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of the American Mathematical Society

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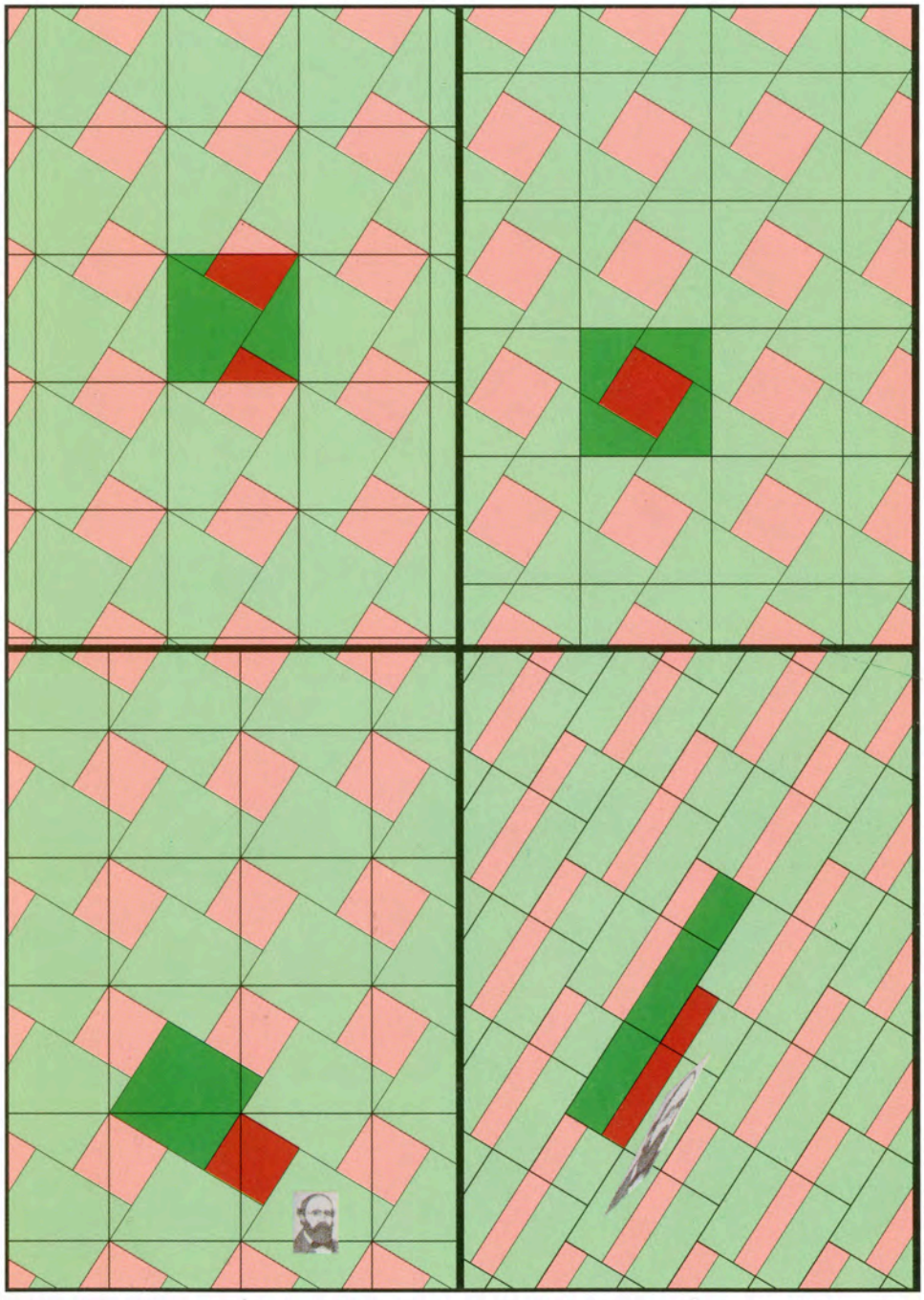

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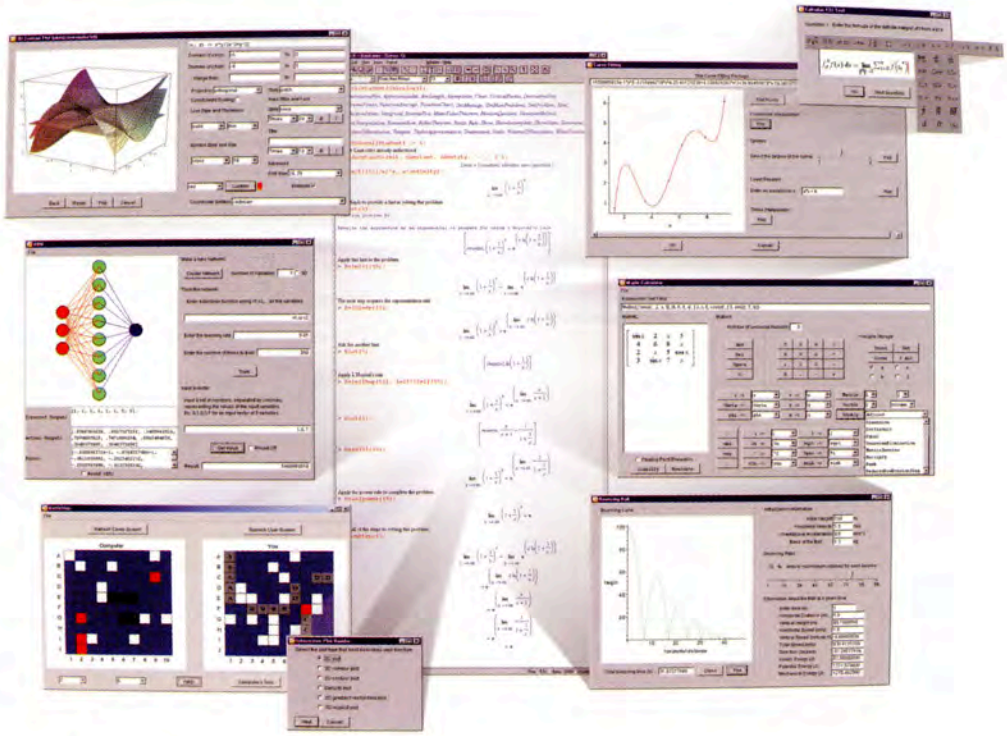

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- A priori L^p-Estimates for Solutions of Riemann-Hilbert Problems, *Percy Deift and Xin Zhou*
- An Elliptic Incarnation of the Bailey Chain, *V. P. Spiridonov*
- Equilibrium Distribution of Zeros of Random Polynomials, *Bernard Shiffman and Steve Zelditch*
- Inequality for Voiculescu's Free Entropy in Terms of Brown Measure, *Piotr Śniady*
- Invariance Principle for Inverse Problems, *Evgeni Korotyaev*
- Local Coefficients as Mellin Transforms of Bessel Functions; Towards a General Stability, *Freydoon Shahidi*
- On a Question of Dusa McDuff, *Felix Schlenk*
- On the Dimension of the Space of Cusp Forms Associated to 2-Dimensional Complex Galois Representations, *Philippe Michel and Akshay Venkatesh*
- On the Low Regularity of the Korteweg-de Vries-Burgers Equation, *Luc Molinet and Francis Ribaud*
- Perturbations of One-Dimensional Schrödinger Operators Preserving the Absolutely Continuous Spectrum, *Rowan Killip*
- Selmer Groups and Chow Groups of Self-Products of Algebraic Varieties, *Tom Weston*
- Sobolev Norms of Automorphic Functionals, *Joseph Bernstein and Andre Reznikov*

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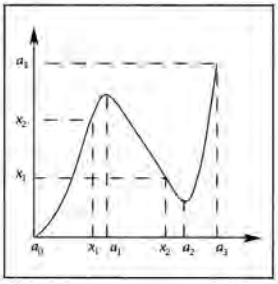
Feature Articles



Communications

Commentary

Notices

of the American Mathematical Society

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Departments

From the AMS Secretary

Sustaining the Momentum

I was asked to explain (a) why I have been an active supporter of the mathematical community, (b) what I have done, and (c) what needs to be done to sustain the mathematical sciences initiative at the National Science Foundation (NSF).

The answer to why is fairly simple. While serving as the director of the National Security Agency, I realized that world-class mathematicians devoted to cryptology and cryptanalysis were critical for success. I was even more fascinated when I was made aware that continuing advances in mathematics are no less critical to breakthroughs in *all* of science and technology.

Most nonmathematicians believe that almost everything in mathematics has already been invented, while they hear regularly of new advances in physics, biology, chemistry, and other sciences. In fact, this belief is wrong. The proof of Fermat's Last Theorem, of course, was a public event, but also a rare one, with little apparent practical relevance in the minds of nonmathematicians. An equivalent event seems unlikely anytime soon. Yet mathematicians do make frequent breakthroughs, and the consequences for all other branches of science can be enormous, not to mention the technological and economic gains that can follow.

That was a dramatic revelation for me, and I soon learned that I was not alone. Even leading scientists in other fields sometimes are not aware that they are limited by extant mathematics and that new mathematics can be developed, leading to major advances in their own work. As a result, mathematics was suffering from declining financial support. Yet a strong mathematics community is critical to both the economic and the military health of the nation. This is why I became involved in support for mathematics as a public policy issue.

In 1995 I was asked to chair a mathematics assessment panel for the NSF. Astonished, I said, "But I am not a mathematician. Are you sure you want me?" Don Lewis, then serving as the head of the Division of Mathematical Sciences at NSF, assured me that this was what qualified me for the job. The panel required a nonmathematician in order to remove any sign of parochial self-interest in its findings. If a poor knowledge of math was the standard, then I was superqualified! For the next year and a half, I had the privilege of working with the extraordinary group of mathematicians on the panel, who lucidly explained the many problems in the field.

The panel discussions made me aware that U.S. mathematics, although dominant in the world at the time, was heading for serious trouble unless it received greater resources. Armed with the strong arguments that the panelists brought to their report, we all could make the case for more funding for mathematics.

A lot of positive change has occurred within the pure mathematics community, and that has helped in making the budget case within the NSF. Philippe Tondeur, who succeeded Don Lewis, kept up the momentum of Lewis's initiatives. That explains the subsequent success in improving support for mathematics. An old maxim of bureaucratic politics holds that policy outcomes are determined, not by the intellectual merits of the arguments for the alternatives, but by the bureaucratic power behind them. Unlike theorems in mathematics, this maxim has exceptions. When NSF director Rita Colwell had to make a decision about funding priorities, she made it on the merits—a true act of putting public interest over private interest. Tondeur's abundant supply of good arguments found an open mind at the top of the NSF. In turn, he and the director found some remarkable support in the White House and in the Office of Management and Budget, where mathematics is now seen as a high-payoff investment.

This sums up the little that I have done, which is mainly to observe, urge now and then, and applaud. What now needs to be done?

Winning the budget battle in the executive branch is only the beginning. Ultimately, Congress controls the purse strings. The mathematics community at large, therefore, needs to keep making its case to key legislators.

There is also a larger public information challenge. We "lay people" don't hear about the exciting advances regularly occurring in mathematics the way we do in other sciences. Once we know about the feats of mathematics, we become supporters. A few leaders in mathematics are addressing this problem by cultivating public awareness programs. The USA Mathematical Olympiad makes a great contribution. Such work is not undignified advertising or PR. It is analogous to the outreach programs offered by conductors of major symphony orchestras to build future audiences. It is like music theory taught in secondary schools in parts of Europe, where students are introduced to fugue and sonata forms.

The mathematics community has an incredible case to make and remarkable stories to tell. Creating a mathematics culture in the larger society should be the community's strategic goal. Not just mathematics, but all the sciences and society as a whole will gain from it.

—General William E. Odom (U.S. Army, Ret.)
Senior Fellow, Hudson Institute

Letters to the Editor

Menahem Max Schiffer

The sad passing on November 11, 1997, at the age of 86 of Menahem Max Schiffer, one of the most distinguished mathematicians and scholars of his time, seems for some years to have escaped the notice of the mathematical community. A belated obituary appears in the February 13, 2002, issue of the *Stanford Report*, a publication devoted to news and information for the Stanford University community. The following comments are excerpted from that article.

Schiffer was born in Berlin in 1911, attended a secondary school that stressed science and mathematics, and entered the Friedrich-Wilhelms Universität, Bonn, in 1930, with a major in physics, which he studied under von Laue, Nernst, and Schrödinger. He also studied mathematics under Bieberbach, Schmidt, and Schur. Schiffer changed his major to mathematics and worked for a time under the guidance of Schur. His initial paper, "Finiteness theorems of invariant theory", was published in 1934 in the *Mathematische Zeitschrift*.

With the Nazis in power and with Schur having been forcibly "retired" because he was not of Aryan descent, Schiffer emigrated to Palestine. He received his M.A. degree at the Hebrew University of Jerusalem, based on the material of his 1934 publication. His Ph.D. dissertation at the Hebrew University in 1938, "Conformal representation and univalent functions", initiated his active interest in complex analysis. It is for his work in this field that Schiffer achieved his greatest acclaim. His thesis introduced what was later to be known universally as the "Schiffer variation", actually one of two important variational methods that he initiated and developed. Schiffer's work opened up the possibility of applying variational methods in a systematic way to geometric problems in complex analysis. His results provided new, powerful, and flexible tools for studying classical problems, and they moved the subject in exciting new directions. He had great success in applying his methods to many fundamental questions, and anyone working in the field has to be familiar with the techniques he crafted.

Never losing his interest in mathematical physics, Schiffer also made important contributions to eigenvalue problems, to partial differential equations, and to the variational theory of "domain functionals" that arise in many classical boundary value problems. And he coauthored a book on general relativity. Schiffer was a prolific author over his entire career, with 135 publications from the 1930s to the 1990s, including four books and around forty different coauthors. He was also an outstanding mathematical stylist, always writing, by his own testimony, with the reader in mind. He sought always to convey the joy of discovery and the deep satisfaction in the unity of the subject. Among his publications are several long expository papers which still remain the best and most accessible treatments of the subjects.

The spirit and polish in Schiffer's papers were also evident in his teaching. His lectures at Stanford and around the world ranged greatly in subject matter and were widely appreciated. He was invited to address the International Congress of Mathematicians in 1950 and again in 1958. At Stanford he often taught graduate courses in applied mathematics and mathematical physics. Students from all departments flocked to them, as did many faculty. Each lecture was a perfect set piece—no pauses, no slips, and no notes. In 1976 he was chosen as one of the first recipients of the Dean's Award for Teaching in the School of Humanities and Sciences.

Schiffer became professor of mathematics at Stanford University on September 1, 1952, following earlier positions at the Hebrew University, Harvard, and Princeton. He served as executive head from 1954–1959. In 1967 he was appointed to the Robert Grimmett Professorship of Mathematics, becoming the first member of the department to be awarded an endowed chair; he held that position until his retirement in 1977. In 1968 he was elected to the American Academy of Arts and Sciences and in 1970 to the National Academy of Sciences.

Menahem Schiffer's passing marked the end of an era, in which celebrated names from the "old world", including Bergman, Loewner, Pólya, Schiffer, and Szegő, created at Stanford University one of the great world centers for classical analysis.

—Robert Finn
—Brad Osgood
—Robert Osserman
Stanford University

(Received May 3, 2002)

WHAT IS . . .

Not to Miss

What is a gerbe? How about a brane, a grope, a shtuka? Today's mathematics is full of intriguing objects with weird and wonderful names. This issue of the *Notices* inaugurates a new feature called the "WHAT IS...?" column.

The *American Mathematical Monthly* has published, starting in 1942 under the editorship of Lester R. Ford Jr., an occasional series of articles with the title "What is...?". The *Notices* "WHAT IS...?" column is a bit different, in that each column treats a single mathematical object, rather than a theory. The column is pitched to graduate students, so the technical level is low and the accessibilty is high.

"WHAT IS an amoeba?" by Oleg Viro appears on page 916 in this issue.

Comments on the "WHAT IS...?" column are welcome and should be sent to `notices-whatis.org`.

—Allyn Jackson

Dynamical Zeta Functions and Transfer Operators

David Ruelle

Certain generating functions—encoding properties of objects like prime numbers, periodic orbits, ...—have received the name of *zeta functions*. They are useful in studying the statistical properties of the objects in question. Zeta functions have generally been associated with problems of arithmetic or algebra and tend to have common features: meromorphy, Euler product formula, functional equation, location of poles and zeros (Dirichlet series expansion, Riemann hypothesis), and relation with certain operators (typically operators acting on cohomology groups). The *dynamical zeta functions* to be discussed here are set up to count periodic orbits but to count them with fairly general *weights*. As a consequence the subject will have a more function-theoretic flavor than the study of arithmetic or algebraic zeta functions. Apart from that, our zeta functions will have properties similar to those of the more traditional ones. The main difference will be that the relevant operators (called *transfer operators*) will act on (infinite-dimensional) cochain groups instead of (finite-dimensional) cohomology groups. Intuitively, the weights that we have introduced prevent passage from cochains to cohomology groups. Technically this will force us to consider determinants in infinite dimension. The study of dynamical zeta functions uses original tools (transfer operators, kneading determinants), which we shall discuss below.

The simplest invariant measures for a dynamical system are those carried by periodic orbits. Counting periodic orbits is thus a natural task from the point of view of ergodic theory. And dynamical zeta functions are an effective tool to do the counting. The tool turns out to be so effective in fact as to make one suspect that there is more to the story than what we currently understand.

David Ruelle is professor of mathematics at Rutgers University and the Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France. His e-mail address is ruelle@ihes.fr.

Some Traditional Examples of Zeta Functions

The grandmother of all zeta functions is the Riemann zeta function defined by

$$\zeta_R(s) = \sum_{n=1}^{\infty} n^{-s}$$

for Re $s > 1$. Actually, this function was first considered by Euler, who noted that

$$\zeta_R(s) = \prod_{p \text{ prime}} (1 - p^{-s})^{-1}$$

(this is the *Euler product formula*). Riemann showed that $\zeta_R(s)$ extends meromorphically to $\mathbf{C}$ with a single pole at $s = 1$ and that there is a *functional equation* relating $\zeta_R(s)$ and $\zeta_R(1 - s)$. Because ζ_R is a generating function for the primes, it can be used to prove the prime number theorem: that the number of primes up to x is $\sim x/\log x$. A theorem from harmonic analysis called the Wiener-Ikehara Tauberian theorem yields the prime number theorem from the fact that $\zeta_R(s)$ has a simple pole at $s = 1$ and no other pole or zero for Re $s \geq 1$.

After the Riemann zeta function, innumerable functions with related properties have been introduced. In particular, given an algebraic variety over a finite field $\mathbf{F}_q$, we may define a "Weil zeta function" by

$$\zeta_W(z) = \exp \sum_{m=1}^{\infty} \frac{z^m}{m} |\mathrm{Fix} f^m|.$$

Here one has extended the algebraic variety to the algebraic closure of $\mathbf{F}_q$, obtaining a space M, and $f : M \to M$ is the Frobenius map (acting by $z \mapsto z^q$ on coordinates); $|\mathrm{Fix}\, f^m|$ is the number of fixed points of the m-th iterate of f. The function $\zeta_W(z)$ satisfies the Weil conjectures (Weil, Dwork, Grothendieck, Deligne); in particular it is rational. Note

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The idea of using the zeta function to study the asymptotic distribution of primes is due to Georg Friedrich Bernhard Riemann (1826-1866), perhaps the greatest mathematician of all times.

that the variable z in $\zeta_W(z)$ has to be thought of as the exponential of $-s$ in $\zeta_R(s)$.

The Weil zeta function counts periodic points (or periodic orbits) for the dynamical system (M, f), where f is the Frobenius map. It is natural to consider a more general space M and map $f : M \to M$ and (assuming that $|\mathrm{Fix}\, f^m|$ is finite for each m) to define

$$\zeta(z) = \exp \sum_{m=1}^{\infty} \frac{z^m}{m} |\mathrm{Fix} f^m|.$$

We have here again an "Euler product formula", namely, the following identity between formal power series:

$$\zeta(z) = \prod_P (1 - z^{|P|})^{-1} \tag{1}$$

where the product is over periodic orbits P and $|P|$ is the period of P. For example, one can take for f a diffeomorphism of a compact manifold M (Artin-Mazur). In the special case when f is hyperbolic (technically, f is an Axiom A diffeomorphism restricted to a basic set), one finds that this zeta function is rational (Smale, Guckenheimer, Manning, Bowen, Fried).

As an example of (1), consider the map $x \mapsto 1 - \mu x^2$ of the interval $[-1, 1]$ to itself. For the Feigenbaum value $\mu = 1.401155\ldots$, this map has one periodic orbit of period 2^n for each integer $n \geq 0$. Therefore

$$\zeta(z) = \prod_{n=0}^{\infty} (1 - z^{2^n})^{-1} = \prod_{n=0}^{\infty} (1 + z^{2^n})^{n+1}$$

where we have used (1) and $(1 - z)^{-1} = \prod_{n=0}^{\infty} (1 + z^{2^n})$. Note that this ζ satisfies the functional equation $\zeta(z^2) = (1 - z)\zeta(z)$.

A natural way to count periodic orbits for a map f is to weight them with the topological index $L(x, f)$. Specifically, assume that f is a diffeomorphism of the compact manifold M, $x \in \mathrm{Fix} f$, and $1 - T_x f$ is invertible (where $T_x f$ is the tangent map to f at x). Then

$$L(x, f) = \mathrm{sgn} \det(1 - T_x f)$$

and we have the Lefschetz trace formula

$$\sum_{k=0}^{\dim M} (-1)^k \mathrm{tr}\ f_{*k} = \sum_{x \in \mathrm{Fix} f} L(x, f)$$

where f_{*k} is the action of f on the k-th homology group of M with real coefficients. Suppose now that $1 - T_x f^m$ is invertible for all fixed points x of f^m for all $m > 0$, and define the Lefschetz zeta function

$$\zeta_L(z) = \exp \sum_{m=1}^{\infty} \frac{z^m}{m} \sum_{x \in \mathrm{Fix} f^m} L(x, f^m).$$

Then the trace formula yields

$$\zeta_L(z) = \prod_{k=0}^{\dim M} \det(1 - z f_{*k})^{(-1)^{k+1}}$$

(therefore $\zeta_L(z)$ is rational). In many interesting cases $L(x, f^m) = 1$ for all periodic points x, so that $\zeta_L(z) = \zeta(z)$.

Suppose now that instead of a discrete time dynamical system generated by $f : M \to M$, we have a continuous time dynamical system, i.e., a semiflow or flow (f^t) on M. Then the Euler formula (1) with z replaced by e^{-s} suggests defining a zeta function

$$\zeta(s) = \prod_{\varpi} (1 - e^{-s\ell(\varpi)})^{-1} \tag{2}$$

where the product is over (prime) periodic orbits ϖ and $\ell(\varpi)$ is the period of ϖ.

A much-studied example of a flow is the geodesic flow on a Riemann manifold N. We recall the definition. If a point $x(t)$ moves at unit speed along a geodesic of N and $u(t) = \frac{d}{dt} x(t) \in T_{x(t)} N$, we have $\|u(t)\| = 1$. Writing $u(t) = f^t u(0)$ defines a diffeomorphism f^t of the unit tangent bundle M of N, and $(f^t)_{t \in \mathbf{R}}$ is called the geodesic flow. Note that it is a flow on the unit tangent bundle M rather than on N. Observe also that the period of a periodic orbit for the geodesic flow is the length of a closed geodesic on N.

Closely related to (2) is the definition of the Selberg zeta function ζ_S. This zeta function appears in questions of arithmetic and is defined in terms of a Fuchsian group $\Gamma \subset SL(2, \mathbf{R})$ operating on the complex upper half-plane H (and a matrix representation of Γ which we shall ignore here). If Γ is torsion-free and $\Gamma \backslash H$ is compact, then $\Gamma \backslash H$ is a compact surface with curvature -1 (because H with the Poincaré metric is the Lobatchevsky plane

with curvature -1, the geodesics of H are half-circles centered on the real axis). Let (f^t) be the geodesic flow on $\Gamma\backslash H$ so that the periods $\ell(\varpi)$ in (2) are the lengths of the closed geodesics. Then the Selberg zeta function is

$$\zeta_S(s) = \prod_{k=0}^{\infty} \zeta(s+k)^{-1} = \prod_{\varpi} \prod_{k=0}^{\infty} (1 - [\exp \ell(\varpi)]^{-s-k}).$$

It can be shown that ζ_S is an entire analytic function satisfying a functional equation and a form of the Riemann hypothesis. In fact the zeros of ζ_S are related to the eigenvalues of the Laplace-Beltrami operator Δ on $\Gamma\backslash H$. We thus have a connection between classical mechanics (the geodesic flow) and quantum mechanics (with the Hamiltonian Δ). This connection has been much studied in relation with "quantum chaos".

To conclude our list of examples let us mention the currently popular Ihara-Selberg zeta function associated with a finite unoriented graph G. This function ζ_I is of the form (1) where periodic orbits are replaced by cycles (circuits on G without immediate backtracking). It is known that $1/\zeta_I$ is a polynomial and that ζ_I satisfies the Riemann hypothesis precisely when G is Ramanujan (Ramanujan graphs were named by Lubotzky, Phillips, and Sarnak; examples are not easy to construct).

Dynamical Zeta Functions

Let us now equip the dynamical system (M, f), where f need not be invertible but $\mathrm{Fix} f^m$ is finite for all $m > 0$, with a weight $g : M \to \mathbf{C}$ (real positive weights will be of special interest). A zeta function associated with the weighted dynamical system (M, f, g) is defined by

$$\zeta(z) = \exp \sum_{m=1}^{\infty} \frac{z^m}{m} \sum_{x \in \mathrm{Fix} f^m} \prod_{k=0}^{m-1} g(f^k x) \tag{3}$$

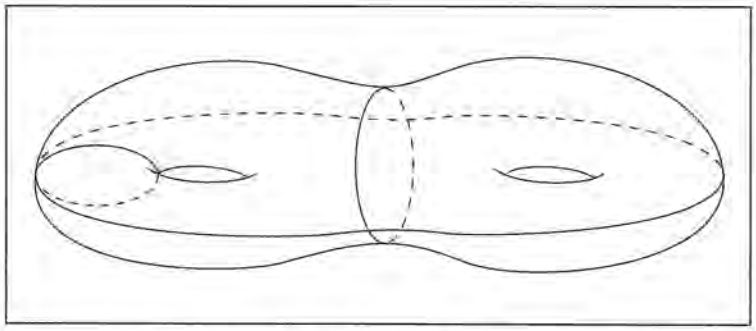
as a formal power series. This is the prototype of what we want to call a dynamical zeta function. We have here again an Euler product formula

$$\zeta(z) = \prod_P \left(1 - z^{|P|} \prod_{k=0}^{|P|-1} g(f^k x_P)\right)^{-1}$$

where $x_P \in P$ is chosen arbitrarily. So, introducing a weight does not spoil the basic combinatorial properties of the zeta function.

What about analyticity? Can we get more analyticity than is immediately obvious and then make use of it to obtain statistical properties of the (weighted) periodic orbits we are counting here? To be specific, suppose that $g = \exp A$, where A is a real function, and write

$$P(A) = \limsup_{m \to \infty} \frac{1}{m} \log \sum_{x \in \mathrm{Fix} f^m} \exp \sum_{k=0}^{m-1} A(f^k x).$$



A compact surface on which a metric with curvature -1 can be put: several geodesics have been drawn.

Then the radius of convergence of $\zeta(z)$ is $\exp(-P(A))$. Can we prove more: that $\zeta(z)$ has an isolated pole at $\exp(-P(A))$? This could, for instance, be used to prove analyticity of $A \mapsto P(A)$. We shall now give an example of this situation.

Let t be an $r \times r$ matrix with elements $t_{ij} = 0$ or 1. Define

$$\Omega = \{(\xi_k)_{k \in \mathbf{Z}} : t_{\xi_k \xi_{k+1}} = 1 \text{ for all } k\}$$

and let $d((\xi_k), (\eta_k)) = \exp[-\min\{|k| : \xi_k \neq \eta_k\}]$. Then Ω is a compact metric space with respect to the metric d. The map $\tau : (\xi_k) \mapsto (\xi_{k+1})$ is called a *shift* and is a homeomorphism of Ω. If we assume that $r \geq 2$ and that for some power t^N of t all the matrix elements t_{ij}^N are positive, the dynamical system (Ω, τ) is called a mixing *subshift of finite type*. Let $C^\alpha(\Omega)$ be the Banach space of real α-Hölder continuous functions on Ω. Since the α-Hölder norm is given by

$$\|A\|_\alpha = \max\{\sup_\xi |A(\xi)|, \sup_{\xi \neq \eta} \frac{|A(\xi) - A(\eta)|}{d(\xi, \eta)^\alpha}\},$$

we see that $A \in C^\alpha(\Omega)$ says that the dependence of $A((\xi_k)_{k \in \mathbf{Z}})$ on ξ_k is exponentially small for large k (bounded by $\|A\|_\alpha e^{-\alpha|k|}$).

1. *Proposition.* *The limit*

$$P(A) = \lim_{m \to \infty} \frac{1}{m} \log \sum_{\xi \in \mathrm{Fix} \tau^m} \exp \sum_{k=0}^{m-1} A(\tau^k \xi) \tag{4}$$

exists, and there is $\mathcal{R} > \exp(-P(A))$ such that the dynamical zeta function $\zeta(z)$ associated with the weighted dynamical system $(\Omega, \tau, \exp A)$ is meromorphic for $|z| < \mathcal{R}$, with a single pole at $\exp(-P(A))$ and no other pole or zero.

[Note that if $A = 0$, the zeta function counts periodic orbits with weight 1 and can be computed exactly (Bowen-Lanford) because $|\mathrm{Fix} \tau^m| = \mathrm{tr}\ t^m$, as one readily checks. Here one finds

$$\zeta(z) = \exp \sum_{m=1}^{\infty} \frac{z^m}{m} \mathrm{tr}\, t^m$$
$$= \exp(-\mathrm{tr}\ \log(1 - zt)) = 1/\det(1 - zt).]$$

The function $A \to P(A)$, called *pressure*, arises in a theory called *thermodynamic formalism* which is based on ideas and methods of statistical mechanics. Having obtained the above nontrivial but apparently useless result, I put it as Exercise 7(c) on page 101 in my book *Thermodynamic Formalism* [3]. A few years later (December 29, 1982) Bill Parry of Warwick wrote to me about very interesting results on Axiom A flows he had obtained with his student Mark Pollicott. These results used Exercise 7(c), which unfortunately he had been unable to do. Could I help? By the time I had (painfully) managed to reconstruct the solution of the exercise I received another letter: *13 Jan 83 / Dear David, / We've finally managed to do your exercise! So ignore my last letter. / Sincerely / Bill Parry.*

Before we look into the work of Parry and Pollicott, let me remark on a relation between the zeta function (2) for a flow and the dynamical zeta function (3). Let M be a compact manifold, $f : M \to M$ a diffeomorphism, and $T : M \to \mathbf{R}$ a smooth positive function. A manifold $\widetilde{M}$ is obtained by identifying in $\{(x,\tau) : x \in M,\ 0 \le \tau \le T(x)\}$ the points $(x, T(x))$ and $(fx, 0)$. Furthermore, there is a smooth flow $(\tilde{f}^t)$ on $\widetilde{M}$ such that $\tilde{f}^t(x,\tau) = (x, t+\tau)$ if $0 \le \tau + t \le T(x)$. This flow $(\tilde{f}^t)$ is called the suspension of f corresponding to the ceiling function T. It is now easy to check that the zeta function $\tilde{\zeta}$ defined by (2) for the flow $(\tilde{f}^t)$ satisfies

$$\tilde{\zeta}(s) = \exp \sum_{m=1}^{\infty} \frac{1}{m} \sum_{x \in \operatorname{Fix} f^m} \prod_{k=0}^{m-1} e^{-sT(f^k x)}$$

and is thus equal to the dynamical zeta function (3) for $z = 1$ and $g = e^{-sT}$. In particular, $\tilde{\zeta}(s)$ will be analytic in s when $\zeta(z)$ defined by (3) is analytic at $z = 1$.

By the way, it is natural to introduce a generalization of (2) associated with a function $B : M \to \mathbf{C}$, viz.

$$\zeta(s) = \prod_{\varpi} \left(1 - \exp\Big[-s \int_0^{\ell(\varpi)} dt\, B(f^t x(\varpi))\Big]\right)^{-1},$$

where $x(\varpi)$ is an arbitrarily chosen point in ϖ. In the case of a suspension this is again related to (3).

Hyperbolic Dynamics and Thermodynamic Formalism

Let K be a compact invariant set for the C^r diffeomorphism $f : M \to M$. One says that K is hyperbolic if the tangent bundle restricted to K has a continuous splitting

$$T_K M = V^s \oplus V^u$$

invariant under Tf and such that, for a suitable Riemann metric and $0 < \theta < 1$,

$$\|T_x f^n v\| \le \|v\| \theta^n \quad \text{when} \quad v \in V^s_x, n \ge 0$$
$$\|T_x f^{-n} v\| \le \|v\| \theta^n \quad \text{when} \quad v \in V^u_x, n \ge 0.$$

If the entire manifold M is hyperbolic, f is called an Anosov diffeomorphism. Of particular interest are the *hyperbolic sets with local product structure*. We shall not define this concept, introduced by Smale, but mention as an example the closure K of the set of periodic points for an Anosov diffeomorphism. (It is conjectured that for an Anosov diffeomorphism, the closure of the set of periodic points is in fact always M itself.)

Arnold's *cat map* is an example of an Anosov diffeomorphism on $\mathbf{R}^2/\mathbf{Z}^2$. It is defined by $(x, y) \mapsto (x + y, x + 2y) \pmod 1$. Hyperbolicity is seen by checking that the eigenvalues of $\left(\begin{smallmatrix} 1 & 1 \\ 1 & 2 \end{smallmatrix}\right)$ have modulus $\neq 1$.

If K is hyperbolic with local product structure, then f restricted to K is essentially a subshift of finite type. This follows from the existence of *Markov partitions* first proved (after an example of Adler and Weiss) by Sinai for Anosov diffeomorphisms, then by Bowen in the general case. More precisely, there is a subshift of finite type (Ω, τ) and a Hölder continuous map π of Ω onto K such that

a. $f \circ \pi = \pi \circ \tau$,

b. π^{-1} is uniquely defined on a residual set (countable intersection of dense open subsets of K)

c. $\max_{x \in K} |\pi^{-1} x|$ is finite.

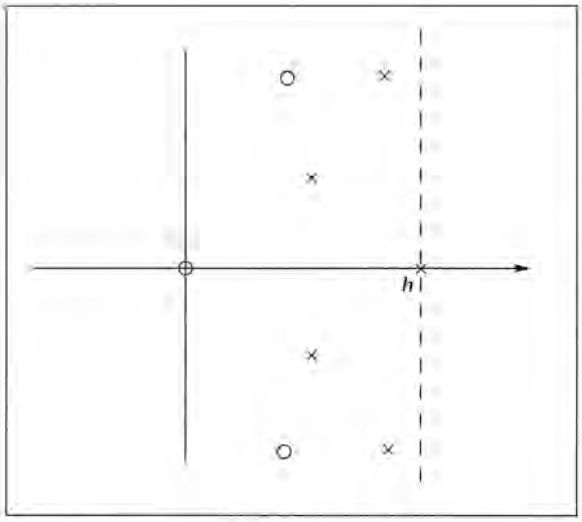
Counting periodic points for τ is not quite the same thing as counting periodic points for f, but almost (Manning and Bowen have shown how to do an exact counting, using finitely many subshifts of finite type). It simplifies matters to assume that f is topologically mixing on K: if O_1, O_2 are nonempty open subsets of K, then $O_1 \cap f^{-n} O_2 \neq \emptyset$ for sufficiently large n. In brief, from Proposition 1 one obtains the following.

2. *Proposition.* *Let K be hyperbolic with local product structure such that $f|K$ is topologically mixing. If $A : K \to \mathbf{R}$ is Hölder continuous, then*

$$P(A) = \lim_{m \to \infty} \frac{1}{m} \log \sum_{x \in \operatorname{Fix} f^m} \exp \sum_{k=0}^{m-1} A(f^k x)$$

exists and there is $\mathcal{R} > \exp(-P(A))$ such that the dynamical zeta function $\zeta(z)$ associated with the weighted dynamical system $(K, f|K, \exp A)$ is meromorphic for $|z| < \mathcal{R}$, with a single pole at $\exp(-P(A))$ and no other pole or zero.

Let me return to the letter that Bill Parry sent me at the end of 1982. His interest was in hyperbolic flows (in particular Anosov flows), which have a theory very similar to hyperbolic (and Anosov) diffeomorphisms. We shall not give detailed definitions but note an important example: *the geodesic flow on a compact manifold of variable negative*



The function $\zeta(s)$ defined by (2) for the geodesic flow on a compact manifold of variable negative curvature has a pole at $h > 0$. Other zeros and poles are in $\{z : \mathrm{Re}\, z < h\}$.

curvature is an Anosov flow. Bowen has shown that if (f^t) is a smooth flow restricted to a hyperbolic set K with local product structure, then counting periodic orbits for (f^t) is basically the same thing as counting periodic orbits with weights for a subshift of finite type. (This is because (f^t) has a Markov partition; i.e., it is basically a suspension of a subshift of finite type with a suitable ceiling function.) Assuming that (f^t) is topologically mixing, one can then show that $\zeta(s)$ defined by (2) has a meromorphic extension to an open set containing $\{s : \mathrm{Re}\ s \geq h\}$, without zero and with a single pole at $s = h$. (The number $h > 0$ is known as "topological entropy of (f^t) restricted to K", with a general definition that need not concern us here.) The analyticity of $\zeta(s)$ is thus very similar to the analyticity of the Riemann zeta function as used to prove the prime number theorem. The same method (Wiener-Ikehara Tauberian theorem) allowed Parry and Pollicott to prove that the number of periodic orbits ϖ with period $\ell(\varpi) \leq x$ is $\sim e^{hx}/hx$. This extended an earlier result of Margulis by a new and very elegant method. Later Lalley, Katsuda and Sunada, Parry, Pollicott, and Sharp followed the same line of thought and studied the distribution of periods for periodic orbits satisfying various conditions, with error terms, etc. When (f^t) is the geodesic flow on a manifold of variable negative curvature, one thus obtains detailed information about the lengths of geodesics on the manifold. The special case of surfaces of constant curvature -1 is of arithmetic interest (as we said when we introduced Selberg's zeta function). So the study of dynamical zeta functions extends to manifolds of variable negative curvature some results of arithmetic interest known in the case of constant negative curvature.

The Method of Transfer Operators

The proof of Proposition 1 uses *transfer operators*. Given a set Λ (which need not be a manifold) and maps $F : \Lambda \to \Lambda$, $g : \Lambda \to \mathbf{C}$, a transfer operator $\mathcal{L}$ acting on functions $\Phi : \Lambda \to \mathbf{C}$ is defined by

$$(\mathcal{L}\Phi)(x) = \sum_{y \in F^{-1}\{x\}} g(y)\Phi(y). \tag{5}$$

[As an example, if F has Jacobian determinant J and $g = 1/|J|$, the direct image by F of the measure $\Phi(x)dx$ is $(\mathcal{L}\Phi)(x)dx$.] The situation to keep in mind is when F is finite-to-one, expanding, and the functions g and Φ have some kind of smoothness so that $\mathcal{L}$ preserves (or improves) smoothness.

Consider now a one-sided subshift of finite type (Λ, F); i.e., with the notation used earlier, $\Lambda = \{(\xi_k)_{k\geq 0} : t_{\xi_k\xi_{k+1}} = 1 \text{ for all } k\}$ and $F(\xi_k) = (\xi_{k+1})$. We define a metric on Λ by analogy with that on Ω and take $g = \exp A$ where A is β-Hölder continuous. Then

$$(\mathcal{L}\Phi)(\xi_1, \xi_2, \dots) = \sum e^{A(\xi_0,\xi_1,\xi_2,\dots)}\Phi(\xi_0, \xi_1, \xi_2, \dots),$$

where the sum is over the ξ_0 such that $t_{\xi_0\xi_1} = 1$. Similarly

$$(\mathcal{L}^m\Phi)(\underline{\xi}) = \sum_{\underline{\eta}:F^m\underline{\eta}=\underline{\xi}} \Big[\exp \sum_{k=0}^{m-1} A(F^k\underline{\eta})\Big]\Phi(\underline{\eta}). \tag{6}$$

Now, expressions like (6) or like

$$\sum_{\underline{\eta}:F^m\underline{\eta}=\underline{\eta}} \exp \sum_{k=0}^{m-1} A(F^k\underline{\eta}) \tag{7}$$

(where the sum is over periodic points) are known in statistical mechanics as *partition functions*, and one can prove under various conditions that the logarithm of the partition function divided by m tends to a limit $P(A)$ when $m \to \infty$. Here one finds that when $\mathcal{L}$ acts on the Banach space of β-Hölder functions,

$$\lim_{m\to\infty} \|\mathcal{L}^m\|^{1/m} = e^{P(A)},$$

where $P(A)$ is defined as in (4) with τ replaced by F. Therefore $\exp P(A)$ is the spectral radius of $\mathcal{L}$. By a formula due to Nussbaum we can estimate the essential spectral radius of $\mathcal{L}$ to be

$$\leq \limsup_{m\to\infty} \|\mathcal{L}^m - E_m\|^{1/m}$$

when the E_m have finite rank. Pollicott noticed that by taking $E_m = \mathcal{L}^m P_m$ and $P_m\Phi$ a piecewise constant approximation of Φ, one gets that the essential spectral radius of $\mathcal{L}$ is $\leq \exp(-\beta + P(A))$. So the part of the spectrum which is $> \exp(-\beta + P(A))$ consists of isolated eigenvalues of finite multiplicity. In fact, because $\mathcal{L}$ is positivity preserving and F is mixing, $\exp P(A)$ is a simple

eigenvalue, and there is no other eigenvalue with the absolute value $\exp P(A)$. (This is a Perron-Frobenius type result. Because of this, transfer operators are sometimes called Perron-Frobenius operators.)

Notice that (7) is something like a trace of $\mathcal{L}^m$, and because of this one can show that each eigenvalue λ of $\mathcal{L}$ contributes a factor $1/(1-\lambda z)$ to $\zeta(z)$ defined by (3). It is not obvious that the part of the spectrum $\le \exp(-\beta + P(A))$ will contribute a factor analytic for $|z| < \exp(\beta - P(A))$, but this can be proved by a trick due to Haydn (and techniques of the thermodynamic formalism). We have just outlined a modern proof of (an improved version of) Proposition 1, up to a detail: our function A depends on the one-sided sequence

$$\underline{\xi} = (\xi_0, \xi_1, \xi_2, \dots)$$

instead of on

$$\hat{\xi} = (\dots, \xi_{-1}, \xi_0, \xi_1, \dots).$$

This is, however, not a problem, because it can be proved (Livšic) that an α-Hölder function $A(\hat{\xi})$ may be rewritten as $\hat{A}(\underline{\xi}) + B(\hat{\xi}) - B(\tau\hat{\xi})$ where $\hat{A}$ is β-Hölder with $\beta = \alpha/2$, so that A and $\hat{A}$ give the same dynamical zeta function.

We have just seen how to derive analyticity properties of the zeta function associated with the weighted dynamical system $(\Lambda, F, \exp A)$ from study of the transfer operator $\mathcal{L}$ defined by (6). The same technique applies to other cases; its success depends on the choice of a Banach space $\mathcal{B}$ of "smooth" functions for which the essential spectral radius of $\mathcal{L}$ is strictly smaller than its spectral radius (i.e., $\mathcal{L}$ is quasicompact).

An important example, that of piecewise monotone maps of the interval, was treated by Baladi and Keller. Let $a = a_0 < a_1 < \dots < a_N = b$. We take Λ to be the compact set $[a, b]$ in $\mathbf{R}$ and assume that $F : \Lambda \to \Lambda$ is such that $F|(a_{i-1}, a_i)$ is continuous and strictly monotone for $i = 1, \dots, N$. Also assume that $F^m x$, $F^m y \in (a_{i(n)-1}, a_{i(n)})$ for all $m \ge 0$ implies $x = y$, and that $g : \Lambda \to \mathbf{C}$ is ≥ 0, of bounded variation with regular discontinuities. Writing

$$R = \lim_{m\to\infty} (\sup_x |\mathcal{L}^m 1(x)|)^{1/m},$$

$$\hat{R} = \lim_{m\to\infty} \Big(\sup_x \prod_{k=0}^{m-1} g(F^k x) \Big)^{1/m},$$

one obtains that $\zeta(z)$ is analytic for $|z| < R^{-1}$, meromorphic for $|z| < \hat{R}^{-1}$, and the eigenvalues λ with $\lambda > R$ of $\mathcal{L}$ acting on the functions of bounded variation correspond to poles λ^{-1} of $\zeta(z)$, with the same multiplicity. Usually, $R > \hat{R}$ and (since we assumed $g \ge 0$) R^{-1} is a pole of $\zeta(z)$.

Traces and Determinants

A trace on an algebra S over $\mathbf{C}$ is a linear operator $\mathrm{Tr} : S \to \mathbf{C}$ such that $\mathrm{Tr}\,\mathcal{M}_1\mathcal{M}_2 = \mathrm{Tr}\,\mathcal{M}_2\mathcal{M}_1$. In particular we shall be interested in traces on algebras generated by transfer operators (or containing them). Remember that the transfer operator $\mathcal{L}$ associated with the weighted dynamical system (M, f, g) satisfies

$$(\mathcal{L}\Phi)(x) = \sum_{y : fy = x} g(y)\Phi(y). \tag{8}$$

If $\mathcal{L}_1$, $\mathcal{L}_2$ are transfer operators associated with maps $f_1, f_2 : M \to M$ and weights $g_1, g_2 : M \to \mathbf{C}$, we have

$$(\mathcal{L}_2\mathcal{L}_1\Phi)(x) = \sum_{y : f_2 f_1 y = x} g_2(f_1 y) g_1(y) \Phi(y) \tag{9}$$

so that $\mathcal{L}_2\mathcal{L}_1$ is again a transfer operator. An example of a trace is the counting trace defined on transfer operators by

$$\mathrm{Tr}^c \mathcal{L} = \sum_{x \in \mathrm{Fix}\, f} g(x).$$

[It is readily seen from (9) that $\mathrm{Tr}^c \mathcal{L}_1\mathcal{L}_2 = \mathrm{Tr}^c \mathcal{L}_2\mathcal{L}_1$. In specific cases one would want to check that the sum in $\mathrm{Tr}^c \mathcal{L}$ converges and that $\mathrm{Tr}^c \mathcal{M}$ depends only on $\mathcal{M}$ as an operator, not on its specific representation as sum of transfer operators of the form (8).]

When we have a trace Tr we can define a determinant $\mathrm{Det}(\mathbf{1} - z\mathcal{M})$ as a formal power series

$$\mathrm{Det}(\mathbf{1} - z\mathcal{M}) = \exp\Big(- \sum_{m=1}^{\infty} \frac{z^m}{m} \mathrm{Tr}\mathcal{M}^m \Big)$$

(where $\mathbf{1}$ denotes the identity operator). If S is the algebra of $N \times N$ matrices and Tr, Det are the usual trace and determinant, the above is an identity that one can check by putting $\mathcal{M}$ in normal Jordan form. Note also that the counting determinant $\mathrm{Det}^c(\mathbf{1} - z\mathcal{L})$ constructed with the counting trace is related to the dynamical zeta function (3) by

$$\zeta(z) = 1/\mathrm{Det}^c(\mathbf{1} - z\mathcal{L}).$$

Suppose now that M is a smooth manifold and that the algebra S is generated by transfer operators of the form (8) with smooth $f : M \to M$ and $g : M \to \mathbf{C}$. We can then define a sharp trace $\mathrm{Tr}^\sharp$ such that

$$\mathrm{Tr}^\sharp \mathcal{L} = \sum_{x \in \mathrm{Fix}\, f} L^\sharp(x, f) g(x),$$

where $L^\sharp(x, f) = \mathrm{sgn}\det(\mathbf{1} - (T_x f)^{-1})$. [We assume here that $T_x f$ and $\mathbf{1} - T_x f$ are invertible, but we shall see later that the definition of $\mathrm{Tr}^\sharp$ extends to more general situations where $\mathrm{Fix} f$ need not be finite. Note also that if f is a diffeomorphism, $L^\sharp(x, f) = L(x, f^{-1})$.] A sharp determinant $\mathrm{Det}^\sharp(\mathbf{1} - z\mathcal{L})$ is defined correspondingly, and a sharp zeta function $\zeta^\sharp(z) = 1/\mathrm{Det}^\sharp(\mathbf{1} - z\mathcal{L})$.

Let me interrupt the discussion of traces to address an obvious problem. Following geometric intuition, we have introduced dynamical zeta

functions and transfer operators associated with a weighted dynamical system (M, f, g). But the use of traces makes it natural to introduce linear combinations of transfer operators, so we lose the geometric connection with a single dynamical system. What is a natural formalism in the more general situation? Note that if there is a partition of unity (χ_ω) such that f restricted to $\mathrm{supp}\chi_\omega$ has an inverse ψ_ω, we may rewrite (8) as

$$\sum_\omega G_\omega(x)\Phi(\psi_\omega x),$$

where $G_\omega = (\chi_\omega g)\circ\psi_\omega$. We are thus led to define a *generalized transfer operator* $\mathcal{M}$ (associated with a family of weights $G_\omega : M \to \mathbf{C}$ and a family of maps $\psi_\omega : \mathrm{supp}G_\omega \to M$) by

$$(\mathcal{M}\Phi)(x) = \int d\omega\, G_\omega(x)\Phi(\psi_\omega x),$$

where $d\omega$ denotes a measure (which may be taken to be a probability measure). Linear combinations of generalized transfer operators are again generalized transfer operators: they form an algebra (under suitable conditions on the choice of the G_ω and ψ_ω). It is possible to consider $\mathcal{M}$ as a transfer operator associated with a (nonunique) random dynamical system. There is no longer a pressure associated with the generalized transfer operator $\mathcal{M}$, but writing

$$(|\mathcal{M}|\Phi)(x) = \int d\omega\, |G_\omega(x)|\Phi(\psi_\omega x),$$

we shall denote by e^P the spectral radius of $|\mathcal{M}|$ acting on bounded functions.

Let us return to the smooth situation (the G_ω and ψ_ω are C^r) and note that the sharp trace is now

$$\mathrm{Tr}^\sharp\,\mathcal{M} = \int d\omega \sum_{x\in\mathrm{Fix}\psi_\omega} L(x,\psi_\omega)G_\omega(x).$$

It is convenient at this point to introduce operators $\mathcal{M}^{(k)}$ acting on k-forms α such that

$$\mathcal{M}^{(k)}\alpha = \int d\omega\, G_\omega\cdot\psi_\omega^*\alpha,$$

where $\psi_\omega^*\alpha$ is the pullback of α by ψ_ω. [If $\wedge^k(T_x\psi) : \wedge^k(T_xM) \to \wedge^k(T_{\psi x}M)$ is the extension of $T_x\psi$ to the exterior algebra of T_xM and if $(\wedge^k(T_x\psi))^* : \wedge^k(T^*_{\psi x}M) \to \wedge^k(T^*_xM)$ denotes its transpose, we write $(\psi^*\alpha)(x) = (\wedge^k(T_x\psi))^*\alpha(\psi x)$.] In particular $\mathcal{M}^{(0)}$ reduces to $\mathcal{M}$. Following Atiyah and Singer, we define now a flat trace $\mathrm{tr}_k^\flat$ such that

$$\mathrm{Tr}_k^\flat\,\mathcal{M}^{(k)} = \int d\omega \sum_{x\in\mathrm{Fix}\psi_\omega} \frac{G_\omega(x)\mathrm{tr}_k(\wedge^k(T_x\psi_\omega))}{|\det(\mathbf{1}-T_x\psi_\omega)|},$$

where tr_k and det are the finite-dimensional trace and determinant. [Writing $\mathcal{M}^{(k)}$ as the limit of a regularized operator with kernel $M(x,y)$, we obtain $\mathrm{Tr}_k^\flat\,\mathcal{M}^{(k)}$ as the limit of $\int dx\,\mathrm{tr}_k M(x,x)$.] It is readily seen that

$$\mathrm{Tr}^\sharp\,\mathcal{M} = \sum_{k=0}^n (-1)^k \mathrm{Tr}_k^\flat\,\mathcal{M}^{(k)}$$

so that

$$\mathrm{Det}^\sharp(\mathbf{1}-z\mathcal{M}) = \prod_{k=0}^n \mathrm{Det}_k^\flat(\mathbf{1}-z\mathcal{M}^{(k)})^{(-1)^{k+1}}.$$

3. *Proposition.* *Let M be a compact Riemann manifold. We assume that $G_\omega : M \to \mathbf{C}$ and $\psi_\omega : X_\omega \to M$ (where X_ω is a δ-neighborhood of* $\mathrm{supp}\ G_\omega$*) are C^r, $r \geq 1$, depending measurably on ω, and that*

$$\int d\omega\, \|G_\omega\|_r < \infty, \quad \sup_\omega \|\psi_\omega\|_r < \infty.$$

Also assume that there is $\theta \in (0,1)$ such that

$$\mathrm{dist}(\psi_\omega x, \psi_\omega y) \leq \theta\,\mathrm{dist}(x,y)$$

for all x, y, ω. Then the part of the spectrum of $\mathcal{M}$ in $\{\lambda : |\lambda| > \theta^r e^P\}$ consists of isolated eigenvalues of finite multiplicities. Furthermore, $\mathrm{Det}_0^\flat(\mathbf{1}-z\mathcal{M})$ converges in $\{z : |z|\theta^r e^P < 1\}$, and its zeros there are precisely the inverses of the eigenvalues of $\mathcal{M}$ with the same multiplicity.

There are results similar to the above proposition for $\mathcal{M}^{(k)}$ and $\mathrm{Det}_k^\flat(\mathbf{1}-z\mathcal{M}^{(k)})$. It follows in particular that $1/\mathrm{Det}^\sharp(\mathbf{1}-z\mathcal{M})$ is meromorphic for $|z| < \theta^{-r}e^{-P}$. Note that for contracting ψ we have $L(x,\psi) = 1$; hence $\mathrm{Det}^\sharp = \mathrm{Det}^c$, and we obtain results for the dynamical zeta functions $\zeta(z)$ associated with smooth expanding maps (first studied by Tangerman). Proposition 3 also applies to a rational map F if it is hyperbolic, i.e., uniformly expanding in a neighborhood of the Julia set J (the closure of the set of repelling periodic orbits).

Proposition 3 is a nonstandard extension of the theory of Fredholm determinants. In its simplest form, Fredholm's theory applies to complex continuous kernels $K(x,y)$, where x and y vary over a bounded interval $[a,b]$. The formula

$$K\phi(x) = \int_a^b K(x,y)\phi(y)dy$$

defines a compact operator on the Banach space $\mathcal{B}$ of complex continuous functions on $[a,b]$ with the sup norm. The operators K as above form an algebra, with a trace

This result is proved in [4]. The condition $\sup_\omega \|\psi_\omega\|_r < \infty$ is missing in [4], but some form of this condition is used in Remark 3.3 of that paper. Note that we may take fractional $r = s + \alpha$, meaning that the s-th derivative is α-Hölder.

$$\mathrm{Tr}_F K = \int_a^b K(x,x)dx,$$

and one can define a *Fredholm determinant* by

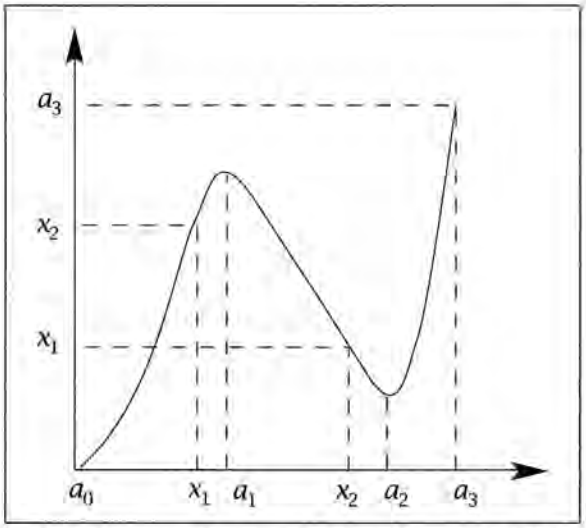
$$\mathrm{Det}_F(\mathbf{1} - zK) = \exp\left(-\sum_{m=1}^{\infty} \frac{z^m}{m} \mathrm{Tr}_F K^m\right)$$

or some equivalent formula. This determinant is an entire function of z which has a zero at λ^{-1} precisely when λ is an eigenvalue of K (the order of the zero and of the eigenvalue are the same). Fredholm's theory has been put on a more conceptual basis by Grothendieck, using kernels in the topological tensor product $\mathcal{B}^* \hat{\otimes} \mathcal{B}$ of a Banach space $\mathcal{B}$ and its dual $\mathcal{B}^*$. Grothendieck's extension of Fredholm's theory applies in particular to holomorphy-improving operators (these send a function holomorphic in D to a function holomorphic in D', where D is relatively compact in D'). The Fredholm-Grothendieck determinant $\mathrm{Det}_F(\mathbf{1} - zK)$ is an entire function of z, but note that in Proposition 3, $\mathrm{Det}_0^{\flat}(\mathbf{1} - z\mathcal{M})$ has in general a finite radius of convergence and that $\mathcal{M}$ is not a compact operator.

Proposition 3 applies to expanding maps. What about hyperbolic maps (say Anosov) on a compact manifold M? For such maps there is an invariant family of submanifolds of M called stable manifolds, which are uniformly contracted by the map. These manifolds are smooth, but the stable manifold through x does not depend smoothly on x, only Hölder continuously. For this reason one cannot readily extend to the smooth situation what was done (see Proposition 2 above) in the Hölder setting. [The case of C^ω Anosov maps in two dimensions has been elegantly treated by Rugh. The general case has been discussed by Kitaev, but his paper is difficult. Work by Fried on the subject remains unpublished. There is also recent work of Blank and of Keller and Liverani on transfer operators in two dimensions.] When the stable manifolds form a smooth family, an extension of Proposition 3 to the hyperbolic situation works well. This happens in particular for the geodesic flow on a manifold of constant negative curvature, where everything is C^ω: the zeta functions are quotients of Grothendieck-type determinants, and thus meromorphic in $\mathbf{C}$ (Ruelle). This agrees with what is known about Selberg zeta functions and extends to other situations (Mayer, Patterson).

Kneading Determinants

Milnor and Thurston have studied continuous piecewise monotone maps of the interval $[a_0, a_N]$ to itself that are strictly monotone on subintervals $[a_{i-1}, a_i]$, where $a_0 < a_1 < \ldots < a_N$. A (slightly modified) zeta function ζ_{MT} which counts periodic orbits with a weight 1 satisfies



A continuous piecewise monotone map of the interval $[a_0, a_3]$ to itself, with three subintervals where the function is strictly monotone. $\{x_1, x_2\}$ is a periodic orbit of order 2.

$$\zeta_{MT}(z).\Delta(z) = 1, \tag{10}$$

where Δ is the determinant of a certain $(N-1)\times(N-1)$ matrix called the *kneading matrix*. The elements of the kneading matrix are power series in z with coefficients $0, \pm 1$ determined in terms of the signs of the $f^m a_i - a_j$. In particular, $\zeta_{MT}(z)$ is meromorphic in the unit disc. Can one extend the combinatorial identity (10) to dynamical zeta functions with weights? Baladi and I obtained an extension where Δ is replaced by a functional determinant.

