seminar programs, and help create an atmosphere in which the educational programs of graduate students and postdoctoral staff in applied mathematics can flourish.

To this end, the Purdue mathematics department seeks applicants for the position of professor of mathematics and director, Center for Applied Mathematics, with a strong national reputation in research in applied mathematics; proven ability to work with graduate students, postdocs, and colleagues; a record of funding success; and flexibility in pursuing opportunities. Applicants should possess a broad vision compatible with Purdue's strong traditions in mathematics, the sciences, and engineering and demonstrate the ability to promote applied mathematics as a part of mathematics.

Persons interested in applying for this position or discussing it in confidence should contact

Carl C. Cowen, Head  
Department of Mathematics  
Purdue University  
West Lafayette, IN 47907-1395  
cowen@math.purdue.edu  
765-494-1908 (voice)  
765-494-0548 (fax)

Purdue University is an Affirmative Action/Equal Opportunity Employer.
THE UNIVERSITY OF IOWA
The Department of Mathematics at The University of Iowa invites applications for the following positions:

1. Tenure-track assistant or early associate professorship, starting in August 1998, in the broadly interpreted area of numerical analysis. Exceptional candidates at higher rank may be considered. Selection will be based on evidence of outstanding research accomplishments or potential and excellent teaching. A Ph.D. or equivalent is required.

2. Pending availability of funds, one or more visiting positions for all or part of the 1998-99 academic year. Selection will be based on research expertise and teaching ability. Preference will be given to applicants whose scholarly activity is of particular interest to members of the current faculty.

Women and minority candidates are especially urged to apply for the above positions.

Formal screening will begin December 15, 1997; applications will be accepted until the positions are filled. To apply, send a complete vita and three letters of recommendation to:

Professor Bor-Luh Lin, Chair
Department of Mathematics
The University of Iowa
Iowa City, IA 52242

The University of Iowa is an Equal Employment Opportunity/Affirmative Action Employer.

KANSAS
KANSAS STATE UNIVERSITY
Department of Mathematics
Subject to budgetary approval, applications are invited for tenure-track and visiting positions commencing August 9, 1998; rank and salary commensurate with qualifications. The department seeks candidates whose research interests mesh well with current faculty. The department has research groups in the areas of analysis, algebra, geometry/topology, and differential equations. For one of the tenure-track positions, a preference will be given to candidates in algebra/algebraic geometry, and otherwise to candidates in pure or applied mathematics whose specialties mesh well with those already represented in the department. Candidates must have a Ph.D. or its requirements completed by August 15, 1998. Postdoctoral experience is preferred.

Letter of application, detailed résumé with description of research, completed AMS standardized application form, and three recommendation letters should be sent to C. J. Himmelberg, Chairman, Department of Mathematics, 405 Snow Hall, University of Kansas, Lawrence, KS 66045-2142.

Deadline: Review of applications will begin on January 1, 1998, and will continue until the position is filled.

EO/AA Employer.

LOUISIANA
TULANE UNIVERSITY
Department of Mathematics
Applications are invited for two tenure-track positions beginning in the fall 1998 semester, subject to final administrative and budgetary approval. Applications will be kept confidential. All letters will be kept confidential. Review of applications will begin December 8, 1997, but the position is filled.

The Department of Mathematics of the University of Kansas seeks an internationally renowned scholar for the Henry J. Bischoff professorship. This position is one of 23 distinguished chairs in the College of Liberal Arts and Sciences. In addition to an outstanding research record, applicants for the position must have a demonstrated interest in teaching mathematics.

Interested individuals should submit a letter of inquiry and a vita. All inquiries will be kept confidential. Review of applications will begin January 15, 1998, and will continue until the position is filled. The University of Kansas is an EEO/AA Employer.

Send correspondence to: Charles J. Himmelberg, Chairman, Department of Mathematics, 405 Snow Hall, University of Kansas, Lawrence, KS 66045-2142.

Applications are invited for a tenure-track position at the assistant professor level beginning August 18, 1998, or as negotiated. This position is contingent on final budgetary approval. Preference will be given to candidates in algebra/algebraic geometry, and otherwise to candidates in pure or applied mathematics whose specialties mesh well with those already represented in the department. Candidates must have a Ph.D. or its requirements completed by August 15, 1998. Postdoctoral experience is preferred.

Letter of application, detailed résumé with description of research, completed AMS standardized application form, and three recommendation letters should be sent to C. J. Himmelberg, Chairman, Department of Mathematics, 405 Snow Hall, University of Kansas, Lawrence, KS 66045-2142.

Deadline: Review of applications will begin on January 1, 1998, and will continue until the position is filled.

EO/AA Employer.

NOTICES OF THE AMS

DECEMBER 1997

MAINE
UNIVERSITY OF SOUTHERN MAINE
Assistant Professor
Mathematics and Statistics

The Department of Mathematics and Statistics at the University of Southern Maine invites applications for a tenure-track position at the rank of assistant professor starting in the fall of 1998.

The search will focus on the areas of numerical analysis, graph theory and combinatorics, or related fields.

Candidates must have a Ph.D. or must accompany the application with a statement from the institution in which enrolled for doctoral studies confirming that the degree will be completed by August 1, 1998. Candidates must demonstrate a strong commitment to teaching at all levels of the curriculum and show potential for productive research.

Women and minorities are encouraged to apply.

Send letter of application, curriculum vitae, graduate transcripts, and three letters of recommendation to: Search Committee, Department of Mathematics and Statistics, University of Southern Maine, P.O. Box 9300, Portland, ME 04104-9300. Please include e-mail address if available. USM is an EEO/AA Employer committed to diversity, quality, and reasonable accommodation.

Review of applications will begin February 1, 1998, and will continue until position is filled.

Classified Advertisements
MARYLAND
TOWSON UNIVERSITY
Mathematics: Entry-level tenure-track assistant professor, pure mathematics, beginning in fall 1998. Preference will be given to applicants with a strong research program and commitment to teaching innovative courses with technology or mathematics across the disciplines. Ph.D. in mathematics is required. Teaching assignment is twelve contact hours per semester. The salary is commensurate with that of an entry-level position. The mathematics department (http://www.towson.edu/math) offers bachelor's programs in various concentrations and a master's program in applied and industrial mathematics. Submit cover letter, vita, transcripts, and three letters of recommendation addressing both teaching and research by February 1, 1998, to:

Dr. J. Chollet, Chair
Search Committee
Mathematics Department
Towson University
8000 York Road
Towson, MD 21252-0001
fax: 410-830-4149
e-mail: jchollet@towson.edu
Towson University is an Equal Opportunity/Affirmative Action Employer and has a strong institutional commitment to diversity. Women, minorities, persons with disabilities, and veterans are encouraged to apply.

MASSACHUSETTS
SMITH COLLEGE
Department of Mathematics
The mathematics department of Smith College invites applications for a tenure-track position of assistant professor in the fall of 1998. Candidates must have a Ph.D. in mathematics or statistics and must provide evidence of excellent teaching and an active research program. All specializations will be considered. Send a curriculum vitae and three letters of recommendation to: Mathematics Search Committee, Clark Science Center, Smith College, Northampton, MA 01063. To receive full consideration, you must provide a completed application before January 1, 1998. Smith College is an Equal Opportunity/Affirmative Action Institution. Minorities and women are encouraged to apply.

WILLIAMS COLLEGE
Department of Mathematics
Williamstown, MA 01267
Anticipated visiting position(s) in mathematics or statistics for the 1998–99 year, probably full-time, probably at the rank of assistant professor; in exceptional cases, however, more advanced appointments may be considered. Excellence in teaching and statistics, including scholarship and consulting, and Ph.D. required. Please have a vita and three letters of recommendation on teaching and research sent to Visitor Hiring Committee. Evaluation of applications will begin November 15 and will continue until the position is filled. As an EEO/AA Employer, Williams especially welcomes applications from women and minority candidates.

WILLIAMS COLLEGE
Department of Mathematics
Williamstown, MA 01267
Anticipated visiting position(s) in mathematics or statistics for the 1998–99 year, probably full-time, probably at the rank of assistant professor; in exceptional cases, however, more advanced appointments may be considered. Excellence in teaching and statistics, including scholarship and consulting, and Ph.D. required. Please have a vita and three letters of recommendation on teaching and research sent to Visitor Hiring Committee. Evaluation of applications will begin November 15 and will continue until the position is filled. As an EEO/AA Employer, Williams especially welcomes applications from women and minority candidates.

MICHIGAN
CENTRAL MICHIGAN UNIVERSITY
Department of Mathematics
Chairperson
Applications or nominations are invited for the position of department chairperson, beginning fall 1998. The department includes pure and applied mathematics, statistics, and mathematics education in both K–12 and collegiate mathematics. It offers bachelor's and master's degrees and a Ph.D. in mathematics with a concentration in the teaching of college mathematics. Applicants should have academic credentials qualifying for appointment at or near full professor. He or she should have the following qualifications: a strong and ongoing research record, excellence in teaching, demonstrated administrative ability, a commitment to faculty development, compassion for faculty and students, effective communication skills, and openness to instructional innovation. The applicant should have a strong interest in the continued development of our Ph.D. program. The following experiences will be viewed favorably: successful grant writing, curriculum and program development, expository writing, and involvement with professional organizations.

Central Michigan University has an enrollment of 16,600, of which 2,000 are graduate students. The Department of Mathematics has 32 tenure-track faculty.

Research strengths are in applied mathematics in polymer science, approximation theory, combinatorics, operator theory, mathematics education, and statistics. The selection process will begin January 19, 1998. Applicants should submit a letter of application that includes a statement of academic leadership philosophy, vita, and the names of at least three references to:
Chair, Search Committee
Central Michigan University
Mt. Pleasant, MI 48859
517-774-3596
math@cmich.edu
www.cmich.edu/unitas/mth/

KALAMAZOO COLLEGE
Assistant Professor of Mathematics
Kalamazoo College invites applications for a tenure-track position at the assistant professor level beginning September 1998. A Ph.D. in mathematics, statistics, or operations research is required, with preference given to candidates of broader experience in mathematics, science, or the liberal arts. Teaching load is two courses per quarter, three quarters per year. Salary is competitive and consistent with level of experience.

Experience with and interest in the application of statistics to problems in the life or social sciences is essential. The ideal candidate will also have an interest in developing an active research program that involves undergraduate student participation. Candidates are expected to have high aptitude and interest in undergraduate teaching, a commitment to the liberal arts, and a desire to involve undergraduates in scholarship both inside and outside the classroom.

Kalamazoo College is a selective, private, four-year liberal arts institution of 1,200 students known for its innovative program and strong tradition in the sciences. Founded in 1833, it is the oldest institution of higher education in Michigan. The campus is located midway between Chicago and Detroit in Kalamazoo, Michigan, a community of 80,000 in a metropolitan area of 225,000 which supports four college and university campuses along with numerous civic, arts, and cultural associations. Thirty-five miles from Lake Michigan, the area offers many opportunities for outdoor activities. For more information about the college, visit our Web home page at http://www.kzoo.edu/

Completed applications received by December 31, 1997, will receive full consideration, with later applications reviewed as needed until the position is filled. Send curriculum vitae, undergraduate and graduate transcripts (unofficial acceptable), a two- to three-page statement of teaching
The Department of Mathematics and letters of recommendation to Employer.

Kalamazoo College encourages candidates who will contribute to the cultural diversity of the College to apply and to identify themselves if they wish. Equal Opportunity Employer.

MISSISSIPPI

MISSISSIPPI STATE UNIVERSITY
Department of Mathematics and Statistics
Faculty Positions

Applications are invited for four tenure-track or visiting positions at the rank of assistant professor/full professor for the 1998-99 academic year. Requirements include a doctoral degree, demonstrated success or a strong potential for research, and a commitment to effective undergraduate and graduate teaching. Preference will be given to candidates with research interests in algebra/combinatorics, mathematics education, numerical analysis, or statistics, but especially strong candidates in any area of research are encouraged to apply. Salary is competitive and commensurate with qualifications.

The department is housed in the College of Arts and Sciences and offers the B.A. and B.S. in mathematics, the M.S. in both mathematics and statistics, and a Ph.D. in mathematical sciences. Opportunities exist for applicants with an interest in interdisciplinary research or consulting. Applicants should submit a resume with a completed AMS Application Cover Sheet and arrange for three letters of recommendation to be sent to:

Mohsen Razzaghi, Chair
Screening Committee
Department of Mathematics and Statistics
Mississippi State University
Mississippi State, MS 39762

The screening process will begin on December 1, 1997, and will continue until all positions are filled.

The department especially welcomes applications from women and minority candidates. Mississippi State University is an AA/EO Employer.

MISSOURI

UNIVERSITY OF MISSOURI-KANSAS CITY
Department of Mathematics & Statistics
Assistant Professorship in Statistics

The Department of Mathematics and Statistics invites applications for a tenure-track position of assistant professor of statistics beginning in August 1998. The applicant should have a Ph.D. in statistics or a Ph.D. in mathematics with a specialization in statistics. Duties include teaching courses in probability and statistics at both the undergraduate and graduate levels and research of a quality sufficient to enable the successful candidate to participate in the department's doctoral and master's programs. The salary is competitive.

Please apply to:
Search Committee
Department of Mathematics & Statistics
4825 Troost, Room 101
University of Missouri-Kansas City
Kansas City, MO 64110-2499

Applications should include a vita and three letters of recommendation. Prior experience is not necessary, but the application materials should demonstrate strong potential for successful research and effective teaching. Women and minorities are especially encouraged to apply. The University of Missouri-Kansas City is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF MISSOURI-ROLLA
Department of Mathematics and Statistics
Rolla, MO 65409-0020

Tenure-track positions at the assistant professor level, one approved and another anticipated, are available for fall 1998. We specifically seek applicants who work in complex dynamical systems, complex analysis, or functional analysis and its applications. We prefer applicants whose research will complement the ongoing research efforts of the department. The Ph.D. is required and should be completed by August 15, 1998. Both research potential and teaching ability will be considered in the selection. Submit an AMS Cover Sheet, curriculum vitae, a summary of research, copies of transcripts, and three letters of reference to W. T. Ingram, Chair. In your cover letter and on the outside of the envelope please clearly identify your area of training. Applicant review will begin in January 1998. Applications which are complete on or before January 1, 1998, will receive full consideration. AA/EOE.

NEW HAMPSHIRE

DARTMOUTH COLLEGE
John Wesley Young Research Instructorship in Mathematics

The John Wesley Young Research Instructorship is a two-year postdoctoral appointment for promising new or recent Ph.D.'s whose research interests overlap a department member's. Current departmental interests include areas in algebra, analysis, combinatorics, differential geometry, logic and set theory, number theory, probability and topology. Teaching duties of four ten-week courses spread over two or three quarters typically include at least one course in the instructor's specialty and include elementary, advanced, and (at instructor's option) graduate courses. Nine-month salary of $39,000 supplemented by summer research stipend of $8,667 for instructors in residence for two months in summer. Send letter of application, résumé, graduate transcript, thesis abstract, description of other research activities and interests if appropriate, and three, or preferably four, letters of recommendation (at least one should discuss teaching) to Betty Harrington, Department of Mathematics, 6188 Bradley Hall, Hanover, NH 03755-3551. Applications received by January 15 receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to Affirmative Action and strongly encourages applications from minorities and women.

DARTMOUTH COLLEGE

The Department of Mathematics anticipates a tenure-track opening for an assistant professor of mathematics in the field of combinatorics, with initial appointment in the 1998-99 academic year. In exceptional cases an appointment at a higher level is possible. A candidate for the position must be committed to outstanding teaching at all levels of the undergraduate and graduate curriculum and must give evidence of a well-regarded research program that shows real promise for the future. Candidates with several years of experience should in addition be ready to direct Ph.D. theses.

To create an atmosphere supportive of research, Dartmouth offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence, and flexible scheduling of teaching responsibilities. The teaching responsibility in mathematics is four courses spread over two or three quarters. The department encourages good teaching with a combination of committed colleagues and bright, responsive students.

To apply, send a letter of application, curriculum vitae, and a brief statement of research results and interests. Also arrange for four letters of reference to be sent, at least one of which addresses teaching and, if the applicant's native language is not English, the applicant's ability to use English in a classroom. All application materials should be addressed to Betty Harrington, Recruiting Secretary, Department of Mathematics, 6188 Bradley Hall, Dartmouth College, Hanover, NH 03755-3551. Applications completed by January 1 will receive first consideration. Dart-
moum is committed to Affirmative Action and encourages applications from African Americans, Asian Americans, Hispanics, Native Americans, and women. Inquiries about the progress of the selection process can be directed to C. Dwight Lahr, Recruiting Chair.

DARTMOUTH COLLEGE

The Department of Mathematics anticipates an opening for a professor of mathematics, with appointment effective in the 1998-99 academic year. Field open. A candidate for the position must demonstrate evidence of an exceptional research program that has achieved peer recognition and research leadership in the mathematical community. Moreover, a candidate must demonstrate a record of exceptional teaching and continued interaction with students at all levels of undergraduate and graduate study. Leadership in guiding Ph.D. theses is also essential. Applications are welcome in all fields of mathematics.

To create an atmosphere supportive of research, Dartmouth offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence, and flexible scheduling of teaching responsibilities. The teaching responsibility in mathematics is four courses spread over two or three quarters. The department encourages good teaching with a combination of committed colleagues and bright, responsive students.

To apply, send a letter of application, curriculum vitae, and a brief statement of research results and interests, and the names of four references, at least one of whom can specifically address teaching. These materials should be sent to Betty Harrington, Recruiting Secretary, Department of Mathematics, Dartmouth College, 6188 Bradley Hall, Hanover, NH 03755-3551. Applications complete by January 1, 1998, including reference letters (allow enough lead-time for us to make the solicitations from the names you provide), will receive consideration. Dartmouth is committed to Affirmative Action and encourages applications from African Americans, Asian Americans, Hispanics, Native Americans, and women. Inquiries about the progress of the selection process can be directed to C. Dwight Lahr, Recruiting Chair.

NEW JERSEY

DIMACS CENTER
Postdoctoral Fellowships

DIMACS, the Center for Discrete Mathematics and Theoretical Computer Science, invites applications for several postdoctoral fellowships for 1998-99. DIMACS, an NSF Science and Technology Center, is a partnership of Rutgers University, Princeton University, AT&T Labs - Research, Bell Laboratories, and Bellcore. Research at DIMACS focuses on such areas as analysis of algorithms, combinatorics, complexity, computational algebra, discrete and computational geometry, discrete optimization, and graph theory. Recent Ph.D.s in all areas of theoretical computer science and discrete math are invited to apply. Some positions will be in special year and focus areas of large scale discrete optimization, massive data sets, DNA computing, networks, mathematical and computational support for molecular biology and simulations.

Postdoctoral Fellows conduct research and may collaborate with many visitors and permanent members at the partner sites. They are encouraged to participate in the research, outreach, and educational activities of the Center.

Application procedure: The Center's WWW site, http://dimacs.rutgers.edu/Participation/, contains full information about these postdoctoral positions and should be consulted for application information. Applications are due December 12, 1997, for full consideration. DIMACS Center, P.O. Box 1179, Rutgers University, Piscataway, NJ 08855-1179; tel: 732-445-5928; e-mail: postdoc@dimacs.rutgers.edu.

DIMACS is an EO/AA Employer.

RUTGERS UNIVERSITY
Mathematics Department

The Rutgers University mathematics department invites applications for the following positions, which may be open beginning September 1998.

1. Tenure-Track and Tenure Positions.

The department anticipates a few openings, mainly tenure-track assistant professorships. Current priority areas include analysis and geometry. However, strong candidates in all fields are encouraged to apply and will be given careful consideration. Candidates must have Ph.D., outstanding research ability in pure or applied mathematics, and concern for teaching. Semester course load now averages 6 hours.

2. Hill Assistant Professorship (non-tenure track). The Hill Assistant Professorships are three-year nonrenewable positions. Candidates should have received the Ph.D., show outstanding promise of research ability in pure or applied mathematics, and have concern for teaching. Semester course load is approximately 6 or 7 hours.

Applications should send resume, with the AMS Application Cover Sheet attached, and at least three letters of recommendation to: Search Committee, Department of Mathematics-Hill Center, Rutgers University, 110 Frelinghuysen Road, Piscataway, NJ 08854-8019. No electronic applications will be accepted. Applications should be received by January 5, 1998. Please indicate position(s) desired and give the AMS Subject Classification number of your area(s) of specialization. Applicants who applied in 1996-97 may, if they wish, request to have their previous application reactivated and submit only such new materials as they choose. Rutgers is an Affirmative Action/Equal Opportunity Employer and encourages applications from women and minority group members.

INSTITUTE FOR ADVANCED STUDY AND PRINCETON UNIVERSITY

The School of Mathematics at the Institute for Advanced Study and the Department of Mathematics at Princeton University have recently established the Veblen Research Instructorship. Commencing with the 1998-99 academic year, 3 three-year instructorships will be offered each year to candidates who have received their Ph.D. within the last three years. The first and third year of the instructorship will be spent at Princeton University and will carry regular teaching responsibilities. The second year will be spent at the Institute and will be dedicated to independent research of the instructor's choice.

Application materials for the instructorship position may be requested either from Scott Kenney, Department of Mathematics, Princeton University, Princeton, NJ 08544; 609-258-4300; e-mail address: skenney@princeton.edu; or from Applications, School of Mathematics, Institute for Advanced Study, Olden Lane, Princeton, NJ 08540; 609-734-8112; e-mail address: applications@math.ias.edu. Forms may also be accessed via a Web connection to http://www.math.ias.edu/.

NEW YORK

RENSSELAER POLYTECHNIC INSTITUTE
Department of Mathematical Sciences

Applications are invited for a tenure-track assistant professor position in applied mathematics to begin in August 1998. Applicants are expected to have demonstrated outstanding research potential and to have a strong interest and ability in teaching. Of particular interest are candidates with a commitment to interdisciplinary research who are knowledgeable in scientific computation.

Applicants should submit a letter of application, a curriculum vitae, a description of research interests, and three letters of recommendation to: Search Committee Chair, Department of Mathematical Sciences, Rensselaer Polytechnic Institute, Troy, NY 12180. Evaluation of applications will begin October 15, 1997, and will continue until a candidate is selected. Rensselaer is an Equal Opportunity/Affirmative Action Employer and strongly encourages applications from women and underrepresented minorities.

1520 NOTICES OF THE AMS VOLUME 44, NUMBER 11
THE STATE UNIVERSITY OF NEW YORK COLLEGE AT POTSDAM

The State University of New York College at Potsdam invites applications for one (possibly two) anticipated full-time tenure-track position(s) effective September 1, 1998, at the rank of assistant professor. Responsibilities of the position are to teach twelve hours per semester of undergraduate and first-year graduate courses. Required qualifications are a Ph.D. in any area of mathematics with a strong interest in and preparation for teaching undergraduate major mathematics courses. In addition, some preparation in computer science is desirable though not essential. Applications, which must include a letter of interest, a statement of the applicant’s philosophy of teaching, a résumé, three letters of recommendation describing teaching experience and abilities, and a transcript (a copy is acceptable), should be sent to Dr. Cheryl Chute Miller, Staffing Committee Chair, Math. Department, SUNY Potsdam, Potsdam, NY 13676 (millercc@potsdam.edu). To ensure full consideration, complete applications must be received by January 21, 1998.

STATE UNIVERSITY OF NEW YORK, STONY BROOK

The mathematics department and the Institute for Mathematical Sciences plan to make several appointments beginning fall 1998. These include two 3-year James H. Simmons Instructorships, two tenure-track assistant professorships, two or more post-doctoral or visiting positions. We seek candidates with an outstanding research potential and a strong commitment to teaching. Some preference will be given to candidates in algebra, algebraic geometry, or analysis. Applicants should submit one application (automatically considered for both department and Institute) together with a C.V. and three letters of recommendation to Appointments Committee, Dept. of Mathematics, SUNY at Stony Brook, Stony Brook, NY 11794-3651. Application deadline: March 1, 1998. Application forms must also be submitted electronically to the department Web site. Those forms and further information are available at the Web site (http://www.math.sunysb.edu/hiring/) or can be obtained by sending a blank e-mail message to hiring@math.sunysb.edu with subject "Information.

SUNY at Stony Brook is an EEO/AA Employer.

NORTH CAROLINA

DUKE UNIVERSITY

W. W. Elliott Assistant Research Professorship of Mathematics

Applications are invited for two positions as assistant research professor of mathematics. Candidates should have completed a doctorate as of September 1, 1997, and should define promise in research and teaching. The teaching load will be six hours per week during one semester and three hours per week during the other, so that the appointee will have additional time for research. Duke University is an Affirmative Action/Equal Opportunity Employer.

The appointments are for one year and will be renewable for two additional years. The salary will be $38,000, covering work in the regular two-semester year.

Applicants please send (a) a vita, (b) a description of current and past research (1-3 pages), and (c) a plan for future research. The AMS Standard Cover Sheet should be completed electronically from the address below. Each applicant is requested to include in their materials the name(s) of one or more members of the faculty of the Department of Mathematics at Duke working in their general area of research.

Applications should be filed by December 20; early application is advisable. The applicant should have at least three letters of recommendation, including one which evaluates teaching, sent directly to Duke by mid-January. All correspondence, including references, except AMS Cover Sheet, should be addressed to:

Appointments Committee
Department of Mathematics
Box 90320
Duke University
Durham, NC 27708-0320

AMS Cover Sheets should be completed at http://www.phds.org/jobs/. E-mail inquiries: appts@math.duke.edu.

DUKE UNIVERSITY

Professorship in Mathematics

The Duke University mathematics department is seeking to fill a new position at the full professor level beginning July 1, 1998. We invite applications or inquiries from senior mathematicians with a distinguished record of leadership in research and teaching. Minority and women candidates are encouraged to apply. Duke University is an Affirmative Action/Equal Opportunity Employer.

We are especially interested in mathematicians who will interact well with our established groups in differential geometry, geometric analysis, mathematical physics, and nonlinear analysis. For further information about our department, its faculty, and their specific areas of interest, please consult our departmental Web pages at http://www.math.duke.edu.

Applicants should send a curriculum vitae, list of publications, a few selected reprints or preprints, and the names and addresses of three references to the Senior Search Committee at the address below. The department will assume responsibility for soliciting letters of evaluation. Applications received by January 15 will receive our full consideration.

Senior Search Committee
Department of Mathematics
Box 90320
Duke University
Durham, NC 27708-0320
e-mail: search@math.duke.edu

DUKE UNIVERSITY

Lecturer in Mathematics

Applications are invited for one position as Lecturing Fellow in the Department of Mathematics at Duke University. Candidates should have completed a doctorate as of September 1, 1997, have excellent teaching credentials, and have a strong interest in curriculum development.

The teaching load will be six hours per week per semester. In addition, Lecturing Fellows are expected to participate in the department’s ongoing revision of laboratory calculus and to continue their own research program in mathematics. Duke University is an Affirmative Action/Equal Opportunity Employer.

The appointment is for two years and is not renewable. The nine-month salary will be $33,500, covering work in the regular two-semester year.

Applicants please send (a) a vita (b) a teaching statement and a description of any experience in curriculum development, (c) a description of current and past research (1-3 pages), and (d) a plan for future research. The AMS Standard Cover Sheet should be completed electronically from the address below. Each applicant is requested to include in their materials the name(s) of one or more members of the faculty of the Department of Mathematics at Duke working in their general area of research.

Applications should include at least three letters of recommendation, including two which evaluate teaching, and should be sent directly to Duke. All correspondence, including references, except AMS Cover Sheet, should be addressed to:

Appointments Committee
Department of Mathematics
Box 90320
Duke University
Durham, NC 27708-0320

 AMS Cover Sheets should be completed at http://www.phds.org/jobs/. E-mail inquiries: appts@math.duke.edu.

DUKE UNIVERSITY

Assistant Professor

Applications and nominations are invited for one tenure-track position as assistant professor in applied mathematics. Salary is open; the position is to start September 1, 1998. Duke University is an Affirmative Action/Equal Opportunity Employer.

Applicants please send (a) a vita, (b) a description of past research (1-3 pages), and (c) a plan for future research. The AMS
Standard Cover Sheet should be completed electronically from the address below. Applications should be filed by December 15; early application is advisable. The applicant should have at least three letters of recommendation, including one which evaluates teaching, sent directly to Duke by mid-January. All correspondence, including references, except AMS Cover Sheet, should be addressed to: Faculty Search Committee Department of Mathematics Box 90321 Duke University Durham, NC 27708-0321

AMS Cover Sheets should be completed at http://www.phds.duke.edu. E-mail inquiries: appts@math.duke.edu.

NORTH CAROLINA STATE UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for a tenure-track position at the assistant or associate professor level in representation theory and combinatorics beginning in the fall of 1998. Candidates must have a doctoral degree in mathematics, a strong ongoing research program in representation theory and/or algebraic combinatorics, and a commitment to effective teaching at the undergraduate and graduate levels. Preference will be given to candidates with postdoctoral experience. Applicants should send a vita and at least three letters of recommendation to Algebra Search Committee, Department of Mathematics, North Carolina State University, Raleigh, NC, 27695-8205. Review of completed applications will begin immediately. Applications will continue to be accepted until the position is filled. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, veteran status, or disability.

WAKE FOREST UNIVERSITY
Department of Mathematics and Computer Science

Applications are invited for a tenure-track position in mathematics at the assistant professor level beginning August 1998. Duties include teaching mathematics at the undergraduate and graduate levels and conducting research. A Ph.D. in mathematics is required. Leadership and participation in the departmental major in mathematical economics is also required; this is a joint major with the Department of Economics. Research areas of interest include optimization, control theory, and dynamical systems, but other areas of research will be considered. Women and minorities are encouraged to apply. The department has 24 members and offers a B.S. and M.A. in mathematics, a B.S. and M.S. in computer science, and a B.S. in each of mathematical economics and mathematical business. Send a letter of application and résumé to Richard D. Carmichael, Chair, Department of Mathematics and Computer Science, Wake Forest University, P. O. Box 7388, Winston-Salem, NC 27109-7388. AA/EOE Employer.

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Chapel Hill, NC 27599
Tenure-Track Position

Applications are invited for one tenure-track assistant or associate professor position in applied mathematics effective fall 1998. An associate professor position would be available for an exceptional candidate in applied scientific computation. A strong research record and doctorate in mathematics, applied mathematics, or a closely related field are required. Preference is given to candidates with a commitment to interdisciplinary university research, collaborations with industry or government, and teaching including development of applied math curricula at undergraduate and graduate levels. This position contributes toward a five-year plan to build a strong applied and computational mathematics group interacting with existing strengths at UNC in mathematics and in materials, marine, biomedical, and environmental sciences. A copy of this ad may be found on our World Wide Web page at http://www.math.unc.edu/General/Job.announcements/. Send curriculum vitae, abstract of current research, and four letters of recommendation to Professor M. Gregory Forest, Chair, Applied Mathematics Search Committee, Dept. of Mathematics, CB #3250, Phillips Hall, UNC-Chapel Hill, Chapel Hill, NC 27599-3250. EO/AA Employer. Women and minorities are encouraged to apply and to identify themselves. Applicants are encouraged to submit a statement of teaching interests and goals. Completed applications received by January 1, 1998, are assured of full consideration.

OHIO
DENISON UNIVERSITY

Denison University has a three-semester position in the Department of Mathematics and Computer Science beginning January 1998. Ph.D. required in mathematics. A commitment to quality instruction of undergraduates is essential. Denison University is a liberal arts college of 1,800 students located in a village of 4,000 seven miles from Newark (population 50,000) and twenty-five miles east of Columbus, Ohio. The Department of Mathematics and Computer Science offers B.A. and B.S. degrees in mathematics and computer science. Send résumé and transcripts of graduate work to:

Dr. Joan Krone, Chair
Department of Mathematics and Computer Science
Denison University
Granville, OH 43023

Also ask three persons whom know you well to send reference letters in support of your application. Applications will be processed until the position is filled.

OBERLIN COLLEGE
Department of Mathematics

Full-time, tenure-track position beginning in the 1998-99 academic year. Responsibilities include teaching undergraduate courses in statistics and mathematics (5/ year), supervising honors students, and sustaining scholarly production. Ph.D. degree in statistics or mathematics (in hand or expected by August 31, 1998) required. All research specialties in statistics and related fields considered. Candidates must demonstrate potential excellence in teaching. Send letter of application, curriculum vitae, academic transcripts (graduate and undergraduate), and three letters of reference to Jeffrey Witmer, Department of Mathematics, Oberlin College, Oberlin, OH 44074, by December 15, 1997. Oberlin College has admitted women since its founding in 1833 and has been historically a leader in the education of blacks. AA/EOE.

OBERLIN COLLEGE
Department of Mathematics

Full-time, tenure-track position beginning in the 1998-99 academic year. Responsibilities include teaching undergraduate courses in mathematics (5/year), supervising honors students, and sustaining scholarly production. Ph.D. degree (in hand or expected by August 31, 1998) required. Candidates must demonstrate potential excellence in teaching. All specialties considered except statistics and related fields. Send letter of application, curriculum vitae, academic transcripts (graduate and undergraduate), and three letters of reference to Michael Henle, Department of Mathematics, Oberlin College, Oberlin, OH, 44074 by December 15, 1997. Oberlin College has admitted women since its founding in 1833 and has been historically a leader in the education of blacks. AA/EOE.

THE OHIO STATE UNIVERSITY
Department of Mathematics

The Department of Mathematics of The Ohio State University expects to have available at least one tenure-track/tenured position and several visiting positions, effective autumn quarter 1998. Candidates in all areas of applied and pure mathematics are invited to apply. Preference will be given to those in applied mathematics for one tenure-track position. The
Applicants should use the AMS standardized form, Academic Employment in Mathematics, Application Cover Sheet, and indicate their subject area using the AMS Subject Classification Numbers.

Full consideration will be given to applications received by December 15, 1997; however, all applications will be given consideration until the available positions are filled. Application materials should be sent to the address below. Electronic applications are encouraged and may be sent to mathposition@math.okstate.edu. Oklahoma State University is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

Prof. Sheldon Katz, Chair
Appointments Committee
Department of Mathematics
401 Math Science
Oklahoma State University
Stillwater, OK 74078-1058
mathposition@math.okstate.edu

OLAYA STATE UNIVERSITY
Department of Mathematics
Postdoctoral Positions

The department invites applications for several permanent postdoctoral positions beginning fall 1998. The positions are for new or recent recipients of the Ph.D. and are a one-year appointment with possibility of renewal. Applications are welcome from individuals who have held postdoctoral appointments; an appointment to one of these positions does not exclude an individual from future consideration for a tenure-track position. The duties incorporate a blend of research and teaching; the usual teaching load is 5 or 6 hours each semester. Applicants should submit a curriculum vitae, abstracts of completed research, a statement regarding teaching experience and philosophy, and four letters of recommendation to the address below. One letter of recommendation should address the applicant’s teaching experiences.

Oklahoma State University is located in Stillwater, a town of approximately 40,000 in north central Oklahoma. The department boasts a very dynamic faculty; with over 40 members successfully engaged in mathematics research and education. An active Ph.D. program, support for colloquium speakers and other visitors, approximately 8-10 postdoctoral fellows, as well as involvement of undergraduates in research experiences add to the lively and scholarly atmosphere of the department. The department has received national recognition for the research of its faculty and for the faculty’s contributions to mathematics education. More information on the department and the University can be obtained through its Web page, http://www.math.okstate.edu/.

Pennsylvania

DICKINSON COLLEGE
Carlisle, Pennsylvania
Faculty Position in Mathematics

The Department of Mathematics and Computer Science invites applications for a tenure-track position in mathematics at the assistant professor level starting August 1998. Applicants should have a Ph.D. in mathematics and a strong commitment to liberal arts education. Excellence in undergraduate teaching and strong research potential are expected.

Dickinson is a private, highly selective liberal arts college with 1,800 students located in south central Pennsylvania. The department has eight full-time members. We offer major and minor programs in both mathematics and computer science.

Please send a cover letter, C.V., and separate statements on teaching philosophy and research interests to: Prof. Barry Tesman, Department of Mathematics and Computer Science, Dickinson College, Carlisle, PA 17013. Also arrange for three letters of recommendation and copies of graduate transcripts to be sent to the same address. Review of completed applications will begin on December 15. Please indicate whether you will be attending the Joint AMS-MAA Meetings in Baltimore, where we will be conducting preliminary interviews. Inquiries may be made to tesman@dickinson.edu. Further information is available from http://www.dickinson.edu/departments/mathcs/.

Dickinson is an Affirmative Action/Equal Opportunity Employer. Women and minorities are especially encouraged to apply.
SOUTHERN METHODIST UNIVERSITY  
Department of Mathematics  
Applications are invited for two positions starting in the fall semester of 1998. The first is a tenure-track assistant professorship. Applicants for this position must provide evidence of outstanding potential for research in applied mathematics or scientific computation and a strong commitment to teaching at all levels. The Department of Mathematics has an active doctoral program in applied mathematics, numerical analysis, and scientific computation. The second position is a two-year appointment as a non-tenure-track lecturer whose duty is to teach introductory courses.

Applications will be accepted until February 2, 1998, or until the position is filled. The Search Committee will notify applicants of its employment decision after the position is filled. Applicants should arrange for three letters of recommendation, as well as their vita, to be sent to: Search Committee, Department of Mathematics, Southern Methodist University, 208 Clements Hall, P. O. Box 750156, Dallas, TX 75275-0156; tel: 214-678-2506; fax: 214-678-2355.

SMU is an Equal Opportunity/Affirmative Action/Title IX Employer.

Visit the department's WWW site at http://www.math.smu.edu/AMS, and contact the Search Committee by sending e-mail to: search@mail.smu.edu.

TENNESSEE  
VANDERBILT UNIVERSITY  
Department of Mathematics  
Nashville, TN 37240  
Position in Computational Mathematics  
We invite applications for a tenure-track assistant professorship beginning fall 1998. This position carries an initial three-year appointment and requires a Ph.D. in mathematics. We are looking for someone whose primary research involves computing and who can interact with existing groups in approximation theory, wavelets, and biomedical modeling and imaging. Outstanding research potential and evidence of effective teaching are required. To apply, send a letter of application (including e-mail address and fax number), a curriculum vitae, and a brief research summary to Professor Larry Schumaker, Chair of the Search Committee, at the above address. Do not send additional information (including letters of recommendation) unless requested to do so after the initial screening.

Vanderbilt University is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF TENNESSEE  
Mathematics Department  
The Mathematics Department of The University of Tennessee (www.math.utk.edu) seeks to fill a tenure-track assistant professorship with an Outreach Mathematician (OM). The duties of the OM will be to foster close relations between the University and the community colleges and/or high schools across the state as well as to teach in the department. A Ph.D. in mathematics or a doctoral degree in another discipline with a Master's of Science degree in mathematics is required, together with a clear commitment to outreach activities. Some postdoctoral experience is preferred but not required. Dedication to teaching is paramount. Employment begins August 1, 1998.

Interested applicants should arrange to have a vita, three reference letters, a statement of accomplishments, qualifications, plans for outreach activities, and evidence of quality teaching sent to Professor John B. Conway, OM Search, Mathematics Department, University of Tennessee, Knoxville, TN 37996-1300, Electronic applications are not accepted. Use of the recent AMS application form is encouraged. Review of applications will begin January 1 and will continue until the position is filled.