We consider generalized transfer operators $\mathcal{M}$ acting on the Banach space $\mathcal{B}$ of functions of bounded variation on $\mathbf{R}$, so that

$$(\mathcal{M}\Phi)(x) = \sum_{\omega} G_\omega(x)\Phi(\psi_\omega x).$$

Here the $G_\omega : \mathbf{R} \to \mathbf{C}$ are of bounded variation, compactly supported, and (for simplicity) continuous; ψ_ω is a homeomorphism of an interval of $\mathbf{R}$ containing supp G_ω to an interval of $\mathbf{R}$, and we assume $\sum_\omega \mathrm{Var}\, G_\omega < \infty$. Write $\epsilon_\omega = +1$ ($\epsilon_\omega = -1$) if ψ_ω is increasing (decreasing). The operators $\mathcal{M}$ form an algebra $\mathcal{A}$ with an involution $\mathcal{M} \to \widehat{\mathcal{M}}$ where

$$(\widehat{\mathcal{M}}\Phi)(x) = \sum_{\omega} \epsilon_\omega G_\omega(\psi_\omega^{-1}x)\Phi(\psi_\omega^{-1}x)$$

and, using the sup norm $\|\cdot\|_0$, we write

$$R = \lim_{m\to\infty} (\|\mathcal{M}^m\|_0)^{1/m}, \quad \hat{R} = \lim_{m\to\infty} (\|\widehat{\mathcal{M}}^m\|_0)^{1/m}.$$

It turns out that, for the spectrum of $\mathcal{M}$ acting on $\mathcal{B}$,

$$\hat{R} \le \text{spectral radius of } \mathcal{M} \le \max(R, \hat{R})$$
$$\text{essential spectral radius of } \mathcal{M} \le \hat{R}.$$

The interesting case is when $R \neq \hat{R}$. In particular, if $\hat{R} < R$ and all G_ω are ≥ 0, then R is an eigenvalue of $\mathcal{M}$.

The sharp trace $\mathrm{Tr}^\sharp$ defined earlier can be extended to $\mathcal{A}$ by writing

$$\mathrm{Tr}^\sharp \mathcal{M} = \sum_\omega \int \frac{1}{2}\mathrm{sgn}(\psi_\omega(x) - x)\, dG_\omega(x),$$

where $\mathrm{sgn}\ \xi = \xi/|\xi|$ if $\xi \neq 0$ and $\mathrm{sgn}\ 0 = 0$. We can then define the zeta functions

$$\zeta(z) = \frac{1}{\mathrm{Det}^\sharp(\mathbf{1} - z\mathcal{M})}, \quad \hat{\zeta}(z) = \frac{1}{\mathrm{Det}^\sharp(\mathbf{1} - z\widehat{\mathcal{M}})},$$

and interestingly we have the *functional equation* $\zeta(z)\hat{\zeta}(z) = 1$ (from $\mathrm{Tr}^\sharp \mathcal{M} + \mathrm{Tr}^\sharp \widehat{\mathcal{M}} = 0$).

A bounded nonatomic measure on $\mathbf{R}$ is given by

$$\mu(dx) = \sum_\omega |dG_\omega(x)| + \sum_\omega |dG_\omega(\psi_\omega^{-1}x)|.$$

We define now a *kneading operator* $\mathcal{D}$ on $L^2(\mu)$ by

$$(\mathcal{D}\phi)(y) = \sum_\omega \int \phi(x)\, d(zG_\omega(x)) \times \{[(\mathbf{1} - z\mathcal{M})^{-1}\frac{1}{2}\mathrm{sgn}(\cdot - y)](\psi_\omega x)\}$$

and similarly an operator $\widehat{\mathcal{D}}$. The kernel of $\mathcal{D}$ is given by

$$\mathcal{D}_{xy} = \sum_{k=1}^{\infty} z^k \sum_{\omega_1,\cdots,\omega_k} \frac{dg_{\omega_1}(x)}{\mu(dx)} \cdot g_{\omega_2}(\psi_{\omega_1}x)\ldots g_{\omega_k}(\psi_{\omega_{k+1}}\ldots\psi_{\omega_1}x) \times \frac{1}{2}\mathrm{sgn}(\psi_{\omega_k}\ldots\psi_{\omega_1}x - y).$$

It turns out that $\mathcal{D}$ is Hilbert-Schmidt, and one can define a functional determinant

$$\mathrm{Det}(\mathbf{1} + \mathcal{D}) = \exp\Big(\int \mu(dx)\,\mathcal{D}_{xx} + \sum_{m=2}^{\infty} \frac{(-1)^{m-1}}{m}\mathrm{Tr}\mathcal{D}^m\Big).$$

What corresponds to the Milnor-Thurston determinant is here $\mathrm{Det}(\mathbf{1} + \widehat{\mathcal{D}})$; i.e., one can prove the identity

$$\zeta(z) = \mathrm{Det}(\mathbf{1} + \widehat{\mathcal{D}})^{-1}.$$

From this one can deduce that the determinant $\mathrm{Det}^\sharp(\mathbf{1} - z\mathcal{M}) = \mathrm{Det}(\mathbf{1} + \widehat{\mathcal{D}})$ is holomorphic for $|z| < \hat{R}^{-1}$ and that its zeros there are the λ^{-1} where $\hat{R} < |\lambda| < R$ and λ is an eigenvalue of $\mathcal{M}$ (of the same multiplicity).

Extensions of the theory of kneading determinants to dimension greater than 1 have been studied (Baladi, Kitaev, Ruelle, Semmes, Baillif) and are currently an active area of research, but only partial results have been obtained so far.

Some Loose Ends

Counting periodic orbits with weights is a natural idea. And we have seen that it relates to very different areas of mathematics: thermodynamic formalism, hyperbolic dynamics, Selberg zeta functions, Grothendieck-Fredholm determinants, kneading determinants, etc. The "hyperbolic" part of the theory of dynamical zeta functions is excellently presented in the monograph of Parry and Pollicott [2], which gives more details on the relation with the thermodynamic formalism than could be given here. For further developments we refer to Baladi's monograph [1], which discusses in particular the relation between spectral properties of transfer operators and the decay of correlations. A discussion of the decay of correlations would have taken us too far afield, but this is an important topic which has progressed in recent years, thanks to the work of Dolgopyat on hyperbolic flows and the very general ergodic results of Young [5]. Using the extensive bibliography of [1], the interested reader can get access to many other questions: for instance, the surprising results of Mayer on the continued fraction transformation and the modular surface, and the very explicit formulas obtained by Levin, Sodin, and Yuditskii in the study of Julia sets.

Dynamical zeta functions and the related concepts discussed in this article form a rather open field of investigation. Some astonishing developments have occurred in the past. And new technical or structural ideas might again drastically change our view of the subject in the future.

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The IAS School of Mathematics

Allyn Jackson

Depending on how one counts, the number of major mathematics institutes worldwide falls between ten and twenty. In a very real sense, the forerunner of them all is the School of Mathematics at the Institute for Advanced Study (IAS) in Princeton, New Jersey. That the school is still known informally among mathematicians as *the* institute is an indication of its preeminent status. Founded in the 1930s as the first of four schools at the IAS, the School of Mathematics is internationally known for having a powerhouse permanent faculty and for giving many postdocs their first opportunities for independent research. Over the years the school has grown and evolved as mathematics has changed and as the institutional structures supporting the field have grown more diverse and complex. Nevertheless, the School of Mathematics remains, as one recent visitor put it, "an island of sanity where scholarship is rewarded on its own terms."

Birth of the IAS

The IAS was founded in 1930 with funds donated by Louis Bamberger and his sister, Caroline Bamberger Fuld. The siblings had made $25 million by selling Bamberger's, a large department store chain, to the R. H. Macy Company just six weeks before the 1929 stock market crash that set off the Great Depression. They wanted to donate $15 million to a good philanthropic cause and initially thought of starting a medical school. They solicited advice from Abraham Flexner, a prominent authority on higher education in the United States. At this time Flexner was just finishing a book about universities in which he set forth a vision of a new kind of institution that would be devoted to advanced research. He convinced the Bambergers that their money would best be put to use in realizing this vision.

Also around this time Flexner had been in touch with the mathematician Oswald Veblen, who was at Princeton University, and Veblen eventually became one of his close advisers and one of the first professors appointed to the new institute. Flexner decided to start the institute with mathematics partly because the field's fundamental character fit with his notion of an institute where pure intellectual achievement was the goal. But he was also a practical man: one reason for starting with mathematics was that it was cheap. As Beatrice Stern put it in her history of the IAS [S], mathematics "required only a few rooms, books, blackboards, chalk, paper, and pencils." Flexner also found he could count on a degree of unanimity of opinion about who were the best mathematicians to hire for his new venture. Mathematics made sense, too, because of its connections to economics and physics, two other areas that Flexner had in mind for the IAS.

The institute's prestige was virtually assured from the start, for one of its first appointments was that of Albert Einstein. Like many other American institutions, the IAS benefited from the flight of intellectuals from Europe during the rise of Nazism. The institute officially began in 1933, and by the following year the faculty had grown to six: Einstein,

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Veblen, James Alexander, Marston Morse, John von Neumann, and Hermann Weyl; Kurt Gödel also came in 1933 but was not made a professor until twenty years later. At first the IAS occupied offices in Fine Hall, home of the Princeton University mathematics department. In 1939 the IAS moved to the newly built Fuld Hall, which is now the institute's main building, located in a bucolic setting of lawns and trees about one mile from the Princeton campus. Today, in addition to the School of Mathematics, the IAS has three other schools: the School of Natural Sciences, the School of Historical Studies, and the School of Social Science.

In an article about the history of the School of Mathematics [B], Armand Borel, now a professor emeritus there, comments that the institute was based on a "somewhat romantic vision" of a handful of elite scholars surrounded by a few carefully chosen associates who together would churn out one great idea after another. Borel writes: "Einstein, Weyl, and Veblen soon decided they were not quite up to that lofty ideal and that a justification for the Institute would not be just their own work but, even to a much greater extent, to exert an impact on mathematics...chiefly through a vigorous visitors program." Thus, from the very beginning the School of Mathematics established itself as a center where visiting mathematicians could get away from everyday distractions and concentrate on research. Initially there were suggestions that the IAS should award degrees, and Flexner obtained the necessary accreditation in 1934. Though the accreditation remains valid today, the institute has never granted any degrees. The emphasis has always been on education and training from the postdoctoral level upward.

Much of the early history of the institute can be found in the book *Who Got Einstein's Office?* [R], by the science writer Ed Regis. The question posed in the book's title is one that, according to IAS public affairs officer Georgia Whidden, is often asked today; people seem to expect that the office Einstein used would have been made into a sort of shrine, and Whidden says some grow testy when told it was not. The office was passed on to astronomer Bengt Strömgren and then to mathematician Arne Beurling; now it is the office of Robert Langlands. Entertaining and down-to-earth, Regis's book outlines the institute's history and describes some of the research that has gone on there. The book also delights in taking an irreverent look at what Regis describes as "infighting and backstabbing" going on behind the scenes. A mention of the book elicits a groan from Borel, who says that the book suffers from historical inaccuracies and makes it seem as if no serious intellectual activity goes on at the IAS.

The history by Beatrice Stern also had a less-than-enthusiastic reception by some of the institute

Photograph by Allyn Jackson.

Fuld Hall, the main building on the IAS campus.

faculty. J. Robert Oppenheimer, who served as IAS director from 1946 to 1966, commissioned Stern to write it. In *Who Got Einstein's Office?* Regis says he had a hard time obtaining a copy of Stern's history—no one at the IAS would show it to him—and winds up concluding that the institute was trying to suppress the document. Today a copy of Stern's history sits innocuously on a shelf in the Historical Studies Library. Ponderously written and meticulously researched, the book does not appear to contain any scandalous revelations. According to one IAS official, the history was never published because its scholarship was not up to institute standards and because it was somewhat gossipy. Some on the faculty were offended by Stern's portrayal of Oswald Veblen as scheming and power hungry.

Old Traditions, New Directions

Just as in Flexner's time, today IAS professors have no teaching duties, few administrative chores, and plenty of time to think. But having so much freedom year-round is not to everyone's taste. "The pressure of only doing research might be counterproductive," says Andrew Wiles of Princeton University. He has a special arrangement at the moment whereby he spends one term teaching at Princeton and one term doing research at the institute. In explaining why he likes this arrangement, he recalls a saying: with an undergraduate one can answer almost any question, with a graduate student one can answer some of the questions, but with a postdoc one can rarely answer any question at all. Right now Wiles is spending his time learning some analytic number theory, which he believes is especially important for the Langlands Program. His Princeton colleague and fellow number theorist Peter Sarnak has a similar arrangement and spends one term each year at the IAS.

Photograph by Allyn Jackson.

A bust of André Weil in the common room of the IAS mathematics building.

The research areas of Wiles and Sarnak are very much in keeping with the tradition in number theory that has been a mainstay of the School of Mathematics for many years, nourished by such permanent faculty as Carl Ludwig Siegel, Atle Selberg, André Weil, Enrico Bombieri, and Robert Langlands. Other areas historically associated with the IAS are algebraic geometry, representation theory, and Lie group theory. When he was on the IAS faculty from 1963 until his untimely death twenty years later, Harish-Chandra faithfully lectured two hours every week on his own work. His prodigious output is one reason the School of Mathematics came to be known around this time as the Institute for the Study of Semisimple Lie Groups. Jokes aside, breadth of coverage has always been a concern of the School of Mathematics faculty. Its small size—which has varied from six to eight permanent professors over the years—means that the school cannot cover the whole field. Efforts are made to avoid too much duplication in the professors' research and to respond to developments in mathematics by making permanent appointments in new areas. Such considerations led to the appointment of Michael Atiyah in 1969, John Milnor in 1970, and Shing-Tung Yau in 1980 (all three have since moved on to new positions). The school gained strength in analysis and applied mathematics through the 1985 appointments of Luis Caffarelli and Thomas Spencer and the 1994 appointment of Jean Bourgain; Caffarelli has now left, but Bourgain and Spencer are still at the institute. And in 2000 the school branched out into theoretical computer science with the appointment of Avi Wigderson, 1994 winner of the Nevanlinna Prize.

But the breadth of the permanent faculty does not tell the whole story; each year the school has about sixty long-term visitors, called "members", who range across all of mathematics. Indeed, some of the great achievements associated with the IAS were carried out by members: for example, Raoul Bott discovered crucial ideas leading up to his periodicity theorem while he was at the IAS, and Friedrich Hirzebruch completed his proof of the Riemann-Roch theorem there. Most mathematics institutes are organized around programs focused on particular areas, and the majority of visitors are clustered in those areas. At the IAS it is just the reverse: the majority of the members are not associated with the so-called "special programs". One, two, or sometimes three special programs are held each year, but they account for at most one-third of the members and do not dominate the school's activities. Consequently, over an academic year at the IAS, a great variety of different mathematical areas are represented. As Borel points out, the school offers many opportunities for chance encounters with new ideas. "Very often [such an encounter] creates a considerable change in the outlook and career of that person," he notes. "That is to me one of the main virtues of the institute, and it remains as it ever was."

The special programs at the School of Mathematics are usually organized by a senior mathematician from outside the IAS. Bombieri remembers one program in the 1970s on the classification of finite simple groups, organized by the late Daniel Gorenstein. "He would come to my office and teach me finite groups," Bombieri recalls. Under Gorenstein's tutelage, Bombieri began to get interested in the classification of finite simple groups. "Somehow it was the atmosphere here at the institute," Bombieri says. "Everybody was very excited about finite groups." It was while Robert L. Griess Jr. was a member at the IAS that he proved the existence of the celebrated monster group. Sometimes a program organizer is appointed as a Distinguished Visiting Professor (DVP), meaning that he or she has the same salary and benefits as the permanent IAS faculty. During the 2001–2002 academic year Yakov Eliashberg was named DVP and organized a program in symplectic geometry, the activities for which encompassed about fifteen members and two conferences. Sometimes faculty from Princeton University organize programs, such as the one to be held during 2002–2003, organized by Weinan E, which will focus on stochastic partial differential equations and models of turbulence.

That the school is running a program in such an applied area is indicative of an evolution that has been going on at the IAS for the past fifteen or twenty years. "It used to be that if you understood what a differential is, you were out—that was already too applied," one observer joked. Since the hiring of Spencer, who has broad interests ranging from statistical mechanics to turbulence to materials science, the School of Mathematics has begun to expand into more applied areas. "We have a reasonably high profile [in applied mathematics], so people who would never have applied here before,...now they know this is a place that is interested in the area," Spencer notes. With a grant from the Sloan Foundation, which was specifically aimed at helping the institute explore areas of applied mathematics, the school organized several programs in theoretical computer science and combinatorics between 1993 and 1999. At the end of

this time the school hired Wigderson, whose appointment represented an expansion of the faculty size from seven to eight. "We believe that [discrete mathematics and theoretical computer science] is an area which is extraordinarily interesting and will be so for the next thirty years at least," Bombieri says. "It took six years of continuous programs and presence in combinatorics and computer science before we said, 'Okay, now we are convinced that it's really good and we want that.' And that's when we hired Avi."

Biology has never had a permanent presence at the IAS. Borel has been a faculty member during the tenure of five different directors, and he says all of them considered adding biology, including Oppenheimer. "I remember a faculty meeting where Oppenheimer said that the first third of this century was for physics, the second third was for mathematics, and the third third will be for biology," Borel recalls. But nothing more than inviting a few biologists as members was done. A much more ambitious move came in 1998, when, at the initiative of director Phillip Griffiths and Natural Sciences faculty member Frank Wilczek, the IAS launched the Program in Theoretical Biology (PTB). Griffiths explains that the plan is for the institute to try out several areas of biology for periods of five years. In this way, he says, "the institute is seeking to develop a sense of the way we can best contribute to biology on an ongoing basis."

The PTB began with the area of mathematical biology and with the five-year appointment of Martin Nowak, who came to the IAS in 1998. A leading theoretical biologist and protégé of Robert May, Nowak uses mathematical modeling to investigate a wide range of problems, such as language evolution, the development of tumors, and the spread of viruses, especially HIV, in the human body. At the moment Nowak's group has eight people, some of them postdocs and some midcareer or senior researchers. During 2001–2002 he has run a seminar together with Spencer and Joel Lebowitz, a member visiting from Rutgers University. The aim of the seminar is to bring in speakers who can communicate well with mathematicians about mathematical aspects of biology. Nowak also collaborates with medical researchers at nearby institutions.

Naming bioinformatics, protein folding, theoretical neurobiology, and theoretical ecology as some of the areas the institute could pursue, Nowak contends that there should be no hesitation in starting a permanent IAS School of Biology. "It's obvious that this is the thing to do," he remarks. Others at the institute seem less sure. The main question is whether, with its small size and without laboratories, the IAS can make a contribution to biology at the highest level. "Biologists correctly criticize a lot of mathematical work as being irrelevant," Spencer says. "But on the other hand, they've realized they do need more mathematical tools. So you have to pick the problems, you have to pick the areas pretty carefully." Faculty member Pierre Deligne sums up how some in the School of Mathematics feel about adding biology at the IAS: "If we can do it well, then it's worth doing. But if we cannot do it really well, we can do without."

The institute has moved to continue its exploration of biology: in early June 2002 it announced that the next area of emphasis would be biophysics and that Arnold Levine of Rockefeller University has been appointed to a five-year term. Levine is "perhaps the leading cancer biologist of his generation," Griffiths notes. "He sees the future of biology as being tightly dependent on linking it to physics,

School of Mathematics Faculty

Below are the names of past and present professors in the IAS School of Mathematics, followed by the year of the appointment and the year of resignation or retirement.

* James W. Alexander, 1933–1947
Michael F. Atiyah, 1969–1972
* Arne Beurling, 1954–1973; Emeritus, 1973–1986
Enrico Bombieri, 1977–present
Armand Borel, 1957–1993; Emeritus, 1993–present
Jean Bourgain, 1994–present
Luis A. Caffarelli, 1986–1996
Pierre Deligne, 1984–present
* Albert Einstein, 1933–1946; Emeritus, 1946–1955
* Kurt Gödel, 1953–1976; Emeritus, 1976–1978
* Harish-Chandra, 1963–1983
Lars Hörmander, 1964–1968
Robert P. Langlands, 1972–present
Tsung Dao Lee, 1960–1962
Robert D. MacPherson, 1994–present
John W. Milnor, 1970–1990
* Deane Montgomery, 1951–1980; Emeritus, 1980–1992
* Marston Morse, 1935–1962; Emeritus, 1962–1977
* J. Robert Oppenheimer, 1947–1966
Abraham Pais, 1950–1963
Tullio Eugene Regge, 1965–1966
Atle Selberg, 1951–1987; Emeritus, 1987–present
Carl Ludwig Siegel, 1945–1951
Thomas Spencer, 1986–present
Bengt Strömgren, 1957–1966
* Oswald Veblen, 1932–1950; Emeritus, 1950–1960
Vladimir Voevodsky, 2002–present
* John von Neumann, 1933–1957
* André Weil, 1958–1976; Emeritus, 1976–1998
* Hermann Weyl, 1933–1951; Emeritus, 1951–1955
* Hassler Whitney, 1952–1977; Emeritus, 1977–1989
Avi Wigderson, 1999–present
Chen Ning Yang, 1955–1966
Shing-Tung Yau, 1980–1984

* Deceased

Photograph by Allyn Jackson.

Clifford H. Taubes of Harvard University presenting the 2002 Hermann Weyl Lectures in the seminar room of the IAS mathematics building.

computer science, mathematics, etc., and establishing those linkages was the hallmark of his tenure as president of Rockefeller University." Levine will start his appointment at the institute in 2002 or early 2003.

Another way in which the institute has changed is that it now has some programs that address education and equity issues. Since 1991 the IAS has sponsored the Park City Mathematics Institute (PCMI), an annual three-week program held at a conference center in Park City, Utah. The PCMI brings together mathematicians, postdocs, graduate students, undergraduates, and mathematics school teachers. While there are activities tailored for the different groups—this year the research part will focus on automorphic forms, and the education part will focus on mathematics knowledge for teachers—a main goal is to get the groups to interact. The IAS Mentoring Program for Women in Mathematics was originally designed to prepare women for participation in the PCMI. But the two-week program developed a life of its own and is now an independent program jointly sponsored by the School of Mathematics and the mathematics department at Princeton University. The School of Natural Sciences is starting a similar program this year, which will target members of minority groups as well as women.

Appointing New Professors

When it comes time to fill a vacant professorship, the School of Mathematics has a big job on its hands. The number one requirement is stellar mathematical achievements, but there are other considerations as well. "You want to avoid too much overlap between the interests of the faculty," Bombieri explains, "but at the same time, you don't want the faculty areas to be so far apart that they become overly isolated." Personality characteristics such as whether the candidate interacts well with other people or tends mostly to work alone can also come into play. Another factor is the current age distribution in the faculty. Deligne remarks that the school has had a tendency to appoint older, established people rather than taking risks on younger mathematicians. "We have been a little bolder recently," he notes. "I think hiring Voevodsky was very good." Vladimir Voevodsky, appointed in February 2002, is thirty-six years old. The school will not make any more permanent appointments until the retirement of Bombieri and Langlands.

As might be expected in a place where high-achieving, strong-minded people are brought together, there are disagreements from time to time about who should join the elite group of IAS professors. In the late 1980s there was a contentious battle over a proposal by the School of Social Science to appoint Bruno Latour, a French sociologist of science whose works have been lambasted by some scientists. The entire IAS faculty is invited to comment on all appointments, and professors in the School of Social Science enthusiastically backed Latour's appointment, while those in the Schools of Mathematics and of Natural Sciences adamantly opposed it. Before a final decision was made about whether to make an offer to Latour, he withdrew his candidacy, in order, he told *Lingua Franca* magazine [Be], to avoid embarrassing his backers at the institute.

Controversy has also surrounded Piet Hut, an astrophysicist who was appointed to the faculty of the School of Natural Sciences in 1985. The initial proposal to appoint Hut met with skepticism among some of the IAS faculty, but his supporters at the institute won out. Dissatisfaction grew as Hut began to write nontraditional papers relating Western science and Eastern philosophy. A 1993 visiting committee evaluating the School of Natural Sciences singled Hut out as a weak point. In an attempt to settle the matter quietly, Griffiths drew up a letter of agreement, which Hut signed, stipulating that Hut would leave the institute by the year 2001. When the time came for him to leave, Hut declared the agreement invalid and said he would remain on the faculty. The institute filed a motion in court to determine whether the agreement he signed was legally binding. News of the motion provoked outrage within the academic community, where the motion was mistakenly seen as a lawsuit and as an attempt to revoke Hut's tenure and restrict his academic freedom. The institute quickly backed out of the legal proceedings, because, Griffiths says, "In the big picture this is a relatively small matter, and we didn't want it to be a distraction for the members and faculty." Hut remains at the IAS, and next year he will become a professor without a school affiliation.

The Hut and Latour appointments were proposed at a time when the procedure for evaluating such proposals was handled completely internally by the IAS. Today the evaluation is made by a

six-person committee consisting of three IAS professors from outside the school where the appointment would be made and three experts from outside the IAS. Since the new procedure was put in place, no public battles have erupted. It is a fact that in mathematics, more so than in other fields, there is greater consensus about who is at the top of the field, and disagreements like the ones over Hut and Latour have never plagued the School of Mathematics. When a mathematician is proposed for a permanent appointment, "the other schools care a lot, and they look carefully at the files," says mathematics faculty member Robert MacPherson, but there has never been widespread disagreement. "There were none that were turned down, and none that were later seen as a mistake by the faculty at large."

The Atmosphere: Serious, Intense

Every afternoon at three o'clock IAS members and faculty gather for tea in the common room of Fuld Hall, the 1939 Georgian-style brick building that is the focal point of the institute campus. The common room has an Old World feel, with oriental rugs and leather sofas. Some remember the good old days, when the serving staff was a bit less brusque and the beverages were served in china rather than paper cups. But the purpose of teatime remains the same: to provide an opportunity for relaxation and informal chit-chat. Because so many mathematicians from so many places pass through the institute during a year, going to tea is a good way to catch up on the latest news and gossip.

The atmosphere at the institute is intense and serious, but not frenetic. In the School of Mathematics there are seminars and lectures every day, but the schedule is not so overloaded as to distract members from their own work (though members participating in a special program tend to be busier than others). Some members might have a specific project they are focusing on, while others come to the IAS to expand their horizons, explains Mark de Cataldo, a member visiting from the State University of New York at Stony Brook. He has been doing the latter, reading papers that he would not ordinarily find the time to read. "The IAS gives you time to think about new things," he remarks. Members can literally do whatever they want, including doing nothing. "But if you come here for a whole year and you get nothing done, you'll feel bad," de Cataldo says. "So there is an internal pressure. It's a pretty large pressure."

Generally the working conditions are excellent. Each member gets his or her own computer-equipped office (though sometimes short-term visitors must share). The computing facilities work fairly well but can be a little chaotic: for example, a "print" command may send one's document to a printer in another building. The school's ample and helpful

Photograph courtesy of Public Affairs Office, IAS.

Simonyi Hall.

secretarial staff runs a tight ship. Some members were surprised to find the lecture hall patrolled by one of the staff, who forbade anyone from taking drinks inside. One member who broke the rule received a reprimand by letter. A short-term visitor who had just arrived and was filling out the necessary forms was treated to a lecture from a staffer about the necessity of following the institute's rules, though he was unaware he had broken any.

The mathematics and physics library, located on the second floor of Fuld Hall, is well stocked for IAS needs. When it comes to mathematics books, the collection is quite good; lack of space, rather than lack of funds, is the main limitation. As for mathematics journals, the holdings are less extensive: the library subscribes to a core set of about 140 journals. Just about anything that is not in the IAS library can be obtained within a day or two from the Princeton University library. And if one needs a single paper not available at the institute, there is an electronic system whereby a request can be sent to Princeton to scan the article and send it as a PDF file. Librarian Momota Ganguli, a cheery and helpful presence at the IAS for the past twenty years, is happy to make such requests and says that they are usually filled within a couple of hours. In another sign that the good old days are gone, the library is no longer open to all around the clock; members are issued passkeys to enter after hours. The passkey system, which is also used for other buildings on the campus, was installed a few years ago after a security guard found a couple of men rolling up rugs and carrying them out of the common room.

For many years the offices of the School of Mathematics were spread across the IAS campus. Some were in Fuld Hall and some were in Building C, the squat brick structure a few steps away. Others were in the ECP Building, which was purposely built for von Neumann's Electronic Computer Project. After von Neumann died, the computer was moved to the Smithsonian Institution, and the ECP Building was converted into offices. A 5-minute walk from Fuld Hall, the ECP Building is much less convenient for

Photograph courtesy of Public Affairs Office, IAS.

Aerial view of the IAS campus.

accessing the library and going to tea. Some liked having offices in the ECP because it was quiet and had central air-conditioning; others felt like second-class citizens. Today the ECP houses a child-care center and a fitness room, and the School of Mathematics has a new building, Simonyi Hall, finished in 1993. The building is named after Charles Simonyi, distinguished engineer at Microsoft and an IAS trustee, who made a major donation to the School of Mathematics.

Comfortable and elegant, Simonyi Hall bears little resemblance to other purpose-built mathematics institute buildings, such as the Mathematical Sciences Research Institute in Berkeley or the Isaac Newton Institute in Cambridge, where the buildings encourage interactions by their very design. Simonyi Hall, by contrast, is more like an office building, with long corridors and no central area for mingling. Even the design and placement of the common room do not invite one to wander in and hang around. Because the library and the afternoon teas were to remain in Fuld Hall, creating spaces for informal contacts at Simonyi was not a priority. In addition, Simonyi Hall was not designed to hold the entire School of Mathematics; about thirty, or around half, of the mathematics offices remain in Fuld Hall.

The institute's several buildings stand in a parklike setting of lawns and trees. Flocks of geese collect around an artificial pond that forms part of the institute's heating and cooling system. There is comfortable on-campus visitor housing and laundry facilities, as well as the much-beloved IAS dining hall. All of this is situated on 800 acres of woods, which are under a permanent preservation agreement and will never be developed. The somewhat sleepy town of Princeton is about half an hour by foot; New York City is an hour by train. Whether the setting strikes one as idyllic or boring may depend on one's mood. As one younger member put it, "If you want to work, it's great. But if you don't feel like working, it's a prison." But probably the prevailing view was expressed by a senior member, who said, "For a mathematician coming here on sabbatical, it's like a country club."

Where the Gods Reside

John Nash comes quietly down the stairs and makes his way over to a stack of lunch trays, his sneakers padding softly across the floor. Edward Witten, tall and stately, carries his tray to the table where the physicists have lunch. Next one might see Andrew Wiles, then more Fields Medalists: Enrico Bombieri, Jean Bourgain, Pierre Deligne. This is the daily scene in the IAS dining hall, one of the main centers of social activity at the institute. The excellence of the food and the reasonable prices mean that a large fraction of the faculty and members eat lunch in the dining hall every day.

At the table where the mathematicians customarily sit, the conversation is casual and lively—and not always about mathematics. Despite the informality, it can be daunting to be plunged into the company of so many mathematical giants. Recalling his own time as an IAS postdoc in the late 1960s, Herb Clemens of the University of Utah says, "Your first goal when you arrive is to avoid embarrassing yourself" in front of all these "gods who are floating around." A legend from the 1950s, promulgated by the late Irving Segal and still in circulation today, maintains that the School of Mathematics professors keep in the basement a list of the top ten mathematicians in the world—and the list is updated *daily*.

The perception of the IAS as an intimidating place is very much in the eye of the beholder and probably afflicts postdocs more than midcareer or senior mathematicians. Finding that some postdocs end up feeling a bit lost and isolated, the School of Mathematics has set up a system whereby each faculty member is assigned about five postdocs to look after. In the old days each member was expected to turn up in Hermann Weyl's office and spend ten minutes describing what he or she was working on. Taking a less pressurizing tack, the school now has established a tradition whereby each member presents such a description in a 15-minute talk that is open to the whole institute. The IAS also sponsors a host of social events, from wine tastings to dancing lessons to excursions in New York City and Philadelphia, all designed to help members get to know one another and become acclimated to the social environment.

That it takes postdocs some time to get settled is one reason some mathematics faculty members support the idea of more multiyear postdocs. Very few postdoctoral visitors are offered more than one year in the School of Mathematics, and a handful are renewed after a year. By contrast, in the

School of Natural Sciences three- and five-year appointments are the norm. But in mathematics for a postdoc not to teach for such a long period puts him or her at a big disadvantage when it comes time to look for a permanent position. A good compromise is reached with the three-year Veblen Research Instructorships, in which a year of research at the institute is sandwiched between two years of teaching at Princeton University. The School of Mathematics now has about five Veblen postdocs in residence each year.

The school annually receives over four hundred applications for about sixty member slots. Usually fifteen to twenty slots are set aside for invitations to participants in the year's special programs, and about half of the slots go to postdocs. Most members come for the full academic year, some for only a term. In coming years the school plans to shift slightly the balance of its memberships away from postdocs and toward midcareer mathematicians. "These are the people who are already reasonably established in their fields, and when they come here, they are not lost; they know what they want to do, and their time can be used efficiently," Spencer explains. "That's sort of the ideal candidate for us."

Decisions about whom to invite as members are made collectively by the School of Mathematics faculty. Each faculty member can appoint one person as an "assistant" without having to get the approval of the full faculty. Nowadays, though, this privilege is rarely exercised. Much more common is to invite collaborators for short-term visits, which might last from a week to a month; members can also extend such invitations after getting the faculty's approval. Decisions about the topics of special programs are also made collectively in the School of Mathematics. "We work as a team," says Bombieri. "We definitely don't say 'It's my turn to do this, I want this, I want that.' There are collective decisions every time." Generally the topics for special programs are decided three or four years in advance.

The standard package for postdocs in the School of Mathematics is $45,000 per year; some younger members who are past the postdoc stage also receive this package. For senior people the compensation picture varies. For example, if a person's presence is important for a special program, then the school will make efforts to see that the compensation is sufficient to attract that person. For a member coming on sabbatical with half-salary from the home institution, the school generally cannot make up the full pay, especially given the rapid growth in salaries for those at the top of the field. The situation for short-term visitors also varies: one person who asks out of the blue to come to the IAS for a month might receive only free housing, while another who is invited for a month to take part in a special program might be paid a stipend and receive travel costs as well. As MacPherson sums it up, "We have flexibility. What we don't have is lots of money." It is this flexibility that allows the IAS to attract a good number of top senior mathematicians every year. As a result, the institute has a quite different atmosphere from other institutes that are populated mostly by postdocs.

Much of this flexibility comes from the institute's $400 million endowment, which covers about $1.5 million paid to members each year; the endowment also pays the salaries of the permanent professors. In addition, there are a few separate endowments, earmarked specifically for School of Mathematics activities. The school has for years received grants from the National Science Foundation (NSF) to support visitors, and these grants carry more restrictions than does the endowment money. For example, there is pressure to use the NSF money predominantly to support U.S. citizens and to move in more applied directions. Right now the school has a $6 million, five-year grant from the NSF. When that grant runs out in 2003, the School of Mathematics will officially become an NSF-funded mathematics institute (see "New NSF Institutes Announced," page 945 in this issue). The school also has a grant from the computer science directorate of the NSF to support activities of Avi Wigderson's group. Altogether, the school runs on a budget of around $6 million per year. As a comparison, the NSF-funded mathematics institutes have budgets in the range of $3 million to $5 million per year.

The Peerless IAS

The influence of the IAS on the development of mathematics, especially in the United States, has been enormous. From its beginnings, the IAS was a magnet for the best mathematicians, giving them ideal working conditions and making a statement, heard clearly by other institutions, about the need to prize and cultivate mathematics research. "Already applications have been received for next year from men who have reached the position of associate professor in the most prominent institutions in the United States," wrote Abraham Flexner in the minutes of a trustee's meeting from 1934 [S, page 187]. "I confess that I myself did not expect that so promptly we should attract scholars who will probably ten years hence be leading figures in the mathematical world."

If the institute today does not have as decisive an influence in the mathematical world as it did in the past, this is probably due to changes in mathematics and the institutions supporting it than to any decline in quality at the School of Mathematics. For one thing, mathematics is simply a much larger field today, and it is far more difficult now than it was, say, forty years ago, for eight faculty members to

exert a large influence in the field. Nowadays there is not just *the* institute, but many institutes, as well as mathematics departments that offer low teaching loads and good conditions for research. "It used to be that if you were a pretty good graduate student and you had a good adviser, you would very likely come to the institute as a postdoc," remarks James Arthur of the University of Toronto, who has visited the institute many times and now sits on the IAS Board of Trustees. The growth in number of mathematicians means that the IAS has lost its position as the way station that everyone destined for a research career would eventually pass through. Nowadays top postdocs sometimes turn down the School of Mathematics in favor of Harvard, Chicago, Berkeley, and the like.

Nevertheless, there remains a sense in which the IAS School of Mathematics is peerless. For one thing, it has been home to some of the great mathematicians of the modern era. Arthur remarks that the "ghosts" of people like André Weil and Harish-Chandra still contribute to the atmosphere. "The traditions here really mean something," he says. "There is a sense in which what went on before inspires people." These traditions are sustained and supported by a well-financed, independent, self-contained operation in charge of its own destiny. Among the permanent faculty of the School of Mathematics one finds a sense of pride and ownership—these are people who take very seriously the development and nourishing of the mathematical life at the IAS. Their attentiveness to this task ensures that the institute will remain an exciting place for mathematics for years to come.

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About the Cover

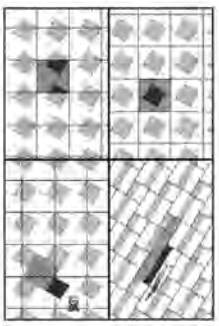
A Remarkable Fundamental Region

This month's cover was suggested by David Ruelle's article on the zeta functions of dynamical maps. The phrase "a remarkable fundamental region" is from Roy Adler's survey article "Symbolic dynamics and Markov partitions" (*Bull. Amer. Math. Soc.* 1998). What one sees are several different aspects of what is sometimes called the Pythagoras tiling of the plane, generated here by a rather special right triangle. Pythagoras' theorem asserts that the assembly of the squares on the sides of the triangle amounts to a fundamental domain for the group of integer lattice translations.

The really remarkable feature of the diagram is that it has ties to at least three cultures across a span of 2,500 years. (1) The figure at upper left illustrates what might be reasonably considered as the first proof of Pythagoras' Theorem, to be found in the Hindu sulbasutras dating from about 600 B.C. (*The Crest of the Peacock*, G. G. Joseph). This diagram also appears in a manuscript of the Arabic mathematician and philosopher Thabit ibn Qurra, perhaps independently of the Hindu tradition (A. Sayili, 'Thabit ibn Qurra's generalization of the Pythagorean Theorem', *Isis* **51** (1960)). (2) The diagram at upper right exhibits the symmetric dissection proof discovered by the eccentric Englishman Henry Perigal in the early nineteenth century, and in comparison with the first figure it also illustrates the observation of Felix Bernstein that there exists a two-dimensional continuum of dissection proofs (*Dissections: Plane and Fancy*, Greg Frederickson). (3) The particular configuration at hand was chosen to give rise to a Markov partition of Arnold's "cat map", which is mentioned by Ruelle. The construction is explained in Adler's article, as is the construction of the partition into five pieces that actually gives rise to the map's symbolic dynamics, shown at lower right. How to use the partition to find the zeta function of the cat map is explained in the booklet *On Axiom A Diffeomorphisms* by Rufus Bowen. (4) The eigenslope of the cat map is the golden ratio. If you look carefully you will be able to find bits of the Fibonacci sequence in there.

The image of Riemann is from a pen sketch by the French *mathématicienne* Anne-Marie Aubert.

—*Bill Casselman* (covers@ams.org)



How the Other Half Thinks: Adventures in Mathematical Reasoning *and* Mathematics Galore! Masterclasses, Workshops, and Team Projects in Mathematics and Its Applications

Reviewed by Edward J. Barbeau

How the Other Half Thinks: Adventures in Mathematical Reasoning
Sherman Stein
McGraw-Hill, 2001
xi + 177 pages
ISBN 0-07-137339-X

Mathematics Galore! Masterclasses, Workshops, and Team Projects in Mathematics and Its Applications
C. J. Budd and *C. J. Sangwin*
Oxford University Press, 2001
viii + 254 pages
ISBN 0-19-850769-0 (hardcover), 0-19-850770-4 (softcover)

How does it happen that there are people who do not understand mathematics? If mathematics invokes only the rules of logic, such as are accepted by all normal minds; if its evidence is based on principles common to all men, and that none could deny it without being mad, how does it come about that so many persons are here refractory?...[T]hat not everyone can understand mathematical reasoning when explained appears very surprising when we think of it.

—Henri Poincaré, *Mathematical Creation* [49]

I am often aware of a deep cultural divide between me as a mathematician and members of the general public, even those who are well educated in other respects. It is not so much a difference of knowledge and technical background as of distinct patterns of thought and analysis. Over the past two centuries many mathematical writers have sought to bridge this gap.

Early authors like Lewis Carroll [8], Courant and Robbins [14], and Hilbert and Cohn-Vossen [22] presumed upon some mathematical background and experience. Much of the literature consists of collections of problems for amateurs (such as [8], [12], [13], [27]). The prolific Martin Gardner [9], [10] has probably done more than anyone to keep the amateur abreast of the most interesting and elegant mathematical problems and results. Other books have been written for a wider audience. The classics of W. W. Rouse Ball and H. S. M. Coxeter [7], Hugo Steinhaus [40], George Gamow [19], and Hans Rademacher and Otto Toeplitz [33], for example, showed that the scope of mathematics goes far beyond what is learned in school. Recent writers such as Ian Stewart [41], Ivars Peterson [30], [31], and A. K. Dewdney [18] follow in this tradition. One of the first attempts to reach a very broad audience was the publication of the 1956 anthology *The World of Mathematics* [28], which drew together a variety of essays touching different aspects of mathematics by many authors, including some nonmathematicians. History and biography are other ways of conveying the significance of mathematics and what it feels like to be a mathematician [1], [2], [3], [4], [5], [6], [24], [45]. A growing and receptive public has accounted for the popularity of such recent books as *Gödel, Escher,*

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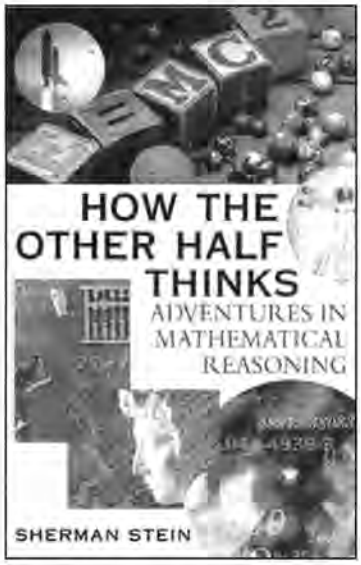

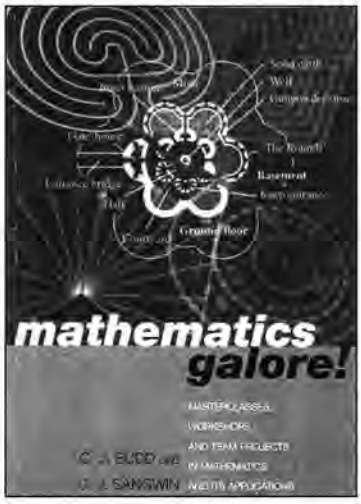

Bach (Hofstadter) [23]; *The Mathematical Experience* and *Descartes' Dream* (Davis and Hersh) [15], [16]; *The Emperor's New Mind* (Penrose) [29]; and *A Brief History of Time* (Hawking) [21], which offer pretty challenging reading as they delve into social, philosophical, and epistemological matters. The book by Lakoff and Núñez [47] is a recent foray in this direction.

Some authors, alarmed by failures of the education system and the innumeracy of much of the public, have turned to polemic [46], [48] and propaganda [17]. There is a vast literature intended to inspire young people to find in mathematics more substance and excitement than is seen in the regular curriculum. An early example is the work of W. W. Sawyer (for example, [34]), which explored the context and conceptual foundation of the school syllabus, but we also have recent books of David Wells [43] and of Anthony D. Gardiner (such as [20]) that engage students in problem solving and investigation, and of Ravi Vakil [42], who while a student himself sought to inspire other students with mathematical lore, elegant problems and solutions, and achievements of other young mathematicians.

Both books under review belong to a relatively small part of the literature that presents readers with case studies of mathematical investigation. Their purpose is to share with the novice a feeling for how mathematicians select objects of study, how they work, and how they validate their results. The audience for *Mathematics Galore!* consists of students, their teachers, mentors and parents; and for *How the Other Half Thinks*, intelligent lay persons with intellectual curiosity and the patience and resolve to satisfy it.

Sherman Stein is probably best known for his book *Mathematics: The Man-Made Universe* [38], which has become a staple of general mathematics courses in colleges. In the last decade he has turned his attention to a broader audience than students and become a missionary to the world at large. In the introduction to a recent collection of essays, *Strength in Numbers* [39], he says that his "purpose is to spread the gospel of mathematics, to carry the word to unbelievers and believers alike." In careful and direct prose he invites his readers to take another, more discriminating, look at the discipline. *How the Other Half Thinks* is even more ambitious. Stein wants to do more than just talk about mathematics. He guides the reader through the experience of solving some significant problems. As the title indicates, Stein recognizes that some readers will be entering alien territory and will need to acclimatize themselves to a mathematics quite different from what they are used to.

What should the lay person appreciate about mathematics? Mathematics has invaded almost every area of human activity, from art to the making of decisions, insofar as there is structure to be analyzed and manipulated. However, while argumentation and analysis occur in many walks of life, in mathematics they have their own peculiar characteristics. People seem to be perfectly capable of reasoning in everyday situations with a context to buttress their thinking, but often have trouble with logically similar tasks framed abstractly when familiar cues are removed. Furthermore, many arguments in ordinary affairs depend on premises weighted according to the context, experience, and values of the proponents; it may be possible for disputants to agree on the facts but not on the interpretation and consequences of them.

Mathematical arguments, on the other hand, are self-contained and ineluctable. They are not contextualized by anything outside themselves so that, in particular, once the premises are clarified and accepted, the conclusions become inevitable. As Leonhard Euler put it, "Wherefore, even if analysis is not without occasions for dispute, nevertheless they are distinguished from all other occasions in that when eventually all the evidence has been thoroughly weighed the matter can be completely settled."[1] There is economy in a good mathematical argument, and different ways of approaching an investigation may cast more light but can never contradict. Mathematicians try to identify and strip away any hypotheses not essential to a conclusion; this leads to results of astonishing generality that are hard to grasp by a neophyte who may become distracted by irrelevant details.

Mathematical discourse occurs at different levels of intensity, from discursive and suggestive to focussed and formal. Experienced mathematicians know the strengths and limitations of each and can switch easily among them. Insight and validation are based on analogy and metaphor, as well as on rigorous argumentation. The ease of understanding mathematical situations depends on finding appropriate representations, and it is hard for

[1] *From the opening paragraph of* "De seriebus divergentibus", *by Leonhard Euler,* Novi Comm. Sci. Petrop. *5 (1754–55), 1760, 205–237* = Opera Omnia *I, 14, 585–617.*

the novice to see commonality between two apparently different formulations and to move from one to another.

These are some of the themes that come up in Sherman Stein's beautiful book. His writing is spare and clear, and he has selected eight problems, loosely connected by their formulation in terms of strings of the two letters a and b, to illuminate some of these points. The reader needs no specialized knowledge, only some elementary arithmetic and reasoning ability to negotiate the examples. The solutions to the problems are developed in great detail, with the evolution of the ideas indicated in some cases. However, he tends to let the mathematics speak for itself and does not intrude with editorial comment on the process that the reader is being guided through. He hopes that the book will help bridge "that notorious gap" that separates the humanities and sciences by demonstrating that mathematics is holistic and intuitive as well as analytic and numerical. He "kept in mind two types of readers: those who enjoyed mathematics until they were turned off by an unpleasant episode, usually around fifth grade, and mathematics aficionados who will find much that is new throughout the book."

While I can attest confidently that he has succeeded with the latter audience, I am less certain about my ability to judge how well he might reach the former. So I enlisted some volunteers from a class of third-year undergraduates to read and comment on individual chapters. These students, planning to become elementary teachers, had a variety of backgrounds in mathematics, and some had not ventured beyond compulsory secondary courses. With one exception, none of them caught fire. They appreciated how the material was organized, particularly the use of charts and tables to summarize information. While some found the explanations reasonably clear, others had considerable difficulty. Stein's analogies were appreciated by some, but others had difficulty negotiating changes in perspective. There were differing levels of satisfaction with the motivation for the examples. One student, who found that her chapter was "easy to follow and understand," did, however, have to "slow down and reread some proofs of the chapter to fully follow the author's argument." Another student, self-described as more of a nonmathematical person, "was delightfully surprised" to discover that she had much less difficulty than expected and praised the "simple, clear steps" of the explanations. While they were not in agreement on recommending the book, their comments underscored for me what a difficult challenge Stein undertook.

The sixth chapter, "Counting Ballots", will give an idea of the flavour of the book. Barbara has won an election against Ann. As the votes are counted, one by one, what is the chance that Barbara always stays ahead of Ann throughout the count? Equivalently, given all possible strings of a's and b's, with more b's than a's, what fraction of them are such that every prefix has more b's than a's? Stein guides the reader through an empirical investigation leading to the conjecture that when Ann has $N(a)$ votes and Barbara has $N(b)$ votes, the likelihood that Barbara is continually ahead is

$$\frac{N(b)-N(a)}{N(b)+N(a)}.$$

Various checks are made. It should be less than the likelihood that the first vote counted is for Barbara. It should be 1 when Ann gets no votes. It should be small when Ann has close to the number of votes for Barbara. It should work when we test it against other specific cases where the number of ballots is small. If we try a simulation with poker chips of two colours, then we should come close to this value. Such an elegant formula must have an elegant proof, so we cast around for a productive way to look at the situation.

Eventually we arrive at a reformulation where we associate each counting of the vote to a zigzag graph starting at the origin of the cartesian plane, where a graph remains in the positive quadrant if and only if Barbara stays ahead throughout the count. This provides a geometrical representation of the problem and opens the door for a reinterpretation and a solution invoking the reflection principle. Stein closes the chapter with a brief account of how the principle can be applied to a minimum path problem to make the point that it is not an isolated trick but a well-used tool.

The remaining chapters highlight other characteristics of mathematical research, including the use of a theoretical model and simulation (runs of consecutive wins in a match between two competitors), existence proofs that are or are not constructive (Sperner's lemma), reduction to a canonical situation (a generalization of the Buffon needle problem), and visualization. The most conventional chapter treats cardinality and Cantor's diagonal problem; this seemed somewhat out of place both in depth of treatment and subject.

However, the final chapter, while not long, packs a particularly effective punch. The question under discussion is:

How long can a string in the letters a, b, c be if one cannot find two adjacent shorter strings of any length right next to each other that are completely identical?

The string $cbabcabcac$ with two adjacent copies of abc does not satisfy the condition, nor does $baabc$ with two adjacent a's. But $acbcabcbacb$ works. As Stein tells us,

> This question and related ones were raised and answered by the Norwegian mathematician Axel Thue (1863–1922) in 1912. His motivation was simply the desire to know the answer. As he explained at the beginning of his paper, "For the development of the logical sciences it is important to find large areas for speculation about difficult problems without any consideration of possible applications."

Then follows a brief account of the works of others, some ignorant of what their predecessors achieved and some who, in fact, investigated the question in order to solve other problems.

If we allow only two letters, then we cannot have a string with more than three entries. So it is astonishing to learn that indefinitely long strings can be created with three letters. The strategy is to begin with a suitable string and replace each a, b, c by strings with several letters so that there continue to be no adjacent pairs of identical substrings. The solution presented is due to P. A. B. Pleasants, who in 1970 found his replacement strings by "just elementary messing about." An appendix comments on Thue's approach and on a computer attempt to construct an arbitrarily long string one element at a time.

Is this a book for the general reader? The answer is a qualified but enthusiastic yes. Judging from the responses of my students, the reader has to be prepared to read slowly and methodically, to sometimes backtrack to pick up a missed point, and to try things out. This is a type of reading that mathematicians are familiar with, but lay persons need to learn to do. The mathematician will enjoy this book, both for the new material that is likely to be found and for some topics that might be presented to students. Perhaps for a class one might best handle this book by assigning readings to the students, to be followed by presentations and class discussions. In a similar way, other adults may wish to use this as a book club selection. Many individuals would find it hard to negotiate the book alone, but with the chance for discussion, they might be encouraged to study it and be enriched thereby.

The second book is of quite a different character. In 1981 Sir Christopher Zeeman induced the Royal Institute of Great Britain to establish mathematics master classes for young teens. Such classes, designed to inform and excite the youngsters about the breadth and creativity of mathematics, have sprung up all over the United Kingdom. *Mathematics Galore!* provides a description of eight of these in the region of Bristol and Bath, which has had these workshops for local schoolchildren since 1990. It can be used as a handbook for others organizing such events.

A master class is a tightly organized event that occupies about 2 1/2 hours of a Saturday morning. Two half-hour talks alternate with two workshops, with a break for refreshments; the goal is to actively involve students with material accessible to the weakest but sufficiently challenging to the more able. The pupils work in small groups with parents and "experts" on hand. Each chapter opens with a description of the mathematical setting, includes the exercises given at the workshop, suggests field trips and extensions, and lists some resources; answers are provided. Insofar as some of the topics are closely aligned to the British situation, readers abroad will need to make some adaptations.

The authors get off to a flying start with a chapter that touches many bases. The classical tale of Theseus and the Minotaur provides the occasion to discuss the construction of the Cretan labyrinth, and we learn that a labyrinth is a tortuous path that leads directly from entrance to centre with no alternatives that might be taken. On the other hand, in a puzzle maze there are different routes that could be taken and one could easily get lost. We come to our first theorem: *If the walls are connected, then we can reach the centre or escape by keeping our hand on the wall at our right.* Mazes that cannot be solved in this way can be recast as a network of nodes and edges, where each node represents a place where alternative routes might be taken. This allows for a more convenient analysis and provides the occasion for a little history (the Königsberg bridges) and a reference to current applications of graph theory.

The chapter entitled "Dancing with Mathematics" uses folk dancing, change ringing of bells, and knitting to illustrate the ideas of group theory. Fortifications provide an incentive to discuss the isoperimetric problem, along with ways of offering attackers the maximum amount of frustration. A description of the work of the cryptographers at Bletchley Park during the Second World War leads to a discussion of ciphers, in particular those that apply the ideas of modular arithmetic.

The magical mathematics discussed in the fourth chapter probably appealed to the young participants. Four easy tricks are presented and analyzed, with only some elementary algebra and arithmetic. Arithmetic intervenes in two other chapters as well. The students learn about different systems of numeration and how to operate in base -2. The final chapter reminds pupils that there was life before calculators and computers when multiplication of large numbers was a significant task. They learn about Napier's logarithms (as well as about inverse functions), are given a little bit of practice with a logarithm table, and learn about that marvellous analogue tool, the slide rule.

The most challenging chapter of the book concerns sundials, the construction and use of which

are greatly complicated by the tilt of the earth on its axis and the eccentricity of its orbit around the Sun. A lot of detail is provided to those who would construct their own sundials, although the mathematical underpinnings are left to the cited literature. The authors use just enough trigonometry to provide an adequate description.

Since the audience for each presentation is "50–100 dynamic teenagers," one has to be impressed by the level of mathematics. There is much for even the brightest of them to follow up on. Undoubtedly, the young people embraced it with differing levels of understanding, but it is highly likely that most were captured by the activity and impressed that mathematics had something to say about a wide range of human activity.

Like the Stein book, *Mathematics Galore!* works better for readers who can meet together rather than for lone readers. It has practical value for those of us trying to organize activities for the young. In particular, one might hope that it will be read by educators who will be inspired to replace some of the more banal and sterile activities that are inflicted upon modern school children by activities with real mathematical substance that are related to everyday interests of people.

Both books deserve a wide circulation. While difficult for many readers, they provide an authentic perspective of our discipline. Those prepared to see in the refined rigour of mathematical arguments "principles common to all men" can rejoice in the potential of mathematics to reach across differences of time and culture to reveal a shared core of human experience.

A complete listing of books written for students and the general public would go on for hundreds of pages. The following items are intended to suggest the scope of the literature and to indicate some possible starting places for the general reader.

History/Biography

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The Hilbert Challenge *and* The Honors Class

Reviewed by Brian E. Blank

The Hilbert Challenge
Jeremy Gray
Oxford University Press, 2000
ISBN 0-198-50651-1, 240 pages, $34.95

The Honors Class
Benjamin Yandell
A K Peters, 2002
ISBN 1-56881-141-1, 500 pages, $39.00

The year 1897 was a momentous one for the development of mathematics. A lasting tradition was initiated that summer when Zürich hosted the first International Congress of Mathematicians. It followed by a few months another event that would have great significance for mathematics: the publication of David Hilbert's *Zahlbericht*. Charged with the task of summarizing the rapid progress that had been made in algebraic number theory, Hilbert delivered a masterpiece that simplified, clarified, and unified existing theories. Above all, it pointed the way to a vast program of further research that would be carried out by the next generation of number theorists. As one of his followers remarked, "Hilbert was not only very thorough but also very fertile for other mathematicians." The *Zahlbericht* alone sufficed to confirm Hilbert's position among the leaders of mathematics. Three years later, when the new century dawned, Hilbert was extended an invitation to give a plenary address at the second International Congress of Mathematicians that was to be held in Paris.

Although Hilbert had not attended the Zürich Congress, he was familiar with the published version of Henri Poincaré's talk on the relationships between analysis and mathematical physics. Poincaré had used his address as a vehicle for reflecting on the role that mathematics would have in the scientific investigation of nature. The result was a philosophical discourse of meager impact. Hermann Minkowski, who had been present for Poincaré's lecture, dismissed it as a "mere chat." Hilbert had a more favorable opinion despite a mathematical philosophy that diverged sharply from that of Poincaré. Indeed, he considered using his own talk as a counterpoint. His other idea was to examine the direction that the study of certain important problems would impart to mathematics in the coming century.

For a dangerously long time Hilbert vacillated. At the end of March 1900 Hilbert confessed to Adolf Hurwitz, "I must start preparing for a major talk at Paris, and I am hesitating about a subject." The month of June arrived, and Hilbert still had not produced his lecture. As a result, the program for the second Congress was mailed without listing Hilbert's talk, the organizers having scheduled another talk for the opening session in its stead. Just two weeks before the start of the Congress, the proof sheets for *Mathematical Problems*, the title of the talk Hilbert eventually settled on, materialized. A slot was found for Hilbert's talk on August 8, 1900, and an important new chapter for twentieth-century mathematics was assured.

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"Who of us would not be glad to lift the veil behind which the future lies hidden: to cast a glance at the next advances of our science and at the secrets of its development during future centuries?" So began Hilbert's lecture. It seems safe to say that no mathematical talk has ever had so great an effect. Although Hilbert had only enough time to consider a selection of ten problems during his oral presentation, the full text of his manuscript issued twenty-three challenges for the gifted masters of the new century to solve. It was published in the *Göttingen Nachrichten* and summarized in French shortly thereafter. An English translation of the entire paper appeared in the 1902 *Bulletin of the American Mathematical Society*.

the hilbert challenge

Hilbert prefaced his list of problems with some general thoughts on the nature of mathematical inquiry. Whereas Poincaré had offered lofty platitudes about the purpose of mathematics, Hilbert cut directly to the chase. He echoed Johann Bernoulli in stating that mathematical science is frequently advanced by nothing more than the challenge of a difficult problem. Time after time the medium *is* the message in mathematics: how often do we judge results not by what they say but by the ingenuity and depth of thought that they require? As Hilbert phrased it, "A mathematical problem should be difficult in order to entice us, yet not completely inaccessible lest it mock our efforts." Several other passages from Hilbert's foreword have been quoted again and again. Surely there has never been a more inspirational call-to-arms than Hilbert's "We hear within us the perpetual call: There is the problem. Seek its solution! You can find it by pure reason, for in mathematics there is no *ignorabimus*." We know a bit more about that now than Hilbert did then, but, even so, who of us on reading his words does not hear the siren call of a problem that has been mocking our efforts?

The future is not always easy to divine, even for a Hilbert. Consider, for example, his third problem, which asks for two tetrahedra of equal volume, neither of which can be cut up into finitely many tetrahedra that can be reassembled to take the form of the other. This is a neat task in solid geometry, but Hilbert probably would not have placed it alongside the Riemann Hypothesis as a challenge for the twentieth century had he an inkling that his own student, Max Dehn, would solve it even before the list of problems appeared in print. Many years later Carl Ludwig Siegel was present at a lecture during which Hilbert told his audience that he was hopeful that he would live to see the Riemann Hypothesis proved (Problem 8), that the youngest members of that 1919 audience might live to see Fermat's Last Theorem proved, but that he did not expect anybody in the hall to see the transcendence of $2^{\sqrt{2}}$ (Problem 7). Hilbert's optimism about the eighth problem did not pan out, and his pessimism about the seventh was equally misplaced. Within a decade of these prognostications Alexander Osipovich Gelfond established the required transcendence and "passed on to the honors class of the mathematical community," the accolade conferred by Hermann Weyl on solvers of the Hilbert problems.

No less than anyone else we mathematicians are creatures of base 10. Now, as in Hilbert's time, there is nothing like the turn of a century to prompt us to take stock of past progress and speculate about what lies ahead. When the new century coincides with the centennial of so influential a wellspring as Hilbert's problems, it is a sure thing that at least a few historians of mathematics will have been busy in anticipation. Indeed, a brief synopsis of the Hilbert problems appeared in the *Notices* [2] during the centenary, but, as its author demurred, nothing less than a "formidable but worthwhile monograph" could do the subject justice. Actually, a retrospective that had been undertaken twenty-five years earlier required *two* such volumes [1]. As it happens, two books that survey the research inspired by the Hilbert problems, Jeremy Gray's *The Hilbert Challenge* and Benjamin Yandell's *The Honors Class*, have recently appeared. Neither attempts to be formidable, but they are both worthwhile in their different ways.

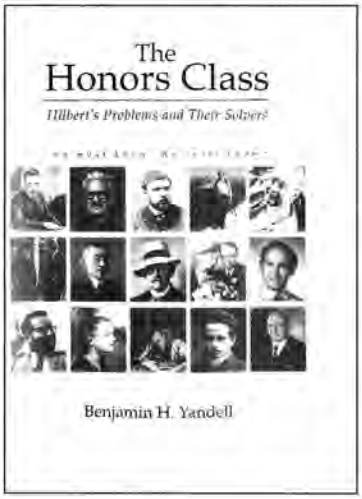
The first thing that must be acknowledged is the boldness that is needed for such a project. When Weyl wrote that Hilbert's Paris address "straddles all fields of our science," he was availing himself of the sort of discreet exaggeration that is overlooked in a eulogy. Famously missing in Hilbert's list—especially to those who ponder the selection Poincaré might have made—is the important role that topology was poised to assume. That there were omissions is not unexpected: by the end of the nineteenth century the mathematical enterprise was already so diverse that there would have been lacunae in any short list of problems. Nevertheless, Hilbert's problems *do* straddle enough logic, algebra, number theory, geometry, and analysis that one does not envy Gray or Yandell for his chosen task. The intensity of effort inspired by Hilbert's lecture is truly astonishing. As Kronecker liked to say about mathematical activity, "When kings build, carters work." The honors class may be extremely exclusive, but over the course of one hundred years the cast of important contributors has become substantial. The bibliographies of the two volumes under review speak to this: 256 items

in Gray's book, 320 in Yandell's. The size of the intersection is even more suggestive: there are only about thirty references common to both!

The symmetric difference of bibliographic materials notwithstanding, the two books have much in common. Each includes a brief biography of Hilbert, drawn primarily from Constance Reid's superb full-length treatment. Each author sketches Hilbert's mathematical development prior to the Paris Congress, explaining, for example, invariant theory and quadratic reciprocity from scratch. Though the levels of exposition here, as well as for the twenty-three Hilbert problems, are elementary, they suffice to provide the novice reader with a reasonable understanding of what is at stake. Both books conclude with a translation of Hilbert's lecture, a scorecard describing the status of the problems at the time of writing, and an inadequate index.

There are also many differences between the two treatments. Yandell considers the twenty-three Hilbert problems in Hilbert's own order, subject to a little rearrangement according to mathematical branch. Such a sequence makes for some temporal choppiness, but given Yandell's perspective, which is directed more toward the members of the honors class than to the problems that they solved, the shuffling of time has little consequence. By contrast, Gray discusses the problems in chronological order of progress: it suits his historian's point of view, allowing him to chart the development of mathematics as the twentieth century unfolds. He relates his story with a writing style that is contemplative and sober but not starchy. Yandell is informal, with prose that is often amusingly breezy. Where Gray opts for "tortuous paths" in his translation of Hilbert, Yandell prefers "mazy paths." To Yandell, numbers and shapes are "oddball," L-functions "proliferate like rabbits," Jean van Heijenoort, historian of logic, is "the epitome of cool," and "Gödel liked Ike."

Not everything about Yandell's relaxed style, however, will draw the reader in. For one thing, his writing can be confused. Every once in a while the reader will be interrupted by a sentence that might fairly be described as a non sequitur. In the story of Problem 10, the question of algorithmic solvability of Diophantine equations, Yandell devotes a paragraph to a priority claim made by Gregory Chudnovsky. The reader is left in wonder when Yandell concludes the paragraph with a sentence that fast-forwards twenty years to tell us about the Chudnovsky brothers calculating mountains of pi in a hot New York apartment. In other instances just one errant word is enough to throw the reader. A paragraph devoted to the geographic origins of Andrew Gleason begins the trail in Fresno and then mentions in short order the San Joaquin Valley, British Guiana, Switzerland, Los Angeles, and Malaga. The paragraph concludes with a puzzling phrase that tells us that the Gleason family "moved *back* to New York, to Bronxville." (As in the upcoming quotes, the emphasis here has been added by the reviewer.) Consider as well Ernst Hellinger, who "reached mandatory retirement age *quickly*," a trick anyone of us might envy after an especially trying class. To be fair, these are minor blemishes. Nevertheless, it is troubling that so many recent mathematics books suffer from inattentive editing. If the "eagle-eyed editor" has become extinct, then the loss of a cliché is poor compensation for passages such as the following one (in which the "she" refers to Adele Gödel): "At the end of their lives, when she fell ill and could no longer take care of him, Gödel died."



Between them the two books display the dangers of concision and prolixity. None too rarely Gray's succinct style will suggest a question that is left unanswered. The reader, for instance, may wonder what Gray has in mind when he asserts, "Koebe published prolifically, pursuing a *ruthless* strategy to gain the attention of the leading mathematicians in Germany." A case can be made for Gray's choice of adjective, but you will not find it in his book. For his part, Yandell usually tells us all we want to know and then some, packing his book with entertaining anecdotes as well as bizarre detail of less certain interest. Name your topic and chances are you will find something. Food? Picture Emil Artin newly arrived in Bloomington consulting the *Encyclopædia Britannica* for instructions on carving a Thanksgiving Day turkey! Or Carl Ludwig Siegel, who, having invited Harold Davenport to dinner, served a large trout as the first course and a large trout as the second course! Religion? Deane Montgomery did not enroll in the University of Minnesota, because his mother did not think it safe for Methodists. Circumcision? Quilted toilet paper? Those too are there. Yandell's exertions in tracking down minutiae at the periphery of his story are praiseworthy, but his indiscriminate presentation suggests a brain dump that was not curbed by a disciplined editor.

Accuracy is usually a thorny issue in popular books pertaining to mathematical history. In this regard Gray strikes no false notes, whether mathematical or historical. That is not the case with Yandell. We read, for example, "Weierstrass introduced the epsilons and deltas that are used to define the basic concepts of calculus." In reality, Weierstrass was of kindergarten age when Cauchy introduced

the symbols ϵ ("erreur") and δ ("différence"), using them exactly as we do now. Ironically, Yandell forgoes epsilons and deltas in his misleading definition of the convergence of an infinite *sequence*: "An infinite series [sic] of numbers converges if the numbers, as one proceeds through the list, move *consistently* closer to a specific number that is said to be the limit. Any wandering that the numbers do from the limit value gets *progressively* smaller." Granted, the harm here is not too great, but the language worsens when Yandell takes another crack at the concept a few pages later: "When we say an infinite series converges to a number, we are saying that the completed infinite of the series equals the number." I suppose that if you cannot fathom the meaning of a sentence, then you cannot get all riled up. On the other hand, a statement such as "logic is about classes and 'class' is a close synonym of 'set'" can induce apoplexy. So too can Yandell's assessment of Antoni Zygmund, who Yandell says "could best be described as a classical analyst persevering amid modernism." The image is reinforced when Yandell refers to "the modern machinery that, except for Zygmund, was the style at Chicago" in the 1950s. Opinions may legitimately differ: a dissenting point of view is that during the decade of which Yandell speaks, Zygmund, together with Alberto Calderón, introduced a significant share of the modern machinery of harmonic analysis.

When it comes to the treatment of individual problems, each author has his successes and failures. Of course, the reader cannot expect exposition that is either deep or complete. At best these books can only hint at what has been done, supplying references that update [1]. On balance it is Gray who most often proves to be the more enlightening guide. Examination of a few particular examples—Problems 6, 8, 17, and 18—will illustrate.

Problem 6 asks for the axiomatization of physics, a program about which the two authors come to near opposite conclusions. On his scorecard Yandell puts Problem 6 down as unsolved, whereas Gray lists the axiomatization of classical mechanics by Hamel, thermodynamics by Carathéodory, special relativity by Robb and Carathéodory, and quantum field theory by Wightman. The situation is virtually reversed for Problem 8, the Riemann Hypothesis, about which Gray has almost nothing to say. That decision is puzzling in view of the many remarkable things that have been learned. Yandell also does not give Problem 8 its due, according it a section that cannot be ranked among his best. At least he is more forthcoming than Gray: Bohr, Landau, and Littlewood are mentioned only in passing, but Hardy's theorem *is* stated. Not content with that, Yandell uses the hint of primes as the segue into a two-page diversion on Ramanujan (which in turn offers the opportunity for a brief digression about novelist F. R. Keating's fictional Inspector Ghote).

In the 1890s Hilbert deduced that a positive polynomial of two variables cannot necessarily be expressed as a sum of squares of polynomials. This led him to pose Problem 17, which asks whether a positive polynomial in many variables can be expressed as a sum of squares of rational functions. In 1927 Emil Artin answered this question in the affirmative for fields in which -1 is not a sum of squares. Like the majority of Hilbert problems, No. 17 has not been a dead end that offers no path of research beyond its solution. In 1940 Habicht used an interesting theorem of Pólya to give a constructive proof of Artin's result. Habicht's paper is not mentioned by either Gray or Yandell, but the latter does refer to a second constructive proof, which was published by Kreisel in 1957. It was Kreisel's work that prompted Artin to confirm his preference for a clear existence proof over a construction with $2^{2^{100}}$ steps. Yandell ignores the flurry of activity subsequent to Kreisel, whereas Gray informs us of Motzkin's explicit counterexample in the polynomial ring, the negative answer to Problem 17 that Dubois established for arbitrary ground fields, and the bounds Pfister found for the number of summands that are needed.

Hilbert's eighteenth problem is one of his questions with multiple parts. One component of Problem 18, namely the sphere packing problem, has proved especially difficult and contentious. Gray skirts the controversy, electing not to explicitly mention either Wu-Yi Hsiang's disputed paper or the manuscript of Thomas Hales that was announced in [3] but which was already circulating in 1998 (and which, at the time of this writing, remains unpublished). Instead, he refers to Hsiang and Hales obliquely, stating, "Everyone expects that the cannonball arrangement will prove to be best possible in 3-dimensional space but even in 1999 this still has not been proved (although a final proof is thought to be close)." Yandell confronts the discord head-on, interviewing Hsiang (on Hales) and Conway (on Hsiang and Hales). Neither Gray nor Yandell says much about packings in higher dimensions, although Gray alerts his readers to the Leech lattice and thereby to unexpected connections with other areas of mathematics.

The evidence presented up to this point may seem to suggest that *The Hilbert Challenge* has it all over *The Honors Class*. I should make it clear that the final evaluation is not so clear-cut. Although I came to Yandell's book after I had finished Gray's, I did not have the sense of reading a twice-told tale. Yandell has new things to tell us, and there is no doubt how he manages to do so. A century may seem like a very long time, but *The Honors*

Class demonstrates that the history of the Hilbert problems has largely occurred within living memory. Just as a generation ago Reid put us in her debt by endeavoring to interview, before it was too late, those who had known Hilbert, so has Yandell done with the honors class. Whether by telephone, correspondence, or email exchange, he has accumulated a wealth of fascinating information that otherwise would likely have gone unrecorded, eventually to pass out of existence. His sources include not only mathematicians but also their family members. He contacted, for example, all of Dehn's children and three of Artin's. The result is a sequence of original character sketches that will not fail to interest any mathematician who reads them. I found the biographies of Artin, Dehn, Kolmogorov, Siegel, and Takagi to be of particular value, but no member of the honors class has been slighted. The entire narrative is enhanced by the inclusion of photographs that, like the reminiscences Yandell sought out, would have remained private but for his efforts. (With regret I note that the publisher did not reproduce the photographs in decent size or on appropriate paper. One image in particular, a photograph taken by Natascha Artin in 1927, cried out to be turned sideways and given its own page: it features Artin, Herglotz, Rademacher, Schreier, Blaschke, and van der Waerden seated at a dinner table in the Hamburg City Hall!)

Every mathematics library should have a browsing shelf, and every browsing shelf should hold both of these books. Anybody who has read this review would enjoy either volume, but I suppose that few will need or want to read both. If you require a concise summary of the work generated by the Hilbert problems, a book that gives a clear overview of each problem with plenty of references to more technical treatments, then *The Hilbert Challenge* is the one to go for. If you enjoy biography or if you have a fondness for mathematical anecdote, then you cannot miss *The Honors Class*.

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WHAT IS . . .

An Amoeba?

Oleg Viro

In mathematical terminology the word *amoeba* is a recent addition.[1] It was introduced by I. M. Gelfand, M. M. Kapranov, and A. V. Zelevinsky in their book [2] in 1994. A mathematical amoeba falls short of similarity to its biological prototype. In the simplest case, it is a region in $\mathbb{R}^2$ that may pretend to be a picture of an amoeba: a body with several holes (vacuoles) and straight narrowing tentacles (pseudopods) going to infinity.

A planar amoeba is the image of the zero locus of a polynomial in two variables under the map $\mathrm{Log} : (\mathbb{C} \setminus 0)^2 \to \mathbb{R}^2 : (z, w) \mapsto (\log|z|, \log|w|)$. The zero locus of a polynomial in two variables is called a *plane complex algebraic curve*. This is a surface in the 4-space $\mathbb{C}^2$ defined by the equation $f(z, w) = 0$, where f is a polynomial $\sum c_{pq} z^p w^q$ with complex coefficients c_{pq}. The minimal convex polygon Δ that contains all points $(p, q) \in \mathbb{R}^2$ corresponding to nonzero coefficients of the equation is called the *Newton polygon* of f. It represents the geometry of the equation, and, as we will see, its geometry is closely related to the geometry of the corresponding complex curve $C \subset \mathbb{C}^2$ and its amoeba $\mathcal{A} \subset \mathbb{R}^2$.

An amoeba reaches infinity by several tentacles. Each tentacle accommodates a ray and narrows exponentially fast towards it. Thus there is only one ray in a tentacle. The ray is orthogonal to a side of the Newton polygon and directed along an outward normal of the side. For each side of Δ there is at least one tentacle associated to it. The maximal number of such tentacles is a sort of lattice length of the side: the number of pieces into which the side is divided by integer lattice points (i.e., points with integer coordinates).

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[1] *I was told that in mathematical logic amoebas have been known for more than twenty years. However, they belong to an entirely different class of mathematical microbes and have never bitten me, so I cannot tell you about them.*

Each connected component of an amoeba's complement $\mathbb{R}^2 \setminus \mathcal{A}$ is convex. Besides components lying between tentacles, there can be bounded components. The number of bounded components is at most the number of interior integer lattice points of Δ, and hence the total number of components of $\mathbb{R}^2 \setminus \mathcal{A}$ is at most the number of all integer lattice points of Δ. Each component corresponds to some integer lattice point of Δ.

To establish this correspondence, take a point in a component of $\mathbb{R}^2 \setminus \mathcal{A}$ and consider its preimage under the map Log. The preimage is a torus and consists of points whose complex coordinates have fixed absolute values but varying arguments. On the torus there are circles: meridians, along which z is fixed, and parallels, along which w is fixed. Consider a meridian, and call the disk it bounds D. Let us count the intersections, with multiplicities, between D and the complex curve C (so this is the homological intersection number $D \circ C$ or, if you like, the linking number $\mathrm{lk}(m, C)$). Denote the intersection number by q. In the same way, consider a parallel and the disk it bounds, count (with multiplicities) the intersections of the disk with C, and denote the intersection number by p. The point $(p, q) \in \mathbb{R}^2$ belongs to Δ and corresponds to the component of $\mathbb{R}^2 \setminus \mathcal{A}$ we started with. (The numbers p and q are independent of the choice of meridian or parallel and depend only on the connected component of $\mathbb{R}^2 \setminus \mathcal{A}$.) Different components of $\mathbb{R}^2 \setminus \mathcal{A}$ give rise to different integer lattice points of Δ. It may happen that some integer lattice points of Δ do not correspond to any component. Only vertices of Δ necessarily correspond to components. Any collection of integer lattice points of Δ that includes all vertices is realizable by the amoeba of an appropriate algebraic curve with this Newton polygon Δ.

Although a planar amoeba is not bounded, its area is finite. Moreover,

$$Area(\mathcal{A}) \leq \pi^2 Area(\Delta).$$

Complex curves whose amoebas have the extremal area are very special. In particular, $\mathbb{R}^2 \setminus \mathcal{A}$ has the

amoeba of a line amoeba of a quartic curve

maximal number of components. A mapping $\mathbb{C}^2 \to \mathbb{C}^2 : (z, w) \mapsto (az, bw)$ with appropriate $a, b \in \mathbb{C}$ makes such a curve *real*, i.e., defined by a polynomial equation with real coefficients. The geometry of the real part of this curve is also very special. Real algebraic curves of this kind were discovered by A. Harnack in 1876 when he constructed real algebraic plane projective curves with the maximal number of components for each degree. Only one component of a Harnack curve meets the coordinate axes (including the line at infinity), and the intersections with the axes lie on disjoint arcs of this component. Consideration of amoebas allowed G. Mikhalkin to prove that any real curve with these properties must be topologically isotopic to a Harnack curve.

One of the main analytic tools used in the study of amoebas is the remarkable *Ronkin function* $N_f : \mathbb{R}^2 \to \mathbb{R}$. For a polynomial f, it is defined by

$$N_f(x, y) = \int_{\mathrm{Log}^{-1}(x,y)} \log|f(z, w)|\, d\frac{z}{2\pi i|z|} d\frac{w}{2\pi i|w|}.$$

If f is a monomial $az^p w^q$, then N_f is a linear function, $N_f(x, y) = px + qy + \log|a|$, with gradient (p, q). For a general f, the Ronkin function is convex. On each component of $\mathbb{R}^2 \setminus \mathcal{A}$, the function N_f behaves like the Ronkin function of a monomial: it is linear, and its gradient is the corresponding integer point of Δ. The maximum of these linear functions is a piecewise linear convex function. The set where it is not differentiable is a union of segments and rays that are contained in the amoeba and that constitute its deformation retract. This set is called the *spine* of $\mathcal{A}$.

Logarithmic coordinates and amoebas disclose a piecewise linear stream in the nature of algebraic geometry. There is a nonarchimedian version of amoebas that brings these ideas to algebraic varieties over other fields. There is also a similar theory in higher dimensions. The notion of an algebraic curve is replaced by the notion of an algebraic variety, and the Newton polygon becomes a Newton polytope. Amoebas provide a new way to visualize complex algebraic varieties. Looking at an amoeba, one can see handles of complex curves and cycles in high-dimensional varieties, watch degenerations, and build more complicated varieties from simple ones.

The theory of amoebas is a fresh and beautiful field of research, still quite accessible to a newcomer, where exciting discoveries are still ahead. The impressive results described above were obtained during a short period of about eight years by various people. The definition and initial fundamental observations are due to I. M. Gelfand, M. M. Kapranov, and A. V. Zelevinsky. Relations between components of $\mathbb{R}^2 \setminus \mathcal{A}$ and integer lattice points of Δ were discovered by M. Forsberg, M. Passare, and A. Tsikh. The spine of an amoeba, the Ronkin function, and the estimate of the area are due to H. Rullgård and M. Passare. Homological interpretations and relations to real algebraic geometry are due to G. Mikhalkin. I enjoyed the feast. About twenty years ago I found a way to construct real algebraic curves by sort of gluing curves to each other. I heard that this gluing and the use of logarithmic coordinates in its description, after being replanted to the complex soil, motivated the introduction of amoebas. A version of the gluing is used to glue amoebas.

Further Reading

[1] Mikael Forsberg, Mikael Passare, and August Tsikh, Laurent determinants and arrangements of hyperplane amoebas, *Adv. Math.* **151** (2000), 45–70.

[2] I. M. Gelfand, M. M. Kapranov, and A. V. Zelevinsky, Discriminants, resultants, and multidimensional determinants, *Mathematics: Theory & Applications*, Birkhäuser Boston, Inc., Boston, MA, 1994.

[3] G. Mikhalkin, Real algebraic curves, moment map and amoebas, *Ann. of Math.* **151** (2000), 309–326.

[4] G. Mikhalkin and H. Rullgård, Amoebas of maximal area, *Internat. Math. Res. Notices* **9** (2001), 441–451.

This is the inaugural installment of the "WHAT IS...?" column, which carries short (one- or two-page), nontechnical articles aimed at graduate students. Each article focuses on a single mathematical object, rather than a whole theory. Comments may be sent to `notices-whatis@ams.org`.

—Allyn Jackson

Interview with Philippe Tondeur

On July 31, 2002, Philippe Tondeur finished his three-year tenure as director of the Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF). He plans to return to the University of Illinois at Urbana-Champaign, where he is a professor of mathematics.

During Tondeur's time in the DMS, the NSF established the mathematical sciences as a priority area. The division's budget for the current fiscal year, fiscal 2002, is $151 million, a 25 percent increase over the previous year. The fiscal year 2003 budget request would add another $30 million, and NSF director Rita Colwell has pledged to bring the DMS budget to around $500 million over the next several years.

What follows is an edited version of an interview with Tondeur conducted by *Notices* senior writer and deputy editor Allyn Jackson on May 17, 2002. At the time of the interview, Tondeur's successor had not been named.

—Allyn Jackson

Notices: *What kind of changes do you foresee in the mathematical sciences community as a result of the increased funding?*

Tondeur: This fantastic, historically unprecedented situation has created for the mathematical sciences community in the U.S. a situation where they can play a much bigger role in the science enterprise. They now have a chance to be funded on a level comparable to the experimental sciences. Young people will see the mathematical sciences as a more attractive career in the future. The major effect will be the pipeline effect for the mathematical sciences.

It's like a huge playing field opening to the mathematical sciences community, because the resources are there. I hope that mathematical scientists will embrace these opportunities. The opportunities are of many kinds: they are in internal developments in math and statistics, but also in connections of math and statistics to the sciences, and drawing young people into the mathematical sciences. The goal is not only to educate people exclusively dedicated to the mathematical sciences but also to have people who are advocates who work outside and with the mathematical sciences.

An analogy I would use is this: In the past sixty or seventy years, molecular biology made biology into a chemistry-based science. Now genomics makes biology into an information-based science, and mathematics and statistics especially will play a huge role. The analogy would be that the mathematical sciences will play a similarly increased role in many sciences.

Notices: *Are there changes within mathematics that change the subject, in the way genomics changed biology?*

Tondeur: Mathematics is not just a self-contained body. Mathematics is profoundly affected by other sciences. The role of mathematics in information sciences creates a dynamic that in turn will affect mathematics. When I say information, data management is the key: data analysis, feature extraction of data, management of massive data sets. The mathematical sciences will fundamentally contribute to this.

Notices: *But the "gods" of the field of mathematics are not doing data management.*

Tondeur: They do, some do. There is a Stanford group, for instance, which uses topology for feature extraction of data. They think of data as simplicial complexes and compute homology. Lots of good classical mathematical ideas will play a role, and this will in turn affect mathematics. The role of combinatorics is immense. Arithmetic geometry, which is a whole platform for doing algebra and number theory using geometric ideas, is immensely important for the future. Another example is string theory, which is a mix of geometrical and physical ideas. These are powerful ideas that will transcend the field itself. I have faith that all these things will play a big role in the information world—not in a way that I could tell you today, but there is good

historical precedent. We want to support the best thinking on all these agendas. It's not really directed; we want to fund whatever is most compelling from an intellectual point of view.

Notices: *How has your vision of mathematics funding changed since you arrived at the NSF?*

Tondeur: It's more of a reinforcement than a change. I think the health of the discipline depends on the interaction with the science enterprise. I was chair of the mathematics department at Illinois, and it was true on our campus, and it's true nationally.

Notices: *But when you first came to the NSF, did you have an idea of what could be done to improve support for mathematics, and did that perception change?*

Tondeur: I had ambitious dreams, and they turned out to be the right ones. The astounding thing is how much persistent advocacy can affect the world. I hoped for it, I had the experience of it in a smaller context at Illinois, and it happened in this national context. And many funding agencies around the world are looking at what happens in the U.S., and some will change their funding tactics as a result. So I think it will have a worldwide impact.

Notices: *NSF director Rita Colwell is a big supporter of mathematics, due in large part to your efforts.*

Tondeur: But it's her own choice. That's what directors do; they decide to do things or not do them.

Notices: *But how did that come about? Did she just one day say, "Yes, math is important"?*

Tondeur: Well, that's what directors do; they develop a philosophy of things they can and wish to do. The ambition of the discipline has to resonate with the director's agenda. The three aspects of the mathematical sciences priority area are internal fundamental advances in the mathematical sciences, the impact on other sciences, and taking responsibility for the next generation. All these are important in the director's view.

All the players do things based on their convictions. I cannot believe in doing science without the next generation being sufficiently attended to. We currently do not draw enough talent into the profession, but on the positive side, we are making progress in doing so. It is the responsibility of research mathematicians to show their students this glorious adventure that the mathematical sciences are. One mode of support has been the increased attention to the Research Experiences for Undergraduates (REU) activities. That is a very effective tool. We do many more REUs than before, and we still don't do enough. I think many people don't do mathematics because they leave the discipline without knowing the fantastic things they could do. There is nothing wrong with the young people. The talent is there. We don't use it; we don't develop it.

Philippe Tondeur

Notices: *Concerning the mathematical sciences priority area, can you tell me how the support was built for that? You were a big influence, but there were other players too. Can you tell me who the other players were, or what the significant events were along the way?*

Tondeur: It's not a sequence of discrete events; it's more like a flow. General William Odom[1] is a key person. He collaborated with my predecessor, Donald J. Lewis, on the assessment report.[2] The report was prepared by an international group, who created a powerful science policy document that I took as my job description, as a vehicle that I could drive. Many people write reports, but most reports are not read or are not used. That was one that has been read and used. From a science policy point of view, that report is probably the key element. General Odom was a coach to the community in some sense during the preparation of that report and during my time at the NSF for how to operate in the political sphere. I can call him up anytime and get his advice.

Notices: *Why is he such a big supporter of mathematics?*

Tondeur: He was the key person who developed the central role of the mathematical sciences at the National Security Agency. They currently hire every year thirty mathematics Ph.D.'s, and ten master's and ten bachelor's in the mathematical sciences.

Notices: *What other components of this flow of support were important?*

Tondeur: Rita Colwell was and will continue to be important.

Notices: *What about people outside the NSF? Who was influential?*

Tondeur: There were lots of visits of the mathematical sciences community leadership to the different funding agencies. There is representation by

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[1]See "Sustaining the Momentum," by William E. Odom, page 885.

[2]Report of the Senior Assessment Panel of the International Assessment of the U.S. Mathematical Sciences, *National Science Foundation, 1998. Information about the report is contained in the article "Reports assess U.S. standing in mathematics", by Allyn Jackson,* Notices, *August 1998, pages 880–2.*

the society leadership in different combinations—AMS and SIAM [Society of Industrial and Applied Mathematics]—both on Capitol Hill and in the funding agencies, and everything helps.

Notices: *What is needed to sustain the momentum that's built up for the mathematical sciences priority area?*

Tondeur: To some extent, delivery by the community, delivery on all the science agendas. First and foremost, good mathematical results. The human resource agenda is important. You have a very supportive Congress right now, and you want to feed the Congress success stories. A congressional visit with young persons who talk about their work is very effective. Presentations on Capitol Hill by the societies, like the one organized by the Coalition for National Science Funding[3] are very important. The most powerful arguments politically are the interactivity of math with the sciences and the attention to the pipeline.

Notices: *You mentioned that the leadership of the math community visited the NSF. I have heard in the past that the other sciences did that more. Is that still true?*

Tondeur: Oh, yes, incredibly more. Mathematics has only awakened recently to this. Just as an example, the math community has one or two professionals in Washington, whereas the physics community has a whole house full of people. I'm not saying mathematicians should do exactly what others are doing, but certainly their representation in the government is very small. To give some kudos, Sam Rankin [director of the AMS Washington Office] is probably the only full-time person in the math community playing this role. SIAM represents hugely important mathematical science activities, and they have just a part-time person in Washington.

Notices: *An emphasis of the AMS Washington Office has been to work with other scientific organizations in Washington to raise the budget for science overall. How does that balance with the need to argue for your own discipline? Is it dangerous for mathematics to go it alone and argue only for mathematics?*

Tondeur: We are not only arguing for mathematics, we are not going it alone, we are acting through this agency. But if you don't advocate your discipline, who will? You have to balance this within the framework of greater support for the sciences, but certainly we have to advocate our discipline. And all disciplines do it, don't worry! They do it—and it's ugly sometimes. We don't do ugly things. We do very nice things. But you do have to advocate. That's what we are here for.

[3] *See "AMS participates in CNSF exhibition", Notices, August 2002, page 826.*

Notices: *When you look at the fiscal 2003 budget request for MPS [the NSF's Mathematical and Physical Sciences Directorate], mathematics is way up and the other disciplines are flat or down.*

Tondeur: But you have to look at the end result, what is finally appropriated by Congress. Our budget is a mix of the agency advocating through the White House and the administration to Congress, and Congress debating and fixing and changing it. I am totally convinced that in the end all disciplines will have positive increases. But how does an agency express its priority through the budget? The budget request numbers say, "This is more important than this, for us, this year." In the end all will have increases, and math will have a higher increase.

Notices: *Suppose you could start with the $151 million the DMS has today and you could draw the budget any way you wanted without regard to traditions of how things have been divided up in the past. How would you draw the budget? How would you balance between the different things the DMS funds—institutes, VIGRE grants, and so on?*

Tondeur: We think that 10 percent of our budget for math institutes is a good percentage. It was 10 percent a few years back. In the much bigger budget, we will still spend 10 percent on the institutes, but there will be six instead of three[4]. We spent 10 percent of our budget on VIGRE this year; I think it's responsible to spend 10 percent on the pipeline issue. Note that this investment is in addition to many human resource investments in other forms. So the institutes, 10 percent; 10 percent for VIGRE; and the rest is a mix of agendas. We spend $3 million annually on postdoctoral fellowships. This year we awarded twenty CAREER grants, which are each $300,000 total over five years; I think it's a good investment, it's a pipeline investment. We have about thirty REU sites and spend about $1.5 million annually on those. We spend some money on professional society program support and programs at the National Academy of Sciences. And the rest is PI [principal investigator]-initiated grants, which include activities like Focused Research Groups, special solicitations like mathematical biology, SCREMS [Scientific Computing Research Equipment in the Mathematical Sciences], etc. That is how it adds up. Support for PI grants is the bulk of our investments. The growth in the PI grants has been better in this period than ever. It's not something we've neglected.

Notices: *When you say the growth in PI grants has been better, do you mean in terms of the number of grants?*

Tondeur: No—size.

[4] *See "New NSF Institutes Announced," page 945.*

Notices: There is a push for increasing size and duration of grants. But many mathematicians feel not enough people are getting grants.

Tondeur: Both statements are true, but I basically respond to the directives of the agency. The National Science Board [the policymaking body of the NSF] has a clear directive that increasing grant size and duration is a big priority.

Notices: But do you think the number of grants will go up, with the coming increases?

Tondeur: Oh, absolutely. But it's not yet visible. The big growth is in grant size and activities like CAREER grants, institutes, VIGRE, and Focused Research Groups. These grants are massive and very well funded compared to classical funding. Grant size and duration are big priorities for the agency. To some extent, if we get these resources and we don't show a big increase in grant size and duration, we haven't done what we were supposed to do.

Notices: Someone told me it's hard to increase the size of PI grants in mathematics, because salary is the biggest part of those grants, and there is a feeling that one shouldn't just enrich the individuals. Is there this feeling at the NSF?

Tondeur: No. Most people ask for two months' salary support, and they get between one and two; that's the pattern. Very few people get two, but the number is increasing and will continue to increase. But you shouldn't underestimate the significant component of graduate student and postdoc support in PI grants. Big dollars go to postdoc and student support. We don't think mainly in terms of salary, but in terms of total support. We want to give them bigger grants and leave it to the researchers' initiative to make judicious use of them. I must say, grants asking for student and postdoc support show interest in the pipeline.

Notices: You are saying most people don't get two months of summer support.

Tondeur: That's right, but it's not a dogma. The practice arose over time out of budgetary constraints, and the situation will improve with increasing budgets. I would like leaders in the field to apply for five-year grants; it's not really necessary to review their work every three years. And we can do it if there is a step-up in the budget. I would like this fall and next fall for lots of people to apply for five-year grants, that would be really desirable. Not all of them, though, because then there would be a problem!

Notices: What about in other NSF divisions? Do they usually give two months, or is it variable?

Tondeur: It's variable. The mathematical sciences have been restrictive as a response to huge budget pressure. And I would be happy to pay two months, but going from one to two on a big scale costs an extra $100 million. The money is not there yet. I am not against it, but our goal is to talk about total support, which includes PI salary support, but also graduate student and postdoc support. Our goal is to talk about PI support and to fund what they consider important to do their work. I hope many will consider the pipeline issues among the most important. And many do.

Notices: What do you consider your best achievement at the NSF?

Tondeur: I think the biggest achievement is to give hope to the community that we can change the support climate, that federal support can improve. But the other side of the equation is that, for this to continue to happen, the community should not think of itself as being an island. The improvement in support happens because the community is not isolated—it's reaching out and doing wonderful things. The funding is in a sense a response to that activity, and we should encourage the community to do more.

Notices: Was there something that you tried to do at the NSF that you could not?

Tondeur: Well, it's never enough. More would be even better. But I know that my successor has a good platform for success and can add further improvements. I have high hopes that this will happen.

Notices: Do you have any advice for your successor?

Tondeur: Be true to thyself, and do things based on your convictions. Do things that make sense for the community, and pay attention to the pipeline. Work with people, lots of people—you need support in the community. Play to your strengths—you have to use whatever skills you have. You need them all.

Notices: Any advice to the math community about what it needs to do?

Tondeur: I think it's a wonderful profession. Do good work; be responsible for the next generation. The mathematical sciences are a glorious enterprise and are destined to play an ever-bigger role. But be responsible to the other sciences, and be responsible to the next generation.

It's an honor to have been able to play this role and a privilege to have an opportunity to repay the NSF for everything it does for the community. I want to thank all the people who have cooperated in these efforts; without them the efforts would not have borne fruit. It is impossible to even begin to name them, because there are so many of them, but all these things are part of a collective enterprise. The science enterprise is a glorious adventure that started in earnest three centuries ago and I hope will be a driving force of society in the future.

Best Current Practices: Recommendations on Electronic Information Communication (2002)

This document was prepared by the Committee on Electronic Information Communication (CEIC) of the International Mathematical Union (IMU) and endorsed by the IMU Executive Committee on April 13, 2002, at a meeting in Paris, France. An electronic version of the document may be found on the CEIC web site at `http:www.ceic.math.ca/ceic_docs/best_practices/Best-Practices.pdf`.

The members of the CEIC are: Peter Michor (chair), University of Vienna, Austria; Jonathan Borwein (deputy chair), Simon Fraser University, Canada; John Ewing, AMS, USA; Jonas Gomes, Instituto de Matemática Pura e Aplicada, Brazil; Wilfrid Hodges, Queen Mary & Westfield College, UK; David Morrison, Duke University, USA; Kapil Paranjape, Institute of Mathematical Sciences, India; Alfred J. (Alf) van der Poorten, Macquarie University, Australia; and Alexei Zhizhchenko, Russian Academy of Sciences, Russia.

—Allyn Jackson

Communication of mathematical research and scholarship is undergoing profound change as new technology creates new ways to disseminate and access the literature. More than technology is changing, however; the culture and practices of those who create, disseminate, and archive the mathematical literature are changing as well. For the sake of present and future mathematicians, we should shape those changes to make them suit the needs of the discipline.

For this reason we have identified a number of "best practices" for those involved with the mathematical literature: mathematicians, librarians, and publishers. Many of these are practices that apply to other academic disciplines as well. Although we focus primarily on mathematics, we recognize that we can learn from each other as we move forward and that no single discipline should act in isolation.

Our advice is meant to guide practice as it changes rather than to set forth a collection of firm rules and admonitions. The recommendations concern all forms of scholarly publishing and do not promote any particular form. Indeed, the authors of this document hold many differing views on the future of scholarly publishing. The common principle used to formulate our recommendations is that those who write, disseminate, and store mathematical literature should act in ways that serve the interests of mathematics first and foremost.

This is advice that is meant to ease the transition in scholarly communication for present mathematicians. Most importantly, however, it is advice aimed at protecting mathematicians in the future.

For Mathematicians

1. Structure and Format

Logically structured documents correctly reflect the content of a mathematician's work, setting forth results, arguments, and explanations to make them understandable to readers. But a logical structure also makes it possible to retrieve and eventually to update the document. Identifying the constituent parts of an electronic document is essential in order to move from one format to another without human intervention. Authoring documents should be more than setting down mathematical research in a pleasing format.

Authors are encouraged to provide the structure necessary to use their documents now and in the future. The aim is to create a master file from which the various other formats can be derived. (In mathematics, LaTeX is a congenial and accessible way to give documents some structure without adding unreasonable burdens on the author.)

2. Linking and Enrichment

An electronic publication can offer much more than a print publication. Electronic publication gives the user the ability to move effortlessly among the various parts of a paper or even from one paper to another. In order to make this possible, however,

someone must add the necessary information to establish links in the electronic version.

Adding links is easier when authors provide the information necessary to establish them. (Correct cross-referencing and citation in LaTeX transforms readily into hyperlinks, yielding enriched electronic versions of one's work. Hyperlinks may be used in PDF files as well.)

Moreover, electronic publication is not restricted by the constraints of the traditional print medium. This provides an opportunity to detail material that might otherwise be dismissed as "well known" and to add explanatory appendices. A little less easily, one may include, whenever appropriate, graphic enhancements, animations, extensive data, tools to analyze that data, or even active examples that may be varied by the reader.

3. Versions

Online publication can lead to severe problems in citation, because the posted paper can be updated continuously until it bears little resemblance to the original, as an author corrects, adds, and deletes material without indicating that changes were made. As the mathematical literature grows, references to nonexistent papers and results will eventually jeopardize its coherence.

To avoid this problem, papers that have achieved a sufficiently final state should be stored in an immutable form. This includes any paper to which others may make reference, whether published in refereed journals or posted as a preprint. If revisions subsequently are necessary, each released version should be clearly labeled with its own version number, and old versions should remain available.

4. Personal Homepages

Mathematical communication is more than merely posting or publishing papers. Information about the mathematical community and its activities is valuable to all mathematicians, and it is now easier than ever to circulate and to find such material.

Mathematicians are encouraged to have their own homepage. Ideally, basic data on such a page (or on a "secondary" homepage) should be presented in standard form to allow ready automatic compilation into databases.

(Material found at `http://www.math-net.org/Math-Net_Page_Help.html` describes the Math-Net project, which provides standardized homepages for departments and institutes.)

5. Personal Collected Works

Mathematics ages slowly. Access to older literature is important for most mathematicians, and yet much of the older literature is likely to remain unavailable in electronic form in the immediate future. Mathematicians can change that by taking collective action.

Whenever legally and technically possible, mathematicians are encouraged to scan their old (pre-TeX) papers and post them on their homepages, making their "collected work" readily available to all. This relatively small effort on the part of every mathematician will provide enormous benefit to the entire community.

The "Call to All Mathematicians" found at `http://www.mathunion.org/` provides further information.

6. Preprints and Archives

Mathematical writing is ineffective if it is not communicated. A generation ago the photocopier made it easy to send preprints to one's peers. Today, as a substitute, we have departmental servers, homepages, and public archives. [The arXiv (`http://www.arxiv.org/`) is one prominent example.]

It is a good practice to place one's preprints both on a homepage and in an appropriate archive. Either copy serves to communicate the mathematics to one's peers, but the public archive will make it more likely that others can reference your work in the future.

7. Copyright

While copyright is a complex subject that is far removed from mathematics, copyright law and policy can profoundly affect the ways in which mathematics is disseminated and used. Copyright is important for mathematicians.

Authors should be aware of the basic principles of copyright law and custom. Decisions about copyright for one's own work should be made thoughtfully.

The material found at `http://www.ceic.math.ca/` serves as a good reference.

For Librarians and Mathematicians

8. Journal Price and Policy

Libraries have limited budgets which often grow more slowly than the prices of journals, forcing libraries to cancel subscriptions. The cumulative effect of cancellations goes beyond individual institutions, because it shifts costs to an ever-smaller number of subscribers, accelerating the process of price increase and cancellation. Journal prices matter to all mathematicians.

When deciding where to submit a paper, an author may choose to be aware of a journal's standing and impact, but an author also should take account of a journal's price (as well as its general policies, including archiving). In addition, one might consider a journal's price and policies when considering whether to referee or serve on an editorial board.

9. Validation

Publication and peer review processes are increasingly detached. The emergence of overlay journals, archival preprint servers, and other new structures of publication raise new and pressing questions about the appropriate forms of validation. These are important issues for all scholarship, but even more important for mathematics, since it is essential to know which parts of the mathematical literature are valid.

Both mathematicians and decision makers need to be alert to the distinction between posting and providing validation. Editorial boards should be explicit about the form and the level of validation they

provide for papers and make this information plain to all users.

10. Statistics

Electronic delivery of information has changed the nature of statistics available to assess the usage and the value of academic literature. Gathering statistics from the Internet is notoriously complicated, and even those who are knowledgeable about the pitfalls can be inadvertently or intentionally misled. As librarians and other decision makers increasingly rely on Web statistics (such as the number of hits, page accesses or downloads), it is important to be informed about the nature of such measurements and the difficulty in gathering and interpreting them. Moreover, the value of a particular resource is often not best measured by simply counting the number of times it is currently used in some way. This is especially true in a field like mathematics, in which current research continues to play such a significant role far into the future.

Given that statistics, while subject to misuse, are valuable and will be used, it is important that mathematics researchers and research librarians are alert to these rapidly changing issues and are prepared to make appropriate arguments for mathematics.

For Publishers and Mathematicians

11. Partial Access

Many journals restrict access to (paying) subscribers. As the web of mathematical literature grows, however, it will be increasingly important for all mathematicians to navigate that web, whether or not they have access to complete articles. This allows mathematicians to learn basic information about an article, even when they do not belong to institutions that have the financial resources to support the journal. It is especially advantageous to mathematicians from the developing world.

Journals should provide unrestricted access to tables of contents, abstracts of papers, and other data, such as keywords. Where practical, journals should also provide unrestricted access to reference lists with links, allowing all mathematicians to navigate the web of literature, even when they don't have access to the full text of some parts of that web.

12. Eventual Free Access

The scholarly enterprise rests on the free exchange of ideas, and scholars need to have easy access to those ideas. Many journals, however, rely on subscriptions to recover costs and to provide an incentive to publish, forcing them to limit access to subscribers. Access should be a balance between those two needs—of scholars and of publishers.

Limiting access to subscribers for a fixed period of time after publication may be necessary for many journals. In order to ensure appropriate accessibility for the electronic literature, we encourage all journals to grant free access after that fixed period of time.

13. Archiving Format

Ensuring the success of long-term archiving is more than storing the electronic data on reliable media in multiple locations. As software and formats change in the future, the data will require modification and updating. Not all electronic formats are suitable for these purposes.

In general, electronic documents should be stored in their most primitive format, that is, the format used to derive subsequent formats. Any format in which material is stored should follow an "open standard" that has a detailed public specification. This will increase the likelihood that scholars working decades or centuries from now will be able to use the material.

14. Archiving Responsibility

Traditionally, maintaining the older literature has been the responsibility of librarians rather than publishers. Even in the electronic age, scholars and the librarians who represent them have the greatest motivation among all of the affected parties to ensure the preservation of older material.

We recommend that electronic archives of the mathematical literature should ultimately be under the control of the academic community.

15. Licensing and Bundling

Some licensing and bundling arrangements for journals accelerate the transfer of control of our literature away from mathematicians and research librarians. When institutions are forced to accept or reject large collections of scholarly literature covering many different disciplines, the decisions are less likely to be made by scholars. As a consequence, the normal processes that promote the highest-quality journals become less effective.

The best protection, as always, comes through staying well informed and alert to these issues. In general, decisions about journal adoptions and cancellations should be made by academics and librarians.

Postscript on Developing Countries

Today, active mathematicians depend on access to electronic information—online journals, databases of reviews, and preprint servers. More than access, research mathematicians need the tools to create and edit documents in standard formats such as LaTeX, PostScript, and PDF. This is true for mathematicians everywhere, including those in developing countries. Implementing many of the recommendations in the preceding document makes little sense if mathematicians are not connected to the Internet or have no tools to create electronic documents.

National mathematical societies and academies in developing countries need to impress on their governments the need to establish the infrastructure necessary to provide high-speed connectivity among academic institutions. The entire mathematics community should encourage and support specific actions designed to help in this effort, which includes:

1. Establishing "mirror" services that provide quick access to users of electronic services within each region.

2. Establishing local help and service centers that spread expertise on the use of common standards (for example, LaTeX).

3. Creating small groups who tour the region and demonstrate the use of technology for research and study.

Because scholarly communication is changing rapidly, there is great urgency to begin these efforts.

—Committee on Electronic Information Communication
International Mathematical Union

Remark: The above recommendations have been stated in very general form. Whenever reference to existing formats (e.g., LaTeX, PDF), to archiving systems (e.g., arXiv), or to information and communication systems (e.g., Math-Net) has been made, this is meant for illustration and not to promote these formats and systems. The IMU Executive Committee (EC) has asked the Committee on Electronic Information Communication (CEIC) to enhance, whenever appropriate and useful, individual recommendations by adding links to webpages that explain some of the technical issues involved, provide additional information, or contain (possibly controversial) discussions of the topics addressed. These links will be the responsibility of the CEIC and are not subject to the IMU EC recommendations. For further information, see `http://www.ceic.math.ca`.

Rao and Stein Receive National Medal of Science

Photograph courtesy of Penn State.

Calyampudi R. Rao

Elias M. Stein

On May 9, 2002, President Bush awarded fifteen National Medals of Science. Among the awardees were two mathematical scientists, CALYAMPUDI R. RAO, emeritus holder of the Eberly Family Chair in Statistics and director of the Center for Multivariate Analysis at Pennsylvania State University, and adjunct professor at the University of Pittsburgh; and ELIAS M. STEIN, Albert Baldwin Dodd Professor of Mathematics at Princeton University.

Calyampudi Rao's pioneering work in multivariate analysis has become the foundation of statistics and has had a significant impact on applications in medical diagnosis, evolutionary genetics, and signal detection theory. Rao has focused equally on the application of statistical methods to real-world problems. One of his early books, *Advanced Statistical Methods in Biometric Research* (1952), was written to assist biomedical researchers who were not equipped to develop the new methods of analysis their data demanded. In response to the needs of industry, he introduced a new method of experimentation through combinatorial arrangements, known as orthogonal arrays, which has become widely used to control and improve the quality of manufactured goods. He developed estimation theory in small samples, which greatly extended the scope of statistical methods in practical work. Rao was the first to introduce differential geometric techniques in discussing problems of statistical inference, based on Rao's Distance Function, which is now an active field of research. Rao was born in Hadagali, India, on September 10, 1920, and received his Ph.D. from the University of Cambridge.

Elias Stein has shaped the field of mathematical analysis and has changed the way mathematicians approach problems in nearly every subarea of the field. He was among the first to appreciate the interplay among partial differential equations, classical Fourier analysis, several complex variables, and representation theory. He was the first to perceive the fundamental insights in each field arising from that interplay. Stein is the world's leading authority in harmonic analysis. He and his colleagues introduced a generalization of analytic functions in higher dimensions known as H^p-spaces. This theory led to important connections between harmonic analysis and probability theory and facilitated the solution of numerous problems. In his studies Stein also showed the power of using square functions to control error terms, a technique that he invented and that is now fundamental in harmonic analysis. Stein was born in Belgium on

January 13, 1931, and received his Ph.D. from the University of Chicago.

The National Medal of Science was established by Congress in 1959. It was intended to be bestowed annually by the president of the United States for outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences. Congress expanded this definition in 1980 to recognize outstanding work in the social and behavioral sciences. In 1962 President John F. Kennedy awarded the first Medal of Science to the late Theodore von Karman, professor emeritus, California Institute of Technology. A committee of twelve scientists and engineers is appointed by the president to evaluate the nominees for this award. The National Science Foundation (NSF) administers the National Medals of Science for the White House.

Including the current awardees, 401 individuals have received the National Medal of Science. The awardees in mathematics and computer science are: Raoul Bott, Richard D. Brauer, Felix E. Browder, Alberto P. Calderón, George F. Carrier, Shiing-shen Chern, John Cocke, Paul J. Cohen, Ronald R. Coifman, George B. Dantzig, Joseph L. Doob, William Feller, Michael H. Freedman, Kurt Otto Friedrichs, Kurt Gödel, Herman H. Goldstine, Ralph E. Gomory, Samuel Karlin, Richard M. Karp, Joseph B. Keller, Stephen C. Kleene, Donald E. Knuth, Martin D. Kruskal, Peter D. Lax, Saunders Mac Lane, John McCarthy, John W. Milnor, Cathleen Synge Morawetz, Allen Newell, Jerzy Neyman, Louis Nirenberg, Isadore M. Singer, Stephen Smale, Donald C. Spencer, Marshall H. Stone, John Griggs Thompson, John Wilder Tukey, Karen K. Uhlenbeck, Hassler Whitney, Norbert Wiener, Shing-Tung Yau, Oscar Zariski, and Antoni Zygmund.

—Compiled from NSF news releases

2001 Annual Survey of the Mathematical Sciences

(Third Report)

Faculty Profile
Enrollment and Undergraduate Majors Profile
Graduate Student Profile

Don O. Loftsgaarden, James W. Maxwell, and Kinda Remick Priestley

This Third Report of the 2001 Survey gives information about faculty size, departmental enrollments, majors, and graduate students for departments of mathematical sciences in four-year colleges and universities in the United States. Prior to 2000, these data were included as part of the Second Report.

The 2001 Annual Survey represents the forty-fifth in an annual series begun in 1957 by the American Mathematical Society. The 2001 Survey is under the direction of the Data Committee, a joint committee of the American Mathematical Society, the American Statistical Association, the Institute of Mathematical Statistics, and the Mathematical Association of America. The current members of this committee are Lorraine Denby, J. Douglas Faires, Mary W. Gray, Alexander J. Hahn, Peter E. Haskell, G. Samuel Jordan, Stephen F. Kennedy, Ellen E. Kirkman, Don O. Loftsgaarden (chair), and James W. Maxwell (ex officio). The committee is assisted by AMS survey analyst Kinda Remick Priestley and survey coordinator Colleen Rose. Comments or suggestions regarding this Survey Report may be directed to the committee.

Introduction

The Annual Survey of the Mathematical Sciences collects information each year about departments, faculties, and students in the mathematical sciences at four-year colleges and universities in the United States. Definitions of the various groups surveyed in the Annual Survey can be found in the box on page 938 of this report. Departments in the former Group Vb are no longer surveyed. (See the 1999 First Report in the February 2000 *Notices of the AMS*.) We present information about the faculties and instructional programs at the undergraduate and graduate levels in these departments for the 2001–2002 academic year. For 1999–2000 and earlier years, these data were presented as part of the Second Report.

Information about departments was gathered on a questionnaire called the Departmental Profile. This questionnaire was mailed to all departments in Groups I, II, III, IV, and Va and to stratified random samples from Groups M and B. The percentage of the departments responding in each of the doctoral groups was between 90 and 100 percent. Prior to this year, if doctoral departments did not respond, simple projections were made to the whole population using the data from those departments who did respond. Beginning this year, if a department did not return the Departmental Profile questionnaire but had returned one within the last two years, the data from the most recent questionnaire was used. This change in procedure will produce even more accurate results than those in past reports for these doctoral departments.

The Departmental Profile questionnaire is mailed to a stratified random sample of departments drawn from each of Groups M and B, and standard statistical projections are made using the data from the respondents. The stratification for Groups M and B is based on the enrollment of the school and whether it is a public or a private school. This year, for the first time, standard errors are calculated for several of the more important projections made in Groups M and B and these standard errors are reported. The box on page 929 discusses these standard errors in more detail.

Don O. Loftsgaarden is professor emeritus of mathematics, University of Montana. James W. Maxwell is AMS associate executive director for Professional Services. Kinda Remick Priestley is AMS survey analyst.

Remarks on New Statistical Procedures

This report is based on information gathered from departments of mathematical sciences in the U.S., separated into groups by highest degree granted as defined on page 938. Groups for doctoral-granting departments are I(Public), I(Private), II, III, IV, and Va. Groups M and B consist of those departments offering master's and bachelor's degrees respectively.

While the questionnaire on which this report is based is sent to every doctoral department, it is sent to a stratified random sample in Group M and B departments.

The response rate is typically between 90 and 100 percent for the doctoral groups. Prior to this year, simple projections were made using the questionnaires that were returned to get estimated totals for the entire population. After a couple of years of experimentation, a new procedure is being used. If a doctoral department did not return their questionnaire this year but returned one within the past two years, those numbers were used as their response for the current year. This procedure will give us even more accurate estimates than we have gotten in the past.

The stratified random sampling procedures used for Groups M and B were put in place three years ago. For the first time this year, standard errors have been calculated for some of the key estimates. Standard errors are calculated using the variability in the data and can be used to crudely measure how closely our estimate is to the true value for the population. As an example, the number of full-time faculty in Group M is estimated at 4,336 with a standard error of 118. This means the actual number of full-time faculty in Group M is most likely between 4,336 plus or minus two standard errors, or between 4,100 and 4,572. This is much more informative than simply giving the estimate of 4,336.

Estimates are also given for parameters that are totals from all groups, such as the total number of full-time faculty. The values given for the doctoral groups are assumed to be the true parameters for these groups because they are not sampled and hence are not subject to sampling variability. The only variability in a total of several groups comes from the sampling for Groups M and B. Using the standard errors for M and B, it is possible to calculate a standard error for the total. For example, an estimate of the total number of full-time faculty in all groups but Group IV is 19,712, with a standard error of 285.

Standard errors, when calculated for an estimate, appear in the tables in parentheses underneath the estimate.

Highlights

Standard errors for key estimates in Groups M and B are calculated for the first time this year.

Groups I, II, III, and Va had 2,314 full-time doctoral positions available, of which 1,618 were tenured/tenure-track. Groups M and B had 1,514 full-time doctoral positions available, of which 1,233 were tenured/tenure-track.

Of the 2,051 positions which were open to new doctoral recipients, 1,459 were tenured/tenure-track, up 27.3% from the 1,146 such positions under recruitment in 1999–2000.

Groups I, II, III, and Va hired 312 new doctoral recipients for fall 2001, and 59 (18.9%) filled tenured/tenure-track positions. Groups M and B hired 374 new doctoral recipients, and 259 (69.3%) filled tenured/tenure-track positions.

The estimated number of full-time faculty for all groups surveyed is 21,128, only 38 less than reported last year. The number of females is 5,135; the number having a doctorate is 17,753; the number of doctoral non-tenure-track is 2,188.

Detailed information is given in this report about the 3,338 nondoctoral full-time faculty and the 8,057 part-time faculty in all groups except Group IV.

The number of junior/senior majors in Groups I, II, III, Va, M, and B is 58,900, down 1,000 from last year.

Groups I, II, III, and Va had slightly more full-time first-year graduate students and non-U.S. citizen full-time graduate students than last year and are down slightly for other types of graduate students.

Standard errors for Group M departments are large for all types of graduate students. This makes possible substantial increases or decreases in Group M numbers from year to year simply due to the sampling variability rather than any real changes.

Faculty Profile

The Departmental Profile, sent in fall 2001 to mathematical sciences departments at four-year colleges and universities as part of the Annual Survey, gathered information about faculties at these schools, which is reported in this section. The 2001 First Report presented data collected earlier about faculty salaries (pages 217–231 of the February 2002 issue of the *Notices of the AMS*).

Faculty Attrition

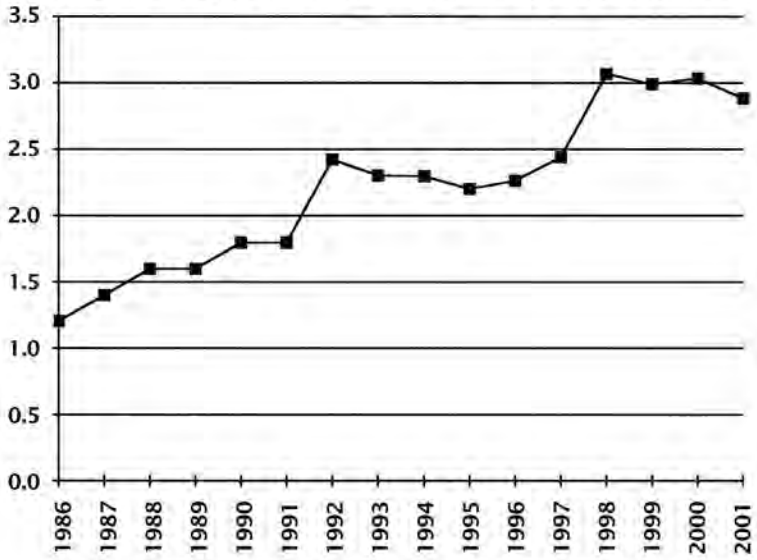
Table 1 displays losses of full-time mathematical sciences faculty due to retirements and deaths. The fall 2001 mathematics faculty attrition rate for Groups I, II, III, Va, M, and B combined was 2.9%, compared with fall 2000, 1999, and 1998 values of 3.0%, 3.0%, and 3.1% respectively. Group I Private had the lowest attrition rate at 0.5%, and Group B the highest at 3.6%. These rates vary quite a bit from year to year for each of the groups. Figure 1 shows

Table 1: Faculty Attrition,[1] Fall 2001

	GROUP									
	I Public	I Private	II	III	Va	I, II, III, & Va	M	B	I, II, III, Va, M, & B	IV
Full-time faculty who retired or died										
Total number	32	4	74	49	9	**168**	113	288	**569**	25
(Standard error)							*(12)*	*(42)*	*(43)*	
Percentage	1.8	0.5	3.0	2.4	3.1	**2.3**	2.6	3.6	**2.9**	1.8

[1] Number and percentage of full-time faculty who were in the department in fall 2000 but were reported to have retired or died by fall 2001.