UTK is an EEO/AA/Title IX Section 504/ADA Employer.

TEXAS  
BAYLOR UNIVERSITY  
Department of Mathematics  
The Department of Mathematics invites applications for a tenure-track position at the assistant professor level starting in August 1998. A Ph.D. is required, excellence in teaching is essential, and research/scholarship is expected. While exceptional candidates in all areas of mathematics will be considered, the department especially encourages people in numerical linear algebra, stochastic analysis, analysis, and applied mathematics to apply.

Applicants should provide a curriculum vitae, three letters of reference, transcripts, and a professional statement describing their philosophy about both teaching and research. Completed applications received by January 2, 1998, will be given full consideration.

Baylor is a Baptist university affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Opportunity Employer, Baylor encourages minorities, women, veterans, and persons with disabilities to apply. Send all materials to: Mathematics Search Committee, P. O. Box 97328, Waco, TX 76798-7328; e-mail address: Ed_Dford@baylor.edu.

COLLEGE OF CHARLESTON  
Department of Mathematics  
Applications are invited for at least one tenure-track position in mathematics at the assistant professor level starting in August 1998. The Mathematics Department at the College of Charleston has 27 full-time faculty and offers the B.S. and M.S. degrees in mathematics. Candidates must have a Ph.D. in one of the mathematical sciences, a commitment to undergraduate and graduate teaching, and potential for continuing research. Preference for one position will be given to applicants in some area of computational mathematics. The normal teaching load is 9 hours per week for those engaged in research. The salary is competitive. Faculty from the College of Charleston will be available to meet with applicants at the AMS-MAA Annual Meeting in Baltimore. Applicants should send a vita and three letters of recommendation to Deanna Caveny, Chair, Department of Mathematics, College of Charleston, Charleston, SC 29424-0001. Questions or requests for additional information may be addressed to caveny@math.cofc.edu. The process of evaluating applications will begin on January 12, 1998, but applications will be considered until the positions are filled. The College of Charleston is an Equal Opportunity/Affirmative Action Employer and encourages applications from minority and women candidates.

UNIVERSITY OF SOUTH CAROLINA  
Department of Mathematics  
The Department of Mathematics expects openings for tenure-track positions starting in fall 1998 and invites applications primarily at the junior level. Applications completed by January 8, 1998, will receive full consideration. While applications in all areas of mathematics will be considered, those whose interests mesh well with the strengths of the department will be given preference. The Ph.D. degree or its equivalent is required as well as an established record of significant research accomplishments. All appointments will be consistent with the department's commitment to excellence in research and in teaching at the undergraduate and graduate levels. A complete application should include a detailed resume with a summary of research accomplishments and goals, a completed copy of the AMS Standard Cover Sheet (see the Notices), and four letters of recommendation. All material should be sent to:

Robert M. Stephenson Jr., Chairman  
Department of Mathematics  
University of South Carolina  
Columbia, SC 29008

We encourage applicants to use the AMS Cover Sheet located on our World Wide Web site, http://www.math.sc.edu/jobs98/. The University of South Carolina is an Affirmative Action/Equal Opportunity Employer.

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Applications are invited for senior faculty positions in the area of numerical analysis with emphasis on computational methods for partial differential equations. We expect to make several offers at the associate professor level and above. Successful candidates must possess a strong continuing record of internationally recognized research in computational mathematics and applications. A proven record of academic leadership, demonstrated by the candidate’s dedication to excellence in research, teaching, graduate student advising, and postgraduate supervision, is desirable. The Department of Mathematics has strong traditional links with the College of Engineering, and appointees would be expected to foster and encourage these ties.

The intellectual climate for applied mathematics at Virginia Tech is lively and challenging. The department has an active group of applied mathematicians in the areas of control and optimization, numerical analysis, stochastic processes, ordinary differential equations, partial differential equations, and integro-differential equations. In addition, the Interdisciplinary Center for Applied Mathematics (ICAM) is a University Center which facilitates interactions among the faculty at Virginia Tech, industry, and other research institutions. Faculty in the Virginia Tech mathematics department have access to excellent computational facilities as well as to several national high-performance computing centers.

Applications will be accepted until all positions are filled. Applicants should send a vita and five letters of recommendation to:

Numerical Analysis Search Committee
Department of Mathematics
Virginia Tech
Blacksburg, VA 24061-0123

Virginia Tech has a strong commitment to the principle of diversity and in that spirit seeks a broad spectrum of candidates, including women, minorities, and people with disabilities. Individuals with disabilities desiring accommodations in the application process should contact Werner Kohler, Department of Mathematics, 540-231-8283 (TDD/PC 1-800-828-1120, Voice 1-800-828-1140).

**George Mason University**
Department of Mathematical Sciences

The department expects to fill two tenure-track positions, preferably at the assistant professor level in the fall of 1998. Successful candidates must demonstrate the potential to make significant contributions to both the B.S. and M.S. programs in either actuarial mathematics or computational and applied mathematics. Candidates are expected to teach at both the undergraduate and graduate levels, maintain an active research program, and pursue external funding opportunities. Computational and applied mathematics faculty also teach courses and supervise Ph.D. students in the interdisciplinary Institute for Computational Sciences and Informatics.

Arrange for a vita, statement of teaching and research interests, and at least three letters of reference to be sent to Ittai Kan, Chair of Search Committee, Department of Mathematical Sciences, George Mason University, MS 3F2, 4400 University Drive, Fairfax, VA 22030-4444 (e-mail: ikan@gmu.edu). To ensure consideration, apply before December 31, 1997; late applications will be accepted until the positions are filled.

George Mason University is an AA/EEO Employer. Women and minorities are encouraged to apply.

**Western Washington University**
Tenure-Track Assistant Professor Mathematics

Begin fall 1998. Candidates with experience in statistics or stochastic processes preferred. Ph.D., refereed publications, and evidence of effective teaching required. Independent and collaborative grant-funded research expected. Commitment to innovative undergraduate instruction essential. Teaching assignments include large lower-division classes. WWU, beside Bellingham Bay between Seattle and Vancouver, has 500 faculty and 12,000 students. Access to excellent recreational opportunities and metropolitan facilities. Get Position Announcement and WWU Summary from http://ww.wwu.edu/~~mathe/web/ or address below, and submit summary, vita, transcripts, description of research and teaching accomplishments and interests, and four letters of recommendation addressing both teaching and research by January 16, 1998, to: Search Committee, Math, WWU, Bellingham, WA 98225-9063; fax: 360-650-7788; tel: 360-650-3785; e-mail: mathdept@henson.cc.wwu.edu. No electronic applications. AA/EOE.

**WYOMING**

**University of Wyoming**
Applied Mathematics

The Department of Mathematics invites applications for a tenure-track assistant professorship in applied mathematics. We seek candidates with an earned doctorate, proven teaching ability, and strong
research in areas of interest in the department, including numerical analysis, partial differential equations, fluid mechanics, and porous media. Applications received by January 15, 1998, will receive first consideration. For more information visit our Web site, http://math.uwyo.edu/.

The University of Wyoming is an Equal Opportunity/Affirmative Action Employer, and we encourage applications from women and underrepresented minorities. Please send vita, three letters of reference, and a statement of teaching qualifications to Myron B. Allen, Head, Department of Mathematics, University of Wyoming, Laramie, WY 82071-3036.

UNIVERSITY OF WYOMING
Department of Mathematics
Tenure-Track Position in Analysis

The University of Wyoming mathematics department (Web site http://math.uwyo.edu/) invites applications for a tenure-track assistant professorship in analysis to start August 1998. Applicants must demonstrate strong ability in research, breadth of mathematical knowledge, strong commitment to undergraduate and graduate teaching, and willingness to supervise master's and doctoral students. Candidates in all areas of analysis will be considered; however, we are particularly interested in strengthening our existing research in function theory, functional, geometric, and harmonic analysis.

Complete applications consist of curriculum vitae, including publication list, a summary of research interests, a statement of teaching qualifications, and three letters of recommendation, sent directly to Myron B. Allen, Head, Department of Mathematics, University of Wyoming, Laramie, WY 82071-3036. Applications received by January 15, 1998, will receive first consideration. The University of Wyoming is an Affirmative Action/Equal Opportunity Employer, and we encourage women and underrepresented minorities to apply.

CANADA
UNIVERSITY OF VICTORIA

The Department of Mathematics and Statistics at the University of Victoria invites applications for two tenure-track positions at the assistant professor level to commence on July 1, 1998. Applicants for the first position should have a Ph.D. in a subject of modern applied mathematics (e.g., wavelet analysis, computational fluid dynamics, neural networks); applicants for the second position should have a Ph.D. in statistics or a related discipline and should possess the expertise to teach both applied and theoretical courses in statistics and probability theory. A strong commitment to undergraduate and graduate teaching and a demonstrated record of research is expected from all applicants.

In consideration of the current gender imbalance in the department, women are especially encouraged to apply.

The positions are subject to approval by the Board of Governors of the University of Victoria. The University of Victoria is committed to employment equity and encourages applications from all qualified individuals, including women, members of visible minorities, Aboriginal peoples, and persons with a disability. In accordance with the Canadian Immigration Requirements, priority will be given to Canadian citizens and permanent residents.

Applications should include a curriculum vitae and should identify the date of availability. In addition, applicants should arrange for three letters of reference to be sent to:

Office of the Chair
Department of Mathematics and Statistics
University of Victoria
P.O. Box 3045
Victoria, BC V8W 3P4, Canada
tel: (250) 721-7456
fax: (250) 721-8902
e-mail: acme@uvvm.uvic.ca

The closing date for applications is December 31, 1997.

SWITZERLAND
THE SWISS FEDERAL INSTITUTE OF TECHNOLOGY, ZURICH (ETHZ)
Professorship in Mathematics

The Swiss Federal Institute of Technology, Zurich (ETHZ) invites applications for a professorship in mathematics. Duties of this position include teaching and research in mathematics. Together with the other members of the department, the new professor will be responsible for undergraduate and graduate courses for students of mathematics, engineering, and the natural sciences.

We are seeking candidates with strong research records and proven ability to direct research of high quality. Willingness to teach at all university levels and to collaborate with colleagues is expected.

Applications with curriculum vitae and a list of publications should be submitted to the President of ETH Zurich, ETH Zentrum, CH-8092 Zurich, no later than January 31, 1998. The ETHZ specifically encourages female candidates to apply, with a view toward increasing the proportion of female professors.

UNIVERSITY OF ZURICH
Assistant Professor in Mathematics

The Institute of Mathematics invites applications for an assistant professorship in pure mathematics, starting in September 1998 or earlier. Preference will be given to candidates in algebra/arithmetic or topology, but applications from other areas are also welcome.

Candidates are expected to have a strong research record and to be willing to teach at all university levels. Applications should include a curriculum vitae and a list of publications and should reach the Dekan der Philosophischen Fakultät II, University of Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland, before December 31, 1997.

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and ask three people to send letters of recommendation.
This material should arrive at the Dekanat der Philosophischen Fakultät II, University of Zurich, Winterturierstrasse 190, CH-8057 Zurich, Switzerland, before December 31, 1997.

PUBLICATIONS FOR SALE

For Sale

PUBLICATIONS WANTED

MATHEMATICS BOOKS PURCHASED

Pure & appl. adv. & research level, any age, usable cond. Reprints OK. One box to whole libraries sought. Contact: Collier Brown or Kirsten Berg @ Powell's Technical Bks., Portland, OR. Call 800-225-6911, fax 503-228-0505, or e-mail: kirsten@technical.powells.com.

American Mathematical Society

Logic and Foundations

Decision Problems for Equational Theories of Relation Algebras
Hajnal Andréka, Mathematical Institute, Budapest, Hungary, Steven Givant, Mills College, Oakland, CA, and István Németh, Mathematical Institute, Budapest, Hungary

This work presents a systematic study of decision problems for equational theories of algebras of binary relations (relation algebras). For example, an easily applicable but deep method, based on von Neumann's coordinatization theorem, is developed for establishing undecidability results. The method is used to solve several outstanding problems posed by Tarski. In addition, the complexity of intervals of equational theories of relation algebras with respect to questions of decidability is investigated. Using ideas that go back to Jónsson and Tarski, the authors show how finite model theory as the lattice of subsets of the set of the natural numbers.

Finally, some new and quite interesting examples of decidable equational theories are given.

Memoirs of the American Mathematical Society, Volume 126, Number 604; 1997; 126 pages; Softcover; ISBN 0-8218-0595-9; List $39; Individual member $23; Order code MEMO/126/604NA

Descriptive Complexity and Finite Models

Neil Immerman, University of Massachusetts, Amherst, and Phokion G. Kolaitis, University of California, Santa Cruz, Editors

We hope that this small volume will suggest directions of synergy and contact for future researchers to build upon, creating connections and making discoveries that will help explain some of the many mysteries of computation.

—from the Preface

The volume presents articles by leading researchers who delivered talks at the "Workshop on Finite Models and Descriptive Complexity" at Princeton in January 1996 during a DIMACS sponsored Special Year on Logic and Algorithms. Each article is self-contained and provides a valuable introduction to the featured research areas connected with finite model theory.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 31; 1997; Hardcover; ISBN 0-8218-0517-7; List $55; Individual member $33; Order code DIMACS/31NA

The SPIN Verification System

Jean-Charles Grégoire, INRS-Telecommunications, Montreal, PQ, Canada, and Gerard J. Holzmann and Doron A. Peled, Lucent Technologies, Murray Hill, NJ, Editors

What is SPIN? SPIN is a general tool for the specification and formal verification of software for distributed systems. It has been used to detect design errors in a wide range of applications, such as abstract distributed algorithms, data communications protocols, operating systems code, and telephone switching code. The verifier can check for basic correctness properties, such as absence of deadlock and race conditions, logical completeness, or unwarranted assumptions about the relative speeds of processes. It can also check for more subtle, system dependent correctness properties expressed in the syntax of Linear-time Temporal Logic (LTL). The tool translates LTL formulae automatically into automata representations, which can be used in an efficient on-the-fly verification procedure.

This DIMACS volume presents the papers contributed to the second international workshop that was held on the SPIN verification system at Rutgers University in August 1996.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 32; 1997; 203 pages; Hardcover; ISBN 0-8218-0680-7; List $49; Individual member $29; Order code DIMACS/32NA

All prices subject to change. Charges for delivery are $3.00 per order. For optional air delivery outside of the continental U. S., please include $6.50 per item. Prepayment required. Order from: American Mathematical Society, P. O. Box 6248, Providence, RI 02940-6248. For credit card orders, fax (401) 455-4046 or call toll-free 800-321-4AMS (4267) in the U.S. and Canada, (401) 455-4003 worldwide. Or place your order through the AMS bookstore at http://www.ams.org/bookstore/. Residents of Canada, please include 7% GST.
Volume 3, 1997

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The American Mathematical Society's electronic-only journal, Electronic Research Announcements of the AMS (ERA-AMS), is available on the World Wide Web at the URL: http://www.ams.org/era/

ERA-AMS publishes high-quality research announcements of significant advances in all branches of mathematics. Authors may submit manuscripts to any editor. All papers are reviewed, and the entire Editorial Board must approve the acceptance of any paper. Beginning with Volume 3, papers will be posted as soon as they are accepted and processed by the AMS.

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For more information, contact: cust-serv@ams.org
800-321-4267, 401-455-4000, fax 401-455-4046

http://www.ams.org/era/
Automorphic Forms on $SL_2(\mathbb{R})$
Armand Borel

This book provides an introduction to some aspects of the analytic theory of automorphic forms on $G=SL_2(\mathbb{R})$ or the upper-half plane $X$, with respect to a discrete subgroup $\Gamma$ of $G$ of finite covolume. The topics treated include the construction of fundamental domains, the notion of automorphic form on $\Gamma G$ and its relationship with the classical automorphic forms on $X$. Poincaré series, constant terms, cusp forms, finite dimensionality of the space of automorphic forms of a given type, compactness of certain convolution operators, Eisenstein series, and unitary representations of $G$.

Cambridge Tracts in Mathematics 130
1997 202 pp. 58049-8 Hardback $47.95

An Introduction to Mathematical Reasoning
Numbers, Sets and Functions
Peter Eccles

This book eases students into the rigors of university mathematics. The author achieves this by exploring set theory, combinatorics, and number theory, topics that include many fundamental ideas and may not be a part of a young mathematician's toolkit. The book presents mathematics as a continually developing subject. Over 250 problems include questions to interest and challenge the most able student but also plenty of routine exercises to help familiarize the reader with the basic ideas.

1997 c.320 pp. 59269-0 Hardback $59.95
59718-8 Paperback $24.95

Bootstrap Methods and Their Application
A.C. Davison and D.V. Hinkley

Special features of the book include: extensive discussion of significance tests and confidence intervals; material on various diagnostic methods; and methods for efficient computation, including improved Monte Carlo simulation. Included with the book is a disk of purpose-written S-Plus programs for implementing the methods described in the text. Computer algorithms are clearly described, and computer code is included on a 3-inch, 1.4M disk for use with IBM computers and compatible machines. Users must have the S-Plus computer application.

Cambridge Series in Statistical and Probabilistic Mathematics 1
1997 c.500 pp. 57391-2 Hardback $100.00
57471-4 Paperback $39.95

Foundations of Probability with Applications
Selected Papers 1974-1995
Patrick Suppes and Mario Zanotti

This is an important collection of essays on dealing with the foundations of probability that will be of value to philosophers of science, mathematicians, statisticians, psychologists and educationalists. The collection falls into three parts: the axiomatic foundations of probability, probabilistic causality and quantum mechanics, probabilistic theories of learning to practical questions of education.

Cambridge Studies in Probability, Induction and Decision Theory
1996 202 pp. 43012-7 Hardback $59.95
56835-8 Paperback $19.95

Dissections
Plane and Fancy
Greg N. Frederickson

Perfect gift for any puzzle enthusiast, this book explores the infinite challenge and beauty in geometric dissections. It shows many ingenious ways to solve geometric problems and the beautiful constructions possible. The author explains solution methods carefully, assuming only a basic knowledge of high school geometry, then poses puzzles to solve. He also introduces the people—famous and obscure—who have worked on these problems, traveling from the palace school of tenth-century Baghdad to the mathematical puzzle columns in turn-of-the-century newspapers.

1997 c.320 pp. 57197-9 Hardback $34.95

Tight and Taut Submanifolds
Thomas E. Cecil and Shing-chen Chern, Editors

Tight and taut manifolds form an important and special class of surfaces within differential geometry. This book contains in-depth articles by experts in the field as well as an extensive and comprehensive bibliography. This survey will open new avenues for further research and will be an important addition to any geometer's library.

Mathematical Sciences Research Institute Publications 32
1997 c.200 pp. 62047-3 Hardback $44.95

Conceptual Mathematics
A First Introduction to Categories
W. Lawvere and S. Schanuel

Written by two of the best-known names in categorical logic, this is the first book to apply categories to the most elementary mathematics. It thus serves two purposes: first, to provide a key to mathematics for the general reader or beginning student; and second, to furnish an easy introduction to categories for computer scientists, logicians, physicists, and linguists who want to gain some familiarity with the categorical method without initially committing themselves to extended study.

1997 c.300 pp. 47249-0 Hardback $90.00
47817-0 Paperback $34.95

Cauchy and the Creation of Complex Function Theory
Frank Smithies

In this book, Dr. Smithies analyzes the process through which Cauchy created the basic structure of complex analysis, describing first the eighteenth century background before proceeding to examine the stages of Cauchy’s own work, culminating in the proof of the residue theorem and his work on expansions in power series.