Figure 1: Percent of Full-Time Doctoral Faculty Who Retired or Died in Groups I, II, III, Va, M, & B, Fall 1986 to Fall 2001



the trend in this attrition rate for mathematics departments during the years 1986 to 2001.

Faculty Recruitment

Table 2A contains detailed information on the number of full-time doctoral faculty positions in mathematical sciences departments under recruitment in 2000–2001 for employment beginning in the academic year 2001–2002. Among mathematics departments (Groups I, II, III, Va, M, and B), 2,314 positions were under recruitment in 2000–2001 for employment beginning in the academic year 2001–2002, up 23.5% compared to last year. Of those 2,314 positions, 2,051 (88.6%) were available to new doctoral recipients, and of those 2,051 positions, 1,459 (71.1%) were tenured/tenure-track positions. The 1,459 tenured/tenure-track positions open to new doctoral recipients was up from the 1,146 such positions under recruitment in 1999–2000.

Under the "Reported Hires for Above" section in Table 2A, four new rows have been added giving the

Table 2A: Recruitment of Doctoral Faculty, Fall 2001

	GROUP									
	I Public	I Private	II	III	Va	I, II, III, & Va	M	B	I, II, III, Va, M, & B	IV
Posted Doctoral Positions										
Total number[1]	**235**	**128**	**222**	**182**	**33**	**800**	**476**	**1038**	**2314**	**203**
(Standard error)							*(49)*	*(83)*	*(96)*	
Tenured/tenure-track	86	38	107	137	17	**385**	436	797	**1618**	144
Open to new doctoral recipients	152	105	174	140	26	**597**	473	981	**2051**	143
Tenured/tenure-track	40	21	81	113	12	**267**	424	768	**1459**	114
Open at assoc/full level	45	15	29	42	7	**138**	93	101	**332**	75
Reported Hires for Above										
Total number	**208**	**119**	**186**	**137**	**29**	**679**	**342**	**844**	**1865**	**131**
Male doctoral hires	171	100	144	102	28	**545**	204	438	**1187**	85
Tenured/tenure-track	62	26	61	70	12	**231**	178	257	**666**	57
Female doctoral hires	32	19	37	32	1	**121**	88	225	**434**	45
Tenured/tenure-track	7	6	11	25	1	**50**	79	167	**296**	27
Male nondoctoral hires	2	0	4	1	0	**7**	24	118	**149**	1
Female nondoctoral hires	2	0	1	2	0	**5**	26	66	**97**	0
Total new doctoral hires	**97**	**83**	**75**	**44**	**13**	**312**	**112**	**262**	**686**	**54**
Male new doctoral hires	79	69	57	32	12	**249**	63	185	**497**	29
Tenured/tenure-track	3	6	9	25	5	**48**	56	103	**207**	29
Female new doctoral hires	18	14	18	12	1	**63**	49	77	**189**	25
Tenured/tenure-track	0	1	1	8	1	**11**	48	52	**111**	16
Unfilled Positions	**28**	**8**	**36**	**45**	**4**	**121**	**135**	**193**	**449**	**73**
Temporarily Filled Positions										
Male	7	10	25	13	2	**57**	58	148	**263**	7
Female	1	0	3	7	0	**11**	45	103	**159**	5

[1] Number of full-time doctoral positions under recruitment in 2000–2001 to be filled for 2001–2002.

number of positions that were tenured/tenure-track for various categories. This is the first year such information has been reported by the Annual Survey, and there are some interesting and surprising results found in these data.

Table 2B condenses the information in Table 2A. It also reorganizes the doctoral hires into one section for new doctoral hires and another for other doctoral hires. Table 2C is derived from Table 2B, with the percentage of the filled positions that were tenured/tenure-track included in the table.

From Table 2B we find that Groups I, II, III, and Va combined filled 666 doctoral positions, of which 281 (42.2%) were tenured/tenure-track positions. Groups M and B combined filled 955 doctoral positions, of which 681 (71.3%) were tenured/tenure-track. From Table 2C we see that these same two percentages for new doctoral recipients only are 18.9% and 69.3% respectively. For other doctoral hires these same two percentages are 62.7% and 72.6% respectively.

From Table 2B we find that of the new doctoral recipients hired in groups I, II, III, and Va combined, 19.3% of the males and 17.5% of the females took tenured/tenure-track positions. For new doctoral recipients hired in Groups M and B combined, 64.1% of the males and 79.4% of the females took tenured/tenure-track positions. Even though 44.7% of the positions available in doctoral departments (Groups I, II, III, and Va) for new doctoral recipients were tenure-track positions, only 18.9% of the new doctoral recipients hired were given tenured/tenure-track positions. At the same time, 354 of those hired were not new doctoral recipients and 62.7% had tenured/tenure-track positions.

Figure 2 shows the number of full-time doctoral positions available in all groups except Group IV, as well as the number of those that were tenured/tenure-track and the number unfilled for the years 1990 to 2001. There was a sharp decrease in available positions in the first three years of the decade of the 1990s, but the number of positions and the number of tenured/tenure-track positions have been increasing since then.

Faculty Size

Table 3A gives the number of faculty for different categories of faculty broken down by group. Table 3B gives the same information for females only. The estimated total number of full-time faculty in Groups I, II, III, Va, M, and B combined is 19,712, down 67 from last year. The standard error for the 19,712, available for the first time this year, is 285. We can be quite confident that the actual total number of faculty in these groups is in the interval 19,712 +/- 570. The doctoral departments I, II, III, and Va were up 133 full-time faculty members, Group M was down 439 faculty members, and Group B was up 239. In a periodic reclassification of departments, several of last year's Group M departments became Group B departments. This probably accounts for much of the drop in full-time faculty members at Group M departments and some of the increase in faculty at Group B departments. The standard errors for the total number of full-time faculty in Groups M and B are 118 and 260 respectively. These indicate there is substantial variation in the number of full-time faculty members in the departments in Groups M and B, even in departments at schools that have approximately the same total enrollments. The standard error for Group M indicates that there is a real drop in the number of faculty members in Group M departments. Although Group B was up 239 full-time faculty this year, there may not be an actual change, as this increase is well within the variability we expect with a standard error of 260.

Table 3C gives some percentages based on the information in Tables 3A and 3B.

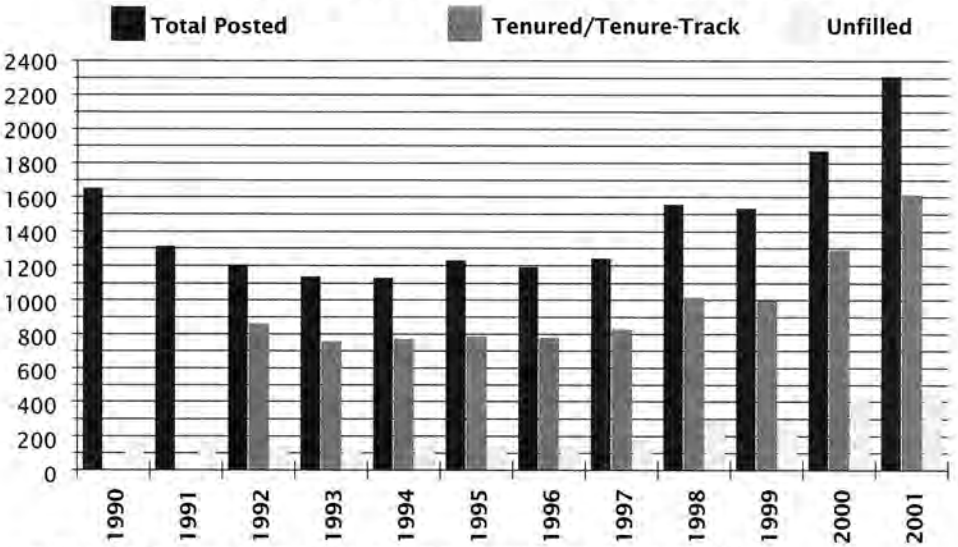
Table 2B: A Summary of Recruitment of Doctoral Faculty, Fall 2001

	GROUP		
	I, II, III, & Va	M & B	IV
Posted Doctoral Positions			
Total number	800	1514	203
Tenured/tenure-track	385	1233	144
Open to new doctoral recipients	597	1454	143
Tenured/tenure-track	267	1192	114
Reported Hires for Above			
Total new doctoral hires	312	374	54
Tenured/tenure-track	59	259	45
Male	249	248	29
Tenured/tenure-track	48	159	29
Female	63	126	25
Tenured/tenure-track	11	100	16
Total not new doctoral hires	354	581	76
Tenured/tenure-track	222	422	39
Male	296	394	56
Tenured/tenure-track	183	276	28
Female	58	187	20
Tenured/tenure-track	39	146	11

Table 2C: Percentage Tenured/Tenure-track for Positions Posted and Filled, Fall 2001

	GROUP		
	I, II, III, & Va	M & B	IV
New Doctoral Positions			
Positions posted	597	1454	143
% tenured/tenure-track	44.7	82.0	79.7
Positions filled	312	374	54
% tenured/tenure-track	18.9	69.3	83.3
Not New Doctoral Positions			
Positions posted	---	---	---
% tenured/tenure-track			
Positions filled	354	581	76
% tenured/tenure-track	62.7	72.6	51.3

Figure 2: Number of Full-Time Doctoral Positions under Recruitment: Total, Tenured/Tenure-Track, and Unfilled in Groups I, II, III, Va, M, & B Combined, Fall 1990 to Fall 2001



Note: The tenured/tenure-track status of positions under recruitment was not surveyed until 1992.

The number of non-tenure-track doctoral full-time faculty and the number of part-time faculty have been increasing in recent years. Table 3D gives a six-year history of these two types of faculty for Groups I, II, III, and Va combined, for Group M, and for Group B. Also shown for each number in this table is the percentage of females. This increase in non-tenure-track full-time doctoral positions continues a disturbing trend reported in "Changes in mathematics faculty composition, fall 1990–fall 1996" (James W. Maxwell, *Notices of the AMS*, November 1997, pages 1321–3). Tables 2B and 2C have information in them that may help in understanding this issue. They give details about the doctoral hires for fall 2001 and how many were tenured/tenure-track

Table 3A: Faculty Size, Fall 2001

	GROUP									
	I Public	I Private	II	III	Va	I, II, III, & Va	M	B	I, II, III, Va, M, & B	IV
Full-time faculty *(Standard error)*	**1746**	**902**	**2456**	**2055**	**273**	**7432**	**4336** *(118)*	**7944** *(260)*	**19712** *(285)*	**1416**
Doctoral full-time faculty	1670	898	2205	1786	272	**6831**	3374	6169	**16374**	1379
Tenured	1171	537	1613	1318	139	**4778**	2346	4115	**11239**	836
Untenured, tenure-track	149	89	248	305	29	**820**	845	1550	**3215**	275
Non-tenure-track *(Standard error)*	350	272	344	163	104	**1233**	183 *(24)*	504 *(73)*	**1920** *(76)*	268
Non-doctoral full-time faculty	76	4	251	269	1	**601**	962	1775	**3338**	37
Part-time faculty *(Standard error)*	**214**	**53**	**459**	**719**	**22**	**1467**	**2393** *(262)*	**4197** *(297)*	**8057** *(396)*	**171**

Table 3B: Female Faculty Size, Fall 2001

	GROUP									
	I Public	I Private	II	III	Va	I, II, III, & Va	M	B	I, II, III, Va, M, & B	IV
Full-time female faculty	**209**	**92**	**409**	**407**	**27**	**1144**	**1368**	**2283**	**4795**	**340**
Doctoral full-time female faculty	165	90	248	260	27	**790**	769	1527	**3086**	321
Tenured	73	26	119	142	7	**367**	465	870	**1702**	121
Untenured, tenure-track	21	12	45	79	6	**163**	261	510	**934**	94
Non-tenure-track	71	52	84	39	14	**260**	43	147	**450**	106
Non-doctoral full-time faculty	44	2	161	147	0	**354**	599	756	**1709**	19
Part-time female faculty	**89**	**10**	**173**	**275**	**7**	**554**	**895**	**1803**	**3252**	**57**

Table 3C: Number and Percentage of Full-Time Faculty, Fall 2001

	GROUP								
	I Public	I Private	II	III	Va	M	B	IV	Total All Groups
Full-Time Faculty									
Number	1746	902	2456	2055	273	4336	7944	1416	**21128**
Percentage of total full-time faculty	8.3	4.3	11.6	9.7	1.3	20.5	37.6	6.7	**100.0**
Female Full-Time Faculty									
Number	209	92	409	407	27	1368	2283	340	**5135**
Percentage of female full-time faculty	4.1	1.8	8.0	7.9	0.5	26.6	44.5	6.6	**100.0**
Female Full-Time Faculty									
Percentage female full-time faculty by group	12.0	10.2	16.7	19.8	10.0	31.5	28.7	24.0	**24.3**

Table 3D: Number, and Percentage of Those Female, of Non-Tenure-Track Doctoral Full-Time Faculty

	1996	1997	1998	1999	2000	2001
Groups I, II, III, & Va						
Non-tenure-track doctoral full-time faculty	672	708	904	1014	993	1233
Percentage female	24.9	21.5	20.7	21.7	20.6	21.1
Part-time faculty	1093	954	1141	1217	1399	1467
Percentage female	36.7	36.8	38.0	37.8	37.0	37.8
Group M						
Non-tenure-track doctoral full-time faculty	138	216	140	146	262	183
Percentage female	23.9	29.6	27.1	56.2	29.0	23.5
Part-time faculty	1879	1612	1768	1906	2323	2393
Percentage female	41.4	45.5	42.8	35.2	36.2	37.4
Group B						
Non-tenure-track doctoral full-time faculty	419	385	427	514	407	504
Percentage female	22.9	26.2	31.1	23.7	30.2	29.2
Part-time faculty	3055	3107	3585	3298	3580	4197
Percentage female	44.0	46.0	42.3	40.7	40.4	43.0

positions. There has also been substantial growth in part-time faculty in recent years.

Table 3E gives a summary of the various types of faculty found in departments of mathematical sciences by sex and group. Nondoctoral full-time faculty have been added to this table this year and make the partition of full-time faculty complete.

Tables 3F and 3G give more information about two types of faculty: full-time faculty without a doctorate and part-time faculty. The top half of Table 3F is a somewhat condensed version of the doctoral full-time faculty in Table 3A broken down by sex. The bottom half of Table 3F shows this same information for the 3,338 full-time faculty who do not have doctoral degrees. The majority of these faculty,

Table 3E: Summary of Full-Time and Part-Time Faculty by Sex, Fall 2001

	GROUP					
	I, II, III, & Va		M & B		IV	
	Male	Female	Male	Female	Male	Female
Full-time faculty	6288	1144	8629	3651	1076	340
Percentage	84.6	15.4	70.3	29.7	76.0	24.0
Doctoral full-time faculty	6041	790	7247	2296	1058	321
Percentage	88.4	11.6	75.9	24.1	76.7	23.3
Tenured	4411	367	5126	1335	715	121
Percentage	92.3	7.7	79.3	20.7	85.5	14.5
Untenured, tenure-track	657	163	1624	771	181	94
Percentage	80.1	19.9	67.8	32.2	65.8	34.2
Non-tenure-track	973	260	497	190	162	106
Percentage	78.9	21.1	72.3	27.7	60.4	39.6
Non-doctoral full-time faculty	247	354	1382	1355	18	19
Percentage	41.1	58.9	50.5	49.5	48.6	51.4
Part-time faculty	913	554	3892	2698	114	57
Percentage	62.2	37.8	59.1	40.9	66.7	33.3

Table 3F: Doctoral and Nondoctoral Full-Time Faculty Size, Fall 2001

	GROUP					
	I, II, III, & Va		M & B		Total	
	Male	Female	Male	Female	Male	Female
Doctoral full-time faculty	**6041**	**790**	**7247**	**2296**	**13288**	**3086**
Tenured	4411	367	5126	1335	9537	1702
Untenured, tenure-track	657	163	1624	771	2281	934
Non-tenure-track	973	260	497	190	1470	450
Nondoctoral full-time faculty	**247**	**354**	**1382**	**1355**	**1629**	**1709**
Tenured	22	15	516	262	538	277
Untenured, tenure-track	4	3	149	171	153	174
Non-tenure-track	221	336	717	922	938	1258

2,737 (82.0%), are found in Groups M and B departments.

There are 8,057 part-time faculty in the mathematical sciences departments in Groups I, II, III, Va, M, and B. Table 3G shows where these part-time faculty are found, broken down by sex and whether they have a doctoral degree.

With the addition of new information gathered in this year's annual survey and the addition of three new tables in this section, this report contains the most complete picture of the faculty in mathematical sciences in the U.S. that has ever been published in this series of reports.

Faculty Profile for Females

Table 3B gives a complete breakdown of all categories of female faculty by group. The total number of full-time faculty in all groups for 2001–2002 is 21,128, of which 5,135 (24.3%) are females.

Table 3C shows the number and percentage of all full-time and female full-time faculty that fall into each group for 2001–2002. The number of faculty in each group and the percentage who are female is given in the bottom section of Table 3C. The number of females as a percentage of full-time faculty varies considerable among the groups, from 10.2% and 10.0% for Groups I Private and Va to 31.5% and 28.7% for Groups M and B respectively. This is the same pattern as reported last year. Note: In Table 3C the percentages for each group in rows 2 and 4 are of the row totals. The percentages in row 6 are column percentages using the numbers in rows 1 and 3.

Table 3D contains information about non-tenure-track doctoral full-time faculty and part-time faculty for the years 1996 to 2001 for Groups I, II, III, and Va combined, M, and B. This table includes the total number for each category as well as the percentage female for each number.

Table 3E gives the male/female breakdown by count and percentage for Groups I, II, III, and Va combined for various categories of faculty in columns 2 and 3. The same breakdowns are given for Groups M and B combined in columns 4 and 5 and for Group IV in columns 6 and 7.

Table 3F shows that of the 3,338 nondoctoral full-time faculty in Groups I, II, III, Va, M, and B, 1,709 (51.2%) are females. In Table 3G we see that in these same groups there are 8,057 part-time faculty, of which 3,252 (40.4%) are females.

Table 3G: Part-Time Faculty Size, Fall 2001

	GROUP				
	I, II, III, & Va		M & B		
	Male	Female	Male	Female	TOTAL
Doctoral part-time faculty	384	142	833	222	**1581**
Non-doctoral full-time faculty	529	412	3059	2476	**6476**
Total	**913**	**554**	**3892**	**2698**	**8057**

Enrollment Profile and Undergraduate Majors Profile

Enrollment

The Departmental Profile Survey obtained information about enrollments and distribution of instructional effort among various course categories in mathematical sciences departments. Table 4A gives the total undergraduate and total graduate enrollments in mathematics courses for each group that is part of the Annual Survey. Each enrollment in this and other tables in this section is projected

Table 4A: Undergraduate and Graduate Enrollments (thousands), Fall 2001

	GROUP									
	I Public	I Private	II	III	Va	I, II, III, & Va	M	B	IV	Total All Groups
Undergraduate Course Enrollments										
Total number (thousands)	176	42	279	246	12	**755**	513	743	81	**2092**
(Standard error)							*(19)*	*(25)*		*(32)*
Graduate Course Enrollments										
Total number (thousands)	7	5	9	9	2	**32**	14		26	**72**

Table 4B: Distribution of Undergraduate Enrollments (thousands), Fall 2001

	GROUP																	
	I Public		I Private		II		III		Va		I, II, III, & Va		M		B		IV		Total All Groups	
Remedial Mathematics[1]																				
Total number (thousands), %[2]	12	7	0	1	17	6	31	13	0	1	**60**	**8**	80	16	101	14	0	0	**241**	**12**
Precalculus																				
Total number (thousands), %	33	19	1	3	67	24	59	24	1	6	**161**	**22**	129	25	144	19	1	1	**435**	**21**
1st-Year Calculus (mainstream)																				
Total number (thousands), %	46	26	15	36	53	19	35	14	3	23	**152**	**20**	46	9	95	13	0	0	**293**	**14**
1st-Year Calculus (nonmainstream)																				
Total number (thousands), %	20	12	5	11	34	12	25	10	0	0	**84**	**11**	34	6	28	4	1	1	**147**	**7**
Statistics																				
Total number (thousands), %	3	1	2	5	13	5	18	7	2	21	**38**	**5**	49	10	85	11	76	93	**248**	**12**
Computer Science																				
Total number (thousands), %	2	1	0	1	1	0	10	4	0	2	**13**	**2**	24	5	72	10	0	0	**109**	**5**
Other Enrollments for Majors																				
Total number (thousands), %	36	21	11	25	42	15	30	12	4	32	**123**	**16**	45	9	76	10	2	3	**246**	**12**
Remaining Undergraduate Enroll.																				
Total number (thousands), %	24	13	8	18	52	19	38	16	2	15	**124**	**16**	106	21	142	19	1	2	**373**	**18**
Total Enrollments	**176**		**42**		**279**		**246**		**12**		**755**		**513**		**743**		**81**		**2092**	

[1] Arithmetic, high school algebra, geometry.
[2] Percents are "column percents" describing relative enrollments within the respective survey groups of the different types of undergraduate courses.

from schools responding to the survey as discussed on page 928. In fall 2001, for the third year, the projections for Groups M and B were made from those schools responding in the stratified random sample for each of these groups. This makes it possible to calculate standard errors for the estimated enrollments for these groups and for the estimated total enrollment for all groups. This was done for the first time for fall 2001, and these standard errors are also found in Table 4A. The estimated total enrollment for all groups is 2,092,000, with a standard error of 32,000, indicating that the actual total enrollment is likely within 2,092,000 +/- 64,000.

Table 4B presents a further breakdown of the undergraduate enrollments into eight categories of courses. For each group, the percentage of the total enrollment in the group that is in each of these eight categories is also given. Column totals in Table 4B give the total enrollments for each group, and they

Table 4C: Total Undergraduate Enrollments (thousands), Fall 1996 to Fall 2001

	GROUP								
	I Public	I Private	II	III	Va	M	B	IV	Total
1996	215[1]		245	212	21[2]	589	705	98	**2085**
1997	173	42	247	220	24[2]	561	701	69	**2037**
1998	182	43	258	214	20[2]	585	741	78	**2121**
1999	182	45	271	251	13	568	810	92	**2232**
2000	175	47	279	241	13	526	729	77	**2087**
2001	176	42	279	246	12	513	743	81	**2092**

[1] Prior to 1997, Group I was not separated into Public and Private.
[2] Prior to 1999, Group Va was combined with Group Vb, which is no longer surveyed. Separate Group Va figures for these years are not available.

Table 4D: Distribution of Undergraduate Enrollments (thousands), Fall 1992 to Fall 2001

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Remedial Mathematics	300	294	279	275	269	274	322	281	265	241
Precalculus	356	341	342	336	332	303	347	429	403	435
1st-Year Calculus (mainstream)	315	319	298	314	312	309	325	321	309	293
1st-Year Calculus (nonmainstream)	127	138	131	145	144	146	148	151	154	147
Statistics	213	215	199	209	218	233	233	282	236	248
Computer Science	141	111	119	108	119	113	116	142	129	109
Other Enrollments for Majors	270	258	233	257	263	233	218	235	220	246
Remaining Undergraduate Enroll.	392	353	353	411	428	426	412	391	371	373
Total Enrollments	**2114**	**2029**	**1954**	**2055**	**2085**	**2037**	**2121**	**2232**	**2087**	**2092**

Table 4E: Undergraduate and Graduate Enrollments per Full-Time Faculty Member, Fall 2001

	GROUP							
	I Public	I Private	II	III	Va	M	B	IV
Undergraduate Course Enrollments Number per full-time faculty member	101	47	114	120	41	118	94	57
Graduate Course Enrollments Number per full-time faculty member	4	5	4	4	7	3		18

are the numbers given in the first row of Table 4A. Table 4C gives these totals for fall 1996 to fall 2001. Row totals in Table 4B give the total enrollments in each of the eight categories of courses for all mathematical sciences departments. Table 4D shows these same enrollments for fall 1992 to fall 2001. In the annual reports for 1999 and 2000, the authors said they felt that the 2,232,000 estimated total enrollment for fall 1999 was too high. With the standard error for total enrollment available in this report (and assuming it would have had a similar value in fall 1999), it appears even more certain this is true. The estimated total enrollment for fall 1999 is probably at least 80,000 too many.

Table 4E gives the undergraduate enrollments per faculty member and the graduate enrollments per faculty member for each group. Table 4F gives the undergraduate enrollments per faculty member in each group for fall 1996 to fall 2001.

Looking at the historical data among the enrollment tables just presented for fall 1992 to fall 2001, no major trends can be seen. This has been a very stable decade for enrollments.

Table 4F: Undergraduate Enrollments per Full-Time Faculty Member, Fall 1996 to Fall 2001

	GROUP							
	I Public	I Private	II	III	Va[2]	M	B	IV
1996	88[1]		110	108	—	112	100	69
1997	110	52	115	113	—	106	96	57
1998	109	52	114	108	—	117	94	60
1999	115	54	111	122	43	127	114	68
2000	107	52	117	119	39	110	95	56
2001	101	47	114	120	41	118	94	57

[1] Prior to 1997, Group I was not separated into Public and Private.

[2] Prior to 1999, Group Va was combined with Group Vb, which is no longer surveyed. Group Va figures for these years are not available.

Majors

Table 5A gives the number of junior/senior majors and the number of female junior/senior majors for each group. Table 5B gives the total number of junior/senior majors and female junior/senior

Table 5A: Undergraduate Junior/Senior Majors (hundreds), Fall 2001

	GROUP								
	I Public	I Private	II	III	Va	M	B	I, II, III, Va, M, & B	IV
Total Undergraduate Junior/senior majors (hundreds)	55	17	48	57	4	121	287	**589**	11
(Standard error)						*(9)*	*(21)*	*(23)*	
Female Undergraduate Junior/senior majors (hundreds)	20	5	20	23	1	53	120	**242**	4

Table 5B: Junior/Senior Majors (hundreds) in Groups I, II, III, Va, M & B Combined, Fall 1992 to Fall 2001

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total Undergraduate Junior/senior majors (hundreds)	732	696	669	678	631	596	590	568	599	589
Female Undergraduate Junior/senior majors (hundreds)	320	301	287	286	273	257	255	248	244	242
Percentage female	43.7	43.2	42.9	42.2	43.3	43.1	43.2	43.7	40.7	41.1

majors for fall 1992 to fall 2001. The number of junior/senior mathematics majors in Groups I, II, III, Va, M, and B dropped from 73,200 in 1992 to 56,800 in 1999 but has been higher in the past two years, with 59,900 in 2000 and 58,900 in 2001. The percentage of the junior/senior majors who are females remained relatively constant, near 43% during the years 1991 to 1999, but dropped 3.0% in 2000 to 40.7%. There was a slight increase in 2001 to 41.1%.

The reader should be aware that at least 50 of the 202 departments in the 2001 Group M population and at least 260 of the 1,025 departments in the 2001 Group B population also offer a computer science program in addition to their offerings in mathematics. In some instances, these computer programs account for a major fraction of the department's undergraduate majors (and even the degrees awarded by the departments). This year's Departmental Profile questionnaire was the first to request that departments give a breakout of the computer science majors from the total majors. These data are not considered reliable enough to report this year. However, a preliminary analysis of the data clearly shows that the number of computer science majors is substantial.

The report of the 2000 CBMS survey, *Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the U.S.: Fall 2000 CBMS Survey* (David J. Lutzer, James W. Maxwell, and Stephen B. Rodi, authors; American Mathematical Society, Providence, RI, 2002), provides a more comprehensive study of departmental bachelor's degrees.

Graduate Student Profile

Table 6A summarizes information gathered about graduate students by the 2001 Departmental Profile survey. This table gives the number of full-time, full-time first-year, and part-time graduate students for each type of graduate department. These same numbers are also given for female graduate students and for U.S. citizen graduate students.

The total number of full-time graduate students in Groups I, II, III, Va, and M combined held steady from 2000 to 2001, with 12,123 and 12,127 respectively. In general, in Table 6A there were gains

Table 6A: Graduate Students, Fall 2001

	GROUP								
	I Public	I Private	II	III	Va	I, II, III, & Va	M	I, II, III, Va, & M	IV
Total Graduate Students									
Number who are full-time	2522	1471	2590	2070	708	**9361**	2766	**12127**	3735
(Standard error)							*(347)*	*(347)*	
Number who are first-year	694	414	816	724	227	**2875**	1236	**4111**	1307
Number who are part-time	157	185	355	731	47	**1475**	3682	**5157**	998
(Standard error)							*(594)*	*(594)*	
Female Graduate Students									
Number who are full-time	646	326	886	825	216	**2899**	1189	**4088**	1981
Number who are first-year	191	118	322	301	82	**1014**	516	**1530**	778
Number who are part-time	71	40	130	321	12	**574**	1735	**2309**	602
U.S. Citizen Graduate Students									
Number who are full-time	1185	696	1409	1009	332	**4631**	1497	**6128**	1680
(Standard error)							*(154)*	*(154)*	
Number who are first-year	389	204	453	353	118	**1517**	651	**2168**	616
Number who are part-time	110	123	286	579	31	**1129**	3151	**4280**	758
(Standard error)							*(547)*	*(547)*	

Table 6B: Full-Time Graduate Students in Groups I, II, III, & Va

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total full-time graduate students	10595	10525	10185	9761	9476	9003	8791	8838	9637	9361
First-year full-time graduate students	2840	2762	2668	2601	2443	2386	2510	2664	2839	2875
Female full-time graduate students	3045	2990	2927	2877	2760	2691	2770	2766	3016	2899
Male full-time graduate students	7550	7535	7258	6884	6716	6312	6021	6072	6621	6462
U.S. citizen full-time graduate students	6020	5865	5945	5623	5445	4947	4831	4668	5085	4631
Non-U.S. citizen full-time graduate students	4575	4660	4240	4138	4031	4056	3960	4170	4552	4730

in Groups I Private, M, and IV, with losses in the other groups. First-year full-time graduate students in Groups I, II, III, Va, and M combined increased by 301 to 4,111, an increase of 7.9%. Full-time female graduate students in Groups I, II, III, Va, and M combined decreased from 4,184 to 4,088, a 2.3% decrease. U.S. citizen full-time graduate students in these same groups decreased by 7.0% to 6,128. There is a great deal of variability in the number of full-time graduate students in Group M, even in universities that are roughly the same size. Evidence of this is the standard error of 347. We can also expect substantial variation in the total number of all full-time graduate students from year to year due to the large variation in Group M.

Part-time graduate students in Groups I, II, III, and Va decreased from 1,600 to 1,475, down 7.8% from last year. Group III has 731 (49.6%) of the part-time graduate students in these groups. In these doctoral groups, 38.9% of the part-time graduate students are females and 76.5% are U.S. citizens. Group M part-time graduate students increased from 2,091 to 3,682, up 76.1%. The standard error for part-time graduate students in Group M departments is 594, indicating huge differences in the number of part-time graduate students from department to department. This also means we can expect to see large differences from year to year in the total number of part-time graduate students in all groups. For Group M, 47.1% of the part-time graduate students are females and 85.6% are U.S. citizens.

Table 6B gives the total number of full-time, full-time first-year, full-time female, full-time male, full-time U.S. citizen, and full-time non-U.S. citizen graduate students in Groups I, II, III, and Va combined for fall 1992 through 2001. All of these had substantial increases from 1999 to 2000, with a leveling off from 2000 to 2001. Only first-year full-time graduate students and non-U.S. citizen full-time graduate students had increases this year, while the other four types of graduate students had small decreases.

Definitions of the Groups

As has been the case for a number of years, much of the data in these reports is presented for departments divided into groups according to several characteristics, the principal one being the highest degree offered in the mathematical sciences. Doctoral-granting departments of mathematics are further subdivided according to their ranking of "scholarly quality of program faculty" as reported in the 1995 publication *Research-Doctorate Programs in the United States: Continuity and Change.*[1] These rankings update those reported in a previous study published in 1982.[2] Consequently, the departments which now comprise Groups I, II, and III differ significantly from those used prior to the 1996 survey.

The subdivision of the Group I institutions into Group I Public and Group I Private was new for the 1996 survey. With the increase in number of the Group I departments from 39 to 48, the Data Committee judged that a further subdivision of public and private would provide more meaningful reporting of the data for these departments.

Brief descriptions of the groupings are as follows:

Group I is composed of 48 departments with scores in the 3.00–5.00 range. Group I Public and Group I Private are Group I departments at public institutions and private institutions respectively.

Group II is composed of 56 departments with scores in the 2.00–2.99 range.

Group III contains the remaining U.S. departments reporting a doctoral program, including a number of departments not included in the 1995 ranking of program faculty.

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

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

Group Va is applied mathematics/applied science; Group Vb, which is no longer surveyed as of 1998–99, was operations research and management science.

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

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

Listings of the actual departments which comprise these groups are available on the AMS website at `www.ams.org/employment/`.

Acknowledgments

The Annual Survey of the Mathematical Sciences attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical sciences scene for the use and benefit of the community and for filling the information needs of the professional organizations. Every year, college and university departments in the United States are invited to respond. The Annual Survey relies heavily on the conscientious efforts of the dedicated staff members of these departments for the quality of its information. On behalf of the Annual Survey Data Committee and the Annual Survey staff, we thank the many secretarial and administrative staff members in the mathematical sciences departments for their cooperation and assistance in responding to the survey questionnaires.

[1] Research-Doctorate Programs in the United States: Continuity and Change, *edited by Marvin L. Goldberger, Brendan A. Maher, and Pamela Ebert Flattau, National Academy Press, Washington, DC, 1995.*

[2] *These findings were published in* An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences, *edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, DC, 1982. The information on mathematics, statistics, and computer science was presented in digest form in the April 1983 issue of the* Notices, *pages 257–67, and an analysis of the classifications was given in the June 1983* Notices, *pages 392–3.*

Mathematics People

Heinrich Receives Prize for Achievement in Information-Based Complexity

STEFAN HEINRICH of the Universität Kaiserslautern is the fourth winner of the Prize for Information-Based Complexity. He was cited for "numerous outstanding contributions to information-based complexity."

The prize committee consisted of Erich Novak, University of Jena; Sergei Pereverzev, Ukranian Academy of Science; Joseph F. Traub, Columbia University; G. W. Wasilkowski, University of Kentucky; and Henryk Wozniakowski, Columbia University and University of Warsaw. The award will be presented at the Foundations of Computational Mathematics Meeting in Minneapolis in August 2002.

The Prize for Achievement in Information-Based Complexity carries an award of $3,000 and a plaque.

—Joseph F. Traub, Columbia University

Kawahigashi Receives MSJ Spring Prize

The 2002 Spring Prize of the Mathematical Society of Japan (MSJ) has been awarded to YASUYUKI KAWAHIGASHI of Tokyo University for his distinguished contributions to the study of operator algebras.

The Spring Prize is awarded each year to a mathematician under forty years old who has made an outstanding contribution to mathematics. Kawahigashi was born in Tokyo in 1962. He received his B.Sc. degree in 1985 from Tokyo University and his Ph.D. in 1989 from the University of California, Los Angeles. He also received a Doctor of Science degree in 1990 from Tokyo University.

Kawahigashi's main research interests are in operator algebras, in particular in subfactor theory. His main contribution is the introduction of a new method called the orbifold construction for subfactors. This method constructs the subfactors that correspond to Coxeter graphs of type D and gives a part of the complete classification of subfactors with index less than four, for example.

As with the introduction of the Jones polynomials for knots, the study of factors deepens the relationship between topology and mathematical physics. By combining analytical and combinatorial methods, Kawahigashi obtains relations between subfactors, topological field theory, and topological invariants for 3-dimensional manifolds. Recently, he has been interested in the relationship between conformal field theory and subfactor theory and has introduced a new setting for algebraic quantum field theory and clarified the meaning of the modular invariant partition functions from the subfactor viewpoint.

—From an MSJ announcement

Biss and Rodnianski Awarded CMI Long-Term Prize Fellowships

The Clay Mathematics Institute (CMI) has announced its selection of two long-term prize fellows for 2002. They are DANIEL K. BISS of the Massachusetts Institute of Technology and IGOR RODNIANSKI of Princeton University.

The prize fellowships are awarded to mathematicians who are thirty years old or younger and who have contributed profound ideas and major achievements to the discipline of mathematics. The long-term prize fellows are employed by CMI for terms ranging from one to five years and and are paid a salary to conduct research at institutions of their choice. Additional research funding can be requested. Areas of research in which current fellows are involved range from the theory of numbers to error correction in quantum computation.

The CMI is a private, nonprofit foundation dedicated to increasing and disseminating mathematical knowledge. It sponsors a series of programs that include creating new mathematical knowledge, disseminating mathematical insights, inspiring talented students, and recognizing extraordinary mathematical achievement and solutions of specific mathematical problems.

—From a CMI announcement

Packard Fellowships Awarded

The David and Lucile Packard Foundation has awarded 24 Fellowships for Science and Engineering for the year 2001. Two mathematical scientists were among the awardees.

ANDREI OKOUNKOV of the University of California, Berkeley, and CHRISTOPHER M. SKINNER of the University of Michigan will each receive a fellowship of $625,000 over five years.

The fellowships are awarded to researchers in mathematics, natural sciences, computer science, and engineering who are in the first three years of a faculty appointment.

—From a Packard Foundation announcement

Royal Society of London Elections

Five mathematical scientists are among those elected as new fellows of the Royal Society of London for 2002: TERENCE J. LYONS, University of Oxford; ERIC R. PRIEST, University of St. Andrews; SUSAN M. REES, University of Liverpool; MILES A. REID, University of Warwick; and PETER SARNAK, Princeton University and Courant Institute of Mathematical Sciences, New York University.

—From a Royal Society announcement

AMS Menger Prizes at the 2002 ISEF

The 2002 Intel-International Science and Engineering Fair (ISEF) was held May 12–18, 2002, in Louisville, Kentucky. This year marked the 53rd anniversary of the ISEF. More than 1,000 ninth- through twelfth-graders competed in the fair. The participants had qualified by winning competitions in local, regional, and state fairs in the United States or national science fairs abroad. In addition to the general awards of the ISEF, more than fifty organizations, including the AMS, participated by giving ISEF Special Awards. The prizes included cash prizes, scholarships, T-shirts, magazines, and books.

This was the fifteenth year of participation in the ISEF by the AMS and the thirteenth year of presentation of the Karl Menger Memorial Prizes. The AMS Menger Prize committee served as the Special Awards Panel of Judges for the AMS; the members were Elwyn Berlekemp, University of California at Berkeley; Gisele Goldstein, University of Memphis (chair); and Julian Palmore, University of Illinois at Urbana-Champaign. The panel reviewed more than fifty projects, all in mathematics, and each student discussed his/her project individually with a panel member. Finalists for the prizes were interviewed additionally by the other panel members. The AMS gave one first-place award, two second-place awards, four third-place awards, and five honorable mention awards. The first-, second-, and third-place winners receive cash awards. All winners receive a personalized certificate, a copy of *What's Happening in the Mathematical Sciences?*, a short biography of Karl Menger, and an AMS briefcase.

The Karl Menger Memorial Prize winners were as follows:

Karl Menger Memorial Prize winners: (back row, left to right) Liang Chen, Jacob Licht, Boris Figovsky, Matthew Tesch; (middle row, left to right) Jonathan Zweig, Ronli Diakow, Amanda Shaw, Mary Brazelton, Nikita Rozenblyum; (front row, left to right) Gisele Goldstein (chair of Judges Panel), Andrew Korth, Chun-Chen Yeh, Ashum Karahanovich Kaibhanov.

First Place Award ($1,000): "Rainbow Ramsey Theory: Rainbow Arithmetic Progressions and Anti-Ramsey Results", JACOB LICHT, 17, William Hall High School, West Hartford, Connecticut.

Second Place Awards ($500): "Is It a Knot or Not? A Study of Knot Theory", MATTHEW AARON TESCH, 16, Northwest High School, Justin, Texas; "Period Doubling Route to Chaos in Driven Bouncing Ball Simulation", ANDREW MICHAEL KORTH, 16, Morris Area High School, Morris, Minnesota.

Third Place Awards ($250): "Winning Strategies for Games Played with Chips", CHUN-CHEN YEH, 16, Taipei Municipal First Girls' Senior High School, Chinese Taipei; "Circle Packing", LIANG CHEN, 18, El Cerrito High School, El Cerrito, California; "New Proof of Transcendence of Mahler's Number", ASHUM KARAHANOVICH KAIBHANOV, 15, Specialized School-Scientifical Center, Moscow, Russia; "Winter Wonderland: A Mathematical Analysis of Snowflakes", AMANDA BRYCE SHAW, 16, Seton School, Manassas, Virginia.

Honorable Mention Awards: "Odd Oscillations", MARY AUGUSTA BRAZELTON, 16, Bishop McNamara High School, Forestville, Maryland; "Nullhomotopic Knots in Real Projective Space", NIKITA ROZENBLYUM, 18, Stuyvesant High School, New York, New York; "Game Theory Models for Middle East Policy", JONATHAN CHARLES ZWEIG, 17, Caddo Parish Magnet High School, Shreveport, Louisiana; "Crystallographic Restriction Theorem in the Euclidean Plane", BORIS O. FIGOVSKY, 18, Leo-Beck, Haifa, Israel; "Investigating the Distance Function on Centrally Symmetric Convex Surfaces", RONLI PHYLLIS DIAKOW, 18, Paul D. Schreiber Senior High School, Port Washington, New York.

The Society's participation in the Intel-ISEF is supported in part by income from the Karl Menger Fund, which was established by the family of the late Karl Menger. For more information about this program or to make contributions to the fund, contact the AMS Development Office, 201 Charles Street, Providence, RI 02904; send e-mail to `development@ams.org`; or telephone 401-455-4111.

—Gisele Goldstein, University of Memphis

Mathematics Opportunities

American Mathematical Society Centennial Fellowships

Invitation for Applications for Awards for 2003–2004
Deadline December 1, 2002

The AMS Centennial Research Fellowship Program makes awards annually to outstanding mathematicians to help further their careers in research. From 1997–2001, the fellowship program was aimed at recent Ph.D.'s. Recently the AMS Council approved changes in the rules for the fellowships. The eligibility rules are as follows.

The primary selection criterion for the Centennial Fellowship is the excellence of the candidate's research. Preference will be given to candidates who have not had extensive fellowship support in the past. Recipients may not hold the Centennial Fellowship concurrently with another research fellowship such as a Sloan or NSF Postdoctoral Fellowship. Under normal circumstances, the fellowship cannot be deferred. A recipient of the fellowship shall have held his or her doctoral degree for at least three years and not more than twelve years at the inception of the award. Applications will be accepted from those currently holding a tenured, tenure-track, postdoctoral, or comparable (at the discretion of the selection committee) position at an institution in North America.

The stipend for fellowships awarded for 2003–2004 is expected to be approximately $57,000, with an additional expense allowance of about $1,600.

The number of fellowships to be awarded is small and depends on the amount of money contributed to the program. The trustees have arranged a matching program from general funds in such a way that funds for at least one fellowship are guaranteed. Due to a change in eligibility criteria and an increase in the stipend beginning in 2002–2003, it is expected that two fellowships will be awarded. A list of previous fellowship winners can be found at `http://www.ams.org/secretary/prizes.html`.

Applications should include a cogent plan indicating how the fellowship will be used. The plan should include travel to at least one other institution and should demonstrate that the fellowship will be used for more than reduction of teaching at the candidate's home institution. The selection committee will consider the plan in addition to the quality of the candidate's research and will try to award the fellowship to those for whom the award would make a real difference in the development of their research careers. Work in all areas of mathematics, including interdisciplinary work, is eligible.

The deadline for receipt of applications is **December 1, 2002**. Awards will be announced in February 2003 or earlier if possible.

Application forms are available via the Internet at `http://www.ams.org/employment/centflyer.html`. For paper copies of the form, write to the Professional Services Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; or send electronic mail to `prof-serv@ams.org`; or call 401-455-4107.

—AMS announcement

NSF Mathematical Sciences Postdoctoral Research Fellowships

The Mathematical Sciences Postdoctoral Research Fellowship program of the Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) awards fellowships each year for research in pure mathematics, applied mathematics and operations research, and statistics. The deadline for this year's applications is **October 18, 2002**. Applications must be submitted via FastLane on the World Wide Web. Go to `http://www.fastlane.nsf.gov/fastlane.jsp` and click on "Postdoctoral Fellowships". Information can be found there for the Mathematical Sciences Postdoctoral Research Fellowships, as

well as other NSF fellowship opportunities. For more information telephone the DMS at 703-306-1870 or e-mail: msprf@nsf.gov.

—From an NSF announcement

NSF Graduate Fellowships

The National Science Foundation (NSF) awards Graduate Research Fellowships to graduating seniors and first-year graduate students. These are three-year fellowships awarded to U.S. students for full-time graduate study at the institutions of their choice. The fellowships include a stipend, tuition coverage, and possible international travel allowances. Awards are made based on the candidates' intellectual merit and potential for research achievement. More information and applications for the 2003 competition will be available early in August 2002 at http://www.orau.org/nsf/nsffel.htm. Further information may be obtained by calling toll-free 866-353-0905 or by sending e-mail to nsfgrfp@orau.gov. The deadline is **November 7, 2002**.

—From an NSF announcement

NSF International Research Fellow Awards

The International Research Fellow Awards Program of the National Science Foundation (NSF) provides support for postdoctoral and junior investigators to do research in basic science and engineering for 3–24 months in any country in the world. The goal of the program is to establish productive, long-term relationships between U.S. and foreign science and engineering communities. Applicants must be U.S. citizens or permanent residents who have earned their doctoral degrees within six years before the date of application or who expect to receive their degrees by the date of the award.

The deadline for applying is **November 1, 2002**. For further information contact the program officer, Susan Parris, 703-292-8711, sparris@nsf.gov; or visit the website http://www.nsf.gov/sbe/int/fellows/start.htm.

—From an NSF announcement

NSA Grant and Sabbatical Programs

The Mathematical Sciences Program of the National Security Agency (NSA) provides grants and sabbatical opportunities to support research by academic mathematical scientists.

The NSA makes grants to universities and nonprofit institutions to support self-directed research in the following areas of mathematics (including possible computational aspects): algebra, number theory, discrete mathematics, probability, statistics, and cryptology. The NSA also accepts proposals for small grants for conferences, workshops, and special academic endeavors. Research grants are designed principally to provide summer salaries for professors and limited support for their graduate students. The deadline for submission of all grant proposals is **October 15, 2002**. Grants begin in the fall of the following year.

The sabbatical opportunities offered by the NSA provide support for academic mathematical scientists to visit the NSA for periods ranging from 9 to 24 months. Visitors' sabbatical stipends will be supplemented with funds to equal their regular monthly salaries. A choice is offered between an allowance for moving expenses or a housing supplement. Applicants and their immediate family members must be U.S. citizens. Because a complete background investigation is required, applications should be submitted well in advance of the requested starting date.

Further information may be obtained from the NSA's website: http://www.nsa.gov/programs/msp/. The telephone number is 301-688-0400, the e-mail address is msp@math.umbc.edu, and the postal address is: Mathematical Sciences Program, National Security Agency, ATTN:R51A, Suite 6557, Ft. George G. Meade, MD 20755-6557.

—From an NSA announcement

BMS Chairs Colloquium 2002

Department heads from the mathematical sciences are invited to attend the National Research Council's 17th annual Chairs Colloquium on November 8–9, 2002. The colloquium will be held at the National Academy of Sciences in Washington, DC. As in past years, this meeting provides an opportunity for chairs of college and university mathematics and statistics departments to share experiences and ideas for addressing challenges and to learn more about federal programs and policies that affect their departments.

Raymond Orbach, head of the Department of Energy's Office of Science and a key player in federal science policy, will give the keynote address on the afternoon of November 8. The remainder of the meeting includes a mix of plenary and break-out sessions aimed at sharing insights on a variety of topics, including: views from various departments; how to develop new programs, such as in bioinformatics, financial mathematics, etc.; increasing the number of undergraduate majors; understanding the dean's viewpoint; learning from the experiences of women faculty members; issues for small colleges; opportunities for mathematical sciences research in support of homeland security; programs in mathematics education; and the Carnegie Foundation for the Advancement of Teaching's study of the doctorate degree.

As is traditional, there will also be a panel discussion of grant opportunities from federal agencies and foundations, and program officers from those organizations have been asked to attend at least a full afternoon of the colloquium

to enable more off-line conversations. This year's colloquium will begin midday on Friday, November 8, and continue until late afternoon on Saturday, November 9.

The program committee is chaired by F. R. McMorris of the Illinois Institute of Technology. Its other members are Marc Lipman, Indiana University-Purdue University at Fort Wayne; Douglas Ravenel, University of Rochester; and Peter Wong, Bates College.

A brochure with registration form is being mailed in August to each four-year U.S. mathematics and statistics department. The agenda and a registration form (which must be mailed in) are available online at `http://www.nas.edu/bms/`. The registration fee for the colloquium is $185. For further information contact the Board on Mathematical Sciences at 202-334-2421 or at `bms@nas.edu`.

—BMS announcement

COBASE Collaborative Grants

With funding from the National Science Foundation (NSF), the Office for Central Europe and Eurasia of the National Research Council, the operating arm of the National Academies, offers grants to individual American specialists who plan to establish new research partnerships with their colleagues from Central/Eastern Europe (CEE) and the Newly Independent States (NIS). This program is designed primarily to prepare these new partnerships for competition in NSF programs. The Collaboration in Basic Science and Engineering (COBASE) program accepts proposals for collaborative research in all fields of basic science supported by NSF. Mathematics is one of the fields in which applications will be given special priority.

Project Development and Initiation Grants support American specialists who wish to host and/or visit their CEE or NIS colleagues in order to initiate research projects and prepare collaborative research proposals for submission to NSF. U.S. applicants may now request support for up to two visits in either or both directions (i.e., either traveling to CEE/NIS or hosting a colleague from the region here in the U.S.), with the total combined duration of the visit(s) not to exceed eight weeks. Each individual visit proposed must be at least two weeks (10–14 days) in length. Grants will be in the range of $2,500 to $10,000. Participating countries: Armenia, Azerbaijan, Bosnia (hosting in U.S. only), Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, (Former Yugoslav Republic of) Macedonia, Moldova, Poland, Romania, Russia (see website for updated list of ineligible partner institutions), Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. Eligibility: All applicants must: (1) be U.S. citizens or permanent residents, (2) be affiliated with U.S. universities or other nonprofit research institutions, and (3) possess Ph.D. degrees or equivalent research experience. Foreign counterparts involved must possess CEE/NIS citizenship, be permanently employed at CEE/NIS institutions, and hold Ph.D. (kandidat) degrees or research training and experience equivalent to a doctoral degree. Employees of private companies and the U.S. government generally are not supported under the COBASE program. Each set of partners may receive no more than one COBASE grant, and each individual may be involved in no more than two grants in a four-year period. Generally, those who hold a current NSF grant and are eligible for an NSF international supplement should not apply to this program. NSF's Central and Eastern Europe Program staff (telephone 703-292-8703) can advise regarding applications for NSF international supplements. *However, for projects in the three special topical areas (including mathematics), applicants with current NSF support are eligible to apply.*

Special Opportunities for Junior Investigators: American applicants who have received their doctoral degrees within the past ten years will receive special consideration. The COBASE program allocates at least 25 percent of its grants to researchers in this category in order to encourage beginning investigators to become involved in international collaboration.

Collaborative proposals involving any field of mathematics are welcome, including, but not limited to: algebra and number theory, analysis, computational mathematics, geometric analysis, statistics and probability, and topology and foundations. Projects in applied mathematics involving collaborations with specialists from other fields such as the biological, computer, and environmental sciences are also encouraged. Collaborative research proposals involving the modeling of complexity are particularly welcome.

The postmarking deadline for proposals is **August 27, 2002**. For application forms and instructions, visit the website `http://www.nationalacademies.org/oia/`. For more information telephone 202-334-2644, send a fax to 202-334-2614, or send e-mail to `ocee@nas.edu`.

—From an NAS announcement

AWM Travel Grants for Women

The National Science Foundation (NSF) and the Association for Women in Mathematics (AWM) sponsor two travel grant programs for women mathematicians.

AWM Travel Grants enable women to attend research conferences in their fields, thereby providing scholars valuable opportunities to advance their research activities and their visibility in the research community. A travel grant provides full or partial support for travel and subsistence for a meeting or conference in the grantee's field of specialization.

AWM Mentoring Travel Grants are designed to help junior women develop long-term working and mentoring relationships with senior mathematicians. A mentoring travel grant funds travel, subsistence, and other expenses for an untenured woman mathematician to travel to an institute or a department to do research with a specified individual for one month.

The final deadline for the Travel Grants program for 2002 is **October 1, 2002**; the deadlines for 2003 are **February 1,**

2003; May 1, 2003; and **October 1, 2003.** For the Mentoring Travel Grants program the deadline is **February 1, 2003.** For further information and details on applying, see the AWM website, http://www.awm-math.org/travelgrants.html; or telephone 301-405-7892; or send e-mail to awm@math.umd.edu. The postal address is: Association for Women in Mathematics, 4114 Computer and Space Sciences Building, University of Maryland, College Park, MD 20742-2461.

—From an AWM announcement

Call for Submissions for Sunyer i Balaguer Prize

Ferran Sunyer i Balaguer (1912–1967) was a self-taught Catalan mathematician who, despite a serious physical disability, was very active in research in classical analysis, an area in which he acquired international recognition. Each year, in honor of the memory of Ferran Sunyer i Balaguer, the Institut d'Estudis Catalans awards an international research prize bearing his name.

The prize is awarded for a mathematical monograph of an expository nature presenting the latest developments in an active area of research in mathematics in which the author has made important contributions. The monograph should be written in English and should be at least 150 pages.

The prize, amounting to 10,000 euros (about US$9,900), is provided by the Ferran Sunyer i Balaguer Foundation. The winning monograph will be published in Birkhäuser-Verlag's series Progress in Mathematics, subject to the usual regulations concerning copyright and author's rights.

Submissions should be sent before **December 1, 2002,** to: Centre de Recerca Matemàtica, Fundació Ferran Sunyer i Balaguer, Apartat 50, E-08193 Bellaterra, Spain. For further information visit the website http://www.crm.es/info/ffsb.htm, or send e-mail to crm@crm.es.

—From an Institut d'Estudis Catalans announcement

Research Experiences for Undergraduates

The Research Experiences for Undergraduates (REU) program supports active research participation by undergraduate students in any of the areas of research funded by the National Science Foundation (NSF). Student research may be supported in two forms: REU supplements and REU sites. REU supplements may be included in proposals for new or renewal NSF grants or cooperative agreements or as supplements to ongoing NSF-funded projects. REU sites are based on independent proposals to initiate and conduct undergraduate research participation projects for a number of students. REU site projects may be based in a single discipline or academic department or on interdisciplinary or multidepartment research opportunities with a strong intellectual focus. Proposals with an international dimension are welcomed. Undergraduate student participants supported with NSF funds in either supplements or sites must be citizens or permanent residents of the United States or its possessions.

The deadline for full proposals for REU sites is **September 15, 2002.** Deadline dates for REU supplements vary with the research program; contact the program director for more information. The full program announcement can be found at the website http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf02136.

—From an NSF announcement

For Your Information

New NSF Institutes Announced

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) has made three new awards and one continuing award for mathematical sciences institutes. Start-up funding for the new institutes will begin this year, and full funding is expected to commence in 2003. The new awards are projected to total $24.8 million over five years; the continuing award is for $9 million over six years. What follows is a brief description of each of the new institutes.

The AIM Research Conference Center (ARCC) will hold focused workshops in the mathematical sciences, initially at the American Institute of Mathematics (AIM) in Palo Alto and later at a new facility in Morgan Hill adjacent to an 80,000-acre state park. ARCC focused workshops will be distinguished by collaboration on a specific mathematical goal, such as a significant unsolved problem, an important new result, or the convergence of two distinct areas. ARCC will emphasize collaborations that include women, minorities, new mathematicians, and researchers at primarily undergraduate institutions. Central to each workshop will be a public website that will outline the specific goal and subsequently serve as a comprehensive research resource. Brian Conrey has been director of AIM since its founding; prior to that he was on the faculty of Oklahoma State University. The ARCC website may be found at `http://www.aimath.org/ARCC/`.

The Mathematical Biosciences Institute (MBI) at the Ohio State University will be a base for interdisciplinary work by mathematical scientists and biological scientists on a broad range of biological problems. The mission of the MBI is (i) to develop mathematical theories, statistical methods, and computational algorithms for the solution of fundamental problems in the biosciences; (ii) to involve mathematical scientists and bioscientists in the solution of these problems; and (iii) to nurture a community of scholars through education and support of students and researchers. The MBI will establish emphasis year programs, current topics workshops, educational programs, and sponsored research projects. The director of the institute is Avner Friedman, who served as director of the Institute for Mathematics and its Applications at the University of Minnesota from 1986 to 1997. Further information about the MBI may be found at the website `http://mbi.osu.edu/`.

The Statistical and Applied Mathematical Sciences Institute (SAMSI) is a partnership of Duke University, North Carolina State University (NCSU), the University of North Carolina at Chapel Hill (UNC), and the National Institute of Statistical Sciences in Research Triangle Park (NISS). SAMSI will forge a new synthesis of the statistical sciences with the applied mathematical sciences and other disciplinary sciences to confront data- and model-driven scientific challenges. Many of these challenges are complex and large, requiring collaborative efforts. SAMSI will have long- and short-term visitors at the postdoctoral-through-senior levels and will also involve graduate and upper-level undergraduate students. James Berger of the Institute of Statistics and Decision Sciences at Duke University is the director, with H. T. Banks of NCSU, J. S. Marron of UNC, and Alan F. Karr of NISS also serving on the directorate. SAMSI's website may be found at `http://www.samsi.info/`.

The continuing award is for the School of Mathematics at the Institute for Advanced Study. The School of Mathematics has for many years received NSF funding for partial support of its visitor program, and this funding will continue through the mathematical sciences institutes program of the DMS. Long- and short-term visitors in a wide range of mathematical areas spend time at the School of Mathematics, either to do independent research or to participate in one of the school's special yearly programs. The executive officer of the School of Mathematics is Jean Bourgain. Information about the school's activities may be found at `http://www.math.ias.edu/`.

The new awards complement the existing three NSF-funded institutes: the Institute for Mathematics and its Applications (IMA) at the University of Minnesota; the Institute for Pure and Applied Mathematics (IPAM) at the University of California, Los Angeles; and the Mathematical Sciences Research Institute (MSRI) in Berkeley.

—Allyn Jackson

New Mathematics Center Established in Berlin

In May 2002, the Deutsche Forschungsgemeinschaft (DFG), the science funding agency of the German government, announced the establishment of a new research center, Mathematics for Key Technologies: Modeling, Simulation, and Optimization of Real-World Processes. Located in Berlin, this international center will develop mathematical methods for a wide spectrum of applications. The DFG will provide 21 million euros (about US$20 million) for the first four years of the center's work. Another 12 million euros of financial support will be added by local institutions in Berlin. The center began operation on June 1, 2002.

The research program for the center will be application-driven, addressing concrete problems that call for the development of new mathematical tools. The center will also help to bridge the gap between theoretical mathematics and users of mathematics in industry, science, and government. Building on the special strengths in mathematics in Berlin, the center will concentrate on optimization and discrete mathematics, numerical analysis and scientific computing, and applied and stochastic analysis. Among the technologies to be addressed initially are the life sciences, traffic and communication networks, industrial production, electronic circuits and optical technologies, finance, and visualization.

The mathematics department at the Technische Universität Berlin will lead development of the center, in cooperation with four other Berlin institutions: the Freie Universität, the Humboldt-Universität, the Weierstrass Institut für Angewandte Analysis und Stochastik, and the Konrad-Zuse-Zentrum für Informationstechnik. About sixty researchers at these five institutions will be involved in activities through the center. Martin Grötschel of the Technische Universität and the Konrad-Zuse-Zentrum is the designated coordinator for the center. The other members of the coordination committee are Peter Deuflhard (Freie Universität and Konrad-Zuse-Zentrum), Hans Föllmer (Humboldt-Universität), Volker Mehrmann (Technische Universität), and Jürgen Sprekels (Humboldt-Universität and Weierstrass Institut). The administration and main activities of the center will be located in the mathematics building of the Technische Universität.

Education, including at the graduate and undergraduate levels, will be a major focus of the center. New interdisciplinary programs and new types of courses will be developed. The center will also support advanced training courses for high school teachers and students, with the aim of bringing mathematical modeling and real-life applications into the classroom.

This center is the fourth of about ten to be funded under a DFG initiative, begun in May 2001, to establish interdisciplinary research centers; the other three centers are in the areas of ocean rims, functional nanostructures, and biomedical research concerning protein. Subject to periodic evaluations, the DFG-funded centers can receive support for up to twelve years. One of the aims of establishing these centers is to create research opportunities in Germany that can attract and retain top researchers, both from within Germany and from abroad.

Further information may be found at the center's preliminary website `http://www.math.tu-berlin.de/DFG-Forschungszentrum/`.

—Allyn Jackson

RAND Report on Research in Mathematics Education

In March 2002 RAND Education & Science and Technology Policy Institute issued a draft report about research in mathematics education. The report, *Mathematical Proficiency for All Students: Toward a Strategic Research and Development Program in Mathematics Education*, was commissioned by the Office of Educational Research and Improvement (OERI) of the U.S. Department of Education. If the recommendations in the report are carried out, they could have a significant impact on the nature and direction of research in mathematics education and on how that research translates into classroom practice.

The report argues that one reason the many efforts to improve mathematics education in the United States have not shown solid, sustained results is that the knowledge base of mathematics education research is too weak. This weakness, the report says, stems from inadequate funding and the lack of a coherent, practice-oriented vision for research in mathematics education. The purpose of the RAND study is to develop such a vision.

Because the resources available for research in mathematics education are quite limited relative to the scale of the problems, the draft report recommends a research program focused on three high leverage areas. The first area is the teaching and learning of algebra for mathematical proficiency. The report argues that algebra is important in all areas of mathematics "because it provides fundamental tools for representing quantities and relationships, modeling situations, solving problems, and stating and proving generalizations." Algebra also serves a "gatekeeper" role: students who do not know algebra usually cannot proceed to higher-level mathematics courses.

The second focal point is the learning, use, and teaching of mathematical practices. The report defines mathematical practices as the tools, skills, and habits of mind that allow people to use their mathematical knowledge flexibly and to adapt that knowledge to diverse situations. These tools, skills, and habits of mind are "less-visible, often implicit, aspects of mathematical thinking," the report says. A better and more precise understanding of mathematical practices would help teachers to explicitly teach those practices to students.

The third focal point is knowledge of mathematics for teaching. The report points out that the kind of mathematical knowledge needed to teach school mathematics effectively is different from that needed by mathematicians to do research in mathematics. However, exactly what kind of knowledge teachers need is not well understood. A

better understanding would provide a basis for making changes in the academic preparation of teachers as well as in professional development programs.

The report describes a plan for carrying out research in mathematics education designed with these three focal points in mind. The need for an interdisciplinary approach combining the expertise of different people, including mathematicians, is emphasized. Because the different groups contributing to and using the research are diffuse and not well integrated, government agencies, such as OERI and the National Science Foundation, would play key roles in orchestrating the research program. The report also recommends the formation of a standing study panel to help government agencies to assess and synthesize the research.

The draft report is available on the website `http://www.rand.org/multi/achievementforall/`. Comments were solicited from various individuals having an interest in mathematics education, and the comments are posted on the website. The Department of Education asked the AMS Committee on Education (COE) to provide comments on the report, and the comments were sent to the RAND study panel in July 2002. Current plans call for the report to be published by the end of 2002.

The RAND Mathematics Study Panel is chaired by Deborah Loewenberg Ball of the University of Michigan. Also on the panel are Hyman Bass of the University of Michigan, Joan Ferrini-Mundy of Michigan State University, Ramesh Gangolli of the University of Washington, Roger Howe of Yale University, W. James Lewis of the University of Nebraska, and Mark Saul of the Bronxville schools. Howe is chair of the COE, and Bass and Lewis are members of the COE.

—Allyn Jackson

News from MSRI

The Mathematical Sciences Research Institute in Berkeley, California, will feature the following three programs during the 2002–2003 academic year:

Commutative Algebra (Fall 2002-Spring 2003). Commutative algebra comes from several sources: the nineteenth-century theory of equations, number theory, invariant theory, and algebraic geometry. A significant development over the past twenty years is the role that commutative algebra is taking as a tool for solving problems from a rapidly expanding list of disciplines. This year-long program will highlight these recent developments and will include the following areas: tight closure and characteristic p methods, toric algebra and geometry, homological algebra, representation theory, singularities and intersection theory, combinatorics and Gröbner bases. Program committee: Luchezar Avramov, Mark Green, Craig Huneke (chair), Karen E. Smith, and Bernd Sturmfels.

Quantum Computation (Fall 2002). Quantum computation is an intellectually challenging and exciting area that touches on the foundations of both computer science and quantum physics. It has drawn on a number of mathematical areas, including computational complexity theory, group representation theory, topology, and information theory. This program will present an introductory workshop August 26–30 that will introduce quantum computing to a broad audience. Three further workshops will follow in the fall: Quantum Algorithms and Complexity, Quantum Information Theory and Cryptography, and Quantum Information Processing. Program committee: Dorit Aharonov, Charles Bennett, Richard Jozsa, Yuri Manin, Peter Shor, and Umesh Vazirani (chair).

Semiclassical Analysis (Spring 2003). Semiclassical analysis studies the transition between quantum and classical mechanics. It has been a central topic in science since the 1920s, and it still generates many questions of both a fundamental and technical nature. The traditional mathematical study of semiclassical analysis has developed tremendously in the past thirty years. The purpose of this program is to bring together experts in traditional mathematical semiclassical analysis, in the new mathematics of "quantum chaos", and in physics and theoretical chemistry. There will be two workshops with different foci: the first oriented toward physics and chemistry and the second toward mathematics. Program committee: Robert Littlejohn, William H. Miller, Johannes Sjöstrand, Steven Zelditch, and Maciej Zworski (chair).

In addition to these programs, MSRI also continues the Complementary Program, in which applications from candidates working in any field of mathematics are welcome. Candidates should specify why a fellowship at MSRI at this time is particularly relevant for their research, for example, by describing potential interactions with one of the above fields or indicating interest in one or more of MSRI's joint industrial fellow/internships.

Further information and application forms are available from `http://www.msri.org/` or by writing to MSRI, 1000 Centennial Drive, Berkeley, CA 94720-5070.

—From an MSRI announcement

Correction

The interview with Louis Nirenberg that appeared in the April 2002 issue of the *Notices* included a photograph on page 446 showing participants in a joint Soviet-American conference held in Novosibirsk in 1963. In the caption the names of two of the participants are reversed: Mikhail Alekseevich Lavrent'ev is in the first row, and his son, Mikhail Mikhailovich Lavrent'ev, is in the sixth row.

—Allyn Jackson

Reference and Book List

*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.*

Contacting the *Notices*

The preferred method for contacting the *Notices* is electronic mail. The editor is the person to whom to send articles and letters for consideration. Articles include feature articles, memorial articles, communications, opinion pieces, and book reviews. The editor is also the person to whom to send news of unusual interest about other people's mathematics research.

The managing editor is the person to whom to send items for "Mathematics People", "Mathematics Opportunities", "For Your Information", "Reference and Book List", and "Mathematics Calendar". Requests for permissions, as well as all other inquiries, go to the managing editor.

The electronic-mail addresses are notices@math.tamu.edu in the case of the editor and notices@ams.org in the case of the managing editor. The fax numbers are 979-845-6028 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

Upcoming Deadlines

August 15, 2002: Applications for National Research Council Research Associateship Program. See http://www4.nationalacademies.org/pga/rap.nsf/, or contact the National Research Council, Associateship Programs (TJ 2114), 2101 Constitution Avenue, NW, Washington, DC 20418; telephone: 202-334-2760; fax: 202-334-2759; e-mail: rap@nas.edu.

August 20, 2002: Letters of intent to submit proposals for NSF Focused Research Groups. See http://www.nsf.gov/pubs/2002/nsf02129/nsf02129.htm.

August 27, 2002: Proposals for COBASE collaborative grants. See "Mathematics Opportunities" in this issue.

September 15, 2002: Full proposals for REU sites. See "Mathematics Opportunities" in this issue.

Where to Find It

A brief index to information that appears in this and previous issues of the *Notices*.

September 15, 2002: Nominations for Sloan Research Fellowships. Contact Sloan Research Fellowships, Alfred P. Sloan Foundation, 630 Fifth Avenue, Suite 2550, New York, NY 10111, or consult the foundation's webpage: http://www.sloan.org/.

September 20, 2002: Full proposals for NSF Focused Research Groups. See http://www.nsf.gov/pubs/2002/nsf02129/nsf02129.htm.

September 27, 2002: Applications for Research Professorships at MSRI. See http://www.msri.org/, or contact MSRI, 1000 Centennial Drive, Berkeley, CA 94720-5070.

October 1, 2002: Nominations for AWM Hay and Schafer Awards. Contact the Hay Award Selection Committee or the Alice T. Schafer Award Selection Committee, Association for Women in Mathematics, 4114 Computer & Space Sciences Building, University of Maryland, College Park, MD 20742-2461; telephone: 301-405-7892; e-mail: awm@math.umd.edu.

October 1, 2002: Applications for NSF/AWM Travel Grants for Women. See "Mathematics Opportunities" in this issue.

October 15, 2002: Proposals for NSA grant and sabbatical programs. See "Mathematics Opportunities" in this issue.

October 15, 2002: Applications for spring semester of Math in Moscow and for AMS scholarships. See http://www.mccme.ru/mathinmoscow/, or contact Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax: +7095-291-65-01; e-mail: mim@mccme.ru. For information about and application forms for the AMS scholarships, see http://www.ams.org/careers-edu/mimoscow.html, or contact Math in Moscow Program, Professional Services Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904; e-mail: prof-serv@ams.org.

October 18, 2002: Applications for NSF Postdoctoral Research Fellowships. See the NSF website at http://www.fastlane.nsf.gov/d11/D11Menu.htm.

November 1, 2002: Applications for NSF International Research Fellow Awards. See "Mathematics Opportunities" in this issue.

November 7, 2002: Applications for NSF Graduate Research Fellowships. See "Mathematics Opportunities" in this issue.

November 15, 2002: Applications for Postdoctoral Fellowships and General Memberships at MSRI. See http://www.msri.org/, or contact MSRI, 1000 Centennial Drive, Berkeley, CA 94720-5070.

December 1, 2002: AMS Centennial Fellowships. See "Mathematics Opportunities" in this issue.

December 1, 2002: Submissions for Sunyer i Balaguer Prize. See "Mathematics Opportunities" in this issue.

February 1, 2003: Applications for NSF/AWM Mentoring Travel Grants for Women. See "Mathematics Opportunities" in this issue.

February 1; May 1, 2003: Applications for NSF/AWM Travel Grants for Women. See "Mathematics Opportunities" in this issue.

Conference Board of the Mathematical Sciences

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Member Societies:

American Mathematical Association of Two-Year Colleges (AMATYC)
American Mathematical Society (AMS)
American Statistical Association (ASA)
Association for Symbolic Logic (ASL)
Association for Women in Mathematics (AWM)
Association of Mathematics Teacher Educators (AMTE)
Association of State Supervisors of Mathematics (ASSM)
Benjamin Banneker Association (BBA)
Institute for Operations Research and the Management Sciences (INFORMS)
Institute of Mathematical Statistics (IMS)
Mathematical Association of America (MAA)
National Association of Mathematicians (NAM)
National Council of Supervisors of Mathematics (NCSM)
National Council of Teachers of Mathematics (NCTM)
Society for Industrial and Applied Mathematics (SIAM)
Society of Actuaries (SOA)

Book List

The Book List highlights books that have mathematical themes and hold appeal for a wide audience, including mathematicians, students, and a significant portion of the general public. When a book has been reviewed in the Notices, *a reference is given to the review. Generally the list will contain only books published within the last two years, though exceptions may be made in cases where current events (e.g., the death of a prominent mathematician, coverage of a certain piece of mathematics in the news) warrant drawing readers' attention to older books. Suggestions for books to include on the list may be sent to the managing editor, e-mail:* notices@ams.org.

Algebraic Number Theory and Fermat's Last Theorem, by Ian Stewart and David Tall. A K Peters, revised third edition, December 2001. ISBN 1-56881-119-5.

The Algorithmic Beauty of Seaweeds, Sponges and Corals, by Jap Kaandorp and Janet Kübler. Springer-Verlag, January 2001. ISBN 3-540-67700-3.

The Bit and the Pendulum: How the New Physics of Information Is Revolutionizing Science, by Tom Siegfried. John Wiley & Sons, February 2000. ISBN 0-47132-174-5. (Reviewed August 2002.)

The Book of Nothing: Vacuums, Voids, and the Latest Ideas about the Origins of the Universe, by John D. Barrow. Pantheon Books, April 2001. ISBN 0-375-42099-1. (Reviewed June/July 2002.)

Calculated Bets: Computers, Gambling, and Mathematical Modeling to Win, by Steven S. Skiena. Cambridge University Press, September 2001. ISBN 0-521-00962-6.

Codes and Ciphers: Julius Caesar, the Enigma, and the Internet, by Robert Churchhouse. Cambridge University Press, January 2002. ISBN 0-521-81054-X.

The Colossal Book of Mathematics: Classic Puzzles, Paradoxes, and Problems, by Martin Gardner. W. W. Norton & Company, August 2001. ISBN 0-393-02023-1.

Conned Again, Watson! Cautionary Tales of Logic, Math, and Probability, by Colin Bruce. Perseus Publishing, January 2001. ISBN 0-7382-0345-9.

Conquering Statistics: Numbers without the Crunch, by Jefferson Hane Weaver. Perseus Publishing, paperback edition, August 2001. ISBN 0-732-820495-1.

Conversations with a Mathematician: Math, Art, Science, and the Limits of Reason, by Gregory J. Chaitin. Springer, November 2001. ISBN 1-85233-549-1.

Curve Ball: Baseball, Statistics, and the Rules of Chance in the Game, by Jim Albert and Jay Bennett. Copernicus-Springer-Verlag, July 2001. ISBN 0-387-98816-5.

Damned Lies and Statistics: Untangling Numbers from the Media, Politicians, and Activists, by Joel Best. University of California Press, May 2001. ISBN 0-520-21978-3.

The Difference Engine: Charles Babbage and the Quest to Build the First Computer, by Doron Swade. Viking Press, September 2001. ISBN 0-670-91020-1.

Does God Play Dice? The New Mathematics of Chaos, by Ian Stewart. Blackwell, revised second edition, January 2002. ISBN 0-631-23251-6.

The Dream Machine: J. C. R. Licklider and the Revolution That Made Computing Personal, by M. Mitchell Waldrop. Viking Press, 2001. ISBN 0-670-89976-3.

The Essential John Nash, Harold Kuhn and Sylvia Nasar, editors. Princeton University Press, December 2001. ISBN 0-691-09527-2.

Euclid's Window: The Story of Geometry from Parallel Lines to Hyperspace, by Leonard Mlodinow. Free Press, April 2001. ISBN 0-684-86523-8. (Reviewed May 2002.)

Exploring Randomness, by Gregory J. Chaitin. Springer, December 2000. ISBN 1-852-33-417-7. (Reviewed October 2001.)

Flatterland: Like Flatland, Only More So, by Ian Stewart. Perseus Publishing, May 2001. ISBN 0-7382-0442-0. (Reviewed April 2002.)

Fooled by Randomness: The Hidden Role of Chance in the Markets and Life, by Nassim Nicholas Taleb. Texere, October 2001. ISBN 1-587-99071-7.

**The Fractal Murders*, by Mark Cohen. Muddy Gap Press, May 2002. 0-9718986-0-X.

Fragments of Infinity: A Kaleidoscope of Math and Art, by Ivars Peterson. John Wiley & Sons, October 2001. ISBN 0-471-16558-1.

A Gardner's Workout: Training the Mind and Entertaining the Spirit, by Martin Gardner. A K Peters, June 2001. ISBN 1-56881-120-9.

Geometry: Our Cultural History, by Audun Holme. Springer, April 2002. ISBN 3-540-41949-7.

Gödel's Proof, by Ernest Nagel and James R. Newman. New York University Press, revised edition, February 2002. ISBN 0-8147-5816-9.

Go To: The Story of the Math Majors, Bridge Players, Engineers, Chess Wizards, Scientists and Iconoclasts Who Were the Hero Programmers of the Software Revolution, by Steve Lohr. Basic Books, October 2001. ISBN 0-465-04225-2.

The Hilbert Challenge, by Jeremy J. Gray. Oxford University Press, December 2000. ISBN 0-198-50651-1. (Reviewed in this issue.)

**The Honors Class*, by Benjamin Yandell. A K Peters, December 2001. ISBN 1-56881-141-1. (Reviewed in this issue.)

How the Other Half Thinks: Adventures in Mathematical Reasoning, by Sherman Stein. McGraw-Hill, July 2001. ISBN 0-071-37339-X. (Reviewed in this issue.)

How the Universe Got Its Spots, by Janna Levin. Princeton University Press, April 2002. ISBN 0-691-09657-0.

In Code: A Mathematical Journey, by Sarah Flannery and David Flannery. Workman Publishing, May 2001. ISBN 0-761-12384-9.

It Must Be Beautiful: Great Equations of Modern Science, Graham Farmelo, Editor. Granta Books, February 2002. ISBN 1-862-07479-8.

The Lady Tasting Tea: How Statistics Revolutionized Science in the Twentieth Century, by David Salsburg. W. H. Freeman & Co, April 2001. ISBN 0-716-74106-7.

Lebesgue's Theory of Integration: Its Origins and Development, by Thomas Hawkins. AMS, September 2001. ISBN 0-8218-2963-7.

The Mathematical Explorer, by Stan Wagon. Electronic book, Wolfram Research, Inc., 2001. (Reviewed June/July 2002.)

Mathematical Vistas, by Peter Hilton, Derek Holton, and Jean Pedersen. Springer-Verlag, January 2002. ISBN 0-387-95064-8.

A Mathematician Grappling with His Century: The Autobiography of Laurent Schwartz. Translated from the French by L. Schneps. Birkhäuser, 2001. ISBN 3-7643-6052-6.

The Mathematician Sophus Lie: It Was the Audacity of My Thinking, by Arild Stubhaug. Springer, 2002. ISBN 3-540-42137-8.

Mathematics and the Roots of Postmodern Thought, by Vladimir Tasic. Oxford University Press, 2001. ISBN 0-195-13967-4.

Mathematics Galore: Masterclasses, Workshops, and Team Projects in Mathematics and Its Applications, by C. J. Budd and C. J. Sangwin. Oxford University Press, June 2001. ISBN 0-198-50769-0 (hardcover), 0-198-50770-4 (paperback). (Reviewed in this issue.)

Mathematics in a Postmodern Age: A Christian Perspective, Russell W. Howell and W. James Bradley, editors. Wm. B. Eerdmans Publishing Company, May 2001. ISBN 0-802-84910-5.

The Measure of the World, by Denis Guedj. University of Chicago Press, October 2001. ISBN 0-226-31030-2.

More Mathematical Astronomy Morsels, by Jean Meeus. Willmann-Bell Inc., 2002. ISBN 0-943396-743.

A New Kind of Science, by Stephen Wolfram. Wolfram Media, Inc., May 2002. ISBN 1-579-55008-8.

Niels Henrik Abel and His Times: Called Too Soon by Flames Afar, by Arild Stubhaug. Translated by R. Daly. Springer, May 2000. ISBN 3-540-66834-9. (Reviewed August 2002.)

Political Numeracy: Mathematical Perspectives on Our Chaotic Constitution, by Michael Meyerson. W. W. Norton & Company, March 2002. ISBN 0-393-04172-7.

Puzzlers' Tribute: A Feast for the Mind, Tom Rodgers and David Wolfe, editors. A K Peters, December 2001. ISBN 1-56881-121-7.

The Quest for the Quantum Computer, by Julian Brown. Touchstone Books, August 2001. ISBN 0-684-87004-5.

Radical Equations: Math Literacy and Civil Rights, by Robert P. Moses and Charles E. Cobb Jr. Beacon Press, February 2001. ISBN 0-807-03126-7. (Reviewed March 2002.)

**The Rainbow Bridge: Rainbows in Art, Myth, and Science*, by Raymond L. Lee Jr. and Alistair B. Fraser. Pennsylvania State University Press and SPIE Press, 2001. ISBN 0-271-01977-8.

The Riddle of the Compass, by Amir Aczel. Harcourt Brace, August 2001. ISBN 0-151-00506-0.

Science and an African Logic, by Helen Verran. University of Chicago Press, January 2002. ISBN 0-226-85389-6 (cloth), 0-226-85391-8 (paper).

The Science of Conjecture: Evidence and Probability before Pascal, by James Franklin. Johns Hopkins University Press, June 2001. ISBN 0-8018-6569-7.

Signs of Life: How Complexity Pervades Biology, by Richard Solé and Brian Goodwin. Basic Books, January 2001. ISBN 0-465-01927-7.

**Spaceland*, by Rudy Rucker. Tor Books, June 2002. ISBN 0-765-30366-3.

Statisticians of the Centuries, C. C. Heyde and E. Seneta, editors. Springer, September 2001. ISBN 0-387-953283-7.

The Story of Mathematics, by Richard Mankiewicz. Princeton University Press, February 2001. ISBN 0-691-08808-X. (Reviewed April 2002.)

Such Silver Currents: The Story of William and Lucy Clifford, 1845-1929, by M. Chisholm. Lutterworth Press, March 2002. ISBN 0-7188-3017-2.

Things a Computer Scientist Rarely Talks About, by Donald Knuth. Center for the Study of Language and Information, July 2001. ISBN 1-57586-327-8.

Thinks, by David Lodge. Viking Press, May 2001. ISBN 0-670-89984-4.

Triangle of Thoughts, by Alain Connes, André Lichnerowicz, and Marcel Paul Schützenberger. AMS, July 2001. ISBN 0-8218-2614-X. (Reviewed March 2002.)

Turing and the Universal Machine: The Making of the Modern Computer, by Jon Agar. June 2001, Totem Books. ISBN 1-840-46250-7.

Understanding Mathematics for Aircraft Navigation, by James S. Wolper. McGraw-Hill, May 2001. ISBN 0-07-137572-4.

The Unfinished Revolution: Human-Centered Computers and What They Can Do for Us, by Michael L. Dertouzos. Harperbusiness, January 2001. ISBN 0-066-62067-8.

The Universal History of Computing: From the Abacus to the Quantum Computer, by Georges Ifrah; translated from the French and with notes by E. F. Harding, assisted by Sophie Wood, Ian Monk, Elizabeth Clegg, and Guido Waldman. John Wiley & Sons, November 2000. ISBN 0-471-39671-0. (Reviewed in two parts, January 2002 and February 2002.)

The Universal History of Numbers: From Prehistory to the Invention of the Computer, by Georges Ifrah; translated from the French by David Bellos, E. F. Harding, Sophie Wood, and Ian Monk. John Wiley & Sons, December 1999. ISBN 0-471-37568-3. (Reviewed in two parts, January 2002 and February 2002.)

The Universe in a Nutshell, by Stephen Hawking. Bantam Doubleday Dell, November 2001. ISBN 0-553-80202-X . (Reviewed May 2002.)

The Unknowable, by Gregory J. Chaitin. Springer, August 1999. ISBN 9-814-02172-5. (Reviewed October 2001.)

What Is Mathematics? An Elementary Approach to Ideas and Methods, by Richard Courant and Herbert Robbins, second edition, revised by Ian Stewart. Oxford University Press, August 1996. ISBN 0-195-10519-2. (Reviewed December 2001.)

What Shape Is a Snowflake?, by Ian Stewart. W. H. Freeman & Company, November 2001. ISBN 0-716-74794-4.

Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being, by George Lakoff and Rafael Núñez. Basic Books, October 2000. ISBN 0-465-03770-4. (Reviewed November 2001.)

The Zen of Magic Squares, Circles, and Stars: An Exhibition of Surprising Structures across Dimensions, by Clifford A. Pickover. Princeton University Press, January 2001. ISBN 0-691-07041-5.

Stipends for Study and Travel

Graduate Support

American Association for the Advancement of Science

Summer Fellowship

Description: Fellows will work for radio and television stations, newspapers, magazines, and online sites and will have their travel expenses and stipends paid by the AAAS. Fellows will have the opportunity to: observe and participate in the process by which events and ideas become news, improve their communication skills by learning to describe complex technical subjects in a manner understandable by the public, and increase their understanding of editorial decision making and the manner in which information is effectively disseminated. Each fellow will: attend an orientation and evaluation session in Washington, DC; begin the internship in mid-June; and submit an interim and final report to AAAS to help evaluate the program.
Eligibility: Provides support for 20–30 outstanding graduate students in mathematics, the natural and social sciences, and engineering as reporters, researchers, and production assistants in the mass media. (Exceptional undergraduate or postdoctoral students also considered.)
Grant amount: $450/week stipend for ten weeks.
Deadline: January 15, 2003.
Application information: Katrina Malloy, Program Coordinator, Mass Media Science and Engineering Fellows Program, American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005.

American Association of University Women (AAUW) Educational Foundation

Selected Professions Fellowships

Description: These fellowships are awarded to women of outstanding academic ability who are citizens or permanent residents of the U.S. for full-time graduate study in designated fields where women's participation has traditionally been low. Eligible fields currently include mathematics and statistics.
Eligibility: Fellowships are for the final year of the master's degree. Fellowship year is July 1–June 30. Degree must be earned at the end of the fellowship year.
Grant amount: $5,000–$15,000.
Deadline: Must be postmarked by January 10 (applications are available August 1–December 20).
Application information: For more information contact: AAUW Educational Foundation, 2201 Dodge Street, Iowa City, IA 52243-4030; tel: 319-337-1716; or visit our website at `http://www.aauw.org/`.

Florida Education Fund

The McKnight Doctoral Fellowship Program

Description: A McKnight Doctoral Fellowship provides funds for up to twenty-five African American citizens annually to pursue Ph.D. degrees at participating Florida universities. Contingent upon successful academic progress, the maximum length of the award is five years. The Florida Education Fund provides the first three years, and the student's university continues funding at the same level of support for an additional two years.
Eligibility: Applicants must hold or be receiving a bachelor's degree from a regionally accredited college or university.
Grant amount: Up to $5,000 in tuition and fees plus an annual stipend of $12,000. Tuition and fees over $5,000 will be waived.
Deadline: The deadline for applications for fall 2003 is January 15, 2003.
Application information: Detailed information and application packets can be obtained by writing or calling: The Florida Education Fund, 201 E. Kennedy Boulevard, Suite #1525, Tampa, FL 33602; 813-272-2772; `mdf@fl-educ-fd.org`; or visit our website at: `http://www.fl-educ-fd.org/`.

Ford Foundation Predoctoral and Dissertation Fellowships for Minorities

Description: Approximately 60 predoctoral and 40 dissertation fellowships will be awarded in a national competition administered by the National Research Council (NRC) of the National Academies for the Ford Foundation. The awards will be made to those individuals who, in the judgment of the review panels, have demonstrated superior scholarship and show the greatest promise for future achievement as scholars, researchers, and teachers in institutions of higher education.

Eligibility: Available to minorities enrolled in research-based doctoral programs in mathematics, engineering, and other fields. The fellowships will be offered on a competitive basis to individuals who are citizens or nationals of the U.S. and who are members of the following groups: Alaskan Natives (Eskimo or Aleut), Native American Indians, Black/African Americans, Mexican Americans/Chicanas/Chicanos, Native Pacific Islanders (Polynesian or Micronesian), or Puerto Ricans.
Grant amount: Annual stipends of $16,500 and $24,000, respectively. The predoctoral awards also include an allowance of $7,500 to the awardee's university in lieu of tuition and fees.
Deadline: Deadline for predoctoral fellowships is early November. For dissertation fellowships, early December.
Application information: For more information, contact: Fellowship Office/FF, TJ 2041, National Research Council, 2101 Constitution Avenue, Washington, DC 20418; tel: 202-334-2872; e-mail: infofell@nas.edu; website: http://national-academies.org/fellowships/.

Georgia Institute of Technology

President's Fellowships

Description: These stipends are awarded to a selected number of highly qualified U.S. nationals who intend to pursue doctoral degrees. The fellowships are intended to supplement other forms of support and can be extended for three additional years based on academic performance and research potential.
Eligibility: The awards are highly competitive; selection is based on academic criteria and evidence of scholarship. Participants are expected to maintain high academic standing.
Grant amount: $5,500 for twelve months.

Graduate Research/Teaching Assistantships

Eligibility: Appointments are based primarily on scholarship and ability to contribute to ongoing programs of the college.
Assistantship amount: $18,161 per twelve months, plus waiver of most tuition and fees.
Application information: Prospective students should write to the Ph.D. Coordinator, College of Computing, Georgia Institute of Technology, Atlanta, GA 30332-0280; or e-mail to phd-info@cc.gatech.edu. For additional information: http://www.cc.gatech.edu/.

National Academies

Christine Mirzayan Internship Program

Description: The Christine Mirzayan Internship Program of the National Academies is designed to engage graduate and postdoctoral science, engineering, medical, veterinary, business, and law students in science and technology policy and to familiarize them with the interactions between science, technology, and government. As a result, students develop essential skills different from those attained in academia and make the transition from being a graduate student to a professional.
Eligibility: Applications for the internships are invited from graduate students through postdoctoral candidates in any physical, biological, or social science field or any field of engineering, medicine/health, or veterinary medicine, as well as business and law students.
Grant amount: The stipend for the 12-week January program is $5,600. The stipend for the 10-week June program is $4,700. The stipend for the September program is $5,600. In addition, travel expenses of up to $500 will be provided.
Deadline: Deadline for the receipt of materials is November 1 for the January program, March 1 for the June program, and June 1 for the September program.
Application information: For more information, e-mail: internship@nas.edu (preferred); fax: 202-334-1667; tel: 202-334-2455; or write to: The National Academies Internship Program, 2101 Constitution Ave., NW, Suite FO-2050, Washington, DC 20418. The website is http://national-academies.org/; then click on "Internships & Careers".

National Science Foundation

Graduate Research Fellowships

Description: Three-year awards available to U.S. citizens or nationals, or permanent resident aliens of the U.S. Fellowships are awarded for graduate study leading to research-based master's or doctoral degree in the fields of science, mathematics, and engineering supported by the NSF. Women in Engineering and Computer and Information Science: Additional awards will be offered to encourage women to undertake graduate study in engineering and computer and information science.
Eligibility: Fellowships are intended for individuals in the early stages of their graduate study in science, mathematics, or engineering.
Grant amount: $21,500 stipend for twelve-month tenure. A one-time research travel allowance of $1,000. No dependency allowances. A cost-of-education allowance of $10,500 is paid to the fellowship institution.
Deadline: Application deadline is early November.
Application information: Apply to NSF Graduate Research Fellowship Program, Oak Ridge Associated Universities, P. O. Box 3010, Oak Ridge, TN 37831-3010; tel: 865-241-4300; fax: 865-241-4513; e-mail: nsfgrfp@orau.gov; website: http://www.orau.org/nsf/nsffel.htm.

State of California

Graduate Assumption Program of Loans for Education

Eligibility: Residents of California who attend accredited graduate or professional schools in program leading to a graduate degree with the intent to become college or university faculty members in California.
Assumption benefits: May assume up to $6,000 in loan balances in return for teaching service at a college or university in California.
Priority filing date: June 30, 2002, or until all awards are filled.

Deadline: June 30, 2003.
Application information: California Student Aid Commission, P. O. Box 419029, Rancho Cordova, CA 95741-9029; tel: 916-526-7599; e-mail: custsvcs@csac.ca.gov; applications on Web: http://www.csac.ca.gov/.

Postdoctoral Support

Air Force Office of Scientific Research

Research Contracts and Grants

Description: Mathematicians and computer scientists are encouraged to submit through their organizations proposals for research support. Research areas include mathematics of dynamics and control, physical mathematics and applied analysis, computational mathematics, optimization and discrete mathematics, signal processing, probability and statistics, software and systems, intelligent software agents, and electromagnetics.
Application information: Research proposals should be forwarded to the Mathematics and Space Sciences Directorate, Air Force Office of Scientific Research (AFOSR NM), 801 N. Randolph Street, Room 732, Arlington, VA 22203-1977.

American Mathematical Society Centennial Fellowships

Postdoctoral Fellowships

Description: The AMS Centennial Research Fellowship Program makes awards annually to outstanding mathematicians to help further their careers in research. The number of fellowships to be awarded is small and depends on the amount of money contributed to the program. The trustees have arranged a matching program from general funds in such a way that funds for at least one fellowship are guaranteed. Due to a change in eligibility criteria and an increase in the stipend beginning in 2002–03, it is expected that two fellowships will be awarded.
Eligibility: Recently the AMS Council approved changes in the rules for the fellowships. The eligibility rules are as follows. The primary selection criterion for the Centennial Fellowship is the excellence of the candidate's research. Preference will be given to candidates who have not had extensive fellowship support in the past. Recipients may not hold the Centennial Fellowship concurrently with another research fellowship such as a Sloan or NSF Postdoctoral Fellowship. Under normal circumstances the fellowship cannot be deferred. A recipient of the fellowship shall have held his or her doctoral degree for at least three years and not more than twelve years at the inception of the award. Applications will be accepted from those currently holding a tenured, tenure-track, postdoctoral, or comparable (at the discretion of the selection committee) position at an institution in North America. Applications should include a cogent plan indicating how the fellowship will be used. The plan should include travel to at least one other institution and should demonstrate that the fellowship will be used for more than reduction of teaching at the candidate's home institution. The selection committee will consider the plan in addition to the quality of the candidate's research and will try to award the fellowship to those for whom the award would make a real difference in the development of their research careers. Work in all areas of mathematics, including interdisciplinary work, is eligible.
Grant amount: The stipend for fellowships awarded for 2003–04 is expected to be approximately $57,000, with an additional expense allowance of about $1,600. Acceptance of the fellowship cannot be postponed.
Deadline: The deadline for receipt of applications is December 1, 2002. Awards will be announced in February 2003 or earlier if possible.
Application information: Application forms are available via the Internet at http://www.ams.org/employment/centflyer.html. For paper copies of the form write to the Professional Services Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; or send electronic mail to prof-serv@ams.org; or call 401-455-4107. Please note that completed applications and references should be sent to the AMS at the address given above, marked "Centennial Fellowships".

American Philosophical Society

Description: Postdoctoral research grants to aid specific research projects. The purpose of the program is to connect scholars with the objects of their research. Tenable abroad and in the U.S. The Committee on Research meets in January and in March.
Eligibility: For candidates with Ph.D. for at least one year.
Grant amount: Up to $6,000. Grants contribute toward travel expenses, food and lodging, and photoduplication. No funds are available for attending conferences or consulting with colleagues.
Deadline: October 1, December 1.
Application information: For application forms please consult the website at http://www.amphilsoc.org/. If electronic access is denied, briefly describe your project and proposed budget in a letter to: Committee on Research, American Philosophical Society, 104 South Fifth Street, Philadelphia, PA 19106; or to eroach@amphilsoc.org.

California Institute of Technology

Harry Bateman Research Instructorships

Description: Offered by the Division of Physics, Mathematics, and Astronomy at the California Institute of Technology. Appointments are for one year and are renewable for one additional year.
Eligibility: Open to persons who have recently received their doctorate in mathematics.

Grant amount: The annual salary for academic year 2003–04 is $49,200. Duties include teaching one course for the full academic year.
Deadline: January 1, 2003.
Application information: Please send applications to Instructorship Search Committee, 253-37 Sloan Laboratory, Pasadena, CA 91125. Include C.V. and a statement of anticipated research. The candidate is requested to ensure that at least three letters of recommendation are sent to Caltech. To avoid duplication of paperwork, your application may also be considered for an Olga Taussky and John Todd Instructorship. Caltech is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and disabled persons are encouraged to apply.

California Institute of Technology

Olga Taussky and John Todd Instructorships in Mathematics

Description: Initial appointments are for two years, with a one-year terminal extension expected. There are three terms in the Caltech academic year, and instructors are expected to teach one course in all but two terms of the total appointment.
Eligibility: Offered to recent Ph.D. recipients who show strong research promise in one of the areas in which Caltech's mathematics faculty is currently active.
Grant amount: The annual salary for 2003–04 is $52,200 per year plus a $2,000 per year research fund.
Deadline: January 1, 2003.
Application information: Apply to the Instructorship Search Committee, 253-37 Sloan Laboratory, Pasadena, CA 91125. Include C.V. and a statement of anticipated research. The candidate is requested to ensure that at least three letters of recommendation are sent directly to Caltech. To avoid duplication of paperwork, your application may also be considered for a Harry Bateman Research Instructorship. Caltech is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and disabled persons are encouraged to apply.

John Simon Guggenheim Memorial Foundation Fellowships

Description: Fellowships are on an advanced professional level. Approximately 230 awards are made.
Eligibility: U.S. or Canadian citizenship or permanent residence is required. Fellowships are also offered to citizens or permanent residents of Latin America and the Caribbean.
Grant amount: Approximately $36,000 in 2001.
Deadline: Application deadline: October 1 for the U.S. and Canada competition, December 1 for the Latin American and Caribbean competition.
Application information: For more information write to John Simon Guggenheim Memorial Foundation, 90 Park Avenue, New York, NY 10016; tel: 212-687-4470; fax: 212-697-3248; e-mail: fellowships@gf.org; World Wide Web: http://www.gf.org/.

IBM Herman Goldstine Postdoctoral Fellowship in Mathematical Sciences

Description: The fellowship provides scientists of outstanding ability an opportunity to advance their scholarship as resident department members at the research center. The department provides an atmosphere in which basic research is combined with work on technical problems arising in industry. Close interaction with permanent department members is expected, but fellows will be free to pursue their own research interests. The fellowship has a period of one year and may be extended by another year by mutual agreement. One fellowship will be awarded yearly. Please see http://www.research.ibm.com/mathsci/goldstine.html for further information.
Eligibility: Candidates must have a doctorate and no more than five years of postdoctoral professional experience (with a preference for less) when the fellowship commences.
Grant amount: Salary: $85,000 to $95,000, depending on experience, plus an allowance for moving expenses.
Deadline: December 2002 or January 2003 (check website above).
Application information: Applications should include: C.V. (with thesis summary), transcripts of graduate-level coursework, reprints of publications, research proposal, and visa status. Applicants are responsible for ensuring that three or more letters of reference, including one from the thesis advisor, also arrive by the deadline. Please direct all materials to: Herman Goldstine Fellowship Committee, Department of Mathematical Sciences, Room 32-248, IBM T. J. Watson Research Center, P. O. Box 218, Route 134, Yorktown Heights, NY 10598. Applications must be sent in hard copy.

Institute for Advanced Study Memberships

Description: The School of Mathematics will grant a limited number of memberships, some with financial support, for research in mathematics at the institute during the academic year 2003–04.
Eligibility: Candidates must give evidence of ability in research comparable at least with that expected for the Ph.D. degree.
Deadline: December 1, 2002.
Application information: Application blanks may be obtained from The School of Mathematics, Institute for Advanced Study, Princeton, NJ 08540, and should be returned (whether or not funds are expected from some other source) by December 1. Forms may also be downloaded but not submitted via Web connection at http://www.math.ias.edu/. An Equal Opportunity/Affirmative Action Employer.

Institute for Mathematics and its Applications (IMA)

Description: The IMA announces membership opportunities in connection with its 2003–2004 thematic

program on **Probability and Statistics in Complex Systems: Genomics, Networks, and Financial Engineering.** Individuals may apply for three classes of membership at the IMA in connection with the 2003–2004 thematic program: IMA postdoctoral memberships, IMA industrial postdoctoral memberships, and general IMA memberships. IMA postdoctoral memberships run two years, starting September 2, 2003. In the second year of the appointment there are a variety of options to enhance career development, including participation in the 2004–2005 academic-year program on "Mathematics of Materials and Macromolecules: Multiple Scales, Disorder, and Singularities". IMA Industrial Postdoctoral Memberships run two years, starting September 2, 2003. They are funded jointly by the IMA and an industrial sponsor, and holders devote 50% effort to the IMA program and 50% effort working with industrial scientists. General IMA memberships provide an opportunity for mathematicians and scientists employed elsewhere to spend a period of one month to one year in residence at the IMA and to participate in the 2003–2004 program. The residence should fall in the period June 1, 2003, through August 31, 2004. Preference will be given to supplementary support for persons with sabbatical leaves, fellowships, or other stipends.
Application information: Application forms and instructions are available at `http://www.ima.umn.edu/docs/genapp.html` with deadline of January 15, 2003. Questions should be directed to `applications@ima.umn.edu` or by phone to 612-624-6066. The University of Minnesota is an Equal Opportunity Educator and Employer.

Los Alamos National Laboratory

Postdoctoral Appointments

Description: Research opportunities are granted in many areas of chemistry, mathematics, computer science, materials science, biological sciences, environmental science, geoscience, and many engineering fields. Appointments are available for two years, subject to renewal for a third year. A postdoctoral committee meets to review candidates for postdoctoral appointments in February, May, August, and December.
Eligibility: Candidates must be recipients of a doctoral degree within the past five years.
Grant amount: Starting salary: $56,700–$64,300.
Application information: Los Alamos National Laboratory is an Equal Opportunity Employer. For more information: e-mail: `postdoc-info@lanl.gov`; tel: 505-667-0872; fax: 505-665-4562; see details and apply online at: `http://www.hr.lanl.gov/postdoc/`.

Los Alamos National Laboratory

J. Robert Oppenheimer, Richard P. Feynman, and Frederick Reines Fellowships

Description: Research opportunities are granted in many areas of chemistry, mathematics, computer science, materials science, biological sciences, environmental science, geoscience, and many engineering fields. Appointments are for three years.
Eligibility: Candidates must be recipients of a doctoral degree within the past five years and must show clear and definite promise of becoming outstanding leaders in scientific research.
Grant amount: Starting salary: $87,000.
Deadline: Application deadline: mid-November each year.
Application information: Los Alamos National Laboratory is an Equal Opportunity Employer. See details and apply online at: `http://www.hr.lanl.gov/postdoc/`.

Mathematical Sciences Research Institute (MSRI)

General Memberships

Description: The Institute will invite an undetermined number of general members for stays of 1 month or more during 2003–04, when one full-year program and two half-year programs will be featured: *Differential Geometry* (August 11, 2003, to May 15, 2004), *Discrete and Computational Geometry* (August 11 to December 19, 2003), and *Topological Aspects of Real Algebraic Geometry* (January 2 to May 14, 2004). Some invitations will be made in other areas, so applications from candidates in all fields are welcome.
Eligibility: For mathematicians postdoctoral and above.
Grant amount: While there is no stipend for general members, MSRI may offer partial expense reimbursement of up to $2,340/month and may offer travel expense reimbursement. General members are expected to visit with at least some outside financial support.
Deadline: Files must be complete by November 15, 2002.
Application information: Please complete online application form at: `http://www.msri.org/applications/applying/`.

Mathematical Sciences Research Institute (MSRI)

Hewlett-Packard and Microsoft Research Postdoctoral Grants

Description: The Mathematical Sciences Research Institute announces the availability of several postdoctoral fellowhips combined with internships at Hewlett-Packard Laboratories (HPL) in Palo Alto, California, and with Microsoft Research (MSR) in Redmond, Washington. HP Labs and Microsoft Research pursue a wide range of mathematical work. Because of the variety of work done at these facilities, no particular fields of mathematics have been specified. However, an essential prerequisite is a strong interest in the applications of mathematics as well as in the research environment at MSRI. **HPL postdocs** will join an active research group at the HP Labs for two months prior to the start of their time at MSRI and will consult three days a month with that group during their tenure at MSRI. Two further months at HP Labs at the end of their time at MSRI is possible. HPL postdocs receive compensation for their work at HP Labs in addition to the standard MSRI Postdoctoral Fellowship.

MSR postdoc fellowships are normally two-year awards, with the recipient spending one year at MSRI and the second year at Microsoft Research.
Eligibility: For new and recent Ph.D.'s (Ph.D. earned in 1998 or later). Applicants should apply through the usual process for MSRI Postdoctoral Fellowships, indicating their interest in these internships/fellowships and adding relevant documentation. Applications indicating interest in the internship program will be reviewed by Hewlett-Packard and/or Microsoft Research as well as by MSRI.
Deadline: Files must be completed by November 15, 2002.
Application information: Please complete online application form at: `http://www.msri.org/applications/applying/`.

Mathematical Sciences Research Institute (MSRI)

Postdoctoral Fellowships

Description: The Institute will award about 18 postdoctoral fellowships during 2003-04, when one full-year program and two half-year programs will be featured: *Differential Geometry* (August 11, 2003, to May 15, 2004), *Discrete and Computational Geometry* (August 11 to December 19, 2003), and *Topological Aspects of Real Algebraic Geometry* (January 2 to May 14, 2004). Some awards will be made in other areas, so applications from candidates in all fields are welcome.
Eligibility: For new and recent Ph.D.'s (Ph.D. earned in 1998 or later).
Grant amount: The stipend will be $3,500/month for 5 months for semester programs and for 10 months for full-year programs.
Deadline: Files must be complete by November 15, 2002.
Application information: Please complete online application form at: `http://www.msri.org/applications/applying/`.

Mathematical Sciences Research Institute (MSRI)

Research Professorships

Description: The Institute will award about 10 research professorships for stays of 3 months or more during 2003-04, when one full-year program and two half-year programs will be featured: *Differential Geometry* (August 11, 2003, to May 15, 2004), *Discrete and Computational Geometry* (August 11 to December 19, 2003), and *Topological Aspects of Real Algebraic Geometry* (January 2 to May 14, 2004). Some awards will be made in other areas, so applications from candidates in all fields are welcome.
Eligibility: For midcareer mathematicians (Ph.D. earned in 1997 or earlier).
Grant amount: The stipend will be limited to a ceiling of $50,000 (for 10 months) and normally will not exceed half the applicant's salary.
Deadline: Files must be complete by September 27, 2002.
Application information: Please complete online application form at: `http://www.msri.org/applications/applying/`.

The Michigan Society of Fellows

Horace H. Rackham School of Graduate Studies, The University of Michigan

Description: The Michigan Society of Fellows was founded in 1970 through grants from the Ford Foundation and Horace H. Rackham Graduate School for the purpose of promoting academic and creative excellence in the arts, sciences, and professions. The objective of the program is to support individuals selected for outstanding achievement, professional promise, and interdisciplinary interests. We invite applications from qualified candidates for three-year postdoctoral fellowships at the University of Michigan. Fellows are appointed as assistant professors/postdoctoral scholars with departmental affiliations. They spend the equivalent of one academic year teaching; the balance of time is devoted to their own scholarly research and creative work. Applications will be screened by faculty in relevant University of Michigan departments. Final selections will be made by the senior fellows of the society. New fellows will be selected for three-year terms beginning September 2003.
Eligibility: Candidates must have received the Ph.D. degree between June 1, 2000, and September 1, 2003.
Grant amount: The annual stipend will be $43,260.
Deadline: Completed applications due October 4, 2002.
Application information: Please see the application on our website or send requests for application materials to: Michigan Society of Fellows, 3030 Rackham Building, University of Michigan, 915 E. Washington St., Ann Arbor, MI 48109-1070; tel: 734-763-1259; e-mail: `society.of.fellows@umich.edu`; Web: `http://www.rackham.umich.edu/Faculty/society.html`.

Michigan State University

MSU Postdoctoral Instructorships

Description: Several three-year positions will be available beginning fall 2002 for new or recent Ph.D.'s who show strong promise in research and teaching. The teaching load is four semester courses per year, and participation in the research activities of the department is expected.
Grant amount: A starting salary of $40,000 per year. Additional income from summer teaching is usually available if desired.
Deadline: Completed applications (including letters of recommendation) received by November 15, 2002, are assured of consideration.
Application information: An applicant should send a vita as well as a brief statement of research interests and arrange for at least four letters of recommendation to be sent, one of which must specifically comment on the applicant's ability to teach. Application via e-mail is strongly encouraged. To receive an electronic application and information, send an e-mail to: `jobs@math.msu.edu` with the message "send application-info". Application

materials can also be mailed to The Hiring Committee, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027. Application should be made as soon as possible. Women and minorities are strongly encouraged to apply. MSU is an Affirmative Action/Equal Opportunity Institution.

National Center for Atmospheric Research

Advanced Study Program

Description: Postdoctoral fellowships are offered for highly qualified atmospheric scientists and scientists from related disciplines who wish to continue basic research in the atmospheric sciences. Appointments are for a one-year period with a possible extension for an additional year.
Eligibility: For recent recipients of the Ph.D. with no more than 4 years' experience past their Ph.D.
Grant amount: Stipends are $42,400 and are adjusted annually in June.
Deadline: The application deadline is January 5, 2003.
Application information: Tel: 303-497-1601; e-mail: barbm@ucar.edu; or Barbara Hansford, NCAR, ASP, P. O. Box 3000, Boulder, CO 80307-3000; fax: 303-497-1646.

National Science Foundation

Mathematical Sciences Postdoctoral Research Fellowships (with Research Instructorship Option)

Description: The format of the 2003 Fellowship program has not been changed from that of 2002. The stipend portion of the awards will consist of support for eighteen academic-year months or their equivalent and six summer months. Awardees have two options for academic year stipends, subject to the constraints that their academic-year support begin by October 1 of the award year and be configured in intervals no shorter than three consecutive months. An awardee may have full-time support for any eighteen academic-year months in a three-year period (the Research Fellowship Option) or have a combination of full-time and half-time support over a period of three academic years, usually as one academic year full-time and two academic years half-time (the Research Instructorship Option). Summer month stipends are limited to two per calendar year.
Grant amount: Stipend amounts are $4,000 per full-time month and $2,000 per half-time month, plus institutional and special allowances, for a total award of $108,000 to be used within 48 months.
Deadline: Deadline for applications is October 18, 2002; applicants will be notified of decisions on or about March 1, 2003.
Application information: For further details write to the Mathematical Sciences Infrastructure Program, Division of Mathematical Sciences, Room 1025, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230; call 703-306-1870; send an inquiry to e-mail: msprf@nsf.gov; or under "Postdoctoral Fellowships" at http://www.fastlane.nsf.gov/.

National Security Agency

Grants Program

Description: Standard research proposals designed principally to provide summer salary for professors and limited support for their graduate students in areas of interest listed below. The National Security Agency (NSA) awards grants to universities in support of self-directed research in the following areas of the mathematical sciences (including possible computational aspects): algebra, number theory, discrete mathematics, probability, and statistics. The NSA also accepts proposals for small grants for conferences, workshops, and special academic endeavors.
Deadline: October 15 each year for all grant and conference proposals. Grants awarded from this funding can expect to incur expenses in the fall of the following year.
Application information: For further information about the program, please call 301-688-0400. All correspondence should be addressed to: Dr. Charles F. Osgood, Director, Mathematical Sciences Program, National Science Agency, Suite 6557, Ft. George G. Meade, MD 20755-6557. Queries can also be made by e-mail to msp@math.umbc.edu.

National Security Agency

Sabbatical Program

Description: The National Security Agency (NSA) has a program supporting sabbaticals for academic mathematical scientists to visit the NSA, usually from 9 to 24 months.
Eligibility: American citizenship for the applicant and all immediate family members is required. Because a complete background investigation is required, applications should be submitted as soon as possible.
Grant amount: (Compensation) A supplement to the university's stipend to bring the visitor's salary up to his or her regular monthly salary and a choice of either an allowance for moving expenses or a housing supplement.
Application information: For further information on the sabbatical program, contact: Dr. Charles F. Osgood, Director, Mathematical Sciences Program, National Security Agency, Suite 6557, Ft. George G. Meade, MD 20755-6557; tel: 301-688-0400; e-mail: msp@math.umbc.edu.

Radcliffe Institute Fellowship Program

Description: The Radcliffe Institute for Advanced Study is a scholarly community where individuals pursue advanced work across a wide range of academic disciplines, professions, or creative arts. Within this broad purpose, and in recognition of Radcliffe's historic contributions to the education of women, the Radcliffe Institute sustains a continuing commitment to the study of women, gender, and society.
Eligibility: Radcliffe Institute Fellowships are designed to support scholars, scientists, artists, or writers of exceptional promise and demonstrated accomplishment who wish to pursue independent work in academic and

professional fields and in the creative arts. Applications are judged on the quality and significance of the proposed project and on the applicant's record of accomplishment and promise. Women and men from across the United States and throughout the world, including developing countries, are encouraged to apply. Proposals are accepted from applicants in any field with the receipt of a doctorate or appropriate terminal degree at least two years prior to appointment or with comparable professional achievement in the area of the proposed project.

Grant amount: Stipends are funded up to $50,000 for one year, with additional funds for project expenses.

Deadline: Applications must be postmarked by October 1, 2002.

Application information: For more information visit http://www.radcliffe.edu/. Write, call, or e-mail for an application: Application Office, 34 Concord Avenue, Cambridge, MA 02138; tel: 617-496-1324; fax: 617-495-8136; or e-mail: fellowships@radcliffe.edu.

Rice University

Griffith Conrad Evans Instructorships

Description: Postdoctoral appointments for two to three years for promising research mathematicians with research interests in common with the active research areas at Rice. Rice University encourages applications from women and minority group members.

Deadline: Applications received by December 31, 2002, will receive thorough consideration.

Application information: Inquiries and applications should be addressed to: Chairman, Evans Committee, Department of Mathematics, Rice University, 6100 Main St.-MS 136, Houston, TX 77005.

Sloan Foundation

Research Fellowships

Description: Unrestricted grants made to selected university scientists in the physical sciences, mathematics, applied mathematics, computer science, economics, and neuroscience. Candidates do not apply, but are nominated by their department chairmen or other scientists.

Eligibility: Candidates must be members of the regular (i.e., tenure-track) faculty, though not necessarily in a tenured position, at a recognized college or university in the United States or Canada.

Deadline: Nominations are due by September 15 for awards to begin the following September.

Application information: For information write to the Sloan Research Fellowships, Alfred P. Sloan Foundation, Suite 2550, 630 Fifth Ave., New York, NY 10111; e-mail: teitelbaum@sloan.org; Web: http://www.sloan.org/.

Trinity College

Harold L. Dorwart Visiting Assistant Professorship

Description: The Department of Mathematics solicits applications for a Harold L. Dorwart Visiting Assistant Professorship. This is a three-year, nonrenewable position, carrying with it a highly competitive salary and travel money. The normal course load is 5 semester courses per year ("3/2"), one of which will be a research seminar to be co-taught with a senior member of the faculty.

Eligibility: We are seeking applicants with a Ph.D. in mathematics and a specialization in geometric group theory. Anticipated fields in future years include harmonic analysis, graph theory, and global analysis, specifically spectral theory and microlocal analysis.

Deadline: There is no closing date for applications; however, the department will begin to read applications in early December, and applications received by December 1, 2002, will receive full consideration.

Application information: Please send a letter of application, C.V., a statement of teaching philosophy, and three letters of reference, at least one of which speaks to teaching, to: Search Committee, Department of Mathematics, Trinity College, 300 Summit Street, Hartford, CT 06106. Be sure to include e-mail contact information. Members of the Search Committee will be at the Joint Mathematics Meetings in Baltimore, Maryland, to participate in the Employment Center. Trinity College is an Affirmative Action/Equal Opportunity Employer. Women and members of minority groups are encouraged to apply. Applicants with disabilities should request in writing any needed accommodation in order to participate more fully in the application process.

University of Michigan, Ann Arbor

Assistant Professorships, VIGRE Assistant Professorships, and T. H. Hildebrandt Research Assistant Professorships

Description: These positions for up to three years are designed to provide mathematicians with favorable circumstances for academic career development in research and teaching. Assistant professorships have a teaching responsibility of two courses per semester; the VIGRE and T. H. Hildebrandt positions have a responsibility of one course per semester. These positions may be combined with other postdoctoral fellowships, giving additional reductions in teaching responsibility.

Eligibility: Preference is given to candidates who receive the Ph.D. degree in 2001 or later and who submit a completed application by December 13, 2002.

Grant amount: Salary is competitive, and there are opportunities for supplemental summer salary.

Application information: Application forms and further important information are available at http://www.math.lsa.umich.edu/information/positions.shtml; by e-mail at math.chair@math.lsa.umich.edu; or by mail to: Hiring Committee, Department of Mathematics, University of Michigan, 2074 East Hall, 525 E. University, Ann Arbor, MI 48109-1109.

University of Wisconsin-Madison

Van Vleck Assistant Professorship

Description: The Department of Mathematics invites applications for possible Van Vleck assistant professorships to begin on August 25, 2003. Appointments are for a fixed term of two or three years. The usual teaching load is two courses per semester.
Eligibility: Ordinarily only those applicants who have received their doctorates since 2000 will be considered. Promise of excellence in research and teaching is important. Preference will be given to candidates who are likely to interact well with other members of the department.
Deadline: The application deadline is December 15, 2002, although applications will continue to be considered until all available positions are filled.
Application information: Applicants should send a completed AMS Standard Cover Sheet, a curriculum vitae which includes a publication list, and a brief statement of research plans to: Hiring Committee, Dept. of Mathematics, Van Vleck Hall, University of Wisconsin-Madison, 480 Lincoln Drive, Madison, WI 53706-1388. Applicants should also arrange to have three or four letters of recommendation sent to the above address. At least one of these letters must discuss the applicant's teaching experience and capabilities. Other evidence of good teaching will be helpful. The University of Wisconsin is an Affirmative Action/Equal Opportunity Employer and encourages applications from women and minorities.
Note: The department also expects to have available one or more VIGRE Van Vleck assistant professorships, partially funded by an NSF VIGRE grant, with a reduced teaching load; only U.S. citizens and permanent residents are eligible for these.