1997 c.250 pp. 59278-X Hardback $59.95

Information Flow
The Logic of Distributed Systems
Jon Barwise and Jerry Seligman

Drawing on ideas from mathematics, computer science, and philosophy, this book addresses the definition and place of information in society. The authors, observing that information flow is possible only within a connected distribution system, provide a mathematically rigorous, philosophically sound foundation for a science of information. They illustrate their theory by applying it to a wide range of phenomena, from file transfer to DNA, from quantum mechanics to speech act theory.

Cambridge Tracts in Theoretical Computer Science 44
1997 290 pp. 58386-1 Hardback $39.95

Available in bookstores or from
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Web site: http://www.cup.org MasterCard/VISA accepted. Prices subject to change.
American Mathematical Society

Professional Resources from the AMS

Assistantships and Graduate Fellowships in the Mathematical Sciences 1997–1998

This publication is an indispensable source of information for students seeking support for graduate study in the mathematical sciences. Providing data from a broad range of academic institutions, it is also a valuable resource for mathematical sciences departments and faculty.

Assistantships and Graduate Fellowships brings together a wealth of information about resources available for graduate study in the U.S. and Canada. Information on the number of faculty, graduate students, and degrees awarded (bachelor’s, master’s, and doctoral) is listed for each department when provided. Stipend amounts and the number of awards available are given, as well as information about foreign language requirements. Numerous display advertisements from mathematical sciences departments throughout the country provide additional information.

Also listed are sources of support for graduate study and travel, summer internships, and graduate study in the U.S. for foreign nationals. Finally, a list of reference publications for fellowship information makes Assistantships and Graduate Fellowships a centralized and comprehensive resource.

AMS Publications Not in Series, 1997, 135 pages; Softcover; ISBN 0-8218-0814-1; List $20; Individual member $12; Order code ASST/97NA

Combined Membership List 1997–1998

The Combined Membership List (CML) is a comprehensive directory of the membership of the American Mathematical Society, the American Mathematical Association of Two-Year Colleges (AMATYC), the Mathematical Association of America (MAA), and the Society for Industrial and Applied Mathematics (SIAM). There are two lists of individual members. The first is a complete alphabetical list of members in all four organizations. For each member, the CML provides his or her address, title, department, institution, telephone number (if available), and electronic address (if indicated), and also indicates membership in the four participating societies. The second is a list of individual members according to their geographic locations. In addition, the CML lists academic, institutional, and corporate members of the four participating societies that provide addresses and telephone numbers of mathematical sciences departments.

The CML is distributed on request to AMS members in even-numbered years. MAA members can request the CML in odd-numbered years from the MAA. The CML is an invaluable reference for keeping in touch with colleagues and for making connections in the mathematical sciences community in the United States and abroad.


The MathResource® Interactive Math Dictionary

Created by: Jonathan Borwein, Simon Fraser University, Burnaby, BC, Canada, Carolyn Watters, Acadia University, Wolfville, NS, Canada, and Ephraim Borowski, University of Glasgow, Scotland

I really like the interactive math dictionary. I have let some of my students use it for project work to try and get feedback from them. I have had only positive results. The most common response from the students seems to be "wow!" I mentioned that this software is available and probably would be a good idea that students entering Science/Math/Engineering at universities have access to it.

I will also mention the software at teachers conferences etc. ... In my opinion, every Mathematics Department should have a copy available for the staff and students. A great reference/investigative item.
—Paul Holder, Mathematics Department Head, St. John High School, New Brunswick, Canada

Finally, coursework I am order for my students with no learning curve. The MathResource put significant interactive math at their fingertips in 5 minutes.
—Dr. Charles Edmunds, Mathematics Department, Mount St. Vincent University

This math visualizing program was designed by mathematicians for mathematics teachers and their students and covers a comprehensive list of topics—from algebra to optimization theory.

The MathResource® Interactive Math Dictionary is an interactive database of mathematical topics that combines the attributes of a dictionary with the functionality of a CD-ROM. This powerful tool can work equally well for classroom display or for studying. Each topic has its own guide for quick and easy access to the database. The 4,500 entries include the mathematical examples that can be explored with sample data or by inputting your own. Computation, plotting, and graphing are powered by the Maple™ computer algebra system (run time version included on disk). The CD-ROM operates within Windows® 3.1 and Windows® 95.

The MathResource Interactive Math Dictionary allows you to ...

1. Perform your own data and do "What if?" analyses.
2. Generate numerical and graphical solutions.
3. Access the information contained in the CD via the following search options:
   - Word search
   - Alphabetical search
   - Curriculum guide search: Each topic, such as algebra, calculus, linear algebra, etc., has its own table of contents. Simply click on the item and the dictionary opens to the appropriate topic.

*Maple® is a registered trademark of Waterloo Maple Inc.
*The MathResource is a registered trademark of MathResources Inc.
*Windows is a registered trademark of Microsoft Corporation.

Published by MathResources, Inc., Halifax, NS, Canada, and distributed worldwide by the American Mathematical Society.

1996; List $95; All AMS numbers $85; Order code MKRDMDNA

Preparing for Careers in Mathematics

Annalisa Crannell, Franklin & Marshall College, Lancaster, PA, Organizer


This video presents an edited version of a panel discussion that took place at the Joint Mathematics Meetings in Seattle in August 1996. The panel, sponsored by the AMS Committee on the Profession, discussed how Ph.D. students in mathematics can prepare themselves for finding jobs once they finish their degrees. The panelists ranged from new Ph.D.s who had recently been on the job market, to senior mathematicians in academia and industry. Among the topics discussed are how to start preparing for a job search while still a graduate student, specific job search strategies, tips on interviewing, and perspectives on what academic and industrial employers are looking for in a job applicant. The video ends with a look at the range of employment resources offered by the AMS.

1997; NTSC format on one-half inch VHS videotape, approximately 30 minutes; ISBN 0-8218-0839-7; List $15; Order code VIDE0/97NA

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Application for Membership 1998
(January–December)

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13 Commutative rings and algebras
14 Algebraic geometry
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16 Associative rings and algebras
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18 Category theory, homological algebra
19 K-theory
20 Group theory and generalizations
22 Topological groups, Lie groups
26 Real functions
28 Measure and integration
30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytic spaces
33 Special functions
34 Ordinary differential equations
35 Partial differential equations
39 Finite differences and functional equations
40 Sequences, series, summability
41 Approximations and expansions
42 Fourier analysis
43 Abstract harmonic analysis
44 Integral transforms, operational calculus
45 Integral equations
46 Functional analysis
47 Operator theory
49 Calculus of variations and optimal control; optimization
51 Geometry
52 Convex and discrete geometry
53 Differential geometry
54 General topology
55 Algebraic topology
57 Manifolds and cell complexes
58 Global analysis, analysis on manifolds
60 Probability theory and stochastic processes
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73 Mechanics of solids
76 Fluid mechanics
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80 Classical thermodynamics, heat transfer
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85 Astronomy and astrophysics
86 Geophysics
90 Economics, operations research, programming, games
92 Biology and other natural sciences, behavioral sciences
93 Systems theory; control
94 Information and communication, circuits
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*For ordinary members* whose annual professional income is below $45,000, the dues are $96; for those whose annual professional income is $45,000 or more, the dues are $128.

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1. **Student Verification** (sign below)
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- Azerbaijan Mathematical Society
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- Deutsche Mathematiker-Vereinigung e.V.
- Edinburgh Mathematical Society
- Egyptian Mathematical Society
- Gesellschaft für Angewandte Mathematik und Mechanik
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- Hellenic Mathematical Society
- Icelandic Mathematical Society
- Indian Mathematical Society
- Irish Mathematical Society
- Israel Mathematical Union
- János Bolyai Mathematical Society
- The Korean Mathematical Society
- London Mathematical Society
- Malaysian Mathematical Society
- Mathematical Society of Japan
- Mathematical Society of the Philippines
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- Mongolian Mathematical Society
- Nepal Mathematical Society
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- Société Mathématique de France
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- Society of Mathematicians, Physicists, and Astronomers of Slovenia
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Providence, RI 02940

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American Mathematical Society

ALGEBRA AND ALGEBRAIC GEOMETRY

Cogroups and Co-rings in Categories of Associative Rings

George M. Bergman, University of California, Berkeley, and Adam O. Hausknecht, University of Massachusetts at Amherst

This book studies representable functors among well-known varieties of algebras. All such functors from associative rings over a fixed ring R to each of the categories of abelian groups, associative rings, Lie rings, and to several others are determined. The book includes a "symbol index", which serves as a glossary of symbols used and a list of the pages where the topics so symbolized are treated, and a "Word and phrase index". The authors have strived—and succeeded—in creating a volume that is very user-friendly.


Enveloping Algebras

Jacques Dixmier, Paris, France

For the graduate student, this is a masterpiece of pedagogical writing, being succinct, wonderfully self-contained and of exceptional precision.

—Mathematical Reviews

The above citation is taken from the review of the first English edition of Dixmier's book. The book, which is the first systematic exposition of the algebraic approach to representations of Lie groups via representations of (or modules over) the corresponding universal enveloping algebras, turned out to be so well written that even today it remains one of the main textbooks and reference books on the subject. In 1992, Jacques Dixmier was awarded the Leroy P. Steele Prize for expository writing in mathematics. The Committee's citation mentioned "Enveloping Algebras" as one of Dixmier's "extraordinary books". For the 1996 printing, the author updated the status of open problems and added some relevant references.

Graduate Studies in Mathematics, Volume 11; 1996; 397 pp.; Hardcover; ISBN 0-8218-0560-6; List $89; All AMS members $57; Order code GSM/11NA

Tight Closure and Its Applications

Craig Huneke, Purdue University, West Lafayette, IN

This monograph deals with the theory of tight closure and its applications. The contents are based on ten talks given at a CBMS conference held at North Dakota State University in June 1995.

Tight closure is a method to study rings of equicharacteristic by using reduction to positive characteristic. In this book, the basic properties of tight closure are covered, including various types of singularities, e.g. $F$-regular and $F$-rational singularities. Several applications of the theory are given. These include the existence of big Cohen-Macaulay algebras and various uniform Artin-Rees theorems.

CBMS Regional Conference Series in Mathematics, Number 86; 1996; 137 pp.; Softcover; ISBN 0-8218-0412-X; List $29; All individuals $23; Order code CBMS/86NA

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Elliptic Boundary Value Problems in Domains with Point Singularities

V. A. Kozlov, Russian Academy of Sciences, Moscow, V. G. Maz'ya, Linköping University, Sweden, and J. Rossmann, Rostock University, Germany

This monograph systematically treats a theory of elliptic boundary value problems in domains without singularities and in domains with conical or cuspidal points. This exposition is self-contained and a priori requires only basic knowledge of functional analysis. Restricting to boundary value problems formed by differential operators and avoiding the use of pseudo-differential operators makes the book accessible for a wider readership.

The authors concentrate on fundamental results of the theory: estimates for solutions in different function spaces, the Fredholm property of the operator of the boundary value problem, regularity assertions and asymptotic formulas for the solutions near singular points. A special feature of the book is that the solutions of the boundary value problems are considered in Sobolev spaces of both positive and negative orders. Results of the general theory are illustrated by concrete examples. The book may be used for courses in partial differential equations.

Mathematical Surveys and Monographs, Volume 52; 1997; 414 pages; Hardcover; ISBN 0-8218-0754-4; List $99; Individual member $59; Order code SURV/52NA

Optimization Methods in Partial Differential Equations

Steven Cox, Rice University, Houston, TX, and Irena Lasiecka, University of Virginia, Charlottesville, Editors

This book presents a collection of papers written by specialists in the field and devoted to the analysis of various aspects of optimization problems with a common focus on partial differential equation (PDE) models. These papers were presented at the AMS-SIAM 1996 Joint Summer Research Conference held at Mount Holyoke College, South Hadley, MA, in June 1996.

The problems considered range from basic theoretical issues in the calculus of variations—such as infinite dimensional Hamilton Jacobi equations, saddle point principles, and issues of unique continuation—to ones focusing on application and computation, where theoretical tools are tuned to more specifically defined problems. The last category of these problems include inverse/recovery problems in physical systems, shape optimization and shape design of elastic structures, control and optimization of fluids, boundary controllability of PDE's including applications to flexible structures, etc.

The papers selected for this volume are at the forefront of research and point to modern trends and open problems. This book will be a valuable tool not only to specialists in the field interested in technical details, but also to scientists entering the field who are searching for promising directions for research.

Contemporary Mathematics, Volume 209; 1997; 349 pages; Hardcover; ISBN 0-8218-0604-1; List $69; Individual member $41; Order code CONM/209NA

Partial Differential Equations

Harold Levine, Stanford University, CA

The subject matter partial differential equations (PDEs) has a long history dating from the 18th century and an active contemporary phase. An early phase (with a separate focus on taut string vibrations and heat flow through solid bodies) stimulated developments of great importance for mathematical analysis, such as a wider concept of functions and integration, the existence of trigonometric Fourier series representations. The direct relevance of PDEs to all manner of mathematical, physical and technical problems continues. This book presents a reasonably broad introductory account of the subject, with due regard for analytical detail, applications and historical matters.

Titles in this series are co-published with International Press, Cambridge, MA.

AMS/IP Studies in Advanced Mathematics, Volume 6; 1997; 706 pages; Hardcover; ISBN 0-8218-0775-7; List $69; All AMS members $55; Order code AMSIP/6NA

Partial Differential Equations and Their Applications

Peter C. Greiner, Victor Ivrii, Luis A. Seco, and Catherine Sulem, University of Toronto, ON, Canada, Editors

This volume presents lectures given at the 1995 Annual Seminar of the Canadian Mathematical Society on Partial Differential Equations and Their Applications held at the University of Toronto in June 1995.

The conference consisted of a combination of mini-courses, invited presentations, and contributed talks. In this volume readers will find contributions on a variety of topics related to PDE, such as spectral asymptotics, harmonic analysis, differential operators in hyperbolic manifolds, applications to geometry, mathematical physics, hydrodynamics, and the interaction between theory and numerical methods in PDE.

CRM Proceedings & Lecture Notes, Volume 12; 1997; 315 pages; Hardcover; ISBN 0-8218-0607-4; List $65; Individual member $51; Order code CRM/P/12NA

All prices subject to change. Charges for delivery are $3.00 per item. For optional air delivery outside of the continental U. S., please include $6.50 per item. Prepayment required. Order from: American Mathematical Society, P. O. Box 6248, Providence, RI 02940, USA. For credit card orders, fax (401) 455-4406 or call toll free 800-321-4AMS (4267) in the U. S. and Canada, (401) 455-4000 worldwide. Or place your order through the AMS bookstore at http://www.ams.org/bookstore/. Residents of Canada, please include 7% GST.
Cosponsored Conference

American Association for the Advancement of Science


The 1998 Annual Meeting of the American Association for the Advancement of Science (AAAS) will feature many outstanding expository talks by prominent mathematicians. These include the following symposia (three-hour sessions) and invited addresses sponsored by Section A (Mathematics) of the AAAS. The Society provides travel support to speakers in these sessions and has a committee to cooperate with AAAS on scientific activities. The AMS believes that strengthening its ties with the AAAS will create new opportunities for mathematicians to interact with scientists from all disciplines. Session titles and names and affiliations of the organizers are:

- Exploring New Frontiers in Geometry: In the World around Us and in Our Classrooms I and II, Colm K. Mulcahy, Spelman College, and David Henderson.
- The Chaotic Mathematical Mysteries of the Social Sciences, organized by Donald G. Saari, Northwestern University.
- Changing Pedagogy in Undergraduate Science and Mathematics Education, Deborah Hughes Hallett, Harvard University, and Brad G. Osgood, Stanford University.
- From Riemann to Strings, The 150-Year Romance of Geometry and Physics, Robert Osserman, Stanford University.
- Wavelets and Applications, Colm K. Mulcahy and Farid Dowla.
- Elementary Methods in Number Theory, Melvyn B. Nathanson, Herbert H. Lehman College (CUNY).
- Frontiers of the Physical Sciences I and II, Warren Page, New York City Technical College (CUNY).

Other symposia that will be of interest to mathematicians and mathematics educators include:

- Not Merely by Science Alone: The Role of Values in Scientific Inquiry
- Population and Carrying Capacity: Beyond Malthus after Two Centuries
- Educational Technology, Contemporary Theories of Learning, and Some Applications
- The Role of Models in Science
- How Scientists Really Think
- Properties of Mind
- Data Selection: Good Research or Fudging the Data?

The above symposia are only a few of the 150 or so AAAS program offerings in the physical, life, social, and biological sciences that will broaden the perspectives of students and professionals alike. Indeed, AAAS annual meetings are the showcases of American science, deserving greater participation by mathematicians. The AAAS Program Committee is genuinely interested in more symposia on mathematical topics of current interest. The Section A Committee seeks organizers and speakers who can present substantial new material in understandable ways. This task is not easy, but the meetings prove that effort and inspiration can accomplish wonders. The mathematics programs at these meetings show that first-rate mathematical researchers and educators can also effectively reach a broad scientific audience.

Section A of the AAAS knows that increasing the representation and participation of mathematicians at AAAS annual meetings is an important means for deepening public awareness and appreciation of the manifold ways that mathematics contributes to science and society. The secretary of Section A welcomes suggestions for symposia topics and individuals who might be able to organize them. Participants are invited to attend the Section A committee meeting, 7:30 p.m. to 10:30 p.m. on Friday, February 13, 1998, in Room 110B of the Philadelphia Convention Center. This meeting is open to all who wish to stimulate interest in activities of the mathematical sciences within the AAAS. Symposia proposals for future AAAS meetings should be sent to Warren Page, Secretary of Section A, Department of Mathematics, New York City Technical College (CUNY), 300 Jay St., Brooklyn, NY 11201.

For up-to-date details on all sessions, as well as registration information, follow the links to the meeting on the AAAS Web page at http://www.aaas.org/. Details will be published in the October 31, 1997, issue of Science.
Meetings & Conferences of the AMS

The most comprehensive and up-to-date information on AMS meetings and conferences is available on e-MATH at http://www.ams.org/meetings/.

Oaxaca, Mexico

Oaxaca, Mexico

December 3–6, 1997

Meeting #929
Third Joint Meeting of the American Mathematical Society and the Sociedad Matematica Mexicana.

Associate secretary: Lesley M. Sibner
Announcement issue of Notices: September 1997
Program issue of Notices: December 1997
Issue of Abstracts: To be announced

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

Invited Addresses
Javier Bracho, IMATE-UNAM, Title to be announced.
Jorge Ize, IIMAS-UNAM, Title to be announced.
Gian-Carlo Rota, Massachusetts Institute of Technology, Title to be announced (SMM Invited Address).
Ronald Stern, University of California, Irvine, Title to be announced (SMM Invited Address).
Alberto Verjovsky, CIC and IMATE-UNAM, Title to be announced.
Raymond O. Wells, Rice University, Title to be announced.

Special Sessions
Algebraic Geometry and Commutative Algebra, Leticia Brambila, UAM-Iztapalapa, and Rick Miranda, Colorado State University.

Applied Nonlinear Analysis, Gustavo Cruz and Pablo Padilla, IIMAS-UNAM, Susan J. Friedlander, University of Illinois at Chicago, and Rafael de la Llave, University of Texas at Austin.

Complex and Functional Analysis, William Abikoff, University of Connecticut, Raul E. Curto, University of Iowa, Salvador Perez-Esteva, IMATE-UNAM, and Michael Porter, CINVESTAV-IPN.

Differential Geometry and Topology, Kevin Corlette, University of Chicago, Luis Hernandez, CIMAT, Max Neu mann, IMATE-UNAM, and Peter Scott, University of California, Berkeley, and University of Michigan.

General Topology, Charles L. Hagopian, California State University Sacramento, and Isabel Puga, FC-UNAM.

Graphs and Combinatorial Geometry, Janos Pach, City College, City University of New York, and Eduardo Rivera, IMATE-UNAM and UAM-Iztapalapa.

Mathematical Physics, Eric Carlen, Georgia Institute of Technology, Micho Durdevich, IMATE-UNAM, Roberto Quezada, UAM-Iztapalapa, and Nicolai Reshetikhin, University of California Berkeley.


Numerical Analysis, Bernardo Cockburn, University of Minnesota, and Jean P. Hennart, IMAS-UNAM.

Representation Theory of Algebras and Groups, Martha Takane and Ernesto Vallejo, IMATE-UNAM, and Dan Zacharia, Syracuse University.

Rings and Category Theory, Sergio Roberto Lopez-Permouth, Ohio University, and Jose Rios and Leopoldo Roman, IMATE-UNAM.

Stochastic Systems, Guillermo Segundo Ferreyra, Louisiana State University, and Daniel Hernandez, CINVESTAV-IPN.
Baltimore, Maryland  
*Baltimore Convention Center*  
**January 7-10, 1998**

**Meeting #930**  
Joint Mathematics Meetings, including the 104th Annual Meeting of the AMS, 81st Annual Meeting of the Mathematical Association of America (MAA), the winter meeting of the Association for Symbolic Logic (ASL), and the annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and .  
Associate secretary: Robert J. Daverman  
Announcement issue of Notices: October 1997  
Program issue of Notices: January 1998  
Issue of Abstracts: Volume 19, Issue 1  

**Deadlines**  
For organizers: Expired  
For consideration of contributed papers in Special Sessions: Expired  
For abstracts: Expired  
For summaries of papers to MAA organizers: Expired  

**Program Updates**  
U. S. Secretary of Education, Richard W. Riley, will speak on the proposed National Test in Mathematics, on Friday, January 9 at 3:10 p.m. Sponsored by the AMS and MAA Committees on Science Policy and AMS Committee on Education.  
Lieutenant General Kenneth A. Minihan, USAF, Director, National Security Agency, will give the AMS-MAA Science Policy Address on Friday, January 9, at 4:20 p.m. Sponsored by the AMS and MAA Committees on Science Policy. A reception will follow.  

**Building Connections to Industry within Graduate Departments**, Wednesday, 4:30 p.m., sponsored by the AMS Committee on the Profession. Panelists will discuss industrial and commercial projects that lie within traditional mathematics graduate programs—how and why these projects were started and the implications for graduate students and faculty involved in the projects. The goals of this presentation are to provide information on professional development to the mathematics community, to help graduate advisors help their students to cross from academia into industry, and to enhance senior mathematician awareness of opportunities for working with industry. Panelists include L. Pamela Cook-loannidis, University of Delaware (Industrial Applied Mathematics); Nielis Nygaard, The University of Chicago (Program in Financial Mathematics); H. T. Banks, Director of the North Carolina State University Industrial Math Modeling Workshops; James Glimm, SUNY at Stony Brook (Program in Industrial Mathematics); and Robert Williamson, The Claremont Graduate School Master of Science Degree in Financial Engineering. The moderator is Annalisa Crannell, Franklin & Marshall College.

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Louisville, Kentucky  
*University of Louisville*  
**March 20-21, 1998**

**Meeting #931**  
Southeastern Section  
Associate secretary: Robert J. Daverman  
Announcement issue of Notices: January 1998  
Program issue of Notices: May 1998  
Issue of Abstracts: Volume 19, Issue 2  

**Deadlines**  
For organizers: Expired  
For consideration of contributed papers in Special Sessions: December 3, 1997  
For abstracts: January 28, 1998  

**Invited Addresses**  
Anders Bjorner, Royal Institute of Technology, Stockholm, Sweden, *Title to be announced.*  
Andrew Bruckner, University of California at Santa Barbara, *Title to be announced.*  
Philippe DiFrancesco, University of North Carolina at Chapel Hill, *Title to be announced.*  
Abigail Thompson, University of California at Davis, *Title to be announced.*

**Special Sessions**  
Algebraic Combinatorics (Code: AMS SS N1), Anders Bjorner, Royal Institute of Technology, and Michelle L. Wachs, University of Miami.  
Applied Probability and Actuarial Science (Code: AMS SS P1), Bogdan Gapinski, Ewa M. Kubicka, Krzysztof Ostaszewski, and Grzegorz Rempala, University of Louisville.  
Banach Space Theory (Code: AMS SS F1), Patrick N. Dowling and Beata Randrianantoanina, Miami University, Ohio.  
Boundary Value Problems for Differential Equations (Code: AMS SS J1), Paul W. Eloe, University of Dayton.  
Combinatorics and Enumerative Geometry (Code: AMS SS A1), Kequan Ding, University of Illinois, Urbana-Champaign, and Chi Wang, University of Louisville.  
Combinatorics and Graph Theory (Code: AMS SS B1), Andre E. Kezdy, Grzegorz Kubicki, and Jenoe Lehel, University of Louisville.  
Discrete Mathematics, Classification Theory and Consensus (Code: AMS SS C1), Robert C. Powers, University of Louisville.  
Fractal Geometry and Related Topics (Code: AMS SS D1), Ka-Sing Lau, University of Pittsburgh, and Weibin Zeng, University of Louisville.  
Functional Equations and Inequalities (Code: AMS SS E1), Thomas Riedel and Prasanna Sahoo, University of Louisville.
Manhattan, Kansas

Kansas State University

March 27–28, 1998

Meeting #932
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: January 1998
Program issue of Notices: June 1998
Issue of Abstracts: Volume 19, Issue 2

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: December 10, 1997
For abstracts: February 2, 1998

Invited Addresses
Gopal Prasad, University of Michigan-Ann Arbor, Title to be announced.

Mikhail Vishik, University of Texas at Austin, Title to be announced.

Clarence Eugene Wayne, Pennsylvania State University, University Park, Title to be announced.

Zihong Jeff Xia, Northwestern University, Title to be announced.

Special Sessions

Abstract Harmonic Analysis (Code: AMS SS H1), Sadahiro Saeki, Kansas State University.

Cohomology of Finite Groups (Code: AMS SS F1), John S. Maginnis, Kansas State University, and Stephen F. Siegel, University of Massachusetts.

Groups and Geometry (Code: AMS SS I1), Ernest Shult, Kansas State University.

Integrable Systems and Their Applications (Code: AMS SS M1), Kirill L. Vaninsky, Kansas State University.

Lie Groups, Algebraic Groups, Their Arithmetic and Representation Theory (Code: AMS SS O1), Gopal Prasad, University of Michigan-Ann Arbor.

Linear Operators and Holomorphic Function Spaces (Code: AMS SS G1), V. V. Peller, Kansas State University.

Mathematics Education and the Internet (Code: AMS SS C1), Andrew G. Bennett, Kansas State University.

Nonlinear Problems (Code: AMS SS D1), Lev Kapitanski, Kansas State University, and Clarence Eugene Wayne, Pennsylvania State University.

Numerical Analysis and Computational Mathematics (Code: AMS SS L1), Huanan Yang and Qisu Zou, Kansas State University.


Quantum Groups and Applications (Code: AMS SS J1), Volodymyr V. Lyubashenko and Ya S. Soibelman, Kansas State University.

Quantum Topology (Code: AMS SS K1), Louis Crane and David N. Yetter, Kansas State University.

Representation Theory of Lie Algebras, Algebraic Groups and Quantum Groups (Code: AMS SS E1), Zongzhu Lin, Kansas State University, and Daniel Ken Nakano, Utah State University.

Philadelphia, Pennsylvania

Temple University

April 4–6, 1998

Meeting #933
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: February 1998
Program issue of Notices: June 1998
Issue of Abstracts: Volume 19, Issue 2
Meetings & Conferences

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: December 17, 1997
For abstracts: February 11, 1998

Invited Addresses
Tobias H. Colding, Courant Institute-New York University, Title to be announced.
Martin Davis, University of California, Berkeley, Title to be announced.
Ezra Getzler, Max-Planck-Institute and Northwestern University, Title to be announced.
Yanyan Li, Rutgers University, Title to be announced.
Elias M. Stein, Princeton University, Title to be announced.

Special Sessions
Harmonic Analysis and Its Applications to PDEs (Code: AMS SS G1), Cristian E. Gutierrez, Temple University, and Guozhen Lu, Wright State University.
Heat Kernel Analysis on Lie Groups (Code: AMS SS H1), Leonard Gross, Cornell University, and Omar Hijab, Temple University.
Mathematical Pedagogy (Code: AMS SS I1), Orin N. Chein, Temple University.
Modular Identities and Q-Series in Number Theory (Code: AMS SS A1), Boris Datskovsky and Marvin I. Knopp, Temple University.
Nonlinear Partial Differential Equations (Code: AMS SS K1), Yanyan Li, Rutgers University.
PDEs in Several Complex Variables (Code: AMS SS B1), Shiferaw Berhanu and Gerardo Mendoza, Temple University.
Radon Transforms and Tomography (Code: AMS SS C1), Eric L. Grinberg, Temple University, and Eric Todd Quinto, Tufts University.
Rings and Representations (Code: AMS SS E1), Maria E. Lorenz, Ursinus College, and Martin Lorenz, Temple University.
Sparse Matrix Computations (Code: AMS SS M1), Jesse Barlow, Pennsylvania State University, and Daniel B. Szyld, Temple University.
The History of American Mathematics (Code: AMS SS D1), Karen H. Parshall, University of Virginia, and David E. Zitarelli, Temple University.
Topology of Manifolds and Varieties (Code: AMS SS F1), Sylvain E. Cappell, Courant Institute-New York University, and Georgia Triantafillou, Temple University.

Davis, California
University of California
April 25–26, 1998
Meeting #934
Western Section
Associate secretary: William A. Harris Jr.
Announcement issue of Notices: February 1998
Program issue of Notices: June 1998
Issue of Abstracts: Volume 19, Issue 2

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: January 7, 1998
For abstracts: March 4, 1998

Chicago, Illinois
DePaul University-Chicago
September 12–13, 1998
Meeting #935
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: June 1998
Program issue of Notices: November 1998
Issue of Abstracts: Volume 19, Issue 3

Deadlines
For organizers: December 12, 1997
For consideration of contributed papers in Special Sessions: May 26, 1998
For abstracts: July 21, 1998

Invited Addresses
Vitaly Bergelson, Ohio State University, Title to be announced.
Sheldon Katz, Oklahoma State University, Title to be announced.
Ralf Spatzier, University of Michigan, Title to be announced.
Vladimir Voevodsky, Northwestern University, Title to be announced.

Special Sessions
Algebraic Coding (Code: AMS SS C1), William C. Huffman, Loyola University of Chicago, and Vera S. Pless, University of Illinois at Chicago.
Fourier Analysis (Code: AMS SS E1), Marshall Ash, DePaul University, and Mark A. Pinsky, Northwestern University.
K-Theory and Motivic Cohomology (Code: AMS SS D1), Kevin Knudson, Northwestern University, and Mark Walker, University of Nebraska-Lincoln.

Stochastic Analysis (Code: AMS SS A1), Elton P. Hsu, Northwestern University, and Richard B. Sowers, University of Illinois-Urbana.

Topics in Mathematics and Curriculum Reform (Code: AMS SS B1), Richard J. Maher, Loyola University Chicago.

Winston-Salem, North Carolina
Wake Forest University
October 9-10, 1998

Meeting #936
Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of Notices: August 1998
Program issue of Notices: December 1998
Issue of Abstracts: Volume 19, Issue 3

Deadlines
For organizers: January 6, 1998
For consideration of contributed papers in Special Sessions: June 23, 1998
For abstracts: August 18, 1998

Special Sessions
Noncommutative Algebra (Code: AMS SS C1), Ellen Kirkman and James Kuzmanovich, Wake Forest University.
Recent Results on the Topology of Three-Manifolds (Code: AMS SS D1), Hugh Nelson Howards, Wake Forest University.

Tucson, Arizona
University of Arizona-Tucson
November 14-15, 1998

Meeting #938
Western Section
Associate secretary: William A. Harris Jr.
Announcement issue of Notices: September 1998
Program issue of Notices: To be announced
Issue of Abstracts: Volume 19, Issue 4

Deadlines
For organizers: February 12, 1998
For consideration of contributed papers in Special Sessions: July 29, 1998
For abstracts: September 23, 1998

State College, Pennsylvania
Pennsylvania State University
October 24-25, 1998

Meeting #937
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: August 1998
Program issue of Notices: January 1999
Issue of Abstracts: Volume 19, Issue 4

Deadlines
For organizers: January 22, 1998

For consideration of contributed papers in Special Sessions: July 7, 1998
For abstracts: September 1, 1998

Invited Addresses
Jeffrey Adams, University of Maryland, College Park, Title to be announced.
Nigel D. Higson, Pennsylvania State University, Title to be announced.
Tasso J. Kaper, Boston University, Title to be announced.
Kate Okikiolu, University of California, San Diego and MIT, Title to be announced.

Special Sessions

San Antonio, Texas
San Antonio Convention Center
January 13-16, 1999

Joint Mathematics Meetings, including the 105th Annual Meeting of the AMS, 82nd Meeting of the Mathematical Association of America (MAA), and annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM).
Associate secretary: Susan J. Friedlander
Meetings & Conferences

Announcement issue of Notices: October 1998
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Las Vegas, Nevada
University of Nevada-Las Vegas
April 10–11, 1999
Western Section
Associate secretary: William A. Harris Jr.
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines
For organizers: July 10, 1998
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Gainesville, Florida
University of Florida
March 12–13, 1999
Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines
For organizers: April 14, 1998
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Buffalo, New York
State University of New York at Buffalo
April 24–25, 1999
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines
For organizers: June 11, 1998
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses
Michele M. Audin, University Louis Pasteur, Strasbourg, Title to be announced.
Jeff Smith, Purdue University, Title to be announced.
Alexander A. Voronov, Massachusetts Institute of Technology, Title to be announced.
Gregg J. Zuckerman, Yale University, Title to be announced.

Urbana, Illinois
University of Illinois, Urbana-Champaign
March 18–21, 1999
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines
For organizers: June 18, 1998
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Special Sessions
Number Theory (Code: AMS SS B1), Jeremy T. Teitelbaum and Yuri Tschinkel, University of Illinois at Chicago.
Recent Progress in Elementary Geometry (Code: AMS SS A1), Clark Kimberling, University of Evansville, and John E. Wetzel, University of Illinois-Urbana.

Providence, Rhode Island
Providence College
October 2–3, 1999
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced
Deadlines
For organizers: January 6, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Austin, Texas
University of Texas-Austin
October 8–10, 1999
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Washington, District of Columbia
Sheraton Washington Hotel and Omni Shoreham Hotel
January 19–22, 2000
Joint Mathematics Meetings, including the 106th Annual Meeting of the AMS, 83rd Meeting of the Mathematical Association of America (MAA), with minisymposia and other special events contributed by the Society for Industrial and Applied Mathematics (SIAM), and the annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM).
Associate secretary: William A. Harris Jr
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines
For organizers: April 20, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Lowell, Massachusetts
University of Massachusetts, Lowell
April 1–2, 2000
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines
For organizers: July 1, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Notre Dame, Indiana
University of Notre Dame
April 7–9, 2000
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines
For organizers: July 7, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

New Orleans, Louisiana
New Orleans Marriott and ITT Sheraton New Orleans Hotel
January 10–13, 2001
Joint Mathematics Meetings, including the 107th Annual Meeting of the AMS, 84th Meeting of the Mathematical Association of America (MAA), and the annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM).
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced
Analysis

Operator Theory for Complex and Hypercomplex Analysis

Enrique Ramirez de Arellano, Centro de Investigación y de Estudios Avanzados del IPN, Mexico City, N. Salinas, University of Kansas, Lawrence, M. V. Shapiro, Instituto Politécnico Nacional, Mexico City, and N. L. Vasilevski, Centro de Investigación y de Estudios Avanzados del IPN, Mexico City, Editors

This book presents a collection of papers on certain aspects of general operator theory related to classes of important operators: singular integral, Toeplitz and Bergman operators, convolution operators on Lie groups, pseudodifferential operators, etc. The study of these operators arises from integral representations for different classes of functions, enriches pure operator theory, and is influential and beneficial for important areas of analysis. Particular attention is paid to the fruitful interplay of recent developments of complex and hypercomplex analysis on one side and to operator theory on the other. The majority of papers illustrate this interplay as well as related applications.

Contemporary Mathematics, Volume 213; 1997; 252 pages; Softcover; ISBN 0-8218-0768-4; List $49; Individual member $29; Order code CONM/213NA

Studies on Composition Operators

Farhad Jafari, University of Wyoming, Laramie, Barbara D. MacCluer, University of Virginia, Charlottesville, Carl C. Cowen, Purdue University, West Lafayette, IN, and A. Duane Porter, University of Wyoming, Laramie, Editors

This book reflects the proceedings of the Rocky Mountain Mathematics Consortium conference on “Composition Operators on Spaces of Analytic Functions” held at the University of Wyoming. The readers will find here a collection of high-quality research and expository articles on composition operators in one and several variables. The book highlights open questions and new advances in the classical areas and promotes topics which are left largely untreated in the existing texts.

In the past two decades, the study of composition operators has experienced tremendous growth. Many connections between the study of these operators on various function spaces and other branches of analysis have been established. Advances in establishing criteria for membership in different operator classes have led to progress in the study of the spectra, adjoints, and iterates of these operators. More recently, connections between these operators and the study of the invariant subspace problem, functional equations, and dynamical systems have been exploited.

Contemporary Mathematics, Volume 212; 1997; 298 pages; Softcover; ISBN 0-8218-0677-7; List $65; Individual member $39; Order code CONM/212NA

Meetings & Conferences

Deadlines

For organizers: April 11, 2000
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Columbia, South Carolina

University of South Carolina

March 16–18, 2001
Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines

For organizers: June 15, 2000
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Williamstown, Massachusetts

Williams College

October 13–14, 2001
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: To be announced

Deadlines

For organizers: January 11, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
The Invited Addresses are one hour long. The talks marked with a "*" are invited survey lectures of the Special Sessions and they are fifty minutes long. All the other talks, including the contributed papers of the General Sessions, are twenty minutes long, plus five minutes for questions and discussion.

Program of the Sessions

WEDNESDAY, DECEMBER 3

Opening Ceremony

18:30-19:00

Invited Address

19:15-20:15

Topological degree and symmetries.

1+ Jorge Ize, IIMAS-FENOME, UNAM.

THURSDAY, DECEMBER 4

Special Session on Algebraic Geometry and Commutative Algebra, I

9:00-12:00

11:30 Vector bundles on $\mathbb{P}^n$.

6 Mohan Kumar Neithalath, Washington University.

Special Session on Applied Nonlinear Analysis, I

9:00 Geometric singular perturbation and Melnikov methods for PDEs: Part I.

7+ David W. McLaughlin+, Jalal Shatah+, Courant Institute, New York University.

10:00 Multi-peaked solutions to some semilinear elliptic equations.

8 Peter Bates.

10:30 Plume analysis in Boussinesq convection.

9 Stephen Childress+, NYU-Courant Institute, Albert Libchaber, and Jun Zhang, Rockefeller University.

11:00 Euler equations of an ideal incompressible fluid and action of volume preserving maps on function classes. Preliminary report.

10 Misha Vishik, University of Texas at Austin.

11:30 Phase diagram for a model liquid crystal confined by asymmetric wall fields.

11 Jacqueline Quintana+, Instituto de Química, UNAM, and Alberto Robledo, Instituto de Física, UNAM.

Special Session on Complex and Functional Analysis, I

9:00-12:00

12* Michael Wolf+, Rice University, and Matthias Weber, Universität Bonn.