Washington University

William Chauvenet Assistant Professorship

Description: The department has three Chauvenet Assistant Professorships. The Chauvenet Instructorship is a two-year, non-tenure-track faculty appointment beginning August 2003. The teaching load consists of three courses per year, two in one semester and one in the other semester. The teaching assignment normally includes introductory courses for undergraduates as well as specialized graduate courses.
Eligibility: To be eligible for a fall 2003 appointment, a candidate must complete all requirements for the Ph.D. by September 2003. Those receiving the Ph.D. prior to 1999 and those currently holding tenure-track faculty positions are ineligible to apply. The applicant's research interests should mesh with those of one or more of our permanent faculty. Current research interests of our faculty include: algebraic geometry, commutative algebra, complex geometry, foliations, functional analysis, harmonic analysis, low-dimensional topology, mathematical biology, operator theory, partial differential equations, probability and statistics, real and complex analysis, representation theory, Riemannian geometry, and wavelets.
Deadline: We will begin reviewing applications on December 1, 2002, and will continue reviewing applications until all positions are filled.
Application information: Applicants should submit a curriculum vitae, thesis abstract, statement of research plans and interests, and should arrange for four letters of recommendation. At least one of these letters should address the candidate's teaching ability. Application materials and inquiries should be sent to the Chauvenet Search Committee, Department of Mathematics, Washington University in Saint Louis, Campus Box 1146, One Brookings Drive, St. Louis, MO 63130-4899. Candidates may address e-mail inquiries to `terri@math.wustl.edu`. Washington University is an Affirmative Action/Equal Opportunity Employer and specifically invites and encourages women and minorities to apply.

Yale University

Josiah Willard Gibbs Instructorships/Assistant Professorships

Description: Offered to men and women with the doctorate who show definite promise in research in pure mathematics. Applications from women and members of minority groups are welcome. Appointments are for two/three years. The teaching load is kept light to allow ample time for research. This will consist of 3 one-semester courses. Part of the teaching duties over the term of the appointment may consist of a one-semester course at the graduate level in the general area of the instructor's research.
Grant amount: The 2003–2004 salary will be at least $51,800.
Deadline: January 1, 2003.
Application information: Applications are available at `http://www.math.yale.edu/`. Inquiries and application supporting documents should be sent to the Gibbs Committee, Department of Mathematics, Yale University via e-mail: `gibbs.committee@math.yale.edu`. Yale University is an Affirmative Action/Equal Opportunity Employer.

Travel and Study Abroad

Alexander von Humboldt Foundation

Research Fellowships

Description: The Humboldt Foundation grants 500 Humboldt Research Fellowships annually to highly qualified scholars under the age of 40 holding doctorates, enabling them to undertake long-term periods of research (6–12 months) in the Federal Republic of Germany. Applications are decided upon by a selection committee which is composed of eminent German scholars from all disciplines. Candidates' academic attainments are the only criterion for selection; there are no limitations in respect to specific countries or subjects.

Eligibility: Application requirements include high academic qualifications, academic publications, a specific research plan, and for humanities scholars a good command of the German language.

Grant amount: Monthly stipends range from 2,100 to 3,000 euros. Family allowances, travel expenses, and language courses are covered by the fellowship.

Deadline: Applications may be submitted at any time; however, the actual selection committees meet in March, July, and November. Applications should be submitted 5 months before the meeting at which the candidate wishes to be considered.

Application information: Interested scholars may contact the Alexander von Humboldt Foundation, Jean-Paul Str. 12, D-53173 Bonn, Federal Republic of Germany; tel: +49-228-833-0; fax: +49-228-833-199; e-mail: post@avh.de; homepage: http://www.humboldt-foundation.de/; or, U.S. Liaison Office, 1012-14th Street, NW, Ste. 301, Washington, DC 20005; tel: 202-783-1907; fax: 202-783-1908; e-mail: avh@bellatlantic.net.

Fulbright Teacher & Administrator Exchange Program

Description: Sponsored by the United States Department of State, this program offers international exchange opportunities for two-year college faculty members and elementary and secondary school teachers and administrators. Currently the program conducts exchanges with over 30 countries in Eastern and Western Europe, Latin America, Africa, and Canada. (The list of countries is subject to change.) Most exchanges are for the full academic year; however, some are for a semester or six weeks. In most cases both the U.S. and international teacher remain on the payroll of their respective home institutions. The Fulbright Teacher & Administrator Exchange Program also offers six- to eight-week summer seminars in Italy and Greece which are open to four-year and two-year college faculty and teachers (grades 9–12) of Latin, Greek, and the Classics.

Eligibility: Eligibility requirements are U.S. citizenship, fluency in English, a bachelor's degree or higher, three years' full-time teaching/administrative experience, a current full-time teaching/administrative position, approval of school administration, and no participation in a Fulbright Program longer than eight weeks in the last two years. In addition to the general eligibility requirements, each applicant must meet the specific subject, level, and language fluency requirements for the countries to which he/she applies; these requirements are detailed in the application booklet.

Deadline: The application deadline is October 15 for the following year's program.

Application information: The application booklet should be requested from the Fulbright Teacher Exchange Program, 600 Maryland Ave., SW, Room 320, Washington, DC 20024-2520; tel: 800-726-0479.

Marshall Scholarships

Description: Marshall Scholarships finance young Americans of high ability to study for a degree in the United Kingdom. The scholarships are tenable at any British university and cover two years of study in any discipline, at either undergraduate or graduate level, leading to the award of a British university degree.

Eligibility: Open only to United States citizens who (by the time they take up their scholarship) hold a first degree from an accredited four-year college or university in the United States with a minimum GPA (after freshman year) of 3.7. To qualify for awards tenable from October 2002, candidates must have graduated from their undergraduate college or university after April 2000 (although this restriction may be waived in the case of those wishing to read business studies or an allied subject). N.B. Persons already studying for or holding a British degree or degree-equivalent qualification are **not** eligible to apply for a Marshall Scholarship.

Deadline: October 9 (postmarked), to commence the following September.

Application information: Apply through British Consulates General in the following regions: Atlanta, 404-954-7708; Boston, 617-245-4500; Chicago, 312-346-1810; Houston, 713-659-6270; Los Angeles, 310-996-3028; New York, 212-745-0252; San Francisco, 415-617-1300; Washington, DC, 202-588-7854.

National Academy of Sciences (NAS)

Collaboration in Basic Science and Engineering (COBASE)

Description: The NAS invites applications from American scientists who wish to visit or to host foreign scientists from Armenia, Azerbaijan, Bosnia (hosting only), Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, former Yugoslav Republic of Macedonia, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. The grants will support in either or both directions for up to 8 weeks in total duration. Applicants for the visits need to demonstrate that a joint proposal for collaborative research will be prepared during their visit for submission to the National Science Foundation for funding.

Eligibility: Applicants must be U.S. citizens or permanent residents and have doctoral degrees or their equivalent. Acceptable topics include physics; chemistry; mathematics and computer sciences; earth, atmospheric, and oceanographic sciences; biological sciences; environmental sciences; engineering; archaeology and anthropology; geography; psychology; science and technology policy; economics; linguistics; or the history and philosophy of science. There is special emphasis on young investigators in each program. In addition, special emphasis is placed on the following topics for 2002: (1) mathematics, (2) extreme events, (3) Black Sea transboundary issues.

Application information: E-mail: ocee@nas.edu; tel: 202-334-2644; Web: http://nationalacademies.org/oia/.

U.S. Department of State Fulbright U.S. Student Program

Fulbright and Related Grants for Graduate Study and Research Abroad

Description: For graduate study or research in any field in which the project can be profitably undertaken abroad. If an applicant is already enrolled in a U.S. university, he must apply directly to the Fulbright Program adviser on his campus. Unenrolled students may apply to the Institute of International Education.
Eligibility: Applicant must be a U.S. citizen, hold a B.A. degree or the equivalent, and have language proficiency sufficient to carry out the proposed study and to communicate with the host country.
Deadline: Application deadline is October 25.
Application information: Further details may be obtained from the U.S. Department of State Fulbright U.S. Student Program, U.S. Student Programs Division, Institute of International Education, 809 United Nations Plaza, New York, NY 10017; tel: 212-984-5330.

Winston Churchill Foundation of the United States

Description: A scholarship program for graduate work in engineering, mathematics, and science at Churchill College, Cambridge University.
Grant amount: Tuition and living allowance worth approximately $27,000, depending upon course of study.
Application information: Application forms are available from representatives on campuses of colleges and universities participating in the program. For further information write to the Winston Churchill Foundation, P. O. Box 1240, Gracie Station, New York, NY 10028; or see foundation homepage, `http://www.thechurchillscholarships.com/`.

Study in the U.S. for Foreign Nationals

Many of the programs in the "Graduate Support" and "Postgraduate Support" sections are also applicable to foreign nationals.

American Association of University Women (AAUW) Educational Foundation

International Fellowships

Description: These are awarded to women of outstanding academic ability who are not citizens or permanent residents of the U.S. for full-time graduate or postgraduate study in the U.S. Six of the 46 awards are available to members of the International Federation of University Women to study in any country other than their own. Upon completion of studies, fellowship recipients are expected to return to their home countries to pursue professional careers. Previous and current recipients of AAUW fellowships are not eligible.
Eligibility: Applicants must hold the equivalent of a U.S. bachelor's degree by December 31.
Grant amount: The fellowships provide $18,000 for master's/first professional degree, $20,000 for predoctoral study, and $30,000 for postdoctoral study.
Deadline: The deadline is December 15 (postmark deadline).
Application information: For more information contact: AAUW Educational Foundation, P.O. Box 4030, Iowa City, IA 52243-4030; tel: 319-337-1716; fax: 319-337-1204.

Kennedy Scholarships

Description: These grants are for postgraduate study at Harvard University or the Massachusetts Institute of Technology.
Eligibility: For citizens of the United Kingdom.
Deadline: Application deadline is October 22, 2002.
Application information: Write to Secretary, Kennedy Memorial Trust, 48 Westminster Palace Gardens, Artillery Row, London SWIP 1RR, England.

Sources of Fellowship Information

Some of the publications listed below are available at school or college and university libraries or in the reference room of a good public library.

Dollars for College: The Quick Guide to Financial Aid for Science and Mathematics

(1997, 75 pages), Garrett Park Press, Garrett Park, MD 20896. $7.95 + $1.50 postage.

Financial Aid for Minorities in Engineering and Science

Financial assistance, scholarship and fellowship programs, resources for further information (1999); Garrett Park Press, P. O. Box 190, Garrett Park, MD 20896. $5.95 + $1.50 shipping.

Graduate School and You: A Guide for Prospective Graduate Students

Council of Graduate Schools, Revised Edition, 1999. Available from the Council of Graduate Schools, 1 Dupont Circle, NW, Suite 430, Washington, DC 20036-1173; or call 202-223-3791. This publication is $10 plus S&H. It can be obtained by calling CGS for an order form or downloading order form from website `http://www.cgsnet.org/`.

Pathways to Career Success for Minorities

(2000, 378 pages), Garrett Park Press, Garrett Park, MD 20896. $29.95 plus $3 shipping. Tel: 301-946-2863; fax: 301-949-3955.

Backlog of Mathematics Research Journals

Journal (Print and Electronic)	Number issues per Year	Approximate Number Pages per Year	2001 Median Time (in Months) from: Submission to Final Acceptance	Acceptance to Print	Acceptance to Electronic Posting	Editor's Current Estimate of Waiting Time between Submission and Publication (in Months) Print	Electronic
Abstr. Appl. Anal.	24	1400	2	4	3	6	5
Acta Inform.	9	720	18	3.5	3.5	12	12
Aequationes Math.	6	640	11	12	12	16	16
Algorithmica	NR	NR	NR	NR	NR	NR	NR
Amer. J. Math.	6	1200	NA	6.84	5.84	12-14	11-13
Ann. Mat. Pura Appl.	4	512	8	13	12.67	20	19
Ann. Sci. Ecole Norm. Sup.	NR	NR	NR	NR	NR	NR	NR
Ann. Statist.	6	1800	20	4	NA	22	20
Anziam J.	4*	576*	12	20	1	18	9
Appl. Math. Lett.	6	1000	6	5	3	9	6
Appl. Math. Optim.	NR	NR	NR	NR	NR	NR	NR
Arch. Hist. Exact Scis.	6	600	6	4.5	4.5	5	5
Arch. Math. Logic	8	630	NR	10	9.5	4	10
Arch. Rational Mech. Anal.	20	1800	NR	6	6	13	12
Bull. London Math. Soc.	6	768	8	11	12	20	21
Bull. Soc. Math. France	4	600	6.5	12	11	12	11
Calc. Var. Partial Diff. Equations	8	1630	18	12	11.67	18	13
Canad. J. Math.	NR	NR	NR	NR	NR	NR	NR
Canad. Math. Bull.	NR	NR	NR	NR	NR	NR	NR
Comm. Algebra	12	5700	20	NA	NA	16	16
Comm. Math. Phys.	27	6500	6	7	7	13	13
Comm. Pure Appl. Anal.	4	600	5	3	1	5	3
Comput. Math. Appl.	24	3600	6	5	3	11	7
Computing	8	768	8	6.9	6.9	14	12
Constr. Approx.	4	160	6-12	2	2	6-12	6-12
Discrete Comput. Geom.	8	1280	8	9	8	13	12
Discrete Contin. Dyn. Syst.	6	1500	8	6	2	8	4
Discrete Contin. Dyn. Syst. Ser. B	4	600	5	3	1	5	3
Duke Math. J.	NR	NR	NR	NR	NR	NR	NR
Graphs Combin.	4	500	12	12	12	10	18
Houston J. Math.	4	900	10	16	13	23	20
Illinois J. Math.	4	1400	5	15	9	12	14
IMA J. Appl. Math.	6	624	NR	5	4.5	NR	NR
IMA J. Math. Appl. Med. Biol.	NR	NR	NR	NR	NR	NR	NR
IMA J. Math. Control Inform.	4	560	6	14	9	12	7-8
IMA J. Numer. Anal.	4	660	11	8	8	12	12
Indiana Univ. Math. J.	4**	1936	4	13	NA	NR	NR
Internat. J. Math. Math. Sci.	48	3000	4	4	3	7	6
Internat. Math. Res. Not.	52	3000	2	2	2	4	4
Invent. Math.	12	2740	10	6	5.67	15	11
J. Algebraic Geometry	4	800	6	12	NA	18	9
J. Algorithms	8	1580	17	3	1	NA	NA
J. Amer. Math. Soc	4	1000	11.9	5.4	2.2	18	15.5
J. Appl. Math.	8	400	4	4	3	7	6
J. Assoc. Comput. Mach.	6	1200	11	5	#	17	12
J. Classification	2	320-384	18	5	NR	12	NR
J. Complexity	4	900	8	14	12	16	13
J. Comput. System Sci.	8	2000	14	3	NR	16	NR
J. Cryptology	4	288	18	9	9	12	12

Journal (Print and Electronic)	Number issues per Year	Approximate Number Pages per Year	2001 Median Time (in Months) from: Submission to Final Acceptance	Acceptance to Print	Acceptance to Electronic Posting	Editor's Current Estimate of Waiting Time between Submission and Publication (in Months) Print	Electronic
J. Differential Geom.	9	2000	6	13	13	10	NR
J. Engrg. Math.	12	1200	6	3	2	8	7
J. Eur. Math. Soc.	4	456	13.02	6	5.67	12	8
J. London Math. Soc.	6	1536	7	11	12	16	17
J. Math. Biol.	12	1150	13	7.4	7.4	8	9
J. Math. Phys	NR	NR	NR	NR	NR	NR	NR
J. Theoret. Probab.	4	1000	8-10	8	NA	18	NR
Linear Algebra Appl.	18	6000	10	6-7	6	12	12
Manuscripta Math.	12	1630	8	3.5	3.3	11.5	10.5
Math. Ann.	12	2500	9.4	7.4	7.1	21	18.5
Math. Biosci.	NR	NR	NR	NR	NR	NR	NR
Math. Comp.	4	1750	10.8	18.6	6.8	29.2	22
Math. Comput. Modelling	24	3600	6	5	3	9	5
Math. Oper. Res.	4	831	18	5	3	18	21
Math. Programming Ser. A	9	1944	19.1	5.2	4.9	21.5	19.5
Math. Social Sci.	6	700	9-12	9-12	9-12	12	12
Math. Z.	12	2650	16	8	7.67	15	10
Michigan Math. J.	3	672	5	8	8	12	11
Monatsh. Math.	12	1056	6	6	6	10	10
Numer. Math.	12	2400	14.03	12.78	12.45	NR	NR
Oper. Res.	6	1170	22	12	12	18	18
Pacific J. Math.	10	2560	20-24	14-18	12-14	18-22	15-18
Probab. Theor. Relat. Fields	12	1850	12	10	9.67	16	11
Proc. Amer. Math. Soc.	12	3520	5.5	16.2	11.6	21.3	16.7
Proc. London Math. Soc.	6	1536	7	11	12	16	17
Quart. J. Math. Oxford Ser. A (2)	4	520	6	9	9	13	13
Quart. J. Mech. Appl. Math.	4	650	8	6	6	14	14
Reliab. Comput.	6	510	7	13	11	12	10
Rocky Mountain J. Math.	4	1600	7	16	14	15-18	15
Semigroup Forum	6	924	15	10	3	15	9
SIAM J. Appl. Math.	6##	2200	10.2	12	5.3	22	14
SIAM J. Comput.	6##	1980	19.3	13	5.5	36	23
SIAM J. Control Optim.	6##	1980	15	12.6	5.5	24	17
SIAM J. Discrete Math.	4##	680	14.5	3.8	2.8	16	15
SIAM J. Math. Anal.	6##	1500	10	12.6	4.8	22	14
SIAM J. Matrix Anal. Appl.	4##	1200	12	11.8	4.8	23	16
SIAM J. Numer. Anal.	6##	2200	10.6	15.4	4.6	24	14
SIAM J. Optim.	4##	1150	15	11.6	5.6	24	17
SIAM J. Sci. Comput.	6##	2180	10.6	12.4	4.6	22	14
SIAM Rev.	4	800	4.1	6.3	5.3	10	9
Smarandache Notions J.	1	300	1	6	1	6	1
Theory Comput. Syst.	6	642	20.6	8.3	4	15	3
Topology	6	1354	8	22	20	20	18
Topology Appl.	27	2970	20	18	20	11	11
Trans. Amer. Math Soc.	12	5000	11.8	10.6	7.4	16.8	13.8

Journal (Print)	Number issues per Year	Approximate Number Pages per Year	2001 Median Time (in Months) from: Submission to Final Acceptance	Acceptance to Final Publication	Editor's Current Estimate of Waiting Time between Submission and Publication (in Months)
Acta Math.	4	600	6	13	23
Algebras Groups Geom.	4	500	2	4	4
Ann. of Math.	6	1500	13	12	12
Ann. Appl. Probab.	4	1400	12	12	18
Ann. Probab.	NR	NR	NR	NR	NR
Bull. Austral. Math. Soc.	6	1000	10	5	10
Circuits Systems Signal Proc.	6	720	10	5	14

Journal (Print)	Number issues per Year	Approximate Number Pages per Year	2001 Median Time (in Months) from: Submission to Final Acceptance	2001 Median Time (in Months) from: Acceptance to Final Publication	Editor's Current Estimate of Waiting Time between Submission and Publication (in Months)
Combinatorica	4	600	10	14	14
Comm. Partial Diff. Equations	6	2400	15	10	15
Indag. Math.	4	500	7	4	10
Inst. Hautes Études Sci. Publ. Math.	NR	NR	NR	NR	NR
Israel J. Math.	6	2280	6	9	15
J. Amer. Statist. Assoc.	NR	NR	NR	NR	NR
J. Appl. Math. Stochastic Anal.	4	430	15	8	12
J. Austral. Math. Soc.	6	860	16	9	23
J. Geom. Anal.	4	720	3-9	12-24	12
J. Integral Equations Appl.	4	500	6	6	NR
J. Operator Theory	5	1100	13.4	21.3	31.2
J. Symbolic Logic	4	2000	12	17	15
Math. Control Signals Sys.	4	393	15	10	24
Mem. Amer. Math. Soc.	6	3200	20.4	12.7	35.8
Methods Appl. Anal.	4	200	3-6	2-6	7-8
Nonlinear Anal.	32	4800	9	18	30
Numer. Funct. Anal. Optim.	NR	NR	NR	NR	NR
Quart. Appl. Math.	4	800	13.7	9.9	22.6
Results Math.	NR	NR	NR	NR	NR

Journal (Electronic)	Number of Articles Posted in 2001	2001 Median Time (in days) from: Submission to Final Acceptance	2001 Median Time (in days) from: Acceptance to Posting	Format(s)
ACM J. Exp. Algorithmics (www.jea.acm.org)	NR	NR	NR	NR
Acta Math. Acad. Paedagog. Nyházi. (www.emis.de/journals/AMAPN)	28	117	42	pdf, ps
Algebr. Geom. Topol. (www.maths.warwick.ac.uk/agt/)	NR	NR	NR	NR
Algebra Montpellier Announcements (www.emis.ams.org/journals/AMA/index.html)	3	20	30	pdf, ps, dvi
Appl. Sci. (www.mathem.pub.ro/apps)	5	15	15	pdf, ps
Chicago J. Theoret. Comp. Sci. (www.cs.uchicago.edu/publications/cjtcs/)	NR	NR	NR	NR
Complex Internat. (www.csu.edu.au/ci)	NR	NR	NR	NR
Conform. Geom. Dyn. (www.ams.org/ecgd)	8	244	49	pdf, ps, dvi, tex
Diff. Eq. Contr. Process (www.neva.ru/journal)	NR	NR	NR	NR
Differ. Geom. Dyn. Syst. (www.mathem.pub.ro/dgds)	5	15	15	pdf, ps
Discrete Math. Theor. Comput. Sci. (dmtcs.loria.fr)	NR	NR	NR	NR
Doc. Math. (www.mathematik.uni-bielefeld.de/documenta/)	22	130	5	html, pdf, ps, dvi
Electron. Comm. Probab. (www.math.washington.edu/~ejpecp)	12	73	7	pdf, ps, dvi
Electron. J. Combin. (www.combinatorics.org)	73	136	10	pdf, ps
Electron. J. Differential Equations (ejde.math.unt.edu) (ejde.math.swt.edu) (www.emis.de/journals/EJDE)	78	93	5	pdf, ps, dvi, tex
Electron. J. Linear Algebra (www.math.technion.ac.il/iic/ela/)	12	198	16	pdf, ps, tex, other

Journal (Electronic)	Number of Articles Posted in 2001	2001 Median Time (in days) from: Submission to Final Acceptance	Acceptance to Posting	Format(s)
Electron. J. Probab. (www.math.washington.edu/~ejpecp)	NR	NR	NR	NR
Electron. J. Qual. Theory Differ. Equ. (www.math.u-szeged.hu/ejqtde/)	9	90	5	pdf, ps, dvi
Electron. Res. Announc. Amer. Math. Soc. (www.ams.org/era)	12	159	9	pdf, ps, dvi, tex
Electron. Trans. Numer. Anal. (etna.mcs.kent.edu)	10	342.5	38	pdf, ps
ESAIM Control Optim. Calc. Var. (www.emath.fr/cocv/)	28	330	90	pdf, ps, dvi
ESAIM Probab. Statist. (www.emath.fr/Maths/Ps/ps.html)	NR	NR	NR	NR
Geom. Topol. (www.maths.warwick.ac.uk/gt/)	28	146	3	pdf, ps
Homology Homotopy Appl. (www.rmi.acnet.ge/hha/)	NR	NR	NR	NR
Integers. Electron. J. Combin. Numb. Th. (www.integers-ejcnt.org)	6	208	7	pdf, dvi, tex, other
J. Artificial Intelligence Res. (www.jair.org/)	25	71	2-14	html, pdf, ps
J. Funct. Logic Programming (www.danae.uni-muenster.de/lehre/kuchen/JFLP/)	11	97	10	pdf, ps
J. Graph Algorithms Appl. (www.cs.brown.edu/publications/jgaa/)	NR	NR	NR	NR
J. High Energy Phys. (jhep.sissa.it)	NR	NR	NR	NR
J. Inequal. Pure Appl. Math. (jipam.vu.edu.au)	38	100†	50†	pdf
J. Integer Seq. (www.math.uwaterloo.ca/JIS)	15	145	1	html, pdf, ps, dvi, tex
JoT J. Turbul. (jot.iop.org)	18	40	20	html, pdf, tex
LMS J. Comput. Math. (www.lms.ac.uk/jcm/)	10	198	28	html, pdf, other
Lobachevskii J. Math. (ljm.ksu.ru)	12	120	30	ps, dvi
Math. Phys. Electron. J. (www.maia.ub.es/mpej)	4	224	2	ps
New York J. Math. (nyjm.albany.edu:8000/nyjm.html)	19	235	15	pdf, ps, dvi
Represent. Theory (www.ams.org/ert)	22	217	31	pdf, ps, dvi, tex
Sem. Lothar. Combin. (www.mat.univie.ac.at/~slc)	17	82.1	11.5	pdf, ps, dvi, tex
Sorites (www.ifs.csic.es/sorites/) (www.filosoficas.unam.mx/~sorites)	NR	NR	NR	NR
Southwest J. Pure Appl. Math. (rattler.cameron.edu/swjpam/swjpam.html)	20	319	195	tex
Stud. Nonlinear Dyn. Econom. (mitpress.mit.edu/e-journals/SNDE/)	15	275	83	html, pdf, ps
Theory Appl. Categ. (www.tac.mta.ca/tac/)	30	253	11	pdf, ps, dvi

NR means no response received. NA means not available or not applicable. * Print issues, 1 electronic; print pages, 176 electronic. ** Increasing to 6 issues in 2002. # Typically a few days. ## Print; electronic varies. † Working days.

American Mathematical Society

2002 Election of Officers

CONTENTS

2002 AMS Elections Special Section

Dear Colleagues:

Once again members of the Society are invited to vote for candidates who are standing for election to several of the Society's governing bodies. These candidates are presented in the material that follows. This information and the official ballot will be sent to you in early September. The choices you will make in these elections directly affect the direction that the Society takes. This may not be obvious to the casual member, so let me take a few lines to explain.

The vice president and the members at large of the Council you select will serve for three years on the AMS Council. That body determines all scientific policy of the Society, oversees committees and creates/discharges them, determines membership on the Society's editorial boards, appoints the treasurers and the members of the Secretariat, and makes nominations of candidates for future elections. Typically each of these new members of the Council will serve on at least one of the Society's policy committees.

The trustees, of whom you will be selecting one for a five-year term, have complete fiduciary responsibility for the Society. The person you select will serve as chair of the Board of Trustees during the fourth year of the term and as secretary of the board during the second year. Among other activities the trustees determine the annual budget of the Society, prices of journals, salaries of employees, dues (in cooperation with the Council), meeting registration fees, and investment policy for the Society's reserves.

The candidates presented to you were suggested to the Council by the Nominating Committee or by petition from members. While the Council has the final nominating responsibility, the groundwork is done by the Nominating Committee. New members of this committee will be elected by you in this coming election. The candidates were nominated by the current president, Hyman Bass. The three elected will serve three-year terms. The main work of the Nominating Committee takes place during the annual meeting of the Society, during which it has four sessions of face-to-face meetings, each lasting several hours. The Committee then reports its suggestions to the Council, which makes the final nominations.

The Editorial Boards Committee is responsible for the operation of the editorial boards of the Society. Members are elected for three-year terms from a list of candidates named by the president. The Editorial Boards Committee makes recommendations for almost all editorial boards of the Society. Chief, or managing, editors of those journals named in the bylaws are appointed by the Council, upon recommendation of the Editorial Boards Committee; in virtually all other cases, editors are appointed by the president, upon recommendation by the Editorial Boards Committee.

If past elections are a reliable measure, about 12 percent of you will vote in this election, which is in line with voting participation in other professional organizations. This is not mentioned as an encouragement for you to throw the ballot in the trash; instead, the other officers and members of the Council join me in urging you to take a few minutes to review the election material, fill out your ballot, and mail it. The Society belongs to its members. You can influence the policy and direction it takes by voting.

Let me urge anyone still reading to consider other ways of participating in Society activities. The Nominating Committee, the Editorial Boards Committee, and the Committee on Committees are always interested in learning of members who are willing to serve the Society in various capacities. Names are always welcome, particularly when accompanied by a few words detailing the person's background and interests. Self-nominations are probably the most useful. Recommendations can be transmitted from the web (`http://www.ams.org/committee-nominate`, also linked from the AMS home page via the secretary's page) or sent directly to the secretary (`secretary@ams.org`), who will forward them to the cognizant body.

PLEASE VOTE.

—Robert J. Daverman
Secretary

Election Information

The ballot for election of officers, members of the Council, a trustee, and committee members will be mailed on or shortly after September 9, 2002, in order for members to receive their ballots well in advance of the November 9, 2002, deadline. A list of members of the Council and Board of Trustees serving terms during 2002 will appear in the "AMS Officers and Committee Members" section of the October issue of the *Notices* (and will be mailed with the election material sent to all members in September).

List of Candidates–2002 Election

Vice President
(one to be elected)
M. Salah Baouendi
Barbara L. Osofsky
Karen Vogtmann

Board of Trustees
(one to be elected)
Carl Pomerance
Jean E. Taylor

Member at Large of the Council
(five to be elected)
Karen M. Brucks
Carlos Castillo-Chávez
Susan M. Hermiller
Henry B. Laufer
Brian H. Marcus
John E. McCarthy
David W. McLaughlin
Yair N. Minsky
Paul J. Sally Jr.
Paul Zorn

Nominating Committee for 2003
(three to be elected)
Francis Bonahon
David M. Bressoud
Constantine M. Dafermos
Nathaniel Dean
Richard M. Hain
Krystyna M. Kuperberg

Editorial Boards Committee for 2003
(two to be elected)
Richard A. Brualdi
Cristian E. Gutiérrez
Svetlana R. Katok
Leonard L. Scott Jr.

Replacement Ballots

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

To help alleviate this problem, the following replacement procedure has been devised: A member who has not received a ballot by October 9, 2002, or who has received a ballot but has accidentally spoiled it may write after that date to the Secretary of the AMS, 201 Charles St., Providence, RI 02904, asking for a second ballot. The request should include the individual's member code and the address to which the replacement ballot should be sent. Immediately upon receipt of the request in the Providence office, a second ballot, which will be indistinguishable from the original, will be sent by first class or airmail. It must be returned in an envelope which will be supplied, on the outside of which is the following statement to be signed by the member:

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

_____

signature

Although a second ballot will be supplied on request and will be sent by first class or airmail, the deadline for receipt of ballots will not be extended to accommodate these special cases.

Suggestions for 2003 Nominations

Each year the members of the Society are given the opportunity to propose for nomination the names of those individuals they deem both qualified and responsive to their views and needs as part of the mathematical community. Candidates will be nominated by the Council to fill positions on the Council and Board of Trustees to replace those whose terms expire January 31, 2003. See the "AMS Officers and Committee Members" section of the October issue for the list of current members of the Council and Board of Trustees. Members are requested to write their suggestions for such candidates in the appropriate spaces below.

COUNCIL AND BOARD OF TRUSTEES

Vice President *(1)*

_____

Members at Large of the Council *(5)*

_____

_____

_____

_____

_____

Member of the Board of Trustees *(1)*

_____

The completed form should be addressed to AMS Nominating Committee, 201 Charles St., Providence, RI 02904, to arrive no later than **November 9, 2002.**

Biographies of Candidates 2002

Biographical information about the candidates has been verified by the candidates, although in a few instances prior travel arrangements of the candidate at the time of assembly of the information made communication difficult or impossible. A candidate had the opportunity to make a statement of not more than 200 words on any subject matter without restriction and to list up to five of her or his research papers.

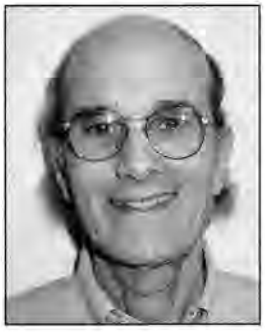
Abbreviations: American Association for the Advancement of Science (AAAS); American Mathematical Society (AMS); American Statistical Association (ASA); Association for Computing Machinery (ACM); Association for Symbolic Logic (ASL); Association for Women in Mathematics (AWM); Canadian Mathematical Society, Société Mathématique du Canada (CMS); Conference Board of the Mathematical Sciences (CBMS); Institute of Mathematical Statistics (IMS); International Mathematical Union (IMU); London Mathematical Society (LMS); Mathematical Association of America (MAA); National Academy of Sciences (NAS); National Academy of Sciences/National Research Council (NAS/NRC); National Aeronautics and Space Administration (NASA); National Council of Teachers of Mathematics (NCTM); National Science Foundation (NSF); Operations Research Society of America (ORSA); Society for Industrial and Applied Mathematics (SIAM); The Institute of Management Sciences (TIMS).

Each candidate had the opportunity to supply a photograph to accompany her or his biographical information.

A candidate with an asterisk (*) beside her or his name was nominated in response to a petition.

Vice President

M. Salah Baouendi



Professor of Mathematics, University of California, San Diego.

Born: October 12, 1937, Tunis, Tunisia.

Ph.D.: University of Paris, 1967.

AMS Offices: Member at Large of the Council, 1989–1995.

AMS Committees: Committee to Select Hour Speakers for Central Sectional Meetings, 1981–1982 (chair, 1982); Nominating Committee, 1986–1988; *Contemporary Mathematics* Editorial Board, 1986–1988; Agenda and Budget Committee, 1986–1993; AMS Representative, *American Journal of Mathematics*, 1988–1993 (chair, 1989–1993); Committee on Committees, 1989–1994; Strategic Planning Task Force, 1990–1991; Executive Committee of the Council, 1990–1993; Long Range Planning Committee, 1991–1992 (chair, 1992); Membership Committee, 1991–1993; Nominating Committee of the ECBT, 1993; Committee on the Profession, 1993–1999 (chair, 1993–1995); Rochester Task Force, 1994–1995; Steele Prize Committee, 2001–; Books and Journal Donations Steering Committee, 2001–.

Selected Addresses: Séminaire Bourbaki, 1965; Invited Address, International Congress of Mathematicians, Vancouver, 1974; AMS Invited Address, Austin, November 1981; Invited Speaker, Special Year in Several Complex Variables, MSRI, 1995; Invited Speaker, École Polytechnique, 1991, 1994, 2002.

Additional Information: Head, Department of Mathematics, Purdue University, 1980–1987; ***Coeditor***: *Communications in Partial Differential Equations*, 1975–1985; *American Journal of Mathematics*, 1988–1993; *Mathematical Research Letters*, 1994–. Board of Governors, Institute for Mathematics and its Applications, University of Minnesota, 1988–1991 (chair, 1991); Scientific Advisory Committee, Centre de Mathematiques, École Polytechnique, France, 1989–1993 (chair); U.S. Delegate, IMU General Assembly, Dresden, 1998, and Shanghai, 2002.

Selected Publications: 1. with C. Goulaouic, Cauchy problems with characteristic initial hypersurface, *Comm. Pure Appl. Math.* **26** (1973), 455–475. MR **49:**3296; 2. with H. Jacobowitz and F. Trèves, On the analyticity of CR mappings, *Ann. of Math. (2)* **122** (1985), 365–400. MR **87f:**32044; 3. with P. Ebenfelt and L. Rothschild, Algebraicity of holomorphic mappings between real algebraic sets in C^n, *Acta Math.* **177** (1996), 225–273. MR **99b:**32030; 4. with P. Ebenfelt and L. Rothschild, *Real Submanifolds in Complex Space and Their Mappings*, Princeton Mathe-

matical Series, vol. 47, Princeton University Press, Princeton, NJ, 1999; 5. with P. Ebenfelt and L. Rothschild, Convergence and finite determination of formal CR mappings, *J. Amer. Math. Soc.* **13** (2000), 697–723. MR **2001h:**32063.

Statement: The American Mathematical Society should continue to play a fundamental role in maintaining the health of the mathematical enterprise in the U.S. and throughout the world. This role has many different important aspects.

First, the Society must continue to promote excellence in research by staying in the forefront of publication of affordable, high-quality journals and books at all levels, sponsoring and encouraging scientific meetings and conferences, and facilitating the rapid communication and dissemination of new mathematical research around the globe.

Second, the Society must help the profession continue to attract the most talented young people from a wide variety of backgrounds by increasing and promoting their career opportunities at all levels.

Third, in collaboration with other scientific societies, the AMS should continue to play an active role in public awareness, both with government agencies as well as with the public at large.

Finally, the Society must work to ensure that the profession maintains the highest level of integrity and accountability.

Barbara L. Osofsky*

Professor of Mathematics, Rutgers University, New Brunswick.

Born: August 4, 1937, Beacon, New York.

Ph.D.: Rutgers University, 1964.

AMS Committees: Committee on Publication of Regional Conference Lectures, 1974; *Proceedings* Editorial Committee (ex officio member of AMS Council), 1974–1977 (managing editor, 1976–1977); *Notices*: Advisory Committee on Editorial Policy, 1976; Editorial Board, 1977; Editorial Committee, 1978–1980; Committee on Principles and Procedures, 1976–1977; Committee on Publication Problems, 1977; Committee on the Agenda, 1977–1978; Nominating Committee, 1978–1979; Program Committee for National Meetings, 1978–1980; Short Course Subcommittee, 1978–1991; AMS-MAA-SIAM Joint Projects Committee for Mathematics, 1982; Committee on Academic Freedom, Tenure, and Employment Security, 1988–1991 (chair, 1989–1991). ***AMS-MAA Joint Program Committees***: San Francisco Meeting, January 1995; Orlando Meeting, January 1996; Seattle MathFest, August 1996 (chair); Nominating Committee, 1997–1999.

Selected Addresses: AMS Invited Address, Dallas, January 1973; MAA Invited Address, Atlanta, January 1978; MAA Invited Address, Albany, August 1983; AMS Special Session on Ring Theory, Columbus, August 1990; AMS Special Session on Rings and Representations, Philadelphia, October 1991.

Additional Information: NSF Postdoctoral Fellowship, 1967–1968; ***CBMS***: Member at Large, 1973–1975; Board of Trustees, 1980–1982 (chair, 1981–1982); ***MAA***: New Jersey Sectional Governor, 1994–1996; First Vice President, 2000–2002; Member: AMS, AWM, MAA.

Selected Publications: 1. *Homological Dimensions of Modules*, CBMS Regional Conf. Ser. in Math., no. 12, Amer. Math. Soc., Providence, RI, 1973. MR **56:**5525; 2. Projective dimension of "nice" directed unions, *J. Pure Appl. Algebra* **13** (1978), 179–219. MR **81d:**16019; 3. with P. Smith, Cyclic modules whose quotients have all complement submodules direct summands, *J. Algebra* **139** (1991), 342–354. MR **92f:**16030; 4. Constructing nonstandard uniserial modules over valuation domains, *Azumaya Algebras, Actions, and Modules*, Contemp. Math., vol. 124, Amer. Math. Soc., Providence, RI, 1992, pp. 151–164. MR **93d:**13006 (see also MR **92c:**13022); 5. Projective dimension is a lattice invariant, *J. Pure Appl. Algebra* **161** (2001), 205–217. MR **2002f:**13030.

Statement: Servicing its members' needs is a prime function of any professional organization. I would like to see the AMS make a priority-one effort to serve all of its members. Consider access to MathSciNet. Currently, that invaluable service is completely divorced from membership in the AMS. If any mathematician, AMS member or not, is employed by or has Internet access through an institution or consortium that subscribes to MathSciNet, he or she has complete access. Presently there are no individual subscriptions. For all practical purposes MathSciNet is unavailable to an AMS member who is self-employed, unemployed, or is affiliated with an institution that never has subscribed and in all likelihood never will subscribe. Surely the AMS can set up a method whereby such members can get access to MathSciNet at a reasonable cost. Are there really a large number of institutional subscribers who would drop their subscriptions to MathSciNet, expecting their employees, students, and visitors to pay for this service? Would it be so bad if some currently unaffiliated mathematicians who do not get MathSciNet at work joined us as members so they could access MathSciNet?

Karen Vogtmann

Professor of Mathematics, Cornell University.

Born: July 13, 1949, Pittsburg, California.

Ph.D.: University of California, Berkeley, 1977.

AMS Offices: Member at Large of the Council, 1997–2002.

AMS Committees: Centennial Fellowships Committee, 1989–1990 (chair, 1990); Committee on Meetings and Conferences, 1997– (chair, 2000–); *Bulletin* (New Series) Editorial Committee, 1997–2000 (associate editor, Research–

Expository Surveys); Executive Committee, 1999–; Interim Committee on the Young Scholars Program, 2000–2002; Nominating Committee of the ECBT, 2000, 2002; Long Range Planning Committee, 2000–2001 (chair, 2001); Agenda and Budget Committee, 2002.
Selected Addresses: AMS Invited Address, Salt Lake City, August 1987; Recent Developments in Topology, Princeton, 1995; Geometric Group Theory, Crete, Greece, 1996; Geometric and Topological Aspects of Group Theory, MSRI, 2000; Plenary Address, Geometric and Combinatorial Group Theory, Haifa, Israel, 2000.
Additional Information: Member, Institute for Advanced Study, 1980–1981; NSF Visiting Professorship for Women, 1984–1985; NSF Career Advancement Award, MSRI, 1989; Member, Institut des Hautes Études Scientifiques, 1993; Research Professor, MSRI, 1994; Professeur Invité, CMI, Université de Provence, Marseille, 2000. Member: AMS, AWM, EMS.
Selected Publications: 1. Spherical posets and homology stability for $O_{n,n}$, *Topology* **20** (1981), 119–132. MR **82d:**18016; 2. with M. Culler, Moduli of graphs and automorphisms of free groups, *Invent. Math.* **84** (1986), 91–119. MR **87f:**20048; 3. with A. Hatcher, Cerf theory for graphs, *J. London Math. Soc. (2)* **58** (1998), 633–655. MR **2000e:**20041; 4. with M. Bridson, The symmetries of outer space, *Duke Math. J.* **106** (2001), 391–409. MR **2001k:**20084; 5. with L. Billera and S. Holmes, Geometry of the space of phylogenetic trees, *Adv. in Appl. Math.* **27** (2001), 733–767.
Statement: The primary mission of the American Mathematical Society is to support research mathematics and the community of research mathematicians. It does this through its publications programs, meetings and conferences, employment services, and awarding of prizes and fellowships.

In recent years the AMS has taken new initiative in areas including Washington politics, public awareness of mathematics, and K–12 education. The efforts in Washington have had a significant impact on recent increases in federal funding for mathematics. The materials and ideas produced by the new Public Awareness Office, advertising the importance and pervasiveness of mathematics in modern life, are impressive and are being used in schools and the media.

The research community has a direct interest in improving K–12 education and should continue to investigate ways to support and to positively affect mathematics education in schools. The new AMS Young Scholars Program gives needed support to summer programs for talented high school students; historically, these have influenced the mathematics research community both by attracting talented students to research and by fostering respect for mathematical research in young people who ultimately choose other careers.

I strongly support all of these new initiatives, but I will also work to ensure that the AMS is not distracted from its basic functions and continues its efforts to ensure that mathematicians from underrepresented groups have equal access to mathematical ideas and equal opportunities for professional advancement.

Trustee

Carl Pomerance

Member of Technical Staff, Bell Labs, Lucent Technologies.
Born: November 24, 1944, Joplin, Missouri.
Ph.D.: Harvard University, 1972.
AMS Offices: Member at Large of the Council, 1990–1992.
AMS Committees: Southeastern Section Program Committee, 1983–1984 (chair, 1984) and 1991–1992 (chair, 1992); AMS-MAA Joint Program Committee for the Atlanta Meeting, 1987; Nominating Committee, 1987–1988; *Mathematics of Computation* Editorial Committee, 1987–1997 (associate editor); *Transactions* and *Memoirs* Editorial Committee, 1988–1991; Committee on Committees, 1993–1995; Advisory Board, *What's Happening in the Mathematical Sciences*, 1993–1997; Student Mathematical Library Editorial Committee, 1998–; AMS-MAA Joint Program Committee for the San Antonio Meeting, 1998; Committee on Science Policy, 2000–2002; Committee to Select the Cole Prize in Number Theory, 2001.
Selected Addresses: MAA Pólya Lecturer, 1993–1995; International Congress of Mathematicians, Zurich, 1994; Lehigh Pitcher Lectures, 1996; MAA Hedrick Lectures, 1999; AMS Erdős Lecture, 2001.
Additional Information: MAA Chauvenet Prize, 1985; MAA Haimo Teaching Award, 1997; AMS Conant Prize, 2001.
Selected Publications: 1. Analysis and comparison of some integer factoring algorithms, *Computational Methods in Number Theory, Part I* (H. Lenstra and R. Tijdeman, eds.), Math. Centre Tracts, vol. 154, Math Centrum, Amsterdam, 1982, pp. 89–139. MR **84i:**10005; 2. with L. Adleman and R. Rumely, On distinguishing prime numbers from composite numbers, *Ann. of Math. (2)* **117** (1983), 173–206. MR **84e:**10008; 3. with J. Buhler and H. Lenstra, Factoring integers with the number field sieve, *The Development of the Number Field Sieve* (A. Lenstra and H. Lenstra, eds.), Lecture Notes in Math., vol. 1554, Springer-Verlag, Berlin, 1993, pp. 50–94; 4. with W. Alford and A. Granville, There are infinitely many Carmichael numbers, *Ann of Math. (2)* **139** (1994), 703–722. MR **95k:**11114; 5. with R. Crandall, *Prime Numbers: A Computational Perspective*, Springer-Verlag, New York, 2001. MR **2002a:**11007.
Statement: I enthusiastically support the efforts of the Society to encourage talented and diverse people to join our profession, to facilitate widespread access to vital research tools, to publish high-quality journals and books, to communicate effectively to nonmathematicians, and to run worthwhile and exciting meetings. To the fullest extent possible, I will let these thoughts guide me as a trustee.

Jean E. Taylor
Professor, Mathematics Department, Rutgers University.
Born: September 17, 1944, San Mateo, California.
Ph.D.: Princeton University, 1973.

AMS Offices: Member at Large of the Council, 1984–1988; Vice President, 1994–1996.
AMS Committees: Nominating Committee, 1977–1978; Committee on Committees, 1985–1986; Long Range Planning Committee, 1986–1987 (chair, 1987); Executive Committee of the Council, 1986–1988; Committee on Applied Mathematics, 1986–1989 (chair, 1987–1989); Committee on the Proposed Structure of the JPBM, 1987–1988 (chair); Agenda and Budget Committee, 1987–1988; Committee on NCTM Standards, 1989; Program Committee for National Meetings, 1989–1991 (chair, 1990–1991); AMS-MAA Joint Program Committee for the Orono Meeting, 1991; Steele Prize Committee, 1991–1995; Arnold Ross Lecture Series Committee, 1992–1996; Science Policy Committee, 1994–1995; AMS-SMM (Sociedad Matematica Mexicana) Joint Program Committee, 1995; Policy Review Committee for the Profession, 1996; Committee to Select the Winner of the Satter Prize, 2001–.
Selected Addresses: 16 Special Sessions, 1977–2002; AMS Invited Address, Wellesley, October 1977; AMS-MAA Invited Address, Boulder, August 1989; MAA Hedrick Lectures, Toronto, 1998; Plenary Lecturer, Mathematical Challenges Meeting, UCLA, 2000; AWM Emmy Noether Lecturer, Baltimore, 2003.
Additional Information: Alfred P. Sloan Foundation Fellow, 1976 and 1978; Joint Policy Board for Mathematics, 1994–1995; AAAS Board of Directors, 1995–1999; AAAS Program Committee, 1999–2002; ***AWM***: Executive Committee (1998–2002), President (1999–2001); Board of Directors, International Mathematical Olympiad 2001 USA, 1998–2001; CBMS, 1999– (executive committee, 2001–2002); Board of Directors, Black Rock Forest Consortium, 2000–; D. Sc., Honoris Causa, Mount Holyoke College, 2001; Scientific Board, American Institute for Mathematics Research Conference Center, 2002–; Governing Board and Nominating Committee, Association of Princeton Graduate Alumni; Fellow: American Academy of Arts and Sciences, Association for Women in Science, American Association for the Advancement of Science; Member: AAAS, AWM, MAA, SIAM; former member of Materials Research Society, TMS.

Selected Publications: 1. The structure of singularities in soap-bubble-like and soap-film-like minimal surfaces, *Ann. of Math. (2)* **103** (1976), 489–539. MR **55:**1208a; 2. with E. Bombieri, Which distributions of matter diffract? An initial investigation. International workshop on aperiodic crystals (Les Houches, 1986), *J. Physique* **47** (1986), C3-19–C3-28. MR **88a:**52015; 3. with J. Cahn and C. Handwerker, Geometric models of crystal growth, *Acta Metall. Mater.* **40** (1992), 1443–1474; 4. Motion of curves by crystalline curvature, including triple junctions and boundary points, *Differential Geometry: Partial Differential Equations on Manifolds*, Proc. Sympos. Pure Math., vol. 54, Part 1, Amer. Math. Soc., Providence, RI, 1993, pp. 417–438. MR **94c:**53012; 5. with F. Almgren, Flat flow is motion by crystalline curvature for curves with crystalline energies, *J. Differential Geom.* **42** (1995), 1–22. MR **96h:**58034.
Statement: When I got my Ph.D., basic mathematics seemed to be more highly regarded among mathematicians; now, applied mathematics is on the ascendancy. All mathematics research is valuable: mathematics needs to interact with the rest of the world and also to move to its own internal music. Mathematicians must also attend to education, both for the next generation of mathematicians and for developing an appreciation for mathematics and its uses among the general population. Individual mathematicians, influenced but not driven by current enthusiasms, choose the problems that interest them the most; these can vary greatly at different points in their careers.

More than any other body, the American Mathematical Society attends to the health of mathematics, and the Board of Trustees of the AMS attends to the health of the AMS. I believe that my extensive experience within the AMS and on boards of other scientific and educational organizations (e.g., AAAS), together with my commitment to working on the leaky pipeline for women in mathematics, positions me well to serve the AMS in this vital capacity.

Member at Large of the Council

Karen M. Brucks

Chair and Associate Professor, Mathematical Sciences Department, University of Wisconsin-Milwaukee.
Born: February 1, 1957, Chicago, Illinois.
Ph.D.: The University of North Texas, 1988.
Selected Addresses: Six AMS Special Sessions, 1992–1999; ***Invited Talks***: Dynamical Systems Symposium, Stefan Banach International Mathematical Center, Warsaw, Poland, June 1995; Real Analysis Symposium, Chattanooga, TN, June 1997; Workshop for Low-Dimensional Dynamics, University of Florida, November 2001.
Additional Information: Course Instructor, NSF-sponsored Summer Mathematics Program for Women, Carleton College, 1997, 1999, 2001; Six 1-hour lectures, 1-D Dynamics Summer School, Gyor, Hungary, July 1997; Fulbright Research Scholar, Eotvos Lorand University, Budapest, Hungary, fall 1997; AAUW American Fellowship Panel, 1997–2000; Advisory Board, UWM Women in Mathematics, Science, and Engineering Program, 2000–.

Selected Publications: 1. MSS sequences, colorings of necklaces, and periodic points of $f(z) = z^2 - 2$, *Adv. in Appl. Math.* **8** (1987), 434–445. MR **90c:**58083; 2. with M. Misiurewicz and C. Tresser, Monotonicity properties of the family of trapezoidal maps, *Comm. Math. Phys.* **137** (1991), 1–12. MR **92e:**58108; 3. with C. Tresser, A Farey tree organization of locking regions for simple circle maps, *Proc. Amer. Math. Soc.* **124** (1996), 637–647. MR **96d:**58037; 4. with Z. Buczolich, Trajectory of the turning point is dense for a co-σ-porous set of tent maps, *Fund. Math.* **165** (2000),

95–123. MR **2002a:**37051; 5. with J. Ringland and C. Tresser, An embedding of the Farey web in the parameter space of simple families of circle maps, *Phys. D.* **161** (2002), 142–162.
Statement: The goals and recommendations of the AMS National Policy Statement include: excellence in mathematical sciences research; connecting mathematics to problems in science, technology, and society; strengthening all levels of mathematics education; and communicating the nature of mathematics and its contributions to society. Moreover, the interdependency of research within the mathematical sciences, applications of mathematics to other disciplines, and the teaching of mathematics is affirmed in the policy statement.

Achieving these goals is a challenge members from academia, government, private industry/business, and the community collaboratively enjoy. As a member of the Council, I would bring my experiences at an urban research university to this challenge.

Carlos Castillo-Chávez

Professor of Biomathematics, Cornell University.
Born: March 29, 1952, Mexico City, Mexico.
Ph.D.: University of Wisconsin-Madison, 1984.
AMS Committees: AAAS Liaison Committee, 2002–.
Selected Addresses: Hollistier-Stier Distinguished Lecture Series Speaker, Washington State University, 1990; Invited Speaker, "The Role of Public Transportation on the Spread of Tuberculosis", AAAS, Medicine and Public Health, Special Session on The Mathematics of Epidemics and Disease, January 1998; Stoll Distinguished Lecture Series Speaker, Akron University, Ohio, 2001; Keynote Speaker, "Mathematics, Germs, Drugs, Disease, Globalization, and Politics", SACNAS National Conference, Phoenix, September 2001; Plenary Lecture Speaker, "Tuberculosis: Past, Current and Future Trends", Third International Conference on Mathematical Biology, Satellite Meeting for the International Congress of Mathematicians, Guangxi Province, P.R. China, August 2002.
Additional Information: ***NSF and the Office of the President of the United States***: Presidential Faculty Fellowship, 1992; Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring, 1997. Distinguished Alumni, University of Wisconsin at Stevens Point, 1999; Coordinated the establishment of the David Blackwell and Richard Tapia Distinguished Lecture Series in the Mathematical and Statistical Sciences at Cornell University (soon to be cosponsored by MSRI), 2000; Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) Distinguished Scientist Award, 2001.
Selected Publications: 1. *Mathematical and Statistical Approaches to AIDS Epidemiology* (C. Castillo-Chávez, ed.), Lecture Notes in Biomathematics, vol. 83, Springer-Verlag, Berlin, 1989. MR **91k:**92022; 2. with S. Blythe, Scaling law of sexual activity, *Nature* **344** (1990), 202; 3. with W. Huang and J. Li, On the existence of stable pair distributions, *J. Math. Biol.* **34** (1996), 413–441; 4. with F. Brauer, *Mathematical Models in Population Biology and Epidemiology*, Texts in Applied Mathematics, vol. 40, Springer-Verlag, New York, 2001; 5. with S. Blower, P. van den Driessche, D. Kirschner, and A.-A. Yakubu (eds.), *Mathematical Approaches for Emerging and Reemerging Infectious Diseases: Models, Methods, and Theory*, IMA volume 126, Springer-Verlag, Berlin, 2002.
Statement: As a member at large I will: (i) promote the fundamental role of mathematics in interdisciplinary research, (ii) work to make the AMS a more welcoming organization for women and underrepresented minorities, (iii) increase the support for undergraduate mathematics research, (iv) support the direct recognition of outstanding teachers and mentors by the AMS, and (v) enhance the involvement of the AMS in the "final" frontier, biology.

Susan M. Hermiller

Associate Professor of Mathematics, University of Nebraska-Lincoln.
Ph.D.: Cornell University, 1992.
AMS Committees: Short Course Subcommittee, 2002–.
Selected Addresses: AMS-IMS-SIAM Joint Summer Research Conference on Geometric Group Theory and Computer Science, South Hadley, July 1998; MSRI-CIMAT Conference on Gröbner Bases, Guanajuato, Mexico, February 1999; Symposium on Computation in Geometry and Group Theory, Warwick, England, July 1999; AMS Special Session on Geometric Group Theory, New Orleans, January 2001; AMS Special Session on Computational Group Theory, Hoboken, April 2001.
Additional Information: Alfred P. Sloan Foundation Doctoral Dissertation Fellowship, 1991–1992; Member, MSRI, 1992–1993 and fall 1998; NSF Postdoctoral Fellowship (International Program), 1993–1994; ***Coorganizer***: Holiday Mathematics Symposium on Rewriting Techniques and Noncommutative Gröbner Bases, New Mexico State University, January 1997; Nebraska Conferences for Undergraduate Women in Mathematics, University of Nebraska-Lincoln, March 1999 and February 2000; Workshop on Gröbner Bases and Rewriting Techniques, Trento, Italy, June 1999; International Conference on Geometric and Combinatorial Methods in Group Theory and Semigroup Theory, University of Nebraska-Lincoln, May 2000.
Selected Publications: 1. with J. Meier, Algorithms and geometry for graph products of groups, *J. Algebra* **171** (1995), 230–257. MR **96a:**20052; 2. with J. Meier, Tame combings, almost convexity and rewriting systems for groups, *Math. Z.* **225** (1997), 263–276. MR **98i:**20036; 3. with X. Kramer and R. Laubenbacher, Monomial orderings, rewriting systems, and Gröbner bases for the commutator ideal of a free algebra, *J. Symbolic Comput.* **27** (1999), 133–141. MR **99m:**16040; 4. with J. Meier, Measuring the tameness of almost convex groups, *Trans. Amer. Math.*

Soc. **353** (2001), 943–962; 5. with J. Groves, Isoperimetric inequalities for soluble groups, *Geom. Dedicata* **88** (2001), 239–254.

Statement: The AMS has the primary role of furthering the mathematics profession and research in mathematics, through a wide variety of avenues. In direct promotion of research through organization of conferences and publications, the Society needs to work to keep up with electronic publication issues, and to ensure that its publications are widely accessible. In an economy that has faltered in the past year or two, there is increased importance for the AMS efforts to lobby for funding with government policymakers, to increase public awareness of the value of mathematics, and to promote education and employment opportunities for young mathematicians. In addition to monitoring employment of new Ph.D.'s, we should also attempt to track Ph.D.'s several years past graduation to study their more permanent job status. We must also work to improve the representation of women and minorities in our profession.

The AMS serves as a forum for the discussion of many issues that arise in our profession. I would appreciate the opportunity to help advance the mission of our Society and contribute further to these discussions.

Henry B. Laufer

Vice President for Research, Renaissance Technologies Corporation.

Born: August 13, 1945, Brooklyn, New York.

Ph.D.: Princeton University, 1966.

Statement: I was a professor in the mathematics department at SUNY at Stony Brook until 1991. Then I left to join the financial world, where I now help to run a hedge fund. If elected, I would bring a different, nonacademic viewpoint to the Council. In particular, I feel that the Society should care much more about mathematicians in exchange for caring somewhat less about mathematics.

Brian Marcus

Research Staff Member, IBM Almaden Research Center.

Born: August 29, 1949, Los Angeles, California.

Ph.D.: University of California at Berkeley, 1975.

AMS Committees: Committee to Monitor Problems in Communication, 1993.

Selected Addresses: Principal Lecturer, Conference on Symbolic Dynamics, University of Maryland, 1986; Distinguished Lecturer Series, Center for Applied Mathematics, Cornell University, 1989; AMS Short Course on Coding Theory, January 1995; Invited Plenary Lecture, IEEE International Symposium on Information Theory, 1995; AMS Short Course on Symbolic Dynamics, January 2002.

Additional Information: Six issued and five pending U.S. patents; Assistant/Associate Professor of Mathematics (with tenure), University of North Carolina-Chapel Hill, 1975–1985; Leonard G. Abraham Prize Paper Award, IEEE Communications Society, 1993; Elected IEEE Fellow, 1999; Consulting Associate Professor of Electrical Engineering, Stanford University, 2000–.