10:00 Parabolic splittings of Kleinian groups and embedding properties.

13 Leonid Potyagailo+, and T. Delzant, Université de Lille, France.

10:30 Multipoles on $CP^1$ and geometry of degenerate Riemann surfaces. Preliminary report.

14 Robert B. Kusner, University of Massachusetts at Amherst.

11:00 Hausdorff dimension and limits of Kleinian groups.

15 Ed Taylor+, and Richard Canary, University of Michigan.
Program of the Sessions – Oaxaca Mexico, Thursday, December 4 (cont’d.)

11:30 Quasiconformal images of circles and spheres.
16 Matti K. Vuorinen, Mathematics Department, University of Helsinki.

Special Session on Differential Geometry and Topology, I

9:00-12:00 Room No. 4

9:00 Einstein metrics and smooth topology.
17* Claude R. LeBrun, SUNY Stony Brook.

10:00 The Lusternik-Schnirelmann category and some related invariants in low dimensions. Preliminary report.
18 José Carlos Gómez-Larrañaga*, CIMAT, A.C. and Florida State University, Francisco J. González-Acuña, Instituto de Matemáticas, UNAM, and W. Heil, Florida State University.

10:30 Seiberg-Witten Floer Theory.
19 Matilde Marcolli, Massachusetts Institute of Technology.

11:00 The disjoint curve property and genus 2 manifolds.
20 Abigail A. Thompson, University of California, Davis.

11:30 Normal surfaces and practical algorithms to study 3-manifolds. Preliminary report.
21 David Letscher*, University of California, San Diego, and Hyam Rubinstein, University of Melbourne.

Special Session on General Topology, I

9:00-12:00 Room No. 5

9:00 Fixed and periodic points in plane and tree-like continua.
22* Piotr Minc, Auburn University.

10:00 The class of fans is not C-determined.
23 Alejandro Illanes, Universidad Nacional Autónoma de México.

10:30 Title to be announced.
24 Heath.

11:00 Title to be announced.
25 McCoy.

11:30 On p-bounded subsets.
26 Ángel Tamariz-Mascarúa*, Facultad de Ciencias, UNAM, and Manuel Sanchis, Universitat Jaume I, Castelló, España.

Special Session on Mathematical Physics, I

9:00-12:00 Room No. 7

9:00 Nondegenerate \( Z_2 \)-graded Poisson structures arising from the canonical 1-form of the cotangent bundle of a split supermanifold. Preliminary report.
33* J. Muñoz-Masqué, IFA-CSIC, Madrid, Spain, and O. A. Sánchez-Valenzuela*, CIMAT.

10:00 Differential calculus in braided abelian categories.
34 Bernhard Drabant*, DAMTP, University of Cambridge, and Yuri N. Bespalov, Bogolyubov Institute for Theoretical Physics.

10:30 Quantum and braided spin groups and the physical content of q-deformed Minkowski spaces.
35 Marcos Rosenbaum, Instituto de Ciencias Nucleares, UNAM.
11:00 Fourier–Gauss transforms of the Al-Salam–Chihara polynomials.

36 Mesuma K. Atakishiyeva, FACULTAD DE CIENCIAS, UAEM, AND Natig M. Atakishiyev+, INSTITUTO DE MATEMATICAS, UNAM.

11:30 Methods of quasigroups in mathematical physics.

37 Lev V. Sabinin, MICHOACAN UNIVERSITY, ECFM, MORELIA, MEXICO.

Special Session on Nonlinear Models in Biology and Celestial Mechanics, I

9:00-12:00 ROOM No. 8

9:00 Tractable Newtonian N-body problems.

38* Donald G. Saari, NORTHWESTERN UNIVERSITY.

10:00 Rotating billiard systems as toy models for celestial mechanics.

39 Luis Benet, INSTITUTO DE FISICA UNAM.

10:30 Chaos in the Gyllén Problem.

40 Florin Diacu.

11:00 Dynamics of the collinear three-body problem.

41 Sam Kaplan.

11:30 Repulsive coulombian problems and geodesic flows on surfaces with negative curvature.

42 Ernesto Lacomba+ and J. G. Reyes, UAM-I.

Special Session on Numerical Analysis, I

9:00-12:00 ROOM No. 9

9:00 Mixed finite elements and finite volume methods for elliptic problems with piecewise constant coefficients.

43* Jean-Marie Thomas, UNIVERSITÉ DE PAU, FRANCE.

10:00 Numerical methods for air quality models.

44 Aron D. Jazcilevich+, Luis Gerardo S. Ruiz, and Vicente Fuentes-Gea, CENTRO DE CIENCIAS DE LA ATMÓSFERA, UNAM.

10:30 New nodal finite element schemes for the discrete ordinates transport equation.

45 Jean-Pierre Hennart+, IIMAS-UNAM, AND Edmundo del Valle, ESFM-IPN.

11:00 Transverse integration on composite nodal finite elements for hexagons.

46 Jean-Pierre Hennart, IIMAS-UNAM, Edmundo del Valle+, ESFM-IPN, AND Ernest H. Mund, UNIVERSITÉ LIBRE DE BRUXELLES, BELGIUM.

9:00 Spectral approximation in the numerical stability study of viscous flows on a sphere.

47 Yuri N. Skiba, CENTRO DE CIENCIAS DE LA ATMÓSFERA, UNAM.

Special Session on Representation Theory of Algebras and Groups, I

9:00-12:00 ROOM No. 10

9:00 The components $\mathbb{Z}^\infty_p$ in the Auslander-Budzyński quiver of $\mathbb{Z}^\infty_p C_p$. PRELIMINARY REPORT.

48 Maria A. Aviñó, FACULTAD DE CIENCIAS, UNAM.

9:30 Derived canonical algebras as one-point extensions. PRELIMINARY REPORT.

49 Michael S. Barot, UNAM.

10:00 Infinite radical for tame algebras. PRELIMINARY REPORT.

50 Raymundo Bautista+, AND Rita Zuazua, INSTITUTO DE MATEMÁTICAS, UNAM.

10:30 Homological algebra in triangulated categories. PRELIMINARY REPORT.

51 Apostolos Beligiannis, INSTITUTO DE MATEMÁTICAS, UNAM.

11:00 Weakly triangular Artin algebras. PRELIMINARY REPORT.

52 Flávio Ulhoa Coelho+, UNIVERSIDADE DE SÃO PAULO, BRASIL, AND María Inés Platzeck, UNIVERSIDAD NACIONAL DEL SUR.

11:30 Derived-tame algebras.

53 José A. de la Peña, UNAM.

Special Session on Rings and Category Theory, I

9:00-12:00 ROOM No. 11

9:00 On classification of certain group algebras.

54 Sudarshan Sehgal.

9:30 Generalized quotient finite dimensional modules. PRELIMINARY REPORT.

55 John Dauns, TULANE UNIVERSITY.

10:00 Biuniform modules.

56* Alberto Facchini, UNIVERSITÀ DE UDINE, ITALIA.

11:00 Decisive dimension in categories of modules.

57 Jaime Castro+, ITESTM, AND José Rios, IMATE-UNAM.

11:30 Coverings of modules. PRELIMINARY REPORT.

58 Mark L. Teply, UNIVERSITY OF WISCONSIN-MILWAUKEE.
18:00 Estimation of densities and applications to partial stochastics.
102 María Emilia Caballero, Begoña Fernández+, Universidad Nacional Autónoma de México, and David Nuñalart, Universitat de Barcelona.

18:30 Existence of solutions to the master equation with time dependent coefficients. PRELIMINARY REPORT.
103 Alexander Chebotarev, Moscow State University, Julio C. García+, and Roberto Quezada, Universidad Autónoma Metropolitana-Iztapalapa.

Special Session on Nonlinear Models in Biology and Celestial Mechanics, II

16:00-19:00 ROOM NO. 8

16:00 Mathematical models of HIV progression and therapy.
104 Glenn Webb, Vanderbilt University.

16:30 Ring dynamics and forced integrate and fire neurons models.
105 Humberto Carrillo+, Universidad Nacional Autónoma de México, and Fernando Ongay, Universidad Autónoma del Estado de México.

17:00 Electrical coupling between dissimilar cells in a rhythmic network of neurons.
106 Cristina Soto-Treviño, Boston University.

17:30 Efficiency of self-control strategies on the spread of the insect vector of Chagas disease.
107 Carlos Hernández-Suárez, Universidad de Colima.

18:00 Celestial population dynamics.
108 Gerardo Hernández, CINVESTAV-IPN.

Special Session on Numerical Analysis, II

16:00-19:00 ROOM NO. 9

16:00 Isoparametric high-order finite element approximation of incompressible viscous flow.
109 Wenlong Xu, Ralph W. Metcalfe, and L. Ridgway Scott+, University of Houston.

17:00 Title to be announced.
110* Roland Glowinsky.

Special Session on Representation Theory of Algebras and Groups, II

16:00-19:00 ROOM NO. 10

16:00 Specializations of the extended Kronecker algebra. PRELIMINARY REPORT.
111 Andrew P. Dean, Bishop's University.

16:30 Examples of tame repetitive algebras of non-polynomial growth. PRELIMINARY REPORT.
112 Peter Draexler, University of Bielefeld.

17:00 On reflexive representations of local commutative algebras. PRELIMINARY REPORT.
113 Kent R. Fuller, University of Iowa.

17:30 Homomorphisms between representations of clans. PRELIMINARY REPORT.
114 Christof Geiss, Instituto de Matemáticas, UNAM.

18:00 Szekeres theorem, a new proof. PRELIMINARY REPORT.
115 María Alicia Aviñó, Raymundo Bautista, and Mary Glazman+, UNAM.

18:30 Representations of GL_n and Schur Algebras: Some homological aspects.
116 Upendra Kulkarni, Brandeis University.

Special Session on Rings and Category Theory, II

16:00-19:00 ROOM NO. 11

16:00 On the existence of certain ideals in semiprime rings. PRELIMINARY REPORT.
117 Efraim P. Armendariz, The University of Texas at Austin.

16:30 Subgenerators in module categories.
118 Robert Wisbauer, University of Düsseldorf.

17:00 Some relations between spectral torsion theory and the Kaplansky's theory of types.
119 María José Arroyo+, UAM-1, and José Rios Montes, IMATE-UNAM.

17:30 Finiteness properties for co-Frobenius Hopf Algebras.
120 Constantin Nastasescu.

18:00 Dimensions of multi-filtered algebras.
121 José Gómez Torrecillas, Universidad de Granada, España.

18:30 Hereditary pretorsion theories. PRELIMINARY REPORT.
122 Francisco F. Raggi, Instituto de Matemáticas. UNAM.
18:00 Visual averages and computing the Douady-Earle Extension.

79 William Abikoff, University of Connecticut at Storrs.

18:30 Boundary values versus dilatations of planar harmonic mappings.

80 Daoud Bshouty*, Technion IIT, Israel, and Walter Hengartner, Université Laval, St. Foy Quebec, Canada.

Special Session on Differential Geometry and Topology, II

16:00-19:00 Room No. 4

16:00 The topological approach to enzymology.

81 De Witt Sumners, Florida State University.


82 Michael Kapovich*, University of Utah, and John J. Millson, University of Maryland.

17:00 Essential meridional surfaces for tunnel number one knots. Preliminary Report.

83 Mario Eudave-Muñoz, Instituto de Matemáticas, UNAM.

17:30 Curvature obstructions for G-structures.

84 Gil Bor, CIMAT.

18:00 Genera and boundary slopes of incompressible surfaces. Preliminary Report.

85 Marc Culler, and Peter B. Shalen*, University of Illinois at Chicago.

18:30 Quaternionic geometry and Einstein manifolds.

86 Charles P. Boyer, University of New Mexico.

Special Session on General Topology, II

16:00-19:00 Room No. 5

16:00 Continuous images of compact linearly ordered spaces.

87 Mary E. Rudin, University of Wisconsin, Madison.

16:30 Title to be announced.

88 Zoltan T. Balogh, Miami University.

17:00 Aposyndetic properties of symmetric products.

89 Sergio Macías, IMATE-UNAM.

17:30 Some interesting subclasses of the class of first countable compact spaces. Preliminary Report.

90 Vladimir V. Tkachuk, Universidad Autónoma Metropolitana-Iztapalapa.

18:00 Expansive homeomorphisms and indecomposable continua. Preliminary Report.

91 Wayne Lewis, Texas Tech University.

18:30 Fixed-point problems for arc-continua.

92 Charles L. Hagopian, California State University, Sacramento.

Special Session on Graphs and Combinatorial Geometry, II

16:00-19:00 Room No. 6

16:00 Intercalate matrices II: an infinite family of minimal obstructions to signability.

93 Gilberto Calvillo, Banco de México, Isidoro Gitler*, and José Martinez, Departamento de Matemáticas, CINVESTAV.


94 Hans I. Fetter, Universidad Autónoma Metropolitana-Iztapalapa.

17:00 Erdős-Hajnal type problems.

95 András Hajnal, Rutgers University.


96 Jan Kratochvíl, Charles University, Prague.

18:00 Packing convex cones in 3-space.

97 András Bezdek, Mathematical Institute of the Hungarian Academy of Sciences and Auburn University, and Włodzimierz Kuperberg*, Auburn University.

18:30 On existence problems for chiral polytopes.

98 Asia I. Weiss, York University.

Special Session on Mathematical Physics, II

16:00-19:00 Room No. 7

16:00 Stability of matter in magnetic fields.

99* Elliott Lieb, Princeton University, Michael Loss*, Georgia Institute of Technology, and Jan-Philip Solovej, University of Aarhus, Denmark.

17:00 Stability of fronts for the Lebowitz-Orlandi-Pressutti equation.

100 Eric Anders Carlen, Georgia Institute of Technology.

17:30 Stochastic evolution equations with random generators.

101 Jorge A. León, CINVESTAV-IPN.
Program of the Sessions – Oaxaca Mexico, Thursday, December 4 (cont’d.)

Special Session on Stochastic Systems, I
9:00-12:00 ROOM NO. 12

9:00 Linear programming approximations for stochastic control problems.
59* Ounesimo Hernández-Lerma, DEPARTAMENTO DE MATEMÁTICAS, CINVESTAV-IPN.

10:00 Embedding in Markov Decision Theory.
60 Henk Tijms, VRIJE UNIVERSITY, THE NETHERLANDS.

10:30 Adaptive control in stable Markov decision chains endowed with the average reward criterion.
61 Rolando Cavazos-Cadena, UNIVERSIDAD AUTÓNOMA AGRARIA ANTONIO NARRO.

11:00 The stochastic magneto-hydrodynamic system. PRELIMINARY REPORT.
62 P. Sundar+, LOUISIANA STATE UNIVERSITY, AND S. S. Sritharan, NRAD.

11:30 Piecewise smooth viscosity solutions of the HJB equation.
63 J. R. Dorroh, Guillermo S. Ferreyra+, and Jesús A. Pascal, LOUISIANA STATE UNIVERSITY.

Invited Address

12:15-13:15 AUDITORIUM

Wavelet analysis and scalable information processing.
64+ Raymond O. Wells, RICE UNIVERSITY.

Special Session on Algebraic Geometry and Commutative Algebra, II
16:00-19:00 ROOM NO. 1

16:00 Degree bounds in monomial subrings.
65 Winfried Bruns, UNIVERSITÄT OSNABRÜCK, Wolmer V. Vasconcelos, RUTGERS UNIVERSITY, AND Rafael H. Villarreal+, CINVESTAV-IPN.

16:30 The complexity of Frobenius powers of ideals.
66 Mordechai Katzman, UNIVERSITY OF MINNESOTA.

17:00 Commutative algebra methods in coding theory.
67 Carlos Rentería-Márquez, ESCUELA SUPERIOR DE FÍSICA Y MATEMÁTICAS, IPN, AND Horacio Tapia-Recillas+, UNIVERSIDAD AUTÓNOMA METROPOLITANA-IZTAPALAPA.

17:30 Local-global for similarity of matrices.
68 Frank DeMeyer+, Rick Miranda, and Kim Schneider, COLORADO STATE UNIVERSITY.

18:00 Division algebras over p-adic curves.
69 David J. Saltman, UNIVERSITY OF TEXAS AT AUSTIN.

Special Session on Applied Nonlinear Analysis, II
16:00-19:00 ROOM NO. 2

16:00 The complex Ginzburg-Landau equation: A damped-driven perturbation of a Hamiltonian system.
70* David Levermore, UNIVERSITY OF ARIZONA.

17:00 Null-insensitizing controls of the norm of the solution of the semilinear heat equation. PRELIMINARY REPORT.
71 Luz de Teresa+, INSTITUTO DE MATEMÁTICAS, UNAM, AND Enrique Zuazua, DEPARTAMENTO DE MATEMÁTICA APLICADA, UCM.

17:30 On determining the relevant averaging equations for optical dispersion management systems.
72 A. Aceves.

18:00 An Ill-posed Cauchy Problem for the heat equation. PRELIMINARY REPORT.
73 James R. Dorroh+, LOUISIANA STATE UNIVERSITY, AND Xe Ping Ru.

18:30 Nonlocal problems from the study of phase transformations.
74 Paul C. Fife.

Special Session on Complex and Functional Analysis, II
16:00-19:00 ROOM NO. 3

16:00 On the singular Martinelli-Bochner operator. PRELIMINARY REPORT.
75 Reynaldo Rocha+, ESFM-IPN, AND Michael V. Shapiro, ESFM-IPN, Frank Sommen, N.F.W.O. BELGIUM.

16:30 Almost-Clifford structures on manifolds.
76 Enrique Ramirez de Arellano+, CINVESTAV, AND Wieslaw Królikowski.

17:00 Toeplitz operators on the Heisenberg group with n-valued symbols.
77 Nikolai Vasilevski, DEPARTAMENTO DE MATEMÁTICAS, CINVESTAV.

17:30 Tetrahedral groups in complex hyperbolic space.
78 Alberto M. Castro, MATHEMATICS DEPARTMENT, MOUNT HOLYOKE COLLEGE.
**General Session, I**

16:00-19:00 ROOM NO. 12

16:00 Maximal and minimal primitive fixing system for convex bodies.
123 Efren Morales, Centro de Investigación en Matemáticas A.C. and IMATE, UNAM.

16:30 Perfect dominating sets in rectangular lattices.
124 Italo J. Dejter+, University of Puerto Rico, and Jorge Urrutia, University of Ottawa.

17:00 On the number of cycle covers of the rectangular grid graph.
125 H. L. Abbott, and J. W. Moon+, University of Alberta, Edmonton.

17:30 On the number of equilateral triangles in Euclidean spaces I.
126 Bernardo M. Abrego+, and Silvia Fernández-Merchant, Rutgers University.

18:00 On the number of equilateral triangles in Euclidean spaces II.
127 Bernardo M. Abrego, and Silvia Fernández-Merchant+, Rutgers University.

18:30 Vorticity, quaternions and Clifford Algebras. PRELIMINARY REPORT.
128 Leonardo Traversoni, Universidad Autónoma Metropolitana-Iztapalapa.

**Invited Address**

19:15-20:15 AUDITORIUM

*Title to be announced.*

129+ Javier Bracho, Instituto de Matemáticas, UNAM.

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**FRIDAY, DECEMBER 5**

**Special Session on Algebraic Geometry and Commutative Algebra, III**

9:00-12:00 ROOM NO. 1

9:00 Heisssenberg-invariant Abelian and Kummer surfaces. PRELIMINARY REPORT.
130 Klaus Hulek, Isidro Nieto+, CIMAT, A.C., and Gregory K. Sankaran.

9:30 $S_4$-Actions on Jacobians. PRELIMINARY REPORT.
131 Sevin Recillas+, Instituto de Matemáticas, UNAM, Unidad Morelia, and Rubi Rodríguez, Pontificia Universidad Católica de Chile.