Selected Publications: 1. Ergodic properties of horocycle flows for surfaces of negative curvature, *Ann. of Math.* **105** (1977), 81–105. MR **56:**16696; 2. with D. Lind, *An Introduction to Symbolic Dynamics and Coding*, Cambridge University Press, Cambridge, 1995 (reprinted 1999). MR **97a:**58050; 3. with J. Ashley and S. Tuncel, The classification of one-sided Markov chains, *Ergodic Theory Dynam. Systems* **17** (1997), 269–295. MR **98k:**28021; 4. with J. Fan and R. Roth, Lossless sliding-block compression of constrained systems, *IEEE Trans. Inform. Theory* **46** (2000), 624–632; 5. with S. Tuncel, Resolving Markov chains onto Bernoulli shifts via positive polynomials, *Mem. Amer. Math. Soc.* **150** (2001), no. 710. MR **2001m:**37018.

Statement: If elected, I would bring to the AMS Council the voice of a mathematician who has broad experience in both academia and industry. Through this experience I have seen firsthand how industry can benefit from mathematics and how mathematical research can benefit from contact with applications. I also understand the difficulties faced by mathematicians in industry as well as the challenges that face our community in preparing mathematics students to succeed in both academic and industrial environments. I would try to use the influence of the AMS to increase interactions among academia, industry, and government as a means of strengthening mathematics research and education.

John E. McCarthy

Professor of Mathematics, Washington University, St. Louis.

Born: January 20, 1964, London, U.K.

Ph.D.: University of California at Berkeley, 1989.

Selected Addresses: Plenary Speaker, International Conference on Operator Theory, Timisoara, 1998; Colloquium, Brown University, 1999; AMS Special Session, Washington, DC, January 2000; Plenary Speaker, Southeastern Analysis Meeting, Athens, Georgia, 2001; Colloquium, Virginia Polytechnic Institute and State University, 2002.

Additional Information: ***Organizer***: AMS Special Session on Hilbert Spaces of Analytic Functions, South Bend, March 1991; AMS Special Session on Holomorphic Spaces, San Antonio, January 1993; Cochair, Organizing Committee, MSRI program on Holomorphic Spaces, fall 1995. Member: AMS, Irish Mathematical Society, MAA.

Selected Publications: 1. Common range of co-analytic Toeplitz operators, *J. Amer. Math. Soc.* **3** (1990), 793–799. MR **91f:**47041; 2. How to give a good colloquium, *Canad. Math. Soc. Notes* **31** (1995), 3–4. Reprinted and distributed by the AMS; 3. with L. Yang, Subnormal operators and quadrature domains, *Adv. Math.* **127** (1997), 52–72. MR **98i:**47019; 4. with E. Backhaus and J. Fajans, Solving Poisson's equation with interior conditions, *J. Math. Phys.* **39** (1998), 6720–6729. MR **2000m:**82063; 5. with J. Agler, *Pick Interpolation and Hilbert Function Spaces*, Graduate Studies in Mathematics, vol. 44, Amer. Math. Soc., Providence, RI, 2002.

Statement: I love mathematics. Mathematics and its associated culture is vast, however, and the AMS should not seek to encompass it all. I believe the principal function of the AMS should be to support research in mathematics.

Although this statement of belief is simple, it has ramifications beyond the obvious ones of organizing meetings and attempting to obtain financial support for researchers. For example, research in mathematics is enhanced by the ready availability of research literature. It is therefore important that the AMS remain a major publisher of mathematics—both as a source of high-quality and reasonably priced journals and books and also as a moderating influence on commercial publishers of mathematics. Likewise, the AMS should pioneer paradigms of electronic journals that maximize benefit to the users rather than to the publishers.

I believe that the American Mathematical Society has done a good job of serving the interests of mathematics. If elected, I will strive to ensure that it continues to do so. What I lack in experience, I will make up for with enthusiasm.

David W. McLaughlin

Provost, New York University, and Professor of Mathematics and Neural Science, Courant Institute of Mathematical Sciences, New York University.

Born: October 11, 1944, Council Bluffs, Iowa.

Ph.D.: Indiana University, 1971.

AMS Committees: Mathematical Surveys and Monographs Editorial Committee, 1992–1994.

Selected Addresses: Plenary Address, SIAM Conference on Dynamical Systems, Snowbird, 1992; Invited Lecture, International Congress of Mathematicians, Zurich, 1994; IX David Alcaraz Spinola Lecture, University of Mexico, 1995; "Modelling the Visual Cortex", AAAS Annual Meeting, San Francisco, 2001; Plenary Lecture, 7th Latin American Workshop on Nonlinear Phenomena, Morales, Mexico, 2001.

Additional Information: Elected Fellow, American Academy of Arts & Sciences, 2000; Chair, SIAM Activity Group on Dynamical Systems, 2001; Member: AAAS, NAS, SIAM.

Selected Publications: 1. with H. Flaschka and M. Forest, Multiphase averaging and the inverse spectral solution of the Korteweg-de Vries equation, *Comm. Pure Appl. Math* **33** (1980), 739–784. MR **81k:**35142; 2. with N. Ercolani and M. Forest, Geometry of the modulational instability. III. Homoclinic orbits for the periodic sine-Gordon equation, *Phys. D* **43** (1990), 349–384. MR **92k:**35242; 3. with Y. Li, J. Shatah, and S. Wiggins, Persistent homoclinic orbits for a perturbed nonlinear Schrödinger equation, *Comm. Pure Appl. Math.* **49** (1996), 1175–1255. MR **98d:**35208; 4. with D. Cai, A. Majda, and E. Tabak, Special bifurcations in dispersive wave turbulence, Proc. Nat. Acad. Sci. U.S.A., vol. **96**, 1999, pp. 14216–14221; 5. with R. Shapley, M. Shelley, and J. Wielaard, A neuronal network model of the Macaque primary visual cortex. 1. Orientation tuning and dynamics in the input layer 4 C, Proc. Nat. Acad. Sci. U.S.A., vol. **97**, 2000, 14, pp. 8087–8092.

Statement: The AMS fosters excellence in research and education throughout mathematics, and it represents its members in these and other concerns of our profession. The primary focus of the Society should be upon research and education within our discipline.

At this turn of the century, the Society should also focus upon the fundamental role that mathematics can play in modern sciences, technology, and throughout society in that it can provide language, methods, and viewpoints toward the solution of complex interdisciplinary and multidisciplinary problems. In addition, today there are many other important and difficult issues which the AMS addresses, including federal support of basic research, postdoctoral and graduate education, conferences and institutes; undergraduate and graduate education; elementary and secondary school education; diversity within our community; human rights; opportunities within the profession; AMS meetings and their technical content; the perception of the discipline; and many more. It would be an honor to help address these issues as a Council member at large.

Yair N. Minsky

Associate Professor of Mathematics, SUNY at Stony Brook.

Born: November 9, 1962, Jerusalem, Israel.

Ph.D.: Princeton University, 1989.

Selected Addresses: "Geometry and Combinatorics of Curves on Surfaces", 1st Iberoamerican Congress on Geometry and Groups, Chile, January 1998; "Geometry, Topology and Dynamics in Hyperbolic Space", Japanese-American Frontiers of Science Symposium, Tsukuba, Japan, October 1999; "Classification and Rigidity Problems for Kleinian Groups", series of three talks, RIMS meeting on Kleinian Groups and Conformal Dynamics, Kyoto, Japan, October 1999; AMS Invited Address, Santa Barbara, March 2000; "Combinatorial and Geometrical Aspects of Hyperbolic 3-Manifolds", six lectures at the workshop on Kleinian Groups and Hyperbolic 3-Manifolds, University of Warwick, England, September 2001.

Additional Information: ***Awards***: NSF Postdoctoral Fellow, 1992–1995; Alfred P. Sloan Foundation Research Fellow, 1995–1999; ***Coorganizer***: Laminations and Foliations in

Dynamics, Geometry and Topology, Stony Brook, May 1998; Spaces of Kleinian Groups and Hyperbolic 3-Manifolds, Isaac Newton Institute for Mathematical Sciences, Cambridge, England, July–August 2003.

Selected Publications: 1. On rigidity, limit sets, and end invariants of hyperbolic 3-manifolds, *J. Amer. Math. Soc.* **7** (1994), 539–588. MR **94m:**57029; 2. with M. Lyubich, Laminations in holomorphic dynamics, *J. Differential Geom.* **47** (1997), 17–94. MR **98k:**58191; 3. The classification of punctured-torus groups, *Ann. of Math. (2)* **149** (1999), 559–626. MR **2000f:**30028; 4. with H. Masur, Geometry of the complex of curves. I. Hyperbolicity, *Invent. Math.* **138** (1999), 103–149. MR **2000i:**57027; 5. Bounded geometry for Kleinian groups, *Invent. Math.* **146** (2001), 143–192.

Statement: An AMS Regional Conference in Arcata in 1989 was my first intensive introduction to the communal spirit of research mathematics. Since then, AMS meetings and publications have played a large role in my development as an individual mathematician and as a member of the community, and I think they remain the major way in which the Society promotes high-quality research and education and communication among its members. Additionally, the AMS has been strongly involved in outreach, advocacy, and professional support for mathematicians. All of us should at some point take time from our research and educational activities to become involved in these important endeavors. Of particular interest to me are maintaining the excellent level of meetings, improving the interaction between pure and applied mathematics, and building on the Society's successes in online publishing and other services.

Paul J. Sally Jr.

Professor of Mathematics, University of Chicago.

Born: January 29, 1933, Boston, Massachusetts.

Ph.D.: Brandeis University, 1965.

AMS Offices: Member at Large of the Council, 1981–1983; Trustee, 1984–1993 (chair, 1987, 1992).

AMS Committees: Western Sectional Program Committee, 1980–1981; Committee on the Summer Institute on Applications of Group Theory in Physics and Mathematical Physics, 1982 (chair); Executive Committee, 1983; Committee on the Abuse of Subscriptions, 1984; Appeals Committee on Discounted Subscriptions, 1984–1993; Agenda and Budget Committee, 1986–1987 and 1992; Committee on Salaries, 1986–1987 and 1991–1992; Committee on the Recruitment of Young Mathematicians, 1986–1988; Committee on the Publication Program, 1986–1994; Executive Director Search Committee, 1987; Long Range Planning Committee, 1987 and 1992; Fellowship Policy Committee, 1988–1989; Audit Committee, 1989 and 1992; Liaison Committee on Education in Mathematics, 1989–1994 (chair); Committee on Science Policy, 1990–1992; Nominating Committee of the ECBT, 1993; Publications Committee, 1993; Arnold Ross Lecture Series Committee, 1992–2000 (chair, 1994–1998; consultant, 1999–2000).

Selected Addresses: AMS Invited Address, Columbus, March 1978; Distinguished Lecture Series: Emory University, University of Iowa, University of Maryland.

Additional Information: NSF Advisory Committee for Mathematical Sciences, 1977–1980; Mathematical Sciences Education Board (NAS), 1985–1987; U.S. Commission on Mathematics Instruction (NAS), 1986–1990; U.S. Steering Committee for the Third International Mathematics and Science Study, 1991–; AMS Distinguished Public Service Award, 2000; MAA Haimo Award for Distinguished University Teaching, 2002.

Selected Publications: 1. with L. Corwin and A. Moy, Degrees and formal degrees for division algebras and GL_n over a p-adic field, *Pacific J. Math.* **141** (1990), 21–45. MR **90k:**22025; 2. with M. Tadić, Induced representations and classifications for $GSp(2,F)$ and $Sp(2,F)$, *Mém. Soc. Math. France (N.S.)*, no. 52 (1993), 75–133. MR **94e:**22030; 3. with L. Corwin and A. Moy, Supercuspidal character formulas for GL_1, *Representation Theory and Harmonic Analysis* (K. I. Gross, D. St. P. Richards, and P. J. Sally Jr., eds.), Contemp. Math., vol. 191, Amer. Math. Soc., Providence, RI, 1995, pp. 1–11. MR **96m:**22037; 4. An introduction to p-adic fields, harmonic analysis and the representation theory of SL_2, *Lett. Math. Phys.* **46** (1998), 1–47. MR **99m:**22007; 5. with S. Debacker, Germs, characters, and the Fourier transforms of nilpotent orbits, *The Mathematical Legacy of Harish-Chandra* (R. Doran, V. S. Varadarajan, eds.), Proc. Sympos. Pure Math., vol. 68, Amer. Math. Soc., Providence, RI, 2000, pp. 191–221. MR **2001i:**22022.

Statement: The primary activities of the American Mathematical Society should be the promotion of research and the support of young mathematicians. The AMS plays a central role in both of these, and we should always be creative in our approach.

The publication program of the AMS is of central importance, both for the support of research and for the fiscal health of the Society. The publication program has been quite successful and must be monitored continually to ensure that it serves the profession in an effective way.

The AMS must find new ways to be involved in precollege education. The mathematics research community should collaborate with mathematics educators and school systems to aid, in a significant way, in the improvement of education in mathematics for schoolchildren. Without attempting to impose its own ideas, the mathematics research community can influence the direction of K–12 mathematics education in a very positive way.

Paul Zorn

Professor of Mathematics, St. Olaf College, Northfield, Minnesota.

Born: March 22, 1951, Neyoor, Madras, India.

Ph.D.: University of Washington, Seattle, 1981.

Selected Addresses: "The Future of Calculus", keynote talk in theme group, ICME-8, Seville, Spain, July 1996; "Technology in Tertiary Mathematics Education", Keynote Address, Conference on Technology in Mathematics Education at the Secondary and Tertiary Levels, Brock University, Ste.

Catharines, Ontario, June 1999, and Southwest University of Science and Technology, Mianyang, China, June 2001. *Mathematics Magazine* Morsels: Invited Address on the Mathematics in and History of *Mathematics Magazine*, the Virginia/Maryland/DC MAA Section meeting, Bowie, Maryland, April 2000, and East China Normal University, Shanghai, June 2001;"Algebra, Computer Algebra, and Mathematical Thinking", Second International Conference on the Teaching of Mathematics, Crete, Greece, July 2002.
Additional Information: MAA Allendoerfer Prize for Mathematical Expository Writing, for an article on the Bieberbach Conjecture, 1987; Editor, *What's Happening in the Mathematical Sciences*, 1994, 1996, and 1998; Editor, *Mathematics Magazine*, 1996–2000.
Selected Publications: 1. Analytic functionals and Bergman spaces, *Ann. Scuola Norm. Sup. Pisa Cl. Sci. (4)* **9** (1982), 365–404. MR **84d:**46057; 2. The Bieberbach conjecture, *Math. Mag.* **59** (1986), 131–148. MR **87k:**01044; 3. Be He Alive or Be He Dead? Bourbaki in Quebec; report on mathematical activities at ICME-7, Quebec, August 1992, *UME Trends*, December 1992; 4. with A. Ostebee, *Calculus from Graphical, Numerical, and Symbolic Points of View*, second edition, three-volume textbook on elementary calculus, Houghton Mifflin, Boston, 2001–2002.
Statement: Although the AMS properly emphasizes the promotion of mathematical research as its principal mission, other activities and concerns are also important, both in their own right and in maintaining our profession's vitality—and hence, indirectly, its success in research and other efforts. If elected a trustee, I hope to contribute to the AMS in two main areas: (i) promoting excellent undergraduate mathematics education, especially in preparation for graduate work; and (ii) communicating AMS activities and their importance to constituencies beyond the traditional AMS orbit, including the general public. Both of these interests are closely related to my own work and recent experience as an undergraduate teacher, mathematical expositor, and journal editor.

Nominating Committee

Francis Bonahon

Professor of Mathematics, University of Southern California.
Born: September 9, 1955, Tarbes, Hautes Pyrénées, France.
Ph.D.: University of Paris XI, Orsay, France, 1985.
AMS Offices: Member at Large of the Council, 1997–1999.
AMS Committees: Committee on Education, 1997–1999; Committee on Human Rights of Mathematicians, 1998–2000.
Selected Addresses: AMS Invited Address, Claremont, November 1988; Invited Address, International Congress of Mathematicians, Kyoto, 1990.
Additional Information: Alfred P. Sloan Foundation Fellow, 1987–1989; NSF Presidential Young Investigator, 1989–1994; Member: EMS, MAA, SMF.
Selected Publications: 1. Bouts des variétés hyperboliques de dimension 3, *Ann. of Math. (2)* **124** (1986), 71–158. MR **88c:**57013; 2. The geometry of Teichmüller space via geodesic currents, *Invent. Math.* **92** (1988), 139–162. MR **90a:**32025; 3. Geodesic laminations with transverse Hölder distributions, *Ann. Sci. École Norm. Sup. (4)* **30** (1997), 205–240. MR **98b:**57027; 4. A Schläfli-type formula for convex cores of hyperbolic 3-manifolds, *J. Differential Geom.* **50** (1998), 25–58. MR **2000j:**57049; 5. with Y. Sözen, The Weil-Petersson and Thurston symplectic forms, *Duke Math. J.* **108** (2001), 581–597. MR **2002c:**32023.
Statement: The selection of officers and committee members for the Society should fulfill two basic goals: action and representation. It is important to attract to the leadership of the Society talented and dedicated individuals who will energetically promote the cause of mathematics. It is equally important that the persons nominated offer a wide representation of the very diverse spectrum of the mathematical community. This second point serves a dual purpose: maintaining accountability of the Society to its membership, but also making the community better aware of what the AMS does (including what it does well). If elected, I intend to use these two principles to guide my work on the committee.

David Bressoud

DeWitt Wallace Professor of Mathematics, Macalester College.
Born: March 27, 1950, Bethlehem, Pennsylvania.
Ph.D.: Temple University, 1977.
AMS Offices: Member at Large of the Council, 1996–1998.
AMS Committees: Committee on Education, 1996–1998; Student Mathematical Library Editorial Board, 1998– (chair, 2002–); Math Camps Committee (set up Epsilon Fund), 1999.
Additional Information: Liaison from Committee on Education to MAA Committee on the Undergraduate Program in Mathematics, 1999; Member, College Board AP Calculus Committee, 1999– (chair 2002); MAA Beckenbach Book Prize, 2000.
Selected Publications: 1. *Factorization and Primality Testing*, Undergrad. Texts Math., Springer-Verlag, New York, 1989. MR **91e:**11150; 2. *Second Year Calculus from Celestial Mechanics to Special Relativity*, Springer-Verlag, New York, 1992; 3. *A Radical Approach to Real Analysis*, Classroom Resource Materials Ser., vol. 2, MAA, Washington, DC, 1994. MR **95d:**26002; 4. *Proofs and Confirmations: The Story of the Alternating Sign Matrix Conjecture*, MAA Spectrum, MAA, Washington, DC, and Cambridge University Press, Cambridge, UK, 1999. MR **2000i:**15002; 5. with S. Wagon, *A Course in Computational Number Theory*, Key College Publ., Emeryville, in cooperation with Springer-Verlag, New York, 2000. MR **2001f:**11200.
Statement: The AMS serves all mathematicians. I will work to include good candidates who are not at major research universities.

Constantine M. Dafermos

Professor, Division of Applied Mathematics, Brown University.

Born: May 26, 1941, Athens, Greece.

Ph.D.: Johns Hopkins University, 1967.

AMS Committees: AMS-SIAM Committee on Applied Mathematics, 1988–1989; AMS Representative, U.S. National Committee on Theoretical and Applied Mechanics, 1989–1996; AMS-SIAM Committee to Select the Winner of the Birkhoff Prize for 1993; Progress in Mathematics Committee, 1996–1998; Committee to Select the Winner of the Steele Prize, 2000–.

Selected Addresses: ***AMS Special Sessions***: Washington, DC, January 1975; St. Louis, January 1977; New Orleans, January 1986; AMS Invited Address, Atlanta, January 1988; International Congress of Mathematicians, Zurich, 1994.

Additional Information: Member: SIAM; Fellow, American Academy of Arts and Sciences.

Selected Publications: 1. *Hyperbolic Conservation Laws in Continuum Physics*, Fund. Principles Math. Sci., vol. 325, Springer-Verlag, Berlin, 2000. MR **2001m:**35212.

Nathaniel Dean

Associate Professor of Mathematics, Rice University.

Born: January 9, 1956, Mound Bayou, Mississippi.

Ph.D.: Vanderbilt University, 1987.

AMS Committees: Committee on Publications, 2000–2002; *Notices* Editorial Board, 2001– (associate editor).

Selected Addresses: DIMACS Reconnect '98 Conference, Piscataway, 1998; NAM-MAA David Blackwell Lecture, MAA MathFest, Toronto, 1998; Plenary Lecture, Kolloquium über Kombinatorik, Braunschweig, 2000; Albert Turner Bharucha-Reid Lecture, New Orleans, 2001; MAA Short Course, Joint Mathematics Meetings, San Diego, January 2002.

Additional Information: President's Silver Award, Bell Laboratories, 1997; Television series appearance, *Life by the Numbers*, 1998; Vice President, NAM, 2000–; NAM Award of Appreciation, 2001; Member: ACM, MAA, NAM, SIAM.

Selected Publications: 1. with M. Mihail, M. Mostrel, and D. Shallcross, A commercial application of survivable network design: ITP/INPLANS CCS Network Topology Analyzer, *Proc. 7th Annual ACM-SIAM Symposium on Discrete Algorithms*, 1996, pp. 279–287; 2. with R. Thomas and X. Yu, Spanning paths in infinite planar graphs, *J. Graph Theory* **23** (1996), 163–174. MR **97f:**05119; 3. Editor, *African Americans in Mathematics*, DIMACS Ser. Discrete Math. Theoret. Comput. Sci., vol. 34, Amer. Math. Soc., Providence, RI, 1997. MR **98e:**00012; 4. with M. Kouider, Gallai's conjecture for disconnected graphs, *Discrete Math.* **213** (2000), 43–54. MR **2001a:**05083; 5. with D. Archdeacon, C. Bonnington, N. Hartsfield, and K. Scott, Obstruction sets for outer-cylindrical graphs, *J. Graph Theory* **38** (2001), 42–64. MR **2002g:**05061.

Statement: When I studied mathematics as a boy, it seemed like a bunch of puzzles that were usually not too difficult to solve. Later I came to view it as a logical, symbolic language that I could use to describe physical systems and ideas. The problems became more difficult to solve, they required knowledge of other sciences (e.g., physical, social, and biological), and the conclusions were not so infallible. For me now, the main challenge of mathematics is to demonstrate its power as an everyday decision-making tool and to prove its effectiveness in helping us manage those things most dear to us—our lives and our environment. Mathematics is for life.

Richard M. Hain

Professor of Mathematics, Duke University.

Born: August 15, 1953, Sydney, Australia.

Ph.D.: University of Illinois, 1980.

AMS Committees: Centennial Fellowships Committee, 1991–1992; Southeastern Section Program Committee, 1999–2000 (chair, 2000).

Selected Addresses: Six AMS Special Sessions, 1979–2002; Two plenary talks, International Conference on Algebraic Topology, Evanston, March 1988; Arbeitstagung, Bonn, June 1988; AMS Invited Address, Memphis, March 1997; Frontiers in Mathematics Lectures, Texas A&M University, March 1997.

Additional Information: Member, Institute for Advanced Study, 1985–1986 and fall 1994; AMS Research Fellowship, 1987; Organizer, Math Day for High School Students, Seattle, March 1991; Organizer, Conference on Mapping Class Groups and Moduli Spaces of Curves, Seattle, August 1991; Professeur Invité, Institut Henri Poincaré, Paris, February–April 1995; Fellow, Japan Society for the Promotion of Science, May 1998; Department Chair, Duke University, 1999–2002; Editor, *Illinois Journal of Mathematics*, 2002–. ***Coorganizer***: AMS Special Session on Invariants of 3-Manifolds, Memphis, March 1997; 1st *Duke Mathematical Journal* Conference, April 1998; AMS Special Session on Moduli Spaces of Riemann Surfaces, Mapping Class Groups and Invariants of 3-Manifolds, Melbourne, July 1999; 2nd *Duke Mathematical Journal* Conference, April 2001.

Selected Publications: 1. The de Rham homotopy theory of complex algebraic varieties. I and II, *K-Theory* **1** (1987), 271–324 and 481–497. MR **88h:**14029 and MR **89d:**14028; 2. with S. Zucker, Unipotent variations of mixed Hodge structure, *Invent. Math.* **88** (1987), 83–124. MR **88i:**32035; 3. Infinitesimal presentations of the Torelli groups, *J. Amer. Math. Soc.* **10** (1997), 597–651. MR **97k:**14024; 4. with E. Looijenga, Mapping class groups and moduli spaces of curves, *Algebraic Geometry—Santa Cruz 1995*, Proc. Sympos. Pure Math., vol. 62, Part 2, Amer. Math. Soc., Providence, RI, 1997, pp. 97–142. MR **99a:**14032; 5. with M. Matsumoto, Weighted completion of Galois groups and Galois actions

on the fundamental group of $\mathbb{P}^1 - \{0, 1, \infty\}$, *Compositio Math.*, to appear.

Statement: The purpose of the Nominating Committee is to nominate strong and committed candidates for election to important elected offices of the Society, including president-elect, vice president, and trustee. If elected, I will seek to identify candidates who will represent the broad interests of the Society and who will work hard for, and be responsive to, the mathematical community.

Krystyna M. Kuperberg

Professor of Mathematics, Auburn University.

Born: July 17, 1944, Tarnów, Poland.

Ph.D.: Rice University, 1974.

AMS Offices: Member at Large of the Council, 1996–1998.

AMS Committees: *Electronic Research Announcements* Editorial Committee, 1995–; Southeastern Section Program Committee, 1996–1998 (chair, 1997); Committee on the Profession, 1996–1998; Search Committee for the Editor of *Notices*, 1999; Editorial Boards Committee, 1999–2001 (chair, 2000); AMS-MAA Joint Program Committee for the Baltimore Meeting, 2002–.

Selected Addresses: AMS Invited Address, Orlando, March 1995; MAA Invited Address, Orlando, January 1996; Invited Address, International Congress of Mathematicians, Berlin, 1998; AWM Emmy Noether Lecture, San Antonio, January 1999; CBMS Lecture Series, Macon, 2000.

Additional Information: Auburn University Alumni Professorship, 1994–1999; Alfred Jurzykowski Foundation Award, 1995; Auburn University College of Science and Mathematics Research Excellence Award, 1996; Auburn University Creative Research Award, 1999; Auburn University Distinguished Graduate Faculty Lecturer, 2002. Member: AWM, MAA, PTM (Polish Mathematical Society), SIAM.

Selected Publications: 1. On the bihomogeneity problem of Knaster, *Trans. Amer. Math. Soc.* **321** (1990), 129–143. MR **90m:**54043; 2. A smooth counterexample to the Seifert conjecture, *Ann. of Math. (2)* **140** (1994), 723–732. MR **95g:**57040; 3. with G. Kuperberg, Generalized counterexamples to the Seifert conjecture, *Ann. of Math. (2)* **144** (1996), 239–268. MR **97k:**57031b; 4. Bihomogeneity and Menger manifolds, Proceedings of the International Conference on Set-Theoretic Topology and Its Applications, Part 2 (Matsuyama, 1994), *Topology Appl.* **84** (1998), 175–184. MR **99b:**54048; 5. A knotted minimal tree, *Commun. Contemp. Math.* **1** (1999), 71–86. MR **2000f:**57002.

Statement: The American Mathematical Society was founded in 1888 to further mathematical research and scholarship. For over one hundred years the AMS has been upholding its primary mission. Closely working with other mathematical organizations in the United States or abroad, the AMS is seen as the leading representative of the mathematical community. As a member of the Nominating Committee, I would support nominations, from all areas of mathematics, of high-quality research mathematicians dedicated to the Society's purpose.

Editorial Boards Committee

Richard A. Brualdi

Professor of Mathematics, University of Wisconsin-Madison.

Born: September 2, 1939, Derby, Connecticut.

Ph.D.: Syracuse University, 1964.

Selected Addresses: AMS-MAA Invited Address, San Antonio, January 1993; SIAM Conference on Applied Linear Algebra, October 1997; 10th ILAS Conference, Auburn, June 2002.

Additional Information: Board of Governors, IMA, 1988–1991; Chair, Mathematics Department, University of Wisconsin-Madison, 1993–1999; President, International Linear Algebra Society, 1993–1999; Board of Trustees, MSRI, 1999–.

Selected Publications: 1. with H. Ryser, *Combinatorial Matrix Theory*, Encyclopedia Math. Appl., vol. 39, Cambridge University Press, Cambridge, UK, 1991. MR **93a:**05087; 2. with B. Shader, *Matrices of Sign-Solvable Linear Systems*, Cambridge Tracts in Math., vol. 116, Cambridge University Press, Cambridge, UK, 1995. MR **97k:**15001; 3. *Introductory Combinatorics*, Third edition, Prentice-Hall, Englewood Cliffs, NJ, 1999; Second edition, North-Holland Publishing Co., New York, 1992. MR **93g:**05001. First edition, North-Holland Publishing Co., New York, 1977. MR **58:**21631.

Statement: I currently serve as one of three editors in chief of the journal *Linear Algebra and its Applications* and one of four editors in chief of the *Electronic Journal of Combinatorics*. I am also a member of the editorial boards of several other journals. I hope to use this experience in serving the AMS through its Editorial Boards Committee.

Cristian E. Gutiérrez

Professor of Mathematics, Temple University.

Born: November 12, 1950, Buenos Aires, Argentina.

Ph.D.: University of Buenos Aires, 1980.

Selected Addresses: CBMS Conference, Boca Raton, 1997; MSRI, Berkeley, October 1997; Fabes Lectures, University of Cagliari, Italy, June 1999; Fabes Lectures, University of Bologna, Italy, July 2001.

Selected Publications: 1. On the Riesz transforms for Gaussian measures, *J. Funct. Anal.* **120** (1994), 107–134. MR **95c:**35013; 2. with L. Caffarelli, Properties of the solutions of the linearized Monge-Ampère equation, *Amer. J. Math.* **119** (1997), 423–465. MR **98e:**35060; 3. with Q. Huang, A generalization of a theorem by Calabi to the parabolic Monge-Ampère

equation, *Indiana Univ. Math. J.* **47** (1998), 1459–1480. MR **2000a:**35105; 4. with Q. Huang, $W^{2,p}$ estimates for the parabolic Monge-Ampère equation, *Arch. Ration. Mech. Anal.* **159** (2001), 137–177; 5. *The Monge–Ampère Equation*, Progress Nonlinear Differential Equations Appl., vol. 44, Birkhaüser Boston, Boston, MA, 2001. MR **2002e:**35075.

Svetlana R. Katok

Professor of Mathematics, Pennsylvania State University.
Born: May 1, 1947, Moscow, Russia.
Ph.D.: University of Maryland, 1983.
AMS Offices: Member at Large of the Council, 1993–1995.
AMS Committees: Committee on Publications, 1993–1995; *Electronic Research Announcements* Editorial Committee, 1995– (chair); Short Course Subcommittee, 1998–2000; AMS-MAA-SIAM Morgan Prize Committee for Outstanding Research in Mathematics by an Undergraduate Student, 2002–.
Selected Addresses: Workshop on Random Matrices and Their Applications, MSRI, Berkeley, 1999; AMS Summer Research Institute on Smooth Ergodic Theory and Applications, University of Washington, Seattle, July 1999; AMS Special Session on Ergodic Theory and Topological Dynamics of $\mathbb{Z}^d$ and $\mathbb{R}^d$ Actions, Washington, DC, January 2000; Petrovskii Centenary Conference, Moscow State University, Moscow, Russia, 2001; Globus Colloquium, Independent University of Moscow, Moscow, Russia, 2002.
Additional Information: Eberly College of Science Alumni Society Distinguished Service Award, Pennsylvania State University, 2001.
Selected Publications: 1. Closed geodesics, periods and arithmetic of modular forms, *Invent. Math.* **80** (1985), 469–480. MR **86j:**11048; 2. *Fuchsian Groups*, Chicago Lectures in Math., University of Chicago Press, 1992. MR **93d:**20088; 3. with P. Sarnak, Heegner points, cycles and Maass forms, *Israel J. Math.* **84** (1993), 193–227. MR **94h:**11051; 4. Coding of closed geodesics after Gauss and Morse, *Geom. Dedicata* **63** (1996), 123–145. MR **97j:**20045; 5. with B. Gurevich, Arithmetic coding and entropy for the positive geodesic flow on the modular surface, *Moscow Math. J.* **1** (2001), 569–582.
Statement: One of the most important activities of the AMS is to produce high-quality journals which serve the entire mathematical community. To maintain high standards for acceptance of the papers in all fields, the editors should be active mathematicians highly regarded and respected by their colleagues and interested in and committed to their editorial duties. If elected, I will work hard on maintaining the high quality of the journal editorial committees.

Leonard L. Scott Jr.

McConnell/Bernard Professor of Mathematics, University of Virginia.
Born: October 17, 1942, Little Rock, Arkansas.
Ph.D.: Yale University, 1968.
AMS Committees: Committee to Select Hour Speakers for Southeastern Sectional Meetings, 1984–1985 (chair, 1985); Nominating Committee, 1987–1989; University Lecture Series Editorial Committee, 1988–2000 (chair, 1993–1999).
Selected Addresses: AMS Invited Address, College Park, April 1988; Special Session on Group Theory, First Joint Meeting of the AMS and the Israel Mathematical Union, Jerusalem, May 1995; AMS Special Session on Representations of Finite Groups, Algebraic Groups, and Lie Algebras, Baton Rouge, April 1996; Special Session, First International Joint Meeting of the AMS and the Australian Mathematical Society, Melbourne, July 1999; AMS Special Session on Representation Theory of Finite and Algebraic Groups, New Orleans, January 2001.
Additional Information: Member: AAAS, *Journal of Algebra* Editorial Board.
Selected Publications: 1. with E. Cline and B. Parshall, Cohomology of finite groups of Lie type. I, *Inst. Hautes Études Sci. Publ. Math.* no. 45 (1975), 169–191. MR **53:**3134; 2. with E. Cline, B. Parshall, and W. van der Kallen, Rational and generic cohomology, *Invent. Math.* **39** (1977), 143–163. MR **55:**12737; 3. Matrices and cohomology, *Ann. of Math. (2)* **105** (1977), 473–492. MR **56:**5746; 4. with K. Roggenkamp, Isomorphisms of p-adic group rings, *Ann. of Math. (2)* **126** (1987), 593–647. MR **89b:**20021; 5. Linear and nonlinear group actions, and the Newton Institute program, *Algebraic Groups and Their Representations* (Cambridge, 1997), NATO Adv. Sci. Inst. Ser. C Math. Phys. Sci., vol. 517, Kluwer, Dordrecht, 1998, pp. 1–23. MR **99k:**20029.
Statement: An AMS editor must have personal integrity and a broad view of mathematics. He or she must be able to disagree without acrimony and cooperate without compromising standards. As chair of the University Lecture Series Editorial Board during most of the nineties, I guided that series through a very formative time and oversaw a 100 percent rotation in its editorial board. I know what an AMS editor faces and have experience in suggesting and evaluating editorial appointees.

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Please direct all questions and comments to: emp-info@ams.org.

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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
37 Dynamical systems and ergodic theory
39 Difference 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
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
74 Mechanics of deformable 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 Operations research, mathematical programming
91 Game theory, economics, social and behavioral sciences
92 Biology and other natural sciences
93 Systems theory, control
94 Information and communication, circuits
97 Mathematics education

AMERICAN MATHEMATICAL SOCIETY

Mathematical Reviews

Associate Editor

Applications and recommendations are invited for a full-time position as an Associate Editor of *Mathematical Reviews* (MR), to commence as soon as possible after January 1, 2003.

The Mathematical Reviews division of the American Mathematical Society (AMS) is located in Ann Arbor, Michigan, not far from the campus of the University of Michigan. The editors are employees of the AMS; they also enjoy many privileges at the University. At present, MR employs fourteen mathematical editors, about six consultants, and a further sixty nonmathematicians. MR's mission is to develop and maintain the AMS databases covering the published mathematical literature. The chief responsibility is the development and maintenance of the MR Database, from which all MR-related products are produced: MathSciNet, the journals *Mathematical Reviews* and *Current Mathematical Publications,* and MathSciDisc. The responsibilities of an Associate Editor fall primarily in the day-to-day operations of selecting articles and books suitable for coverage, classifying these items, determining the type of coverage, assigning those selected for review to reviewers, and editing the reviews when they are returned.

An individual with a research record and expertise in analysis is sought. Considerable breadth, interest in current developments, and willingness to learn new topics in analysis and related areas of applied mathematics is also important; the ability to write good English is essential and the ability to read mathematics in major foreign languages is an advantage. It is required that the applicant have at least two years' relevant academic (or equivalent) experience beyond the Ph.D. Persons nearing the end of a postdoctoral appointment are encouraged to apply.

The twelve-month salary will be commensurate with the experience the applicant brings to the position. Interested applicants are encouraged to write (or telephone) for further information.

Applications (including curriculum vitae; bibliography; and name, address, phone number, and e-mail of at least three references) and recommendations should be sent to:

Dr. Jane E. Kister
Executive Editor
Mathematical Reviews
P.O. Box 8604
Ann Arbor, MI 48107-8604

e-mail: jek@ams.org
Telephone: 734-996-5257
Fax: 734-996-2916

The closing date for applications is September 15, 2002.

AMS
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The American Mathematical Society is an Equal Opportunity Employer.

Mathematics Calendar

The most comprehensive and up-to-date Mathematics Calendar information is available on e-MATH at http://www.ams.org/mathcal/.

September 2002

September 2002 **International Conference on Mathematics and Economics Dedicated to the 90th Anniversary of Leonid Kantorovich**, Euler International Mathematical Institute, St. Petersburg, Russia.

Brief Description: Academician Leonid Kantorovich (1912–86), the Nobel Prize winner in economics (1975) and an outstanding mathematician of the twentieth century, was born 90 years ago. The conference is dedicated to a modern outlook on the tremendous contributions made by Leonid Kantorovich both to various areas of pure and applied mathematics and to economics. Talks will be presented on invitation of the Organizing Committee. Round tables on major directions of Kantorovich research will be organized.

Organizing Committee: A. Bukhvalov (St. Petersburg State Univ.); L. Faddeev (St. Petersburg Branch of Mathematical Institute, RAS); V. Makarov (Central Institute for Mathematical Economics, RAS); co-chairman, V. Pavlov (Mathematical Institute RAS, Moscow); J. Romanovsky (St. Petersburg State Univ.); A. Sergeev (Moscow State Institute for International Relations); Yu. Vasiliev (Novosibirsk Mathematical Institute, RAS); A. Vershik (St. Petersburg Branch of Mathematical Institute, RAS), co-chairman.

Information: e-mail: admin@euler.pdmi.ras.ru, bukh@pop3.rcom.ru.

September–December 2002 **Set Theory and Analysis Program**, The Fields Inst., Toronto, Ontario, Canada. (Oct. 2001, p. 1051)

Organizing Committee: A. Dow, A. Kechris, M. Laczkovich, C. Laflamme, J. Steprans, S. Todorcevic.

Program: From its very beginnings, set theory has enjoyed a relationship with analysis which, while at times close and at others distant, has always allowed for the possibility of symbiosis. During the fall of 2002 The Fields Institute will host a thematic program devoted to fostering the interaction between these two areas. Internationally recognized experts from both disciplines will be on site from September 2002 through December 2002.

Format: The format of the program will include at least two short but intense thematic workshops. One will focus on set theoretic techniques in the theory of Banach spaces, and another will concentrate on Borel relations. While some participants will actively participate throughout the semester, others will be brought in for a specific workshop. Graduate students and postdoctoral fellows on site for the entire program will be exposed to a wide range of research topics, while invited specialists will be able to contribute in their area of expertise. The program will also incorporate, whenever possible, minicourses intended to quickly bring graduate students to the frontiers of knowledge on particular subjects.

Participants: Among those who have already indicated their interest in participating for at least part of the semester are: T. Bartoszynski, M. Foreman, D. Fremlin, G. Godefroy, G. Hjorth, A. Kechris, M. Laczkovich, R. Laver, D. Mauldin, A. Miller, N. Kalton, E. Odell, J. Pawlikowski, H. Rosenthal, S. Shelah, S. Solecki, S. Todorcevic, H. Woodin.

Information: To be informed when registration is open and to receive updates about the Set Theory and Analysis Program, please subscribe to the mail list at http://www.fields.utoronto.ca/maillist/.

1–5 **3rd WSEAS International MultiConference on Applied and Theoretical Mathematics**, Miedzyzdroje, Poland.

Information: http://www.wseas.org/conferences/2002/

This section contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings and symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete list of meetings of the Society can be found on the last page of each issue.

An announcement will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in every third issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

In general, announcements of meetings and conferences held in North America carry only the date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of 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 the AMS website on the World Wide Web. To access the AMS website, use the URL: http://www.ams.org/.

poland/;e-mail: math2002@wseas.org.

1-8 **17th International Workshop on Differential Geometric Methods in Theoretical Mechanics**, Levico Terme, Trento, Italy. (May 2002, p. 607)

Scientific Organizer: E. Pagani (Trento).

Information: First Announcement at http://www.science.unitn.it/cirm/DGMTM.1ann.html.

1-9 **8th International Congress on Algebraic Hyperstructures and Applications (AHA 2002)**, Democritus University of Thrace, Samothraki Island, Greece. (Mar. 2002, p. 359)

Topics: The congress will cover the following topics: hypergroups, semihypergroups, hypergroupoids, hyperrings, hyperfields, hypervectorial spaces, H_v-structures (H_v-groups, semigroups, rings), nonassociative and feebly associative hypergroupoids, join spaces, hyperstructures associated to geometric spaces, ordered hyperstructures, fuzzy hyperstructures, hypergraphs, generalizations and applications. There will be invited lecturers and special sessions for talks of twenty (20) minutes.

Dates: The second announcement will be sent to the interested researchers by the end of December 2001. Registration, March 31, 2002; abstracts, April 30, 2002; final announcement, June 15, 2002.

Information and Registration: aha2002@agro.duth.gr.

2-6 **BISCA-2002: Design and Cognition**, Bolzano, Italy.

Description: Most of the world that we know is designed. Furthermore, almost everyone in the Western world has become a designer at their personal computers (e.g., publishing their own webpages). Design has become everyone's domain, and the 21st century communicates via design.

Organizer: Mitteleuropa Foundation.

Speakers: John Gero, Professor of Design Science and Co-Director of the Key Centre of Design Computing and Cognition, Department of Architectural and Design Science, at the University of Sydney; Michael Leyton, Center for Discrete Mathematics and Theoretical Computer Science at Rutgers; Michael Pratt, Professor of Computer Aided Engineering and Head of the Department of Applied Computing and Mathematics at Cranfield University in the UK; Gerhard Schmitt, Professor of Architecture and Computer Aided Architectural Design (CAAD) at the Department of Architecture of the Swiss Federal Institute of Technology (ETH), Zürich; and architect Daniel Libeskind.

Information: Attendance will be limited to about 35 participants. Each speaker will give 4 lectures, with ample time for discussion. All lectures will be in English. For more information write to L. Albertazzi (Mitteleuropa Foundation, 30 Portici Street, 39100 Bolzano, Italy), or send e-mail (liliana.albertazzi@soc.unitn.it). Information about Bolzano is available from the city's tourist office: http://www.sudtirol.com/bolzano/; website: http://www.mitteleuropafoundation.it/events.htm.

2-7 **VI International Workshop on Complex Structures, Vector Fields and Applications**, St. Constantine, near Varna/Bulgaria. (Mar. 2002, p. 359)

Main Purpose: Bringing together specialists in complex analysis, potential theory, differential geometry, mathematical physics and applications for stimulating cross-disciplinary activities. Lectures: There will be two types of lectures. The first type of lecture will present the up-to-date state of the subject and could be considered as an introduction in large research domains. The second type of lecture will be authors' contributions.

Organizers: Niigata University (Japan): K. Sekigawa, H. Hashimoto; Bulgarian Academy of Sciences; Institute of Mathematics and Informatics: S. Dimiev, R. Lazov; Institute of Nuclear Research and Nuclear Energetics: S. Manov.

Registration Fee: US$150 including the price of the proceedings volume. Accommodation and meals: no more than US$40 per day.

2-7 **Poisson 2002-Conference on Poisson Geometry**, Instituto Superior Tecnico, Lisbon, Portugal.

Description: The conference will start on Monday, September 2, in the morning, and finish on Saturday, September 7, in the afternoon, with two half-days for sightseeing.

Confirmed Speakers Include: A. Alekseev (Geneva), M. Bertelson (Brussels), A. Cattaneo (Zurich), M. Crainic (Utrecht), J.-P. Dufour (Montpellier), E. Getzler (Northwestern), V. Ginzburg (Santa Cruz), V. Guillemin (MIT), J. Huebschmann (Lille), B. Khesin (Toronto), Y. Karshon (Jerusalem), J.-H. Lu (Arizona), Y. Maeda (Keio), E. Meinrenken (Toronto), J.-P. Ortega (Nice), T. Ratiu (Lausanne), N. Reshetikhin (Berkeley), D. Roytenberg (Penn State), P. Severa (Bratislava), A. Weinstein (Berkeley), C. Woodward (Rutgers), P. Xu (Penn State), N. T. Zung (Montpellier).

Information: http://www.math.ist.utl.pt/Poisson2002/.

4-6 **The Fourth International Workshop on Automated Deduction in Geometry**, RISC-Linz, Hagenberg, Austria. (Mar. 2002, p. 359)

Description: The fourth workshop ADG 2002 to be held in Hagenberg (near Linz), Austria, September 2002, will continue ADG's emphasis on theory and algorithms, implementation, experiments, and applications to science, engineering and industry.

Important Dates: Deadline for extended abstract submission: June 3, 2002; notification of acceptance or rejection: July 3, 2002; workshop taking place: September 4-6, 2002; deadline for full paper submission: November 4, 2002.

Topics: Specific topics for ADG 2002 include (but are not limited to): polynomial algebra, invariant and coordinate-free methods, probabilistic, synthetic, and logic approaches, techniques for automated geometric reasoning from discrete mathematics, combinatorics, and numerics; symbolic and numeric methods for geometric computation, geometric constraint solving, automated generation/reasoning and manipulation with diagrams; design and implementation of geometry software, special-purpose tools, automated theorem provers, experimental studies; applications of ADG to mechanics, geometric modeling, CAGD/CAD, computer vision, robotics and education.

Submission: Potential participants of ADG 2002 are invited to submit an extended abstract of three or more pages or a full paper describing their work to be presented at ADG 2002. The submitted extended abstracts and full papers will be reviewed by members of the program committee (PC) for presentation at the workshop. Electronic submissions are preferred and should be sent to chairman: Prof. Dr. Franz Winkler, RISC-Linz, Johannes Kepler Universitaet, Linz, A-4040 Linz, Austria; e-mail: Franz.Winkler@risc.uni-linz.ac.at; phone: +43 (0)732 2468 9943; fax: +43 (0)732 2468 9930.

Important Dates: Deadline for extended abstract submission: June 3, 2002; notification of acceptance or rejection: July 3, 2002; workshop taking place: September 4-6, 2002; deadline for full paper submission: November 4, 2002.

Information: For an up-to-date version of the cfp, please check http://www.risc.uni-linz.ac.at/conferences/adg2002/.

4-7 **International Conference on Dynamical Methods for Differential Equations**, Medina del Campo, Valladolid, Spain. (Oct. 2001, p. 1051)

Description: The conference will focus on those recent advances in topological methods and ergodic theory which are relevant to the analysis of ordinary differential equations, partial differential equations and functional equations, as well as on their applications to science and technology.

Information: http://wmatem.eis.uva.es/~dmde02/.

*4-7 **Stochastic Analysis and Related Topics**, Research Inst. for Math. Sci., Kyoto Univ., Kyoto, Japan.

Organizer: Y. Takahashi, Research Institute for Mathematical Sciences, Kyoto Univ., Oiwake-cho, Kitashirakawa, Sakyo-ku, Kyoto 606-8502, Japan.

Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

5 **PIMS Numerical Analysis Potlatch 2002**, University of Victoria, Victoria, British Columbia, Canada. (May 2002, p. 607)
Information: Contact: pims@pims.math.ca.

9-13 **Axiomatic and Enriched Homotopy Theory**, Isaac Newton Institute for Mathematical Sciences, Cambridge, England. (Apr. 2002, p. 503)
Workshop Organizers: P. G. Goerss and J. P. C. Greenlees.
Information: Isaac Newton Institute for Mathematical Sciences, 20 Clarkson Road, Cambridge, CB3 0EH; tel: +44 (0) 1223 335999; fax: +44 (0) 1223 330508; e-mail: info@newton.cam.ac.uk. Please refer to our website, http://www.newton.cam.ac.uk/programs/NST/, for full details of how to apply for these workshops.

9-13 **IMA Tutorial: Supply Chain and Logistics Optimization**, Minneapolis, Minnesota.
Organizers: C. Barnhart (MIT), M. Juenger (Univ. zu Koeln), D. Simchi-Levi (MIT).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/fall/t1.html.

9-21 **Marrakech 2002 School on Delay Differential Equations and Applications**, Marrakech, Morocco.
Topics: The school lasts two weeks. The first week starts with a historical perspective given by Prof. J. K. Hale about the motivations and the developments of functional differential equations. It then turns to general theory, with some emphasis on existence results, and first of all on the very notion of a delay or functional differential equation. Linear delay differential equations in finite as well as in infinite dimensions will be presented as well as fundamental results about spectral properties of such equations. The theory of semilinear d.d.e. will also be briefly recapitulated as a preparatory step for a detailed treatment of the Hopf bifurcation theorem, which will be presented both in finite and infinite dimensions. During the second week the emphasis is put on applications, with special attention to the geometry of delay equations. Some attention will also be given to control in delay systems, on delay in population dynamics, and on the effect of (random) "noise" on the dynamical properties of delay equations.
Information: http://euromedbiomath.m2002.free.fr/.

9-27 **School and Conference on Intersection Theory and Moduli**, The Abdus Salam International Centre for Theoretical Physics (ICTP), Strada Costiera 11, I-34014, Trieste, Italy. (Mar. 2002, p. 360)
Directors: E. Arbarello (Scuola Normale Superiore, Pisa, Italy), G. Ellingsrud (University of Oslo, Norway), L. Göttsche (ICTP).
Local Organizer: L. Göttsche.
Deadline: Deadline for requesting participation is April 15, 2002.
Information: Details available shortly from: http://www.ictp.trieste.it/cgi-bin/ICTPsmr/mkhtml/smr2html.pl?smr1426/Announcement/.

10-20 **Advanced Course on Geometric 3-Manifolds**, Bellaterra (Barcelona), Spain. (Jan. 2002, p. 58)
Coordinator: J. Porti.
Information: http://www.crm.es/geom-mani/.

11-13 **EACA-2002, VIII Encuentro de Álgebra Computacional y Aplicacione**, Palacio de Avellaneda, Peparanda de Duero, Spain.
Description: The main goal of this series of meetings on computer algebra and applications (EACA) is to provide a forum for researchers on computer algebra as well as for researchers who essentially use these techniques in their investigation. Originally, this was a Spanish forum, but it is not restricted to Spanish people. In the last EACA events, many researchers from all over the world participated. The EACA-2002 is the eighth EACA meeting. As in the previous events of this series, the participation of young researchers is especially encouraged.
Organizer: P. Gimenez (pgimenez@agt.uva.es, Univ. of Valladolid).
Plenary Speakers: C. Andradas (Univ. Complutense, Madrid), B. Buchberger (RISC-Linz), J. Elias (Univ. Barcelona), I. Emiris (INRIA, Nice), A. Simis (Univ. F. Pernambuco, Recife), U. Walther (Purdue Univ.).
Deadlines: April 30: deadline for abstract submission; June 28: deadline for registration .
Information: http://www.uva.es/eaca2002/; e-mail: eaca2002@agt.uva.es.

* 11-13 **The Structure of Operator Algebras and its Applications**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: K.-S. Saito, Faculty of Science, Niigata Univ., 8050 Nino-cho, Ikarashi, Niigata 950-2181, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

11-18 **NSEC8: Navier-Stokes Equations and Related Topics**, Euler International Mathematical Institute, St. Petersburg, Russia. (Feb. 2002, p. 271)
Scope: The conference is focused on mathematical problems arising in the theory of viscous fluids, such as existence and uniqueness of solutions, differentiability properties of solutions, long-time behavior, and applications of the above topics to the analysis of contemporary problems in fluid mechanics.
Topics: Papers are solicited in all research areas related to mathematical problems in the theory of viscous fluids, including, but not limited to: compressible and incompressible Navier-Stokes equations; mathematical analysis of NS equations in bounded and unbounded domains; existence and regularity of solutions; stability and long-time behavior of solutions, asymptotical analysis; properties of solutions in domains with nonsmooth boundaries; inviscid fluids; mathematical modeling of fluids with complex rheology; models of non-Newtonian fluids; visco-plastic and visco-elastic fluids; fluids with complex rheology (electrorheological fluids, magnetorheological fluids, etc.); mathematical aspects of computational analysis; approximation methods for compressible and incompressible viscous flows; convergence of finite element, finite volume, finite difference, and spectral methods; a priori and a posteriori estimates of the accuracy of approximations.
Program Committee: O. Ladyzhenskaya (St. Petersburg) (chairman); H. Amann (Zurich); H. Beirao da Veiga (Pisa); C. Fefferman (Princeton); Y. Giga (Hokudai); M. Gunzburger (Iowa); R. Kohn (New York); V. Pukhnachev (Novosibirsk); G. Seregin (St. Petersburg); V. Solonnikov (St. Petersburg).
Information: URL: http://www.pdmi.ras.ru/EIMI/2002/NSEC8/; e-mail: nsec8@imi.ras.ru; fax: 7 (812) 3105377, 7 (812) 2345819.

13-14 (REVISED) **Topics in Linear Algebra**, Iowa State Univ., Ames, Iowa. (Oct. 2001, p. 1051; Jan. 2002, p. 58)
Sponsors: Inst. for Mathematics and its Applications, International Linear Algebra Society, and Iowa State Univ.
Organizers: L. Hogben (lhogben@iastate.edu), B. Cain (bcain@iastate.edu), L. DeAlba (luz.dealba@drake.edu), I. Hentzel (hentzel@iastate.edu), M. Mills (millsm@central.edu), Y. T. Poon (ytpoon@iastate.edu), H. Wu (isuhwu@iastate.edu).
Invited Speakers: S. Hedayat (ILAS Lecturer), Univ. of Illinois-Chicago; D. P. Jacobs, Clemson Univ.; C. R. Johnson, College of William and Mary; C. K. Li, College of William and Mary; H. Schneider, Univ. of Wisconsin-Madison.
Description: This conference will provide an opportunity for those working in several areas of linear algebra to meet, share ideas, and work together. The conference is organized around the following topics: matrix completion problems, numerical ranges,

matrix stability and convergence, applications of linear algebra to nonassociative algebra, statistical applications of linear algebra. For each topic there will be a presentation by an invited speaker, a session for contributed papers, and a work session. There will also be a contributed paper session for areas of linear algebra within the focus of the conference but not specifically within one of the topics. Speakers will have the opportunity to submit their papers for publication in a special issue of the *Electronic Journal of Linear Algebra* (ELA), "Proceedings of the Topics in Linear Algebra Conference". All papers will be refereed by ELA to its usual standards.
Call for Papers: Contributed talks of 20 minutes in length are invited. To contribute a talk, submit the title and abstract by May 1, 2002, to L. DeAlba (luz.dealba@drake.edu).
Information: http://www.math.iastate.edu/lhogben/TLA/homepage.html.

15-21 **Theory and Applications of Imaging**, Martina Franca (Taranto), Italy.
Scientific Direction: G. Papanicolau (Stanford Univ., USA, papanico@georgep.stanford.edu); G. Talenti (Univ. di Firenze, Italy, talenti@math.unifi.it).
Courses: Array imaging in noisy environments, G. Papanicolau (Stanford Univ., USA); Tomographic imaging, F. Natterer (Univ. of Munster, Germany); Diffuse imaging for medical diagnoses, S. R. Arridge, (Univ. College, London, UK); Experimental methods and results in laser-tissue imaging, R. R. Alfano (Inst. for Ultrafast Spectroscopy and Lasers, CUNY, New York); Seismic imaging, W. W. Simes (Rice Univ., USA).
Information: For any further information contact: Fondazione C.I.M.E. c/o Dipartimento di Matematica "U. Dini", Viale Morgagni, 67/A - 50134 Firenze, Italy; Tel. +39-55-434975/ +39-55-4237123; fax +39-55-434975 / +39-55-4222695; http://www.math.unifi.it/cime/.

15-22 **International Summer School on Operator Methods for Evolution Equations and Approximation Problems (OMEEAP 2002)**, Hotel Villaggio Cala Corvino, Monopoli, Bari, Italy.
Aim: The school is especially addressed to Ph.D. students and young researchers. A poster session in which the youngest researchers can outline their research work and interests will also be arranged.
Topics: Feller semigroups and Markov processes, positive operators and approximation of functions, positive operators and approximation for evolution equations, semigroups of operators and evolution equations, cosine families of operators and evolution equations.
Invited Speakers of the Courses: J. van Casteren (Univ. of Antwerp), H. H. Gonska (Univ. of Duisburg), J. Prüss (Univ. of Halle-Wittenberg), I. Raşa (Technical Univ. of Cluj-Napoca), Sen-Yen Shaw (National Central Univ. of Chung-li).
Invited Lecturers: J. A. Adell (Univ. of Zaragoza), D.-H. Mache (Univ. of Dortmund), Giuseppe Mastroianni (Univ. of Basilicata), A. Rhandi (Univ. of Marrakech), V. Vespri (Univ. of Firenze).
Executive Organizing Committee: F. Altomare (altomare@dm.uniba.it), A. Attalienti (attalienti@matfin.uniba.it), M. Campiti (campiti@dm.uniba.it), L. D Ambrosio (dambros@dm.uniba.it), S. Diomede (s.diomede@dse.uniba.it), G. Metafune (Giorgio.Metafune@le.infn.it), D. Pallara (Diego.Pallara@le.infn.it).
Grants: In order to foster the participation of young researchers, some scholarships for attendance (as widely as possible) will likely be available. Applications for scholarships must be sent to F. Altomare, Dipartimento di Matematica Dell Univ. e del Politecnico di Bar Campus Univ., Via E. Orabona, 4, 70125 Bari, Italy (altomare@dm.uniba.it, telefax number: +39-080-5963612) no later than May 31; the applicants must also include a short curriculum vitae and a letter of recommendation.
Deadline for Registration: May 31; no registration fee is required.
Information: Contact one of the executive organizers or visit the website http://www.dm.uniba.it/documenti/formazione/SummerSchool-OMEEAP2002/index.htm.

16-18 **KES'2002 Sixth International Conference on Knowledge-Based Intelligent Information & Engineering Systems**, Podere d'Ombriano, Crema, Italy. (Apr. 2002, p. 503)
Topics: Special session: Machine learning in bioinformatics, http://www.dsi.unifi.it/~paolo/kes02.html. This special session aims to present and discuss state-of-the-art algorithms and methodologies in computational molecular biology where machine learning plays a key role. Topics of interest include (but are not limited to) applications of machine learning to: protein folding and protein structure prediction; gene expression data and DNA micro-arrays; protein-protein interaction; finding signals and motifs in DNA sequences; inference of genetic networks; analysis of gene structure and regulation; phylogenetic analysis; QSAR and QSPR.
Information: P. Frasconi, Dept. of Systems and Computer Science, University of Florence, Via di Santa Marta 3, I-50139 Firenze, Italy; phone: +39 055 4796 362; fax: +39 055 4796 363; http://www.dsi.unifi.it/~paolo/.