10:00 Numerically effective divisors on blow-ups and fat points on $P^2$. PRELIMINARY REPORT.
132 Stephanie Fitchett, Duke University.

10:30 An algorithm for fat points on $P^2$.
133 Brian Harbourne, University of Nebraska-Lincoln.

11:00 On the variety of rank 4 quadrics containing a projective curve. PRELIMINARY REPORT.
134 Sevin Recillas, Instituto de Matemáticas, UNAM, Alexis García-Zamora+, Instituto de Matemáticas, UNAM.

**Special Session on Complex and Functional Analysis, III**

9:00-12:00 ROOM NO. 2

9:00 Geometric singular perturbation and Melnikov methods for PDEs: Part II.
135* David W. McLaughlin+ and Jalal Shatah+, Courant Institute, New York University.

10:00 Phase transitions under confinement.
136* Alberto Robledo, Instituto de Física, UNAM.

11:00 Wave propagation in liquid crystals.
137 Clara Garza-Hume+, Catherine García-Reimbert, Antonmaría Minzoni, A. Reyes, and R. Rodríguez, IIMAS-UNAM.

11:30 Stable multi-pulse solutions along a phase-sensitive.
138 James C. Alexander+, Manoussos G. Grillakis, University of Maryland, Christopher Jones, Brown University, and Bjoern Sandstede, Ohio State University.

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DECEMBER 1997 NOTICES OF THE AMS 1565
10:00 On spectral radius and power series in m-convex Algebras. PRELIMINARY REPORT.
141 María de Lourdes Palacios Fabila+, Universidad Autónoma Metropolitana-Iztapalapa, and Hugo Arizmendi Peimbert, IMATE UNAM.

10:30 The true measure of a matrix. PRELIMINARY REPORT.
142 Chandler Davis, University of Toronto.

11:00 Ultradistributions as boundary values of analytic functions and.
143 Ioana Cioranescu, University of Puerto Rico at Rio Piedras.

11:30 The spreading sequences in JH. PRELIMINARY REPORT.
144 Helga N. Fetter+, and Berta Gamboa de Buen, Centro de Investigación en Matemáticas.

Special Session on Differential Geometry and Topology, III

9:00-12:00 ROOM NO. 4

9:00 Title to be announced.
145* Alberto Verjovsky, Universidad de Lille.

10:00 Hyperideal hyperbolic polyhedra. PRELIMINARY REPORT.
146 Xiliang Bao and Francis Bonahon+, University of Southern California.

10:30 Engagement condition and action of semisimple Lie groups.
147 Raúl Quiroga+, ESFM IPN, and Alberto Candel.

11:00 Two-bridge knots with property Q. PRELIMINARY REPORT.
148 Arturo Ramírez+, CIMAT, A.C., and Francisco J. González-Acuña, Instituto de Matemáticas, UNAM and CIMAT A.C.

11:30 Knots with few ideal tetrahedra.
149 John C. Dean+, University of Michigan, Patrick Callahan, University of Texas, and Jeffrey Weeks.

Special Session on General Topology, III

9:00-12:00 ROOM NO. 5

9:00 Some recent results concerning submaximal spaces.
150* Richard G. Wilson, UAM-Iztapalapa.

10:00 Dendrites with closed set of end points. PRELIMINARY REPORT.
151 Wlodzimierz J. Charatonik+, Facultad de Ciencias, UNAM, Daniel Arévalo Grajeda, Patricia Pellicer Covarrubias, and Likin C. Simón Romero, Instituto de Matemáticas, UNAM.

10:30 A return to homogeneous continua.
152 James T. Rogers, Tulane University.

11:00 Cofinally Cech complete spaces.

11:30 Dugundji extenders on ordered spaces.
154 Gary Gruenhage+, Auburn University, Yasunao Hatori, Shimane University, and Haruto Ohta, Shizuoka University.

Special Session on Graphs and Combinatorial Geometry, III

9:00-12:00 ROOM NO. 6

9:00 Clique divergent graphs with unbounded sequence of diameters.
155 Francisco Larrión+, and Víctor Neumann-Lara, Instituto de Matemáticas, UNAM.

9:30 Projections of cyclic polytopes and their fiber polytopes. PRELIMINARY REPORT.
156 Jesús A. De Loera, University of Minnesota.

10:00 Isoperimetric inequalities.
157 László Lovász, Yale University.

10:30 On packings of circles of arbitrary radii.
158 Jiri Matousek+, and Pavel Valtr, Charles University, Prague.

11:00 Geometric transversal theory and topology.
159 Luis Montejano Peimbert, IMATE-UNAM.

11:30 Dichromatic number and Zykov sums of digraphs. PRELIMINARY REPORT.
160 Víctor Neumann-Lara, Instituto de Matemáticas, UNAM.

Special Session on Mathematical Physics, III

9:00-12:00 ROOM NO. 7

9:00 Solution of systems of partial differential equations by means of potentials.
161 Gerardo F. Torres del Castillo, Instituto de Ciencias, Universidad Autónoma de Puebla.

9:30 A geometric approach to the asymptotic of systems of evolution equations.
162 Juan H. Arredondo+, and Peter Seibert, UAM-Iztapalapa.
Program of the Sessions

9:30 On some classes of R-modules and congruences in R-tors. 
PRELIMINARY REPORT.
185 Carlos Signoret*, DEPARTAMENTO DE MATEMÁTICAS 
UAM-I, Francisco Raggi, INSTITUTO DE MATEMÁTICAS 
UNAM, and Hugo Rincón, FACULTAD DE CIENCIAS UNAM.

10:00 Linearization revisited.
186* F. William Lawvere.

11:00 The Moeglin-Rentschler-Vonessen transitivity theorem.
187 Kenneth R. Goodearl+, UNIVERSITY OF CALIFORNIA, AND 
Edward S. Letzter, TEXAS A&M UNIVERSITY.

11:30 Distributivity, from posets to categories.
188 Francisco Marmolejo, DALHOUSIE UNIVERSITY.

Special Session on Stochastic Systems, II

9:00-12:00 ROOM No. 12

9:00 Markov chain approximations for deterministic control problems.
189* Paul Dupuis, BROWN UNIVERSITY.

10:00 Computing mean exit times of diffusion processes using linear programming.
190 Kurt Helmes, HUMBOLDT University, BERLIN.

10:30 Markov control processes with finite state space and compact action sets: The total-reward criterion. PRELIMINARY REPORT.
191 Raúl Montes-de-Oca*, UNIVERSIDAD AUTÓNOMA METROPOLITANA-IZTAPALAPA, AND Rolando Cavazos-Cadena, UNIVERSIDAD AUTÓNOMA AGRARIA ANTONIO NARRO.

11:00 Sample path average optimality of Markov control processes with strictly unbounded cost.
192 Oscar Vega-Amaya, UNIVERSIDAD DE SONORA.

11:30 Risk sensitive controlled Markov processes.
193 Daniel Hernández, DEPARTAMENTO DE MATEMÁTICAS, CINVESTAV.

General Session, II

9:00-12:00 ROOM No. 13

9:00 Cardinality of p-adic Fréchet spaces.
194 Jerzy Kakol*, UNIVERSITY OF NORTH DAKOTA, GRAND FORKS, AND Nicole DeGrande-DeKimpe, BRUSSELS, BELGIUM.

9:30 On the p-adic weak basis theorem. PRELIMINARY REPORT.
195 Thomas E. Gilsdorf* and Jerzy Kakol, UNIVERSITY OF NORTH DAKOTA, GRAND FORKS.

10:00 Substitution lemma for G-spaces of 1-dimensional groups.
196 Juan Antonio Pérez, UNIVERSIDAD AUTÓNOMA DE ZACATECAS.

10:30 Finding optimal convex regions.
197 Alan P. Sprague, UNIVERSITY OF ALABAMA AT BIRMINGHAM.

11:00 The *-scalar curvature relationship on a quasi-Kähler submersion. PRELIMINARY REPORT.
198 Bill Watson, ST. JOHN’S COLLEGE, JAMAICA NY.

Invited Address

12:15-13:15 
AUDITORIUM

Title to be announced.
199* Alberto Verjovsky, UNIVERSITÉ DE LILLE AND IMATE, UNAM.

Special Session on Algebraic Geometry and Commutative Algebra, IV

16:00-19:00 ROOM No. 1

16:00 Chow motives of certain 3-folds and fiber spaces.
200 Stefan Müller-Stach, UNIVERSITÄT GHS ESSEN, AND Pedro Luis Del Angel-Rodriguez*, UNIVERSIDAD AUTÓNOMA METROPOLITANA-IZTAPALAPA.

16:30 On the (almost) Cohen-Macaulayness of the associated graded ring of certain primary ideals.
201 Alberto Corso*, DEPARTMENT OF MATHEMATICS, PURDUE University, Claudia Polini, DEPARTMENT OF MATHEMATICS, MICHIGAN State University, AND Maria Vaz Pinto, CENTRO DE ALGEBRA DA UNIVERSIDADE DE LISBOA.

17:00 Invariants from canonical bases. PRELIMINARY REPORT.
202 Joseph P. Brennan, NORTH DAKOTA State University.

17:30 Chow quotients and projective bundle formulas for Euler-Chow series.

18:00 A simply connected surface with zero geometric genus and ample canonical class.
204 Caryn Werner*, and Igor Dolgachev, UNIVERSITY OF MICHIGAN.

Special Session on Applied Nonlinear Analysis, IV

16:00-19:00 ROOM No. 2

16:00 MHD instability in a complicated convective flow.
205 Antonmaría Minzoni*, and Ignacio Bosch, IIMAS-UNAM.
10:00 Lifschitz tail in a magnetic field: The nonclassical regime.
163 Laszlo Erdos, Courant Institute, New York University.

10:30 Perfect spectra. PRELIMINARY REPORT.
164 Rafael Rene del Rio, Instituto de Investigaciones en Matemáticas Aplicadas y Sistemas.

11:00 The spectrum of quadratic boson's operators.
165 Valeri Kucherenko, Cinvestav-IPN.

11:30 Spherical means and the perturbed Dirac equation. PRELIMINARY REPORT.
166 Jesus Chargoys, Universidad Autónoma Metropolitana-Iztapalapa.

Special Session on Nonlinear Models in Biology and Celestial Mechanics, III

9:00-12:00 ROOM NO. 8

9:00 Continuation of KAM tori.
167 Kenneth R. Meyer, University of Cincinnati.

9:30 Hamiltonian polynomial systems and cubic surfaces.
168 Manuel Falconi+, Facultad de Ciencias, UNAM, and Ernesto Lacomba, UAM-I.

10:00 Recent results in the study of nonlinear resonances in parametrically excited pendula.
169 Steven P. Weibel+, Northeastern University, and T. J. Kaper, Boston University.

10:30 The braid group and periodic orbits for the planar N-body problem.
170 Richard Montgomery, University of California, Santa Cruz.

11:00 Arnold diffusion near hyperbolic-elliptic periodic orbits.
171 Antonio García, Northwestern University.

11:30 The isosceles restricted three-body problem.
172 Martha Alvarez+, and Jaume Llibre, Universitat Autònoma de Barcelona.

Special Session on Numerical Analysis, III

9:00-12:00 ROOM NO. 9

9:00 Trefftz-Herrera formulation of domain decomposition.
173* Ismael Herrera, IIMAS-UNAM.

10:00 Application of a splitting method to Bingham fluid flow simulation. PRELIMINARY REPORT.
174 Francisco Javier Sánchez, Universidad Autónoma Metropolitana-Iztapalapa.

10:30 Numerical simulation of viscous flows in complex geometries.
175 Lorenzo H. Juárez+, UAM-I, Ridgway Scott, Ralph Metcalfe, and Babak Bagheri, University of Houston.

11:00 A logic approach to semicontinuous variables formulation in.
176 Maria Auxilio Osorio Lama+, Facultad de Ciencias de la Computación, BUAP, and John N. Hooker, Graduate School of Industrial Administration, Carnegie Mellon.

11:30 Nonnegative rank of nonnegative matrices.
177 Francisco J. Solis, CIMAT.

Special Session on Representation Theory of Algebras and Groups, III

9:00-12:00 ROOM NO. 10

9:00 Minimal projective resolutions. PRELIMINARY REPORT.
178 Edward L. Green+, Virginia Tech, Oyvind Solberg, NTNU, and Dan Zacharia, Syracuse University.

9:30 Algebras of tame uniserial type. PRELIMINARY REPORT.
179 Birge Huisgen-Zimmermann, University of California, Santa Barbara.

10:00 Representations of Out(P) applied to stable splittings of some infinite groups. PRELIMINARY REPORT.
180 Daniel Juan Pineda, UNAM-Morelia.

10:30 Properties of almost split sequences in subcategories. PRELIMINARY REPORT.
181 Mark Kleiner, Syracuse University.

11:00 Strongly simply connected tilted algebras.
182 Ibrahim Assem, and Shiping Liu+, Université de Sherbrooke.

11:30 Serre duality for a family of Auslander regular algebras. PRELIMINARY REPORT.
183 Roberto Martínez-Villa, Instituto de Matemáticas, UNAM.

Special Session on Rings and Category Theory, III

9:00-12:00 ROOM NO. 11

9:00 Radical endomorphisms of decomposable modules.
184 Julius M. Zelmanowitz, University of California, Santa Barbara.
16:30 On the completeness of the singular eigenfunctions for the continuous spectrum of inviscid shear flow.
206 P. J. Morrison, UNIVERSITY OF TEXAS AT AUSTIN.

17:00 Singularity formation in 2D ideal, incompressible MHD. PRELIMINARY REPORT.
207 Isaac Klapper, MONTANA STATE UNIVERSITY.

17:30 Localized eigenstates for the hydrogen atom.
208 C. Villegas.

18:00 Perturbation problems in control of partial differential equations.
209 Miguel Angel Moreles, CIMAT.

18:30 Continuous descent methods for nonlinear problems. PRELIMINARY REPORT.
210 John W. Neuberger, UNIVERSITY OF NORTH TEXAS.

Special Session on Complex and Functional Analysis, IV

16:00-19:00 ROOM NO. 3

16:00 Qp-Functions and p-Carleson measures. PRELIMINARY REPORT.
211 Luis Manuel Tovar ESFM-IPN.

16:30 Quasiconformally expodable sets.
212 Lino F. Reséndiz+, UNIVERSIDAD AUTÓNOMA METROPOLITANA-AZCAPOTZALCO, and R. Michael Porter, CENTRO DE INVESTIGACIÓN Y DE ESTUDIOS AVANZADOS DEL I.P.N.

17:00 Dynamical properties of certain meromorphic maps of \( \mathbb{P}^2 \). PRELIMINARY REPORT.
213 Araceli Medina-Bonifant, ESCUELA SUPERIOR DE FISICA Y MATEMÁTICAS, L.P.N.

17:30 Projectors of spaces of harmonic functions in the ball with a Dini type weight. PRELIMINARY REPORT.
214 Oscar Blasco, UNIVERSIDAD DE VALENCIA, and Salvador Pérez-Esteva+, UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO.

18:00 The two-weight version of the representation for Hankel operators in Hardy spaces.
215 Mischa Cotlar, UNIVERSIDAD CENTRAL DE VENEZUELA, and Cora Sadosky+, HOWARD UNIVERSITY.

18:30 Multivariate cubatures and dilation theory.
216 Mihai Putinar, UNIVERSITY OF CALIFORNIA, SANTA BARBARA.
18:30 Open sets in arcwise connected homogeneous continua.
   228 David P. Bellamy, UNIVERSITY OF DELAWARE.

Special Session on Graphs and Combinatorial Geometry, IV

16:00 Operators with jumping nonlinearities and extremal problem on a hypercube.
   229 Vojtech Rödl*, Rudolf Svarc, and Beata Wysocka, EMORY UNIVERSITY and UNIVERSITY OF MELBOURNE.

16:30 On tournaments free of large transitive subtournaments.
   230 Adolfo Sánchez-Flores, IIMAS-UNAM.

17:00 Random walks and geometric algorithms.
   231 Ravindran Kannan, CARNEGIE-MELLON, László Lovász, YALE UNIVERSITY, and Miklós Simonovits*, MATHEMATICAL INSTITUTE OF THE HUNGARIAN ACADEMY OF SCIENCES.

17:30 A midrange crossing constant. PRELIMINARY REPORT.
   232 Joel H. Spencer, COURANT INSTITUTE, NYU.

18:00 Crossing numbers of graphs.
   233 László A. Székely, UNIVERSITY OF SOUTH CAROLINA.

18:30 On the Bollobás-Eldridge conjecture for graph packings.
   234 Endre Szemerédi, RUTGERS UNIVERSITY.

Special Session on Mathematical Physics, IV

16:00 Three levels in the theory of quantum groups.
   235* Stanislaw Lech Woronowicz.

17:00 Derivations of an algebra and of a bialgebra.
   236 Zbigniew Oziewicz.

17:30 A $C^*$-algebraic approach to quantum classifying spaces and quantum characteristic classes.
   237 Micho Durdevich, IMATE-UNAM.

18:00 On the geometry of quantum mechanics.
   238 Miguel Socolovsky*, INSTITUTO DE CIENCIAS NUCLEARES UNAM, and Marcelo Aguilar, IMATE UNAM.

18:30 Extracting quantum Lie algebras. PRELIMINARY REPORT.
   239 César Bautista, BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA.
Oaxaca Mexico, Saturday, December 6 - Program of the Sessions

18:30 On the existence of bifurcations arising from saddle sets.
251 José S. Florio, UNAM.

Invited Address

19:15–20:15 AUDITORIUM

Are there too many smooth four-dimensional manifolds?
252 Ronald J. Stern, University of California at Irvine.

SATURDAY, DECEMBER 6

Special Session on Algebraic Geometry and Commutative Algebra, V

9:00–12:00 ROOM NO. 1

9:00 The index of vector fields on singular varieties.
253* Xavier A. Gómez-Mont, CIMAT.

10:00 Generic vanishing via hyperplane sections. Preliminary report.
254 Giuseppe Pareschi, Università di Roma "La Sapienza".

10:30 Gauss-Manin connection arising from arrangements of hyperplanes. Preliminary report.
255 Herbert Kanarek, Instituto de Matemáticas, UNAM.

11:00 Algebraic foliations having several polynomial first integrals.
256 Jesús R. Muciño-Raymundo, Instituto de Matemáticas UNAM, Unidad Morelia.

Special Session on Applied Nonlinear Analysis, V

9:00–12:00 ROOM NO. 2

9:00 Birkhoff normal form for problems of free surfaces and interfaces.
257 Walter Craig, Brown University.

9:30 Absence of caustics for nonlinear reflection laws and Minkowski billiards.
258 Eugene Gutkin, University of Southern California.

10:00 Nonlinear dynamical problems for deformable solids.
259* Stuart S. Antman, University of Maryland.

11:00 Stochasticity of a toroidal magnetic field separatrix due to periodic perturbations.

11:30 On the existence of standing waves for the Davey-Stewartson system.
261 Mariela Guzmán, Universidad Autónoma Metropolitana-Azcapotzalco.

Special Session on Complex and Functional Analysis, V

9:00–12:00 ROOM NO. 3

9:00 The energy sequence of a set of commuting operators.
262* William B. Arveson, University of California at Berkeley.

10:00 Minimal representing measures arising from rank-increasing moment. Preliminary report.
263 Lawrence A. Fialkow, State University of New York, College at New Paltz.

11:00 Separability and compactness in the space of compact operators on a separable and reflexive Banach space.
264 Fernando Galaz, CIMAT.

11:30 Singular integral operators on weighted distribution spaces. Preliminary report.
266 Josefina Alvarez, New Mexico State University.

Special Session on Differential Geometry and Topology, V

9:00–12:00 ROOM NO. 4

9:00 The effect of the topology on the number of positive symmetric solutions of a nonlinear elliptic equations on a symmetric domain. Preliminary report.
267 Mónica Clapp, Instituto de Matemáticas, UNAM.

9:30 Systoles of cusped hyperbolic 3-manifolds. Preliminary report.
268 Colin C. Adams, and W. Reid+.

10:00 Quantum motion on manifolds of non-positive curvature.
269 Frederico Xavier, University of Notre Dame.
10:30 Knots in $S^3$ which admit a strong generalized tangle decomposition and a reducible surgery are cabled. PRELIMINARY REPORT.

270 Luis G. Valdez-Sánchez, UNIVERSITY OF TEXAS AT EL PASO.

11:00 Principal configurations of surfaces of codimension 2.

271 Federico Sánchez-Bringas, FACULTAD DE CIENCIAS, UNAM.

11:30 Title to be announced.

272 Santiago López de Medrano, IMATE-UNAM.

Special Session on General Topology, V

9:00-12:00   ROOM NO. 5

9:00 On feebly monotone mappings.

273 Janusz J. Charatonik, UNIVERSITY OF WROCŁAW AND UNAM.

9:30 Local Siegel disks. PRELIMINARY REPORT.

274 Lex G. Oversteegen, UAB.

10:00 Asymmetric k-spaces and the k-dual. PRELIMINARY REPORT.

275 Ralph D. Kopperman+, CITY COLLEGE, CUNY, AND Jimmie D. Lawson, LOUISIANA STATE UNIVERSITY.

10:30 On linking of cycles in Menger manifolds.

276 Rolando Jiménez+, IMATE MORELIA, AND Evgeni Scepin, STEKLOV INSTITUTE OF MATHEMATICS, MOSCOW.

11:00 A solution of the O. Hajek problem.

277 Sergey Antonyan, UNAM.

11:30 Spaces with all real eigenvalues and asymmetric distance data. PRELIMINARY REPORT.

278 Stephen Watson, YORK UNIVERSITY.

Special Session on Graphs and Combinatorial Geometry, V

9:00-12:00   ROOM NO. 6

9:00 Unsolved problems in dimension theory. PRELIMINARY REPORT.

279 William T. Trotter.

9:30 On measuring areas and volumes. PRELIMINARY REPORT.

280 Felipe Contreras, UNIVERSITY OF OTTAWA, Jurek Czyzowicz, UNIVERSITY OF QUEBEC, AND Jorge Urrutia+, UNIVERSITY OF OTTAWA AND IMATE UNAM.

10:00 Cycle pancyclicity in tournaments.

281 Hortensia Galeana-Sánchez+, and Sergio Rajsbaum, INSTITUTO DE MATEMÁTICAS, UNAM.

Special Session on Mathematical Physics, V

9:00-12:00   ROOM NO. 7

9:00 Hamiltonian structure for degenerate AKNS systems.

285 Gulmaro Corona-Corona, UAM-AZCAPOTZALCO.

9:30 Completeness of left invariant pseudo-Riemannian metrics on Lie groups.

286 Alberto Medina+, UNIVERSITÉ DE MONTPELLIER II, AND Shirley T. Bromberg, UNIVERSIDAD AUTO NÓMA METROPOLITANA - IZTAPALAPA.

10:00 The Lie Transform Method for perturbations generated by deformations of Poisson Brackets. PRELIMINARY REPORT.

287 Rubén Flores-Espinoza+, UNIVERSIDAD DE SONORA, AND Yuri M. Vorobjev, MOSCOW INSTITUTE OF ELECTRONICS AND MATHEMATICS AND UNIVERSIDAD DE SONORA.

10:30 On the Segal-Bargmann space reproducing kernel.

288 Stephen B. Sontz, UNIVERSIDAD AUTO NÓMA METROPOLITANA-IZTAPALAPA.

11:00 On Hausdorff dimension of attractive sets of viscous fluid under a fixed Grashof number.

289 Yuri N. Skiba, CENTRO DE CIENCIAS DE LA ATMÓSFERA UNAM.

11:30 Fredholm determinants as Tau functions for isomonodromic deformations.

290 John Harnad+, and A. Its, CRM, UNIVERSITÉ DE MONTRÉAL.

Special Session on Nonlinear Models in Biology and Celestial Mechanics, IV

9:00-12:00   ROOM NO. 8

9:00 From individuals to ecosystems.

291+ Simon A. Levin, PRINCETON UNIVERSITY.

10:00 The impact of intermediate hosts on the disease dynamics of schistosomiasis.

292 Zhilan Feng, PURDUE UNIVERSITY.
10:30 Interaction between two virus serotypes in a dengue disease model.

293 Lourdes Esteva, FACULTAD DE CIENCIAS-UNAM.

11:00 Avoiding competition by improving resistance to changes in the environment.

294 Ignacio Barradas, CIMAT.

11:30 Models for the spread of tuberculosis.

295 Carlos Castillo-Chávez, CORNELL UNIVERSITY.

Special Session on Representation Theory of Algebras and Groups, IV

9:00-12:00 ROOM NO. 10

9:00 Combinatorics and representations.

296* Arun Ram, PRINCETON UNIVERSITY.

10:00 Diagrams for 3-configurations with only dual affine planes. PRELIMINARY REPORT.

297 Alberto G. Raggi-Cárdenas+, Humberto Cárdenas, Emilio Lluis, INSTITUTO DE MATEMÁTICAS, UNAM, AND Rodolfo San Agustín, FACULTAD DE CIENCIAS, UNAM.

10:30 Homogeneous wild matrix problems. PRELIMINARY REPORT.

298 Dieter Vossieck, INSTITUTO DE MATEMÁTICAS UNAM.

11:00 Total positivity and double Bruhat decomposition. PRELIMINARY REPORT.

299 Andrei V. Zelevinsky, NORTHEASTERN UNIVERSITY.

Special Session on Stochastic Systems, III

9:00-12:00 ROOM NO. 12

9:00 Exponential convergence for filtering problems. PRELIMINARY REPORT.

300* Ofer Zeitouni, TECHNION.

10:00 Some recent advances in stochastic adaptive control.

301 Bozenna Pasik-Duncan, UNIVERSITY OF KANSAS.

10:30 Ergodic boundary/point control and filtering for boundary processes of semilinear stochastic systems.

302 T. E. Duncan, UNIVERSITY OF KANSAS.

11:00 Optimal stopping theory, taxes, and transaction costs. PRELIMINARY REPORT.

303 Abel Cadenillas+, UNIVERSITY OF ALBERTA, AND Stanley Pliska, UNIVERSITY OF ILLINOIS AT CHICAGO.

11:30 Robustness of average cost optimal policies in Markov control processes. Quantitative estimations.

304 Evgueni Gordienko, UNIVERSIDAD AUTÓNOMA METROPOLITANA-IZTAPALAPA.

General Session, IV

9:00-12:00 ROOM NO. 9

9:00 Asymptotic models of orthotropic highly inhomogeneous layered structure. PRELIMINARY REPORT.

305 Orlando Avila-Pozos+, Alexander B. Movchan, BATH UNIVERSITY, AND Andrew Klarbring, LINKÖPING UNIVERSITY.

9:30 Periodic movement and little theorem of Fermat.

306 José Ramón Guzmán+, INSTITUTO DE INVESTIGACIONES ECONÓMICAS, UNAM, Humberto Carrillo, FACULTAD DE CIENCIAS; UNAM.

10:00 On the solvability of boundary value problems for parabolic equations in general Hölder spaces.

307 Martín López Morales, ITESM-CEM.

10:30 Existence of solutions to \( \Delta u = 0 \) with nonlinear boundary conditions \( \frac{\partial u}{\partial n} + p|u|^{m-1}u = \Phi \) from dynamic programming. PRELIMINARY REPORT.

308 Angel Soriano, IMATE, U.N.A.M.

11:00 Schur functions and generalized Gram determinants. PRELIMINARY REPORT.

309 Luis Verde-Star, UNIVERSIDAD AUTÓNOMA METROPOLITANA-IZTAPALAPA.

Invited Address

12:15-13:15 AUDITORIUM

Ten mathematics problems I will never solve.

310+ Gian-Carlo Rota, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: William A. Harris Jr., Department of Mathematics, University of Southern California, Los Angeles, CA 90089-1113; e-mail: wharris@math.usc.edu; telephone: 213-740-3794.

Central Section: Susan J. Friedlander, Department of Mathematics, University of Illinois at Chicago, 851 S. Morgan (M/C 249), Chicago, IL 60607-7045; e-mail: susan@math.uw.edu; telephone: 312-996-3041.

Eastern Section: Lesley M. Sibner, Department of Mathematics, Polytechnic University, Brooklyn, NY 11201-2900; e-mail: lsibner@magnus.poly.edu; telephone: 718-260-3505.

Southeastern Section: Robert J. Daverman, Department of Mathematics, University of Tennessee, Knoxville, TN 37996-1300; e-mail: daverman@novell.math.utk.edu; telephone: 423-974-6577.

The Meetings and Conferences section of the Notices gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. Up-to-date meeting and conference information is available on the World Wide Web via the Internet at URL http://www.ams.org/.

Meetings:

1997
December 3–6 Oaxaca, Mexico p. 1551

1998
January 7–10 Baltimore, Maryland Annual Meeting p. 1552
March 20–21 Louisville, Kentucky p. 1552
March 27–28 Manhattan, Kansas p. 1553
April 4–6 Philadelphia, Pennsylvania p. 1553
April 25–26 Davis, California p. 1554
September 12–13 Chicago, Illinois p. 1554
October 9–10 Winston-Salem, No. Carolina p. 1555
October 24–25 State College, Pennsylvania p. 1555
November 14–15 Tucson, Arizona p. 1555

1999
January 13–16 San Antonio, Texas Annual Meeting p. 1555
March 12–13 Gainesville, Florida p. 1556
March 18–21 Urbana, Illinois p. 1556
April 10–11 Las Vegas, Nevada p. 1556
April 24–25 Buffalo, New York p. 1556
October 2–3 Providence, Rhode Island p. 1556
October 8–10 Austin, Texas p. 1557

2000
January 19–22 Washington, DC Annual Meeting p. 1557
April 1–2 Lowell, Massachusetts p. 1557
April 7–9 Notre Dame, Indiana p. 1557

Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 183 in the January issue of the Notices for general information regarding participation in AMS meetings and conferences.

Abstracts

Several options are available for speakers submitting abstracts, including an easy-to-use interactive Web form. No knowledge of TeX is necessary to submit an electronic form, although those who use plain TeX, AMS-TeX, LaTeX, or AMS-LaTeX may submit abstracts with TeX coding. To see descriptions of the forms available, visit http://www.ams.org/abstracts/instructions.html or send mail to abs-submit@ams.org, typing help as the subject line, and descriptions and instructions on how to get the template of your choice will be e-mailed to you.

Completed abstracts should be sent to abs-submit@ams.org, typing submission as the subject line. Questions about abstracts may be sent to abs-info@ams.org.

Paper abstract forms may be sent to Abstracts Coordinator, AMS, P.O. Box 6887, Providence, RI 02940. Note that all abstract deadlines are strictly enforced. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

Conferences: (See http://www.ams.org/meetings/ for the most up-to-date information on these conferences.)

1998:

Cosponsored Conference:
Hotel Reservations

To ensure accurate assignments, please rank hotels in order of preference by writing 1, 2, 3, etc., in the spaces at the left of the form and by circling the requested room type and rate. If the rate or the hotel requested is no longer available, you will be assigned a room at a ranked or unranked hotel at a comparable rate. Participants are urged to call the hotels directly for details on suite configurations, sizes, etc. Reservations at the following hotels must be made through the MMSB to receive the convention rates listed. All rates are subject to a 12.5% sales occupancy tax. **Guarantee requirements: First night deposit by check (add to payment on reverse of form) or a credit card guarantee.**

<table>
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<tr>
<th>Order of choice</th>
<th>Hotel</th>
<th>Single</th>
<th>Double 1 bed</th>
<th>Double 2 beds</th>
<th>Triple 2 beds</th>
<th>Triple 2 beds w/cot</th>
<th>Quad 2 beds</th>
<th>Quad 2 beds w/cot</th>
<th>Suites</th>
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<td>$85</td>
<td>$105</td>
<td>$155</td>
<td>N/A</td>
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</table>

* Limited Availability

**Special Housing Requests:**
- I have disabilities as defined by the ADA that require a sleeping room that is handicap accessible. My needs are: ____________________________
- If you are a member of a hotel frequent-travel club and would like to receive appropriate credit, please include the hotel chain and card number here: ____________________________
- Other requests: ____________________________

If you are not making a reservation, please check off one of the following:
- I plan to make a reservation at a later date.
- I will be making my own reservations at a hotel not listed. Name of hotel: ____________________________
- I live in the area or will be staying privately with family or friends.
- I plan to share a room with ____________________________, who is making reservations.
# Baltimore Advance Registration/Housing Form

**Name:**

**Mailing Address:**

**Telephone:**

**Fax:**

**Email Address:**

**Badge Information:**

- Name to appear on badge ____________________________
- Affiliation for badge ______________________________
- Nonmathematician Guest Badge _______________________

(please note charge below)

If you do not wish your program and badge to be mailed to you on 12/10/97, check this box.  

## Registration Fees

<table>
<thead>
<tr>
<th>Joint Meetings</th>
<th>by Dec 19</th>
<th>at mtg</th>
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<tbody>
<tr>
<td>Member AMS, ASL, CMS, MAA</td>
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<td>$202</td>
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<tr>
<td>Nonmember</td>
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<td>$312</td>
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<td>$5</td>
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<tr>
<td>Unemployed</td>
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<tr>
<td>Temporarily Employed</td>
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<td>$125</td>
</tr>
<tr>
<td>Developing Countries Special Rate</td>
<td>$35</td>
<td>$45</td>
</tr>
<tr>
<td>Emeritus Member of AMS or MAA</td>
<td>$35</td>
<td>$45</td>
</tr>
<tr>
<td>High School Teacher</td>
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<td>$45</td>
</tr>
<tr>
<td>Librarian</td>
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<td>$45</td>
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<tr>
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</tr>
<tr>
<td>One-day Member</td>
<td>—</td>
<td>$121</td>
</tr>
<tr>
<td>One-day Nonmember</td>
<td>—</td>
<td>$172</td>
</tr>
</tbody>
</table>

### AMS Short Course on Singular Perturbation Concepts for Differential Equations.

Registration for the Joint Meetings is not required for the Short Course.

- Member, Nonmember | $75 | $90 |
- Student, Unemployed, Emeritus | $35 | $45 |

## Employment Register

Registration for the Joint Meetings is required for participation. Applicant résumé forms and employer job listing forms will be on e-MATH in September and in the October issues of Notices and Focus.

- Employer—First Table
  - Regular | $200 | $250 |
  - Self-scheduled
- Employer—Second Table
  - Regular | $50 | $75 |
  - Self-scheduled
- Employer—Posting Only
  - $50 | $50 |
- Applicant | $40 | $75 |

## Events

### Events with Tickets

<table>
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<tr>
<th>Events with Tickets</th>
<th>Price Per</th>
<th>Total</th>
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<tr>
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<td>$32</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
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</table>

## Student Activities

- Mathchats | (no charge) |
- MAA Student Workshop | (no charge) |

## Statistical/Other Information

**Mathematical Reviews** field of interest:

- I am a mathematics department chair.

- How did you hear about this meeting? Check one:
  - Notices
  - Focus
  - WWW
  - Colleague(s)
  - Special Mailing

- Please do not include my name on any mailing list used for promotional purposes.

- Please check this box if you have a disability that requires special services.

## Deadlines

- **Room lottery:** November 7, 1997
- **Housing reservations:** November 20, 1997
- **Advance registration:** December 8, 1997
- **Banquets:** December 19, 1997
- **Advance registration:** January 2, 1998

- **50% Refund on banquets**
- **50% Refund on advance registration**

- **No refunds after this date**

## Payment

<table>
<thead>
<tr>
<th>Category</th>
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<tr>
<td>Joint Meetings fee(s)</td>
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<tr>
<td>AMS Short Course</td>
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<tr>
<td>Employment Register</td>
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<tr>
<td>Event tickets</td>
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</tr>
<tr>
<td>Hotel deposit (only if paying by check)</td>
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</tbody>
</table>

**Total amount paid** $_________

(please note that a $5 processing fee will be charged for each returned check or invalid credit card.)

## Method of Payment

- **Check:** Make checks payable to the AMS. Checks drawn on foreign banks must be in equivalent foreign currency at current exchange rates.
- **Credit Card:** VISA, MasterCard, AMEX, Discover. (no others accepted)

| Card Number: | |
| Exp. Date: | Zipcode of credit card billing address: |

**Name on card:** __________________________

**Signature:** __________________________

**Purchase Order #** __________________________ (please enclose copy)
The Yellow Sale is on until December 31, 1997

The book is an ideal text for an advanced course in the theory of complex functions. The author leads the reader to experience function theory personally and to participate in the work of the creative mathematician. The book contains numerous glimpses of the function theory of several complex variables, which illustrate how autonomous this discipline has become. Remmert elegantly presents the material in short clear sections, with compact proofs and historical comments interwoven throughout the text. The abundance of examples, exercises, and historical remarks, as well as the extensive bibliography, make this book an invaluable source for students and teachers.

Contents: A: Infinite Products and Partial Fraction Series • Infinite Products of Holomorphic Functions • The Gamma Function • Entire Functions with Prescribed Zeros • Hypergeometric Functions with Prescribed Zeros • Asa's Theorem • Regions of Holomorphy • Functions with Prescribed Principal Parts • B: Mapping Theory • The Theorems of Montel and Vitali • The Riemann Mapping Theorem • Appendix to Chapter 8: Caratheodory-Koebe Theory • Automorphisms and Inverse Maps • C: Selecta • The Theorems of Bloch, Picard, and Schottky • Boundary Behavior of Power Series • Runge Theory for Compact Sets • Range Theory for Domains • Invariance of the Number of Holes • Short Biographies • Name Index • Subject Index

1997/376 PP., 19 ILLUS./$49.95/HARDCOVER

GEOMETRIC CONSTRUCTIONS

Geometric constructions have been a popular part of mathematics throughout history. The ancient Greeks made the subject an art, which was enriched by the medieval Arabs, but which required the algebra of the Renaissance for a thorough understanding. Through coordinate geometry, various geometric construction tools can be associated with various fields of real numbers. This book is about these associations. The author writes in a charming style and nicely intersperses history and philosophy within the mathematics. He hopes that readers will learn a little geometry and a little algebra while enjoying the effort. This is as much an algebra book as it is a geometry book. All the algebra and geometry that are needed is developed within the text.

Contents: Euclidean Constructions • The Ruler and Compass • The Ruler and Compass and the Mohr-Mascheroni Theorem • The Ruler and The Ruler and Dividers • The Poncelet-Steiner Theorem and Double Rulers • The Ruler and Rusty Compass • Sticks • The Marked Ruler • Paperfolding

1997/APP., 160 PP., 130 ILLUS./HARDCOVER
$35.00/ISBN 0-387-98276-0

AN INTRODUCTION TO KNOT THEORY

1997/210 PP., 114 ILLUS./HARDCOVER/$44.95

FOUNDTIONS OF REAL AND ABSTRACT ANALYSIS

I: Real Analysis • Analysis on the Real Line • Differentiation and the Lebesgue Integral II: Analysis in Metric Spaces • Analysis in Linear Spaces • Hilbert Spaces • An Introduction to Functional Analysis • Appendices: A: What Is a Real Number? B: Axioms of Choice and Zorns Lemma C: Pareto Optimality


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