16-20 **Homotopy Theory of Geometric Categories**, Isaac Newton Institute for Mathematical Sciences, Cambridge, England. (Apr. 2002, p. 503)
Workshop Organizers: J. F. Jardine and F. Morel.
Information: Isaac Newton Institute for Mathematical Sciences, 20 Clarkson Road, Cambridge, CB3 0EH; tel: +44 (0) 1223 335999; fax: +44 (0) 1223 330508; e-mail: info@newton.cam.ac.uk. Please refer to our website, http://www.newton.cam.ac.uk/programs/NST/, for full details of how to apply for these workshops.

16-20 **LMS/EPSRC Short Course on Differential Geometry, Homogeneous Spaces and Integrable Systems**, University of Durham, United Kingdom.
Description: The instructional course is aimed at research students, both beginning and more advanced. It is funded by the London Mathematical Society and the Engineering and Physical Sciences Research Council (UK). The course consists of three lecture series.
Lecture Series: M. Micallef (Warwick), Introduction to Differential Geometry; D. Alekseevsky (Hull), Lie Groups and Homogeneous Spaces; M. Guest (Tokyo), Geometry and Integrable Systems.
Registration Deadline: July 5, 2002.
Organizers: J. Berndt (Hull), J. Bolton (Durham).
Contacts: j.berndt@hull.ac.uk, john.bolton@durham.ac.uk.
Information: http://www.hull.ac.uk/LMS-DG/.

*16-December 13 **Mathematics in Nanoscale Science and Engineering**, Insitute for Pure and Applied Mathematics at UCLA, Los Angeles, California.
Information: http://www.ipam.ucla.edu/programs/nano2002/.

*17-19 **Nonlinear Analysis and Convex Analysis**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: T. Nishishiraho, Faculty of Science, Univ. of the Ryukyus, 1, Senbaru, Nishiharacho, Nakagami-gun, Okinawa 903-0213, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

*17-19 **Viscosity Solutions of Differential Equations and Related Topics**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: H. Ishii, School of Education, Waseda Univ., 1-6-1, Nishi-Waseda, Shinjuku-ku, Tokyo 169-8050, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

17-23 **International Algebra Conference Dedicated to the Memory of Zenon Borewicz (1922-1995)**, Saint Petersburg, Russia. (Apr. 2002, p. 503)

Topics: The conference will cover all areas of algebra, algebraic number theory and algebraic geometry, with special emphasis in topics close to the research interests of Borewicz, viz. local and global fields, representation theory, homological algebra and algebraic K-theory, linear and algebraic groups. We plan both plenary talks and short communications in smaller thematic sections.
Information: If you are interested in participating in the conference and would like to receive further information, please respond to Borevich.conf@northes.spb.su.

20-21 **AD-HOC NetwOrks and Wireless (ADHOC-NOW)**, The Fields Institute, Toronto, Ontario, Canada. (May 2002, p. 607)
Scope: We are interested in work in progress, experimental and theoretical research in Ad-Hoc, Mobile and Wireless Networks.
Program Co-chairs: M. Barbeau and E. Kranakis, Carleton University, School of Computer Science, Ottawa, Ontario K1S 5B6, Canada.
Information: For more information see website http://www.scs.carleton.ca/%7Eadhocnow/.

20-22 (REVISED) **Conference on the Hilbert-Smith Conjecture and Its Proof**, Instanbul Bilgi University, Instanbul, Turkey.
Description: There will be a limited number of short talks, 20-30 min. Those wishing to speak should send their requests and abstracts to either L. F. McAuley at louis@math.binghamton.edu or louis@bilgi.edu.tr or to A. Ratiu at ratiu@bilgi.edu.tr.
Some of the Principal Speakers Are: A. Borel, A. V. Chernavsky, D. Repovs, S. Illman, L. F. McAuley.

20-22 **Yamabe Memorial Symposium**, University of Minnesota, School of Mathematics, Minneapolis, Minnesota. (Apr. 2002, p. 503)
Description: The Yamabe Memorial Symposium is held in memory of Hidehiko Yamabe (1923-1960), whose significant work on topological groups and geometry were outstanding contributions to modern mathematics.
Main Speakers: P. Li, R. Hamilton, F.-H. Lin, and B. Chow.
Organizing Committee: R. Gulliver, D. Kahn, N.-C. C. Leung, J. Wang.
Financial Support: Interested younger participants are invited to apply for partial support for travel and local expenses. Please supply a brief research summary or C.V. and a letter of reference.
Information: E-mail: yamabe@math.umn.edu, tel: (612) 625-5591. The final list of speakers and other conference details will be posted at http://www.math.umn.edu/~gulliver/confs/yamabe.html.

20-25 **International Conference on Computational and Math. Methods in Science and Engineering (CMMSE 2002)**, Alicante, Spain. (Oct. 2001, p. 1051)
Topics: Celestial mechanics, computational chemistry & physics, computational engineering, computational mathematics, computational statistics, high performance computing, industrial mathematics, mathematical economics & finance, mathematical models for the information society.
Sponsors: Univ. de Alicante, and the Center for Industrial Mathematics, Univ. of Wisconsin-Milwaukee.
Program: The conference aims to act as a unifying, cross-cutting, interdisciplinary catalyst where specialists can have exposure to others' fields as well as participate in special sessions at the forefront of their own specialties. The program consists of 1-hour plenary lectures that highlight major accomplishments, trends, and technical challenges in scientific computing in selected fields of research, special sessions with 25-minute invited talks, and a poster session.
Call for Papers: Researchers are invited to propose special sessions to the general chairs or submit papers for 25-minute talks or the poster session.
Important Dates: December 15, 2001: Declaration of participation and submission of abstract of minimum three A4 pages in standard LaTeX; January 30, 2002: Notice of acceptance, early registration begins; March 1, 2002: End of early registration, standard registration begins; June 15, 2002: Full paper submission; maximum ten A4 pages in standard LaTeX; July 30, 2002: Confirmation, program is set; September 20-25, 2002: Conference (9/22 is a free day).
Information: http://www.ua.es/cmmse2002/ or http://www.uwm.edu/Dept/CIM/.

*21-28 **Random Matrix Theory with Various Applications**, Grand Hotel Bellavista, Levico Terme, Italy.
Description: Random matrix theory has been initiated by Wigner to model energy levels of certain quantum mechanical systems. After his work, random matrices have proven to be useful in many fields. This school gives an introduction to the main random matrix ensembles in the form in several intensive courses.
Main Lecturers: F. Hiai, B. Khoruzhenko, D. Petz, and S. Thorbjornsen.
Deadline: July 15, 2002.
Information: http://www.math.bme.hu/~petz/rmatrix.html; the application form can be downloaded from there. The participation fee is 500 EUR, but some grants are available for young and talented participants.

23-26 **8th European Conference on Logics in Artificial Intelligence: Jelia'02**, Cosenza, Italy.
Aim and Scope: The aim is to bring together active researchers interested in all aspects concerning the use of logics in artificial intelligence to discuss current research, results, and problems and applications of both a theoretical and practical nature. Moreover, Jelia strives to foster links and facilitate cross-fertilization of ideas among researchers from various disciplines; among researchers from academia, industry and government; and between theoreticians and practitioners.
Invited Speakers: M. Gelfond (Texas Tech Univ., USA), G. Gottlob (Vienna Univ. of Technology, Austria), M. Vardi (Rice Univ., USA), K. Apt (CWI National Res. Inst. for Math. and Comput. Sci. in the Netherlands).
Tutorials: V. S. Subrahamanian (Univ. of Maryland, USA): Logic-based agents; D. Pedreschi and F. Giannotti (Univ. of Pisa, Italy): Logics and data mining; G. Pfeifer (Vienna Univ. of Tech., Austria): Answer set programming.
Information: http://www.unical.it/jelia/.

*23-27 **First International Course of Mathematical Analysis in Andalucia**, Dept. of Math., Univ. of Cádiz, Cádiz, Spain.
Topics: Banach algebras, operator theory, Banach spaces, nonlinear analysis.
Organizers: Dept. of Math., Univ. of Cádiz.
Speakers: J. L. González-Llavona, M. González-Ortiz, S. Reich.
Information: http://www2.uca.es/dept/matematicas/curso/; e-mail: cursos.andalucia@uca.es.

23-27 **IMA Workshop 1: The Role of Optimization in Supply Chain Management**, Minneapolis, Minnesota.
Organizers: B. Dietrich (IBM), G. Nemhauser (GATech), D. Simchi-Levi (MIT).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/fall/op1.html.

23-27 **Ramification in Arithmetic and Geometry**, Institut Galilée, Université Paris 13, France. (Oct. 2001, p. 1051)
Organizers: A. Abbes (Paris), B. Erez (Bordeaux), T. Saito (Tokyo).
Information: http://www-math.math.univ-paris13.fr/~ramifica/.

23-28 **Workshop on Categorical Structures for Descent and Galois Theory, Hopf Algebras and Semiabelian Categories**, The Fields Inst. for Research in Math. Sciences, Toronto, Canada. (Dec. 2001, p. 1368)
Description: The goal of the meeting is to spread and to advance categorical methods and their application amongst researchers

working in three overlapping areas of algebra, namely in the study of: (i) algebraic structures in monoidal categories and their classical examples, such as Hopf, Frobenius, and Azumaya algebras, and others, particularly those occurring in quantum field theory; (ii) Galois theory vis-a-vis Grothendieck's descent theory, as well as the general theory of separability and decidability, applied particularly to the structures mentioned in (i); (iii) homological algebra of nonabelian structures, such as groups, rings and (associative or Lie) algebras, and its extension to the structures mentioned in (i).
Organizers: G. Janelidze, B. Pareigis, W. Tholen.
Information: http://www.fields.utoronto.ca/programs/scientific/02-03/galois_and_hopf/ or contact tholen@mathstat.yorku.ca.

23-October 4 **The Calculemus Autumn School**, Pisa, Italy.
Objectives: The main objectives of the Calculemus Autumn School are: to give young researchers a perspective on the state-of-the-art in symbolic computation and symbolic reasoning; to disseminate advanced scientific knowledge on the integration of computer algebra systems and deduction systems; to foster contacts between the research communities of computer algebra, deduction, math education, and industry. The participants will be trained both theoretically as well as experimentally on selected tools.
Courses and Schedule: For the list of courses and the preliminary schedule visit: http://www.eurice.de/calculemus/autumn-school/courses2.html and http://www.eurice.de/calculemus/autumn-school/timetable.pdf/.
Registration: Registration deadline is July 1, 2002.
Contact: E-mail: calculemus-autumn-school@eurice.de.
Information: Please visit our webpage for further information on the event: http://www.eurice.de/calculemus-school/.

*24-26 **Algebraic Systems, Formal Languages and Conventional and Nonconventional Computation Theory**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: M. Ito, Faculty of Science, Kyoto Sangyo Univ., Motoyama, Kamigamo, Kita-ku, Kyoto, 603-8555, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

24-27 **Symposium on Informatics and Telecommunications**, Sevilla, Spain.
Organizer: Organized under the auspices of DINTEL (http://www.fundacion-dintel.org).
Description: SIT'02 is the Spanish Symposium on Informatics and Telecommunications. It is not a pure scientific meeting, but a mixed gathering where people from industry and academia are expected to exchange ideas and experiences and foster lively discussions on topics ranging from pervasive computing to real-time distributed systems or security concerns.
Information: http://tdg.lsi.us.es/~sit02/.

25-28 **International Conference on Computer Geometry: Information Geometry, Foundation of Computer Science, Erdős-Diophantine Graphs**, Plovdiv Universitym-Filial Smolyan, Smolyan, Bulgaria. (Mar. 2002, p. 360)
Conference Topics and Purpose: Bringing together specialists in information geometry, foundations of computer science and Erdős-diophantine graphs for stimulating cross-disciplinary activities.
Registration Fee: US$85. Accommodations and meals: no more than US$30 per day.
Scientific Program Committee: Tsukuba University (Japan): T. Kawaguchi (Chairman), R. Ivanova, S. Igarashi, T. Ida, M. Sato; Plovdiv University (Bulgaria): D. Mekerov (Dean), G. Zlatanov, K. Gribachev, E. Pavlov, A. Rahnev; Sofia University (Bulgaria): Gr. Stanilov, B. Shishkov; local organizing committee: S. Dimiev (Chairman), A. Rahnev, R. Ivanova, M. Manev, D. Frenkev, S. Ludneva.

*30-October 2 **Mathematical Aspects of Quantum Field Theory and Applications**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: M. Abe, Research Institute for Mathematical Sciences, Kyoto Univ., Oiwake-cho, Kitashirakawa, Sakyo-ku, Kyoto, 606-8502, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

30-October 4 **DIMACS Workshop on Geometric Graph Theory**, DIMACS Center, Rutgers University, Piscataway, New Jersey.
Sponsors: DIMACS Center.
Organizers: J. Pach, NYU, Courant Institute.
Deadline for Submissions: May 15, 2002.
Contacts: J. Pach, pach@cims.nyu.edu.
Local Arrangements: J. Herold, DIMACS Center, jessicah@dimacs.rutgers.edu; tel: 732-445-5928.
Information: Visit http://dimacs.rutgers.edu/Workshops/GeometricGraph/.

30-October 4 **K-Theory and Arithmetic**, Isaac Newton Institute for Mathematical Sciences, Cambridge, England. (Apr. 2002, p. 504)
Workshop Organizers: S. Lichtenbaum and V. P. Snaith.
Information: Isaac Newton Institute for Mathematical Sciences, 20 Clarkson Road, Cambridge, CB3 0EH; tel: +44 (0) 1223 335999; fax: +44 (0) 1223 330508; e-mail: info@newton.cam.ac.uk. Please refer to our website, http://www.newton.cam.ac.uk/programs/NST/, for full details of how to apply for these workshops.

*30-October 4 **Mathematics in Nanoscale Science and Engineering Workshop I: Alternative Computing**, Institute for Pure and Applied Mathematics at UCLA, Los Angeles, California.
Information: http://www.ipam.ucla.edu/programs/nanoalt/.

October 2002

4-5 **Ninth Midwest History of Mathematics Conference and 30th Annual Miami University Mathematics and Statistics Conference**, Miami University, Oxford, Ohio.
Theme and Call for Papers: The program will focus on the history of mathematics in America. Authors wishing to contribute a 15-minute paper consistent with this theme should submit an abstract by September 1, 2002.
Invited Speakers: K. H. Parshall (Univ. of Virginia) and D. Zitarelli (Temple Univ.).
Information: The conference director is D. E. Kullman (Miami Univ.), kullmade@muohio.edu. Abstracts of contributed papers and requests for information should be sent to: History of Mathematics Conference, Dept. of Math. and Stat., Miami Univ., Oxford, Ohio 45056; tel: 513-529-5818; fax: 513-529-1493; website: http://unixgen.muohio.edu/~MathStat/. Conference programs with information about registration and housing will be available after August 1.

4-5 **SIAM Symposium on Computational Models and Simulation for Intra-cellular Processes**, Hilton Garden Inn, Washington, DC. (May 2002, p. 608)
Description: The interaction between the mathematical and computational sciences and biology has been growing in importance in the last decade, but it is still a beginning. There is tremendous room for progress. For example, major advances are needed in mathematical and statistical methods to have significant impact on the prediction and control of spatio-temporal cellular behavior. Some specific processes that are amenable to mathematical methods are networks of molecular interactions such as gene-gene, gene-protein, and protein-protein. Applications of such interactions include discovery of functional modules in cellular systems, and rapid and precise identification of targets and design of intervention methods that influence molecular dynamics.

Information: Contact: meetings@siam.org.

5-6 **AMS Eastern Section Meeting**, Northeastern University, Boston, Massachusetts.
Information: http://www.ams.org/amsmtgs/sectional.html.

6-11 **Quantum Control: Mathematical and Numerical Challenges**, Centre de Recherches Mathématiques, Montréal, Canada.
Topic: This conference will concentrate on advanced numerical methods and new mathematical tools for control and optimization in the quantum control of matter at the molecular level using current advanced laser technology.
Organizers: A. Bandrauk (Sherbrooke, Canada), M. Delfour (Montreal, Canada), C. Le Bris (ENPC, Paris, France).
Information: Conference website: http://omega.CRM.UMontreal.CA/QuantumC/.

*7-9 **DIMACS Workshop on Signal Processing for Wireless Transmission**, DIMACS Center, Rutgers University, Piscataway, New Jersey.
Short Description: In contrast to the voiceband telephone channel, the wireless channel suffers from interference from other users and from fading due to destructive addition due to multipath propagation. The aim of this workshop is to explore the ultimate limits that information theory puts on spectral efficiency, as well as the best means of striving toward that efficiency. Multiuser detection and "Dirty Paper Coding" are among the key signal processing countermeasures that promise substantial improvements over existing systems. This workshop will investigate such approaches from both a link and network level perspective. The enhancements from multiple antennas will also be explored, including means of space-time coding.
Sponsors: DIMACS Center.
Organizers: S. Verdu, Princeton University, verdu@princeton.edu; J. Foschini, Bell Labs, gjf@research.bell-labs.com.
Early Registration Deadline: October 1, 2002.
Local Arrangements: J. Thiemann, DIMACS Center, jennifer@dimacs.rutgers.edu; tel: 732-445-5928.
Information: http://dimacs.rutgers.edu/Workshops/Wireless/

*7-10 **Microlocal Analysis and Asymptotic Analysis of Systems of Equations**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: K. Kataoka, Graduate School of Mathematical Sciences, The Univ. of Tokyo, 3-8-1, Komaba, Meguro-ku, Tokyo 153-8914, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

*9-11 **Problems and Applications in General and Geometric Topology**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: T. Kimura, Faculty of Education, Saitama Univ., 255, Shimo-0kubo, Saitama, 338-8570, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

*9-11 **Studies in Relative Consistency Proofs with Particular Emphasis on Set Theoretic Methods**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: T. Miyamoto, Math. Dept., Nanzan Univ., 27 Seirei-cho, Seto City, Aichi 489-0863, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

9-11 **The 7th Conference "Shell Structures. Theory and Applications" (SSTA2002)**, Gdansk, Poland. (Jan. 2002, p. 58)
Information: http://www.pg.gda.pl/ssta2002/. For additional information please contact Conference Secretary (ssta2002@pg.gda.pl).

12-13 **AMS Central Section Meeting**, University of Wisconsin-Madison, Madison, Wisconsin.
Information: http://www.ams.org/amsmtgs/sectional.html.

14-19 **IMA Workshop 2: Computational Methods for Large Scale Integer Programs**, Minneapolis, Minnesota.
Sponsors: Jointly sponsored by the Centre de Recherches Mathématiques.
Organizers: W. Cook (Princeton), M. W. P. Savelsbergh (GATech), G. Nemhauser (GATech).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; Phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/fall/op2.html.

*14-20 **Perspectives in Classification and Moduli Theory: A Conference in Algebraic Geometry**, Scuola Normale Superiore, Cortona, Italy.
Sponsors: INDAM, Cofin, MIUR, MIT.
Scientific Committee: L. Caporaso, A. Lopez, M. Manetti.
Preliminary List of Speakers: D. Abramovich, F. Andreatta, M. Andreatta, L. Bonavero, F. Catanese, L. Chiantini, A. Corti, O. Debarre, L. Ein, C. Faber, W. Fulton*, E. Getzler*, M. Mella, L. Migliorini, M. Mustata, K. O'Grady, G. Pacienza, P. Pirola, N. Shepherd-Barron, K. Smith*, S. Verra, E. Viehweg, A. Vistoli, J. Wlodarczyk, F. Zak (* means "to be confirmed").
Information: http://www.mat.uniroma3.it/cortonaPCMT/; e-mail: cortona@mat.uniroma3.it.

*15-17 **Analysis of Inverse Problems and Its Related Topics**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: Y. Iso, Graduate School of Informatics, Kyoto Univ., Honmachi, Yoshida, Sakyo-ku, Kyoto, 606-8501, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

*16-18 **New Developments in Evolution Equations and Approaches to Nonlinear Phenomena**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizers: S. Oharu, Dept. of Math., Chuo Univ., 1-13-27, Kasuga, Bunkyo-ku, Tokyo 112-8551, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

*18-19 **Second Prairie Analysis Seminar**, University of Kansas, Lawrence, Kansas.
Organizers: E. A. Gavosto (Univ. of Kansas), M. Korten (Kansas State Univ.), C. Moore (Kansas State Univ.), R. H. Torres (Univ. of Kansas).
Principal Lecturer: D. Tataru (UC Berkeley).
Invited Speakers: C. Muscalu (UCLA) and W. Schlag (CalTech).
Information: There will be time allocated for short contributed talks. For more information see http://www.math.ukans.edu/conferences/prairie/, or write to R. Torres, e-mail: torres@math.ukans.edu.

18-19 **The 24th Midwest Probability Colloquium**, Northwestern University, Evanston, Illinois.
Workshops: On Thursday, October 17, there will be a workshop on related topics including talks by Y. Peres (Berkeley) and B. Virag (MIT). Topics include stochastic Lowener evolution with applications, percolation on trees, discrete lattice processes, and scaling limits in higher dimensions.

Main Speaker: O. Schramm (Microsoft), together with A. Dembo (Stanford) and F. Rezhankalou (Berkeley).
Organizing Committee: C. Mueller, E. Kosygina, and S. Sethuraman.
Information: Contact M. Pinsky (pinsky@math.nwu.edu).

*21-23 **Mathematics in Nanoscale Science and Engineering Workshop II: Joint IPAM/MSRI Workshop on Quantum Computing**, Institute for Pure and Applied Mathematics at UCLA, Los Angeles, California.
Information: http://www.ipam.ucla.edu/programs/nanoquant/

*21-24 **WSEAS International Conferences**, Rio de Janeiro, Brazil.
Conferences: System Science (ICOSYS 2002), Applied Mathematics and Computer Science (AMCOS 2002), Power Engineering Systems (ICOPES 2002).
Types of Submission Accepted: Papers, Special Sessions, Tutorials, Workshops, Panel Discussions. All submissions are to be done electronically. The submission pages as well as other conference details can be found at: http://www.wseas.com/conferences/2002/brazil/icosys/ (ICOSYS 2002), http://www.wseas.com/conferences/2002/brazil/amcos/ (AMCOS 2002), http://www.wseas.com/conferences/2002/brazil/icopes/ (ICOPES 2002).
Information: P. Ekel, Pontifical Catholic University of Minas Gerais, Av. Dom Jose Gaspar, 500, 30.535-610, Belo Horizonte, MG, Brazil; tel: +55031-3319-4305; Fax: 55-31-3319-4225.

*21-25 **Diophantine Problems and Analytic Number Theory**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: N. Hirata-Kohno, Dept. of Math., College of Sci. and Tech., Nihon Univ., 1-8, Surugadai, Kanda, Chiyoda-ku, Tokyo 101-8308, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

*23-25 **Mathematical Aspects and Applications of Nonlinear Wave Phenomena**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: T. Yoshinaga, Dept. of Math. Sci., Osaka Univ., 1-3, Machikaneyama-cho, Toyonaka City, Osaka 560-8531, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

24-25 **DIMACS Workshop on Visualization and Data Mining**, DIMACS Center, Rutgers University, Piscataway, New Jersey.
Sponsors: DIMACS Center.
Organizers: E. Gansner, AT&T; M. Goodrich, Univ. of California-Irvine; C. Silva, AT&T; R. Tamassia, Brown Univ.
Contacts: E. Gansner, erg@research.att.com; M. Goodrich, goodrich@ics.uci.edu; C. Silva, csilva@research.att.com; R. Tamassia, rt@cs.brown.edu.
Local Arrangements: J. Thiemann, DIMACS Center, jennifer@dimacs.rutgers.edu; tel: 732-445-5928.
Information: See http://dimacs.rutgers.edu/Workshops/VisDataMining/.

25-27 **2002 Conference on Applied Mathematics (CAM 2002)**, University of Central Oklahoma, Edmond, Oklahoma.
Topics: The conference will feature special sessions in error-correcting codes and wavelets and signal processing.
Speakers: Keynote speakers will be N. Sloane (AT&T Shannon Labs) and V. Wickerhauser (Washington Univ.-St. Louis).
Conference Organizers: J. Byrne, 100 N. University Drive, Edmond, OK 73034; jbyrne@ucok.edu; tel: (405) 974-5575; and C. Simmons, 100 N. University Drive, Edmond, OK 73034; cksimmons@ucok.edu; tel: (405) 974-5316.
Information and Deadlines: Papers are invited for contributed paper sessions, including a session for undergraduate and graduate student talks. Those interested in presenting may send an abstract and minivitae to the organizers by August 2. Grant proposals to provide travel support for a limited number of participants are pending with NSA and NSF. For more information, please visit the conference website at http://www.math.ucok.edu/.

26-27 **AMS Western Section Meeting**, University of Utah, Salt Lake City, Utah.
Information: http://www.ams.org/amsmtgs/sectional.html.

27-29 **King Fahd University of Petroleum and Minerals**, Dhahran, Saudi Arabia. (Mar. 2002, p. 360)
Workshop: For a workshop at KFUPM in related fields, contact W. S. Al-Sabah, organizing committee chairman, e-mail: walid@kfupm.edu.sa; or visit http://users.kfupm.edu.sa/imath/.
Description: Papers will include the following topics and related areas: Analysis on fractals, differential equations on fractals, interconnection between wavelet and fractals, wavelets and differential equations, wavelets and optimization, wavelets and image processing, theoretical aspects as well as real-life applications.
Speakers: U. Mosco (Rome), W. Freeden (Kaiserslautern), and S. Dahlke (Bremen) are guest technical editors. G. Korvin is the editor. The editorial committee invites papers for this issue.
Information: Detailed information can be obtained from A. H. Siddiqi, Dept. of Math. Sci., KFUPM, P.O. Box 1745, Dhahran 31261, Saudi Arabia; e-mail: ahasan@kfupm.edu.sa; tel: 00966-3-860-4548 (office), 00966-3-860-5239 (residence); fax: 00966-3-860-2340 (office); website: http://www.kfupm.edu.sa/webmath/ahasan.htm. Technical details may be obtained by visiting the KFUPM website, http://www.kfupm.edu.sa/ (main menu: Newsletters). The deadline for submission of papers is September 30, 2002.

*28-31 **PECS-IV: International Workshop on Photonic and Electromagnetic Crystal Structures**, Institute for Pure and Applied Mathematics at UCLA, Los Angeles, California.
Information: http://www.ipam.ucla.edu/programs/pecs-iv/.

*28-November 1 **International Conference on the Spectrum of Differential Operators and Inverse Problems**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: H. Isozaki, Graduate School of Science, Tokyo Metropolitan Univ., 1-1, Minami-Osawa, Hachioji City, Tokyo 192-0397, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

30-31 **4th Workshop on Geometric and Topological Methods in Concurrency Theory and Distributed Systems Theory (GETCO 2002)—A Satellite Workshop to DISC 2002**, ENSEEIHT, Toulouse, France.
Topics: Algorithmics for Concurrent or Distributed Systems, Semantics, Concurrency Theory, Model-Checking, Abstract Interpretation, Fault-Tolerant Protocols for Distributed Systems, Geometrical/Topological Models, Applications of Algebraic Topology, Category Theory, etc.
Deadline for Submission of Papers: July 19, 2002.
Program Committee: E. Goubault, Paris; M. Herlihy, Brown; M. Raussen, Aalborg.
Local Organization: E. Goubault.
Information: http://www.di.ens.fr/~goubault/getco02cfp.html and http://www.enseeiht.fr/~disc02/.

*30-November 1 **Mathematical Aspects of Complex Fluids III**, Research Inst. of Math. Sci., Kyoto Univ., Kyoto, Japan.
Organizer: O. Sano, Faculty of Tech., Tokyo Univ. of Agriculture and Technology, 2-24-16, Naka-cho, Koganei City, Tokyo 184-8588, Japan.
Information: For information on the workshops at the Research Institute for Mathematical Sciences, see http://www.kurims.kyoto-u.ac.jp/workshop-e.html.

*31-November 1 **Conference in Honor of Emeritus Regents' Professor Lawrence Markus's 80th Birthday**, School of Mathematics, University of Minnesota, Minneapolis, Minnesota.
Chair: J. Serrin (Minneapolis).
Keynote Speaker: C. Zeeman (Oxford and Warwick, England).
Speakers: N. Everitt (Birmingham, England), B. Lee (Minneapolis), W. Littman (Minneapolis), J. Mallet-Paret (Providence), K. Meyer (Cincinnati), G. Sell (Minneapolis).
Information: e-mail: swedell@math.umn.edu or http://www@math.umn.edu/.

November 2002

2-3 **PIMS Cascade Topology Conference**, University of British Columbia, Vancouver, British Columbia, Canada. (May 2002, p. 608)
Information: Contact: pims@pims.math.ca.

*4-7 **Mathematics in Nanoscale Science and Engineering Workshop III: Data Analysis and Imaging**, Institute for Pure and Applied Mathematics at UCLA, Los Angeles, California.
Information: http://www.ipam.ucla.edu/programs/nanodata/.

8-10 (REVISED) **Conference to Celebrate the 70th Birthday of Professor Avner Friedman**, University of Minnesota, School of Mathematics, Minneapolis, Minnesota.
Speakers: D. Kinderlehrer (Carnegie Mellon), M. Gurtin (Carnegie Mellon), B. Pulleyblank (IBM), G. Papanicolaou (Stanford), H. Matano (Univ. of Tokyo), B. Peletier (Leiden Univ.), R. Brualdi (Univ. of Wisconsin), D. James (Univ. of Minnesota), M. Steele (Univ. of Pennsylvania), G. McDonald (General Motors), N. Kopell (Boston Univ.), J. Guckenheimer (Cornell), K. H. Hoffman (Center for Advanced European Studies & Research, Bonn), W. Newman (UCLA).
Organizing Committee: N. Krylov, W. Littman, F. Reitich (chair), F. Santosa.
Information: Email: dept@math.umn.edu; tel: (612) 625-5591. The final list of speakers and other conference details will be posted on the department's website at http://www.math.umn.edu/.

9-10 **AMS Southeastern Section Meeting**, University of Central Florida, Orlando, Florida.
Information: http://www.ams.org/amsmtgs/sectional.html.

11-15 **IMA Workshop 3: Travel and Transportation**, Minneapolis, Minnesota.
Organizers: R. Anbil (Caleb Tech.), C. Barnhart (MIT), E. Johnson (GATech), W. R. Pulleyblank (IBM).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/fall/op3.html.

14-15 **DIMACS Workshop on Computational Geometry**, DIMACS Center, Rutgers University, Piscataway, New Jersey.
Sponsors: DIMACS Center.
Organizers: J. S. B. Mitchell, SUNY at Stony Brook.
Deadline for Submissions: October 11, 2002.
Contacts: J. S. B. Mitchell, jsbm@ams.sunysb.edu.
Local Arrangements: J. Herold, DIMACS Center, jessicah@dimacs.rutgers.edu; tel: 732-445-5928.
Information: http://dimacs.rutgers.edu/Workshops/CompGeom/

18-22 **International Conference on Fuzzy Systems and Knowledge Discovery (FSKD'02); 9th International Conference on Neural Information Processing (ICONIP'02); 4th Asia-Pacific Conference on Simulated Evolution and Learning (SEAL'02)**, Orchid Country Club, Singapore.
Information: http://www.ntu.edu.sg/home/nef/. Please visit the conference homepage or contact: L. Wang, ICONIP'02-SEAL'02-FSKD'02 General Chair, School of Electrical and Electronic Engineering, Nanyang Technological Univ., Block S2, 50 Nanyang Avenue, Singapore 639798; e-mail: elpwang@ntu.edu.sg; phone: +65 6790 6372.

18-22 **Twenty Years of Tilting Theory: An Interdisciplinary Symposium**, Fraueninsel, Germany. (Apr. 2002, p. 504)
Description: Tilting modules were born about twenty years ago in the context of finite dimensional algebras. Since then, tilting theory has spread in many different directions, and nowadays it plays an important role in various branches of modern algebra, ranging from Lie theory and algebraic geometry to homotopical algebra. The aim of this meeting is to bring together for the first time experts from different fields where tilting is relevant or even of central importance. There will be several lecture series and survey talks on the use of tilting theory in different contexts, as well as a number of additional talks contributed by the participants.
Tentative List of Invited Speakers: M. van den Bergh (Univ. of Limburg), S. Brenner (Univ. of Liverpool), T. Brüstle (Univ. of Bielefeld), M. Butler (Univ. of Liverpool), S. Donkin (Univ. of London), K. Erdmann (Univ. of Oxford), K. Fuller (Univ. of Iowa), B. Keller (Univ. of Paris VII), S. König (Univ. of Leicester), H. Lenzing (Univ. of Paderborn), O. Mathieu (Univ. of Lyon), J. Miyachi (Tokyo Gakugei Univ.), I. Reiten (NTNU Trondheim), J. Rickard (Univ. of Bristol), R. Rouquier (Univ. of Paris VII), J. Trlifaj (Charles Univ. Prague).
Information: See http://www.mathematik.uni-muenchen.de/~tilting/.

*19-22 **Mathematics in Nanoscale Science and Engineering Workshop IV: Modeling and Simulation for Materials**, Institute for Pure and Applied Mathematics at UCLA, Los Angeles, California.
Information: http://www.ipam.ucla.edu/programs/nanomod/.

*21-22 **DIMACS/RECOMB Satellite Workshop on Computational Methods for SNPs and Haplotype Inference**, DIMACS Center, Rutgers University, Piscataway, New Jersey.
Description: The ability to score large numbers of DNA variants (SNPs) in large samples of humans is rapidly accelerating, as is the demand to apply these data to tests of association with diseased states. The problem suffers from excessive dimensionality, so any means of reducing the number of dimensions to the space of genotype classes in a biologically meaningful way would likely be of benefit. Linked SNPs are often statistically associated with one another (in "linkage disequilibrium"), and the number of distinct configurations of multiple tightly linked SNPs in a sample is often far lower than one would expect from independent sampling. These joint configurations, or haplotypes, might be a more biologically meaningful unit, since they represent sets of SNPs that co-occur in a population. Recently there has been much excitement over the idea that such haplotypes occur as blocks across the genome, as these blocks suggest that fewer distinct SNPs need to be scored to capture the information about genotype identity. There is need for formal analysis of this dimension reduction problem, for formal treatment of the hierarchical structure of haplotypes, and for consideration of the utility of these approaches toward meeting the end goal of finding genetic variants associated with complex disease.
Organizers: A. G. Clark, Cornell University and Celera, Andy.Clark@celera.com; S. Istrail, Celera, Sorin.Istrail@celera.com; M. Waterman, Univ. of Southern California and Celera, msw@hto.usc.edu.
Local Arrangements: J. Thiemann, DIMACS Center, jennifer@dimacs.rutgers.edu, 732-445-5928.
Information: http://dimacs.rutgers.edu/Workshops/SNP/.

25-28 **Fifth International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing (MCQMC 2002)**, Singapore, Republic of Singapore. (Apr. 2002, p. 504)
Description: This conference will bring together experts in the fields of mathematics, computer science, statistics, operations research, physics, engineering, and finance to discuss the latest developments in Monte Carlo and quasi-Monte Carlo methods

and their applications. MCQMC 2002 is the fifth in a series of international meetings. The program will consist of invited plenary talks, several special thematic sessions, and contributed talks.
Program Committee: K.-T. Fang (Hong Kong), P. Glasserman (USA), S. Heinrich (Germany), F. J. Hickernell (Hong Kong), P. L'Ecuyer (Canada), H. Niederreiter (Singapore, chair), E. Novak (Germany), A. Owen (USA), I. H. Sloan (Australia), J. Spanier (USA), D. Talay (France), S. Tavare (USA), J.-S. Wang (Singapore), H. Wozniakowski (USA/Poland).
Invited Speakers: P. Boyle (Canada), S. Heinrich (Germany), P. L'Ecuyer (Canada), J. S. Liu (USA), D. Talay (France), W. Wagner (Germany), G. Wasilkowski (USA), C. P. Xing (Singapore).
Call for Papers: Abstracts of contributed talks should be submitted to H. Niederreiter by July 31, 2002. The abstract should fit on one page and include the title of the talk, the name, affiliation, full postal address, and e-mail address of the speaker, and a summary of the talk which provides sufficient information to assess the relevance and novelty of the results. The preferred mode is electronic submission in LaTeX or PostScript format. Notification of the acceptance of the talk will be given about one month after the above deadline.
Contact: H. Niederreiter, Department of Mathematics, National University of Singapore, 2 Science Drive 2, Singapore 117543, Republic of Singapore; e-mail: nied@math.nus.edu.sg.
Information: Regularly updated information can be obtained from the webpage http://www.mcqmc2002.math.nus.edu.sg/.

*28-30 **The Third International Conference on Mathematical Modeling and Computational Experiments (ICMMCE 2002)**, Tajik State National University, Dushanbe, Tajikistan.
Description: The Conference on Mathematical Modeling and Computing Experiments is devoted to different aspects of Applied Sciences. Papers will include the following topics and related areas: theoretical questions of mathematical modeling; mathematical modeling of economical, ecological, social and physical processes.
Deadline: September 30, 2002.
Information: Detailed information can be obtained from M. Yunusi, Department of Modeling and Informatics, TGNU, Rudaki str. 17, Dushanbe, 734025, Tajikistan; e-mail: yunusi@pochtamt.ru, mamadyusuf_tj@yahoo.com, tgnu@mail.ru.

December 2002

2-6 **Joint IMA/CRM Workshop: Distribution Systems: Location and Vehicle Routing**, University of Montreal, Quebec, Canada.
Organizers: M. Gendreau (Montreal), G. Laporte (Montreal).
Information: http://www.crm.umontreal.ca/.

2-21 **Workshop (02-18) & Conference (19-21) on Geometric Group Theory**, Guwahati, India.
Topics: Coxeter groups and complexes, Tits buildings, Bass-Serre theory of groups acting on trees, combinatorial methods in group theory, and Gromov's theory of hyperbolic groups. The participants of the workshop are expected to be young researchers. Besides the invited lectures, there is the possibility of having some contributed talks at the conference.
Organizers: N. S. N. Sastry, Indian Statistical Institute, Bangalore; M. Bhattacharjee, Indian Institute of Technology, Guwahati, India.
Information: http://www.isibang.ac.in/, http://www.iitg.ernet.in/.

4-6 **DIMACS Workshop on Implementation of Geometric Algorithms**, DIMACS Center, Rutgers University, Piscataway, New Jersey.
Sponsor: DIMACS Center.
Description: It is notoriously difficult to implement geometric algorithms. This difficulty arises in part from the conceptual complexity of geometric algorithms, the proliferation of special cases, the dependence of combinatorial decisions on numerical computation, and frequent theoretical focus on worst-case asymptotic behavior.

This workshop will address research issues related to the implementation of geometric algorithms. Typical, but not exclusive, topics include: numerical issues, noisy data and data repair, geometric data structures, massive geometric data sets, algorithm library design, algorithm engineering, and experimental studies.

We plan to bring together both researchers and practitioners. We hope that practitioners will benefit from discussions of the state of the art in research and that researchers will benefit by being exposed to implementation issues of practical importance.
Organizers: H. Bronnimann, Polytechnic University, hbr@poly.edu; S. Fortune, Bell Laboratories, Lucent Technologies, sjf@bell-labs.com.
Local Arrangements: J. Thiemann, DIMACS Center, jennifer@dimacs.rutgers.edu, 732-445-5928.
Information: Visit http://dimacs.rutgers.edu/Workshops/GeomAlgorithms/.

5-8 **Geometry and Topology of Quotients**, University of Arizona, Tucson, Arizona.
Focus: The conference focuses on various aspects of geometry and topology of quotients naturally arising in algebraic and symplectic geometry. The plenary lectures will survey recent progress and current directions of research in geometric invariant theory and symplectic reductions, explain connections with other disciplines and applications to physics. In addition to principal lectures, there will be sessions of contributed talks and round-table discussions. Women and minority researchers are encouraged to participate.
Principal Speakers: I. Dolgachev (Michigan), W. Fulton (Michigan), S. Keel (Texas), J. Li (Stanford), R. Sjamaar (Cornell), S. Tolman (Illinois), A. Weinstein (Berkeley).
Local Organizers: P. Bressler, P. Foth, Y. Hu, J.-H. Lu.
Financial Support: Available for graduate students and researchers with no other means of support.
Information: http://www.math.arizona.edu/~foth/gtq.html.

9-12 **ICDM '02: The 2002 IEEE International Conference on Data Mining Sponsored by the IEEE Computer Society**, Maebashi TERRSA, Maebashi City, Japan.
Information: See http://kis.maebashi-it.ac.jp/icdm02/ or mirror page: http://www.wi-lab.com/icdm02/.

9-13 **9th Annual Biopharmaceutical Applied Statistics Symposium**, Savannah, Georgia.
Organizers: MCV/VCU and GASOU Biostatistics Departments.
Information: 12 tutorials, 4 short courses on topics related to research, development and regulation of pharmaceuticals, with emphasis on biostatistics; e-mail: KEPeace@gasou.edu; http://views.vcu.edu/bis/bass/.

9-13 **Elliptic Cohomology and Chromatic Phenomena**, Isaac Newton Institute for Mathematical Sciences, Cambridge, England. (Apr. 2002, p. 504)
EuroWorkshop Organizers: D. C. Ravenel and H. R. Miller.
Information: Isaac Newton Institute for Mathematical Sciences, 20 Clarkson Road, Cambridge, CB3 0EH; tel: +44 (0) 1223 335999; fax: +44 (0) 1223 330508; e-mail: info@newton.cam.ac.uk. Please refer to our website, http://www.newton.cam.ac.uk/programs/NST/, for full details of how to apply for these workshops.

9-13 **FICOFEST, A Conference in Low-Dimensional Topology to Celebrate the Sixtieth Birthday of Francisco Javier "Fico" Gonzalez Acuna**, Universidad Autonoma de Yucatan, Merida, Yucatan, Mexico. (May 2002, p. 608)
Organizers: M. Eudave-Munoz (UNAM), V. Nunez (CIMAT), L. Armas-Sanabria (UNAM), M. Neumann-Coto (UNAM), J. Seade (UNAM), J. C. Gómez-Larrañaga (CIMAT).
Speakers: M. Boileau, D. Gabai, S. Gitler, C. Gordon, J. Hempel, L. Kauffman, R. Kirby, R. Lickorish, S. López de Medrano, J. Luecke,

L. Montejano, K. Murasugi, R. Myers, D. Rolfsen, D. Roseman, M. Scharlemann, P. Scott, H. Short, J. Simon, D. Sumners, A. Verjovsky, E. Winkelnkemper.
Information: http://www.matem.unam.mx/ficofest/ or contact M. Eudave-Munoz at: ficofest@cimat.mx.

9–13 **27th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing (27ACCMCC)**, The University of Newcastle, Newcastle, NSW, Australia. (Feb. 2002, p. 271)
Topics: 27ACCMCC is a forum in which researchers can present their work and exchange ideas with others in their field. Topics of interest cover all areas of combinatorial mathematics, combinatorial computing, and combinatorial optimization.
Invited Speakers: D. Cvetkovic (Univ. of Belgrade); M. Fellows (Univ. of Newcastle); M. Miller (Univ. of Newcastle); A. Rosa (McMaster Univ.); J. Siran (Slovak Univ. of Technology).
Organizers: L. Brankovic (Univ. of Newcastle); R. Webber (Univ. of Newcastle); N. Natchimuthu (Univ. of Newcastle); L. Mathieson (Univ. of Newcastle); M. Skerritt (Univ. of Newcastle).
Information: http://www.cs.newcastle.edu.au/~accmcc/; accmcc@cs.newcastle.edu.au.

9–13 **II Workshop on Dynamics and Randomness**, Departamento de Ingeniería Matemática, Universidad de Chile, Santiago, Chile.
Brief Description of Workshop: Courses and conferences will cover topics in probability theory, symbolic dynamics, ergodic theory, and statistical physics.
Invited Speakers: V. Baladi (IHES), J. Bertoin (Univ. de Paris VI), A. Bovier (Weierstrass Inst. for Applied Analysis and Stochastics), P. Collet (École Polytechnique), F. Durand (Univ. de Picardie), S. Lalley (Chicago Univ.), E. Lindenstrauss (Stanford Univ.), S. Méléard (Univ. Paris X and Univ. Paris VI), Y. Peres (Univ. of California), K. Petersen (Univ. of North Carolina), P. Picco (CMM UCHILE-CNRS), B. Schmitt (Univ. de Bourgogne), A. Vershik (Math. Inst. of Russian Academy of Science at St. Petersburg), M. Viana (IMPA).
Information: e-mail: dynamics@dim.uchile.cl; http://www.dim.uchile.cl/.

14–16 **International Symposium on Pure and Applied Mathematics: ISPAM 2002**, Calcutta, India.
Dedication: The symposium is dedicated to Niels Henrik Abel to mark the 200th anniversary of his birth.
Topics: (a) Algebra and its applications, (b) Analysis and topology and their applications, (c) Geometry and its applications, (d) Dynamical systems, chaos and fractals, (e) Continuum mechanics, (f) Plasma physics, (g) Control theory and optimization theory, (h) Biomechanics, (i) Applications of mathematics to environmental problems, and (j) History and philosophy of physical science.
Information: All correspondence in regard to the symposium is to be addressed to: M. R. Adhikari, Calcutta Math. Soc., AE-374, Sector-1, Salt Lake City, Calcutta-700064, India; e-mail: cms@cal2.vsnl.net.in; or H. P. Mazumdar, Convenor, Physics and Appl. Math. Unit, Indian Statistical Institute, 203 B. T. Road, Calcutta-700035, India; e-mail: hpm@isical.ac.in.

27–30 **ASL Winter Meeting (with APA)**, Philadelphia Marriott, Philadelphia, Pennsylvania.
Program Committee: J. Burgess, B. Ewald, and S. Weinstein (Chair).
Abstracts: Abstracts of contributed talks submitted by ASL members will be published in *The Bulletin of Symbolic Logic* if they satisfy the rules for abstracts (see http://aslonline.org/Meetings.htm). Abstracts must be received by the deadline of September 16, 2002, at the ASL business office: ASL, Box 742, Vassar College, 124 Raymond Avenue, Poughkeepsie, NY 12604; fax: 1-845-437-7830; e-mail: asl@vassar.edu.

January 2003

January–August **Thematic Program on Automorphic Forms**, The Fields Inst. for Research in Math. Sciences, Toronto, Canada. (Dec. 2001, p. 1368)
Description: The theory of automorphic forms is a wide and deep subject touching many areas of mathematics. Our purpose is to concentrate on the geometric and analytic aspects of the subject. These have far-reaching applications in classical number theory. The Langlands-Shahidi method and the converse theorem of Cogdell-Piatetski-Shapiro have seen exciting new developments recently. These include new cases of functoriality, as well as analytic continuation of symmetric power L-functions. The work of Kim-Shahidi will be one of the central themes of the program. The analytic theory of L-functions and its applications has also seen many advances in recent years. We hope to cover some aspects of these, especially those connected with the analyticity of symmetric power L-functions as well as those of Hasse-Weil zeta functions. An important problem is to express the Hasse-Weil zeta function of a Shimura variety in terms of automorphic L-functions. Here in order to define the local factors not just at primes of good reduction, we need to study the variety at the finite set of primes of bad reduction. Such a description would allow one to apply the aforementioned progress in L-functions to the study of deep arithmetic properties of these varieties. One of the major remaining obstacles to proving such a description is the so-called "fundamental lemma", a conjecture in local harmonic analysis that asserts the equality of certain orbital integrals on a p-adic group and on a related (endoscopic) group. We plan to review recent work of Goresky-Kottwitz-MacPherson and others which gives a geometric approach to this problem.
Organizers: J. Arthur, T. Haines, H. Kim, R. Murty, G. Pappas, F. Shahidi.
Information: To be informed of when registration is open and to receive updates about the Thematic Program on Automorphic Forms, please subscribe to the mail list at http://www.fields.utoronto.ca/maillist/, or contact automorphic@fields.utoronto.ca.

3–5 **3rd Mediterranean Conference on Mathematical Education**, Athens, Greece.
Conference Themes: Mathematics in the Modern World, Mathematics and Didactics, Mathematics and Life, Mathematics and Society.
Invited Speakers: M. Artigue, Univ. Denis Diderot, Paris, France; W. Blum, Univ. of Kassel, Germany; T. Exarchakos, Univ. of Athens; A. Fokas, Univ. of Cambridge; A. Gagatsis, Univ. of Cyprus; C. Laborde, Univ. Joseph Fourier-CNRS, France; M. Niss, Roskilde Univ., Denmark; D. Tirosh, Tel Aviv Univ., Israel.
Language: English.
Information: MEDCONF2003 Organizing Comte.: Hellenic Mathematical Society, 34 Panepistimiou Street, GR 10679 Athens, Greece; tel: +3010-3616532, +3010-3617784; fax: +3010-3641025; e-mail: mes3@hms.gr; http://www.hms.gr/. MEDCONF2003 Scientific Comte.: Cyprus Mathematical Society, 36 Stasinou Street, Office 102, Strovolos 2003, Nicosia, Cyprus; fax: +357-22-379122; e-mail: gagatsis@ucy.ac.cy, cms@cms.org.cy; http://www.cms.org.cy/.

6–7 **IMA Short Course: Industrial Strength Optimization**, Minneapolis, Minnesota.
Presenters: J. Dennis (Rice Univ.), C. Audet (École Polytechnique de Montréal).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/winter/iso.html.

6–9 **Third International Workshop on Scientific Computing and Applications**, City University of Hong Kong, Hong Kong, China.
Organizers: Y. Y. Lu, W.-W. Sun, T. Tang.
Information: http://math.cityu.edu.hk/sca03/.

6–11 **International Conference on Dynamical Systems and Geometry, to Celebrate the Sixtieth Anniversary of Alberto Verjovsky,**

Cuernavaca, Mexico. (Oct. 2001, p. 1051)
Scientific Committee: J. Eells, E. Ghys, M. Lyubich, J. Palis, and J. Seade.
Information: jseade@matcuer.unam.mx.

8 **IMA Tutorial: Optimization in Simulation-Based Models**, Minneapolis, Minnesota.
Organizer: J. Nocedal (NWU).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/winter/t2.html.

9-16 **IMA Workshop 4: Optimization in Simulation-Based Models**, Minneapolis, Minnesota.
Organizers: A. Conn (IBM), O. Ghattas (CMU), J. Nocedal (NWU), F. Santosa (UMN).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/winter/op4.html.

12-14 **ACM-SIAM Symposium on Discrete Algorithms**, Hyatt Regency, Baltimore, Maryland. (May 2002, p. 608)
Information: Contact: meetings@siam.org.

15-18 **Joint Mathematics Meetings**, Baltimore Convention Center, Baltimore, Maryland.
Information: http://www.ams.org/amsmtgs/2074_intro.html.

17-18 **2002-2003 ASL Winter Meeting (with Joint Mathematics Meetings)**, Baltimore Convention Center, Baltimore, Maryland.
Description: This meeting will take place in conjunction with the Joint Mathematics Meetings, which will be held January 15-18, 2003.
Program Committee: H. Becker (Chair), M. C. Laskowski, and R. Solomon.
Abstracts: Abstracts of contributed talks submitted by ASL members will be published in *The Bulletin of Symbolic Logic* if they satisfy the rules for abstracts (see http://aslonline.org/Meetings.htm). Abstracts must be received by the deadline of September 30, 2002, at the ASL business office: ASL, Box 742, Vassar College, 124 Raymond Avenue, Poughkeepsie, NY, 12604, USA; fax: 1-845-437-7830; e-mail: asl@vassar.edu.

February 2003

*3-7 **Emerging Applications of the Nonlinear Schrödinger Equations**, Institute for Pure and Applied Mathematics at UCLA, Los Angeles, California.
Information: http://www.ipam.ucla.edu/programs/nls2003/.

9 **Short Course Prior to Conference on Computational Science and Engineering**, Hyatt Regency Islandia Hotel and Marina, San Diego, California. (May 2002, p. 608)
Information: Contact: meetings@siam.org.

10-14 **Permutation Patterns**, University of Otago, Dunedin, New Zealand. (May 2002, p. 608)
Topics: The unifying theme of the conference is permutation patterns. The topics addressed will include enumeration questions, excluded pattern questions, study of the involvement order, algorithms for computing with permutation patterns, applications and generalizations of permutation patterns, and others.
Speaker: H. Wilf.
Program Chair: M. Albert.
Registration: $100 NZ by November 1, 2002, and $150 thereafter.
Submissions: Extended abstracts (at most 6 pages) of papers to be presented at the conference should be sent to the Program Chair by December 31, 2002.
Information: See http://www.cs.otago.ac.nz/staffpriv/mike/PP2003/FirstAnnouncement.html.

*18-21 **Cells & Materials: At the Tissue Engineering Interface**, Institute for Pure and Applied Mathematics at UCLA, Los Angeles, California.
Information: http://www.ipam.ucla.edu/programs/te2003/.

21-22 **XVIII Inter-University Seminar on Research in the Mathematical Sciences (SIDIM)**, Pontifical Catholic University, Ponce, Puerto Rico.
Description: The SIDIM's (its name in Spanish) activities will include: invited and contributed talks in pure and applied mathematics, computer sciences, statistics and mathematics education; student poster sessions; and exhibit booths and recruiters from universities with graduate programs.

Abstracts for contributed talks or posters should be sent by email to sidim@cuhwww.upr.clu.edu in any one of the standard formats: TeX, LaTeX (preferred), MS Word, Word Perfect, etc., or on diskette to the following address: SIDIM 2003, Attn: Pablo V. Negrón, University of Puerto Rico, Department of Mathematics, Humacao, PR 00791-4300.
Deadline: The deadline for abstract submission is January 15, 2003.
Information: Further details and information about the activity (preliminary program, hotels, etc.) will be available from the SIDIM webpage at http://cuhwww.upr.clu.edu/~sidim/.

March 2003

*10-12 **International Conference on Mathematics and Its Applications**, Kuwait University, Kuwait.
Description: The conference will provide an opportunity for the presentation and exchange of the latest research by those interested in mathematics and its applications in Computational Differential Equations, Computational Linear Algebra, Integral Transforms, Special Functions, Fractional Calculus, Groups, Rings, Categories, and Differential Geometry.
Information: For detailed information please visit our website, http://www.sci.kuniv.edu.kw/ICMA03.html.

11 **IMA Tutorial: Semidefinite Programming and Robust Optimization**, Minneapolis, Minnesota.
Organizer: M. Todd (Cornell).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/winter/t3.html.

12-19 **IMA Workshop 5: Semidefinite Programming and Robust Optimization**, Minneapolis, Minnesota.
Organizers: D. Goldfarb (Columbia), M. Todd (Cornell), M. Overton (NYU), M. Goemans (MIT), L. El Ghaoui (Berkeley).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/winter/op5.html.

14-16 **AMS Southeastern Section Meeting**, Louisiana State University, Baton Rouge, Louisiana.
Information: http://www.ams.org/amsmtgs/sectional.html.

17-20 **SIAM Conference on Mathematical and Computational Issues in the Geosciences**, Radisson Hotel and Suites Austin, Austin, Texas. (May 2002, p. 608)
Information: Contact: meetings@siam.org.

*27-30 **Quadrature Domains and Related Topics**, University of California, Santa Barbara.
Description: The conference will be devoted to the theory of quadrature domains and its ramifications to function theory,

inverse problems, fluid dynamics, and holomorphic PDE's. The event will coincide with the 75th birthday of Harold S. Shapiro, who is one of the founders of the theory.
Confirmed Invited Speakers: D. Aharonov (Technion, Haifa), S. Bell (Purdue Univ.), P. Duren (Michigan Univ.), F. Forsternic (Ljubliana, Slovenia), L. Karp (Ort Braude College, Israel), J. McCarthy (Washington Univ.), W. T. Ross (Univ. Richmond), M. Sakai (Tokyo), A. Solynin (Sankt Petersburg), H. Shahgholian (Stockholm), H. S. Shapiro (Stockholm), S. Webster (Univ. Chicago).
Organizing Committee: P. Ebenfelt (pebenfel@math.ucsd.edu), B. Gustafsson (gbjorn@math.kth.se), D. Khavinson (dmitry@comp.uark.edu), M. Putinar (mputinar@math.ucsb.edu).
Information: Further information will be regularly updated and available on the websites of the organizers.

April 2003

4-6 **AMS Central Section Meeting**, Indiana University, Bloomington, Indiana.
Information: http://www.ams.org/amsmtgs/sectional.html.

6 **IMA Tutorial: Network Management and Design**, Minneapolis, Minnesota.
Organizer: T. Carpenter (Telcordia).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/spring/t4.html.

7-11 **IMA Workshop 6: Network Management and Design**, Minneapolis, Minnesota.
Organizers: D. Bienstock (Columbia), T. Carpenter (Telcordia), D. Johnson (AT&T), C. Monma (Telcordia), B. Shepherd (Lucent Technologies).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/spring/op6.html.

12-13 **AMS Eastern Section Meeting**, Courant Institute, New York, New York.
Information: http://www.ams.org/amsmtgs/sectional.html.

17-19 **The Sixth Asian Symposium on Computer Mathematics (ASCM 2003)**, Beijing, China.
Description: The Asian Symposium on Computer Mathematics (ASCM) is a series of conferences which offers an opportunity for participants to present original research, to learn of research progress and new developments, and to exchange ideas and views on doing mathematics using computers. ASCM 2003 will provide an international forum for active researchers to review the current state of the art and trends on computer mathematics. The symposium will consist of plenary sessions by invited speakers, regular sessions of contributed papers, and software demonstrations.
Information: http://www.mmrc.iss.ac.cn/~ascm/.

May 2003

1-3 **SIAM International Conference on Data Mining**, Cathedral Hill Hotel, San Francisco, California. (May 2002, p. 608)
Information: Contact: meetings@siam.org.

3-4 **AMS Western Section Meeting**, San Francisco State University, California.
Information: http://www.ams.org/amsmtgs/sectional.html.

3-5 **First International Conference on Smarandache Geometries**, Griffith Univ., Gold Coast Campus, Australia. (Dec. 2001, p. 1368)
Description: An axiom is said to be smarandachely denied if in the same space the axiom behaves differently (i.e., validated and invalidated or only invalidated, but in at least two distinct ways). A Smarandache geometry is a geometry which has at least one smarandachely denied axiom (1969). Thus, as a particular case, Euclidean, Lobachevsky-Bolyai-Gauss, and Riemannian geometries may be united altogether, in the same space, by some Smarandache geometries. These last geometries can be partially Euclidean and partially non-Euclidean. It seems that Smarandache geometries are connected with the theory of relativity (because they include the Riemannian geometry in a subspace) and with the parallel universes.
Speakers: M. Antholy (Canada), H. Iseri (USA), M. Bencze (Romania).
Deadline for Submission of Abstracts: April 30, 2003. Papers are welcome and will be published in a collected papers book. See a club about these geometries at http://clubs.yahoo.com/clubs/smarandachegeometries/.
Information: J. Allen, Office 2.36 Education Building, Griffith Univ., Gold Coast Campus, Australia. Conference home page: http://www.gallup.unm.edu/~smarandache/geometries.htm.

5 **IMA Tutorial: Data Analysis and Optimization**, Minneapolis, Minnesota.
Organizers: J. Kleinberg (Cornell), A. Tomkins (IBM).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/spring/t5.html.

6-9 **IMA Workshop 7: Data Analysis and Optimization**, Minneapolis, Minnesota.
Organizers: R. Kannan (Yale), J. Kleinberg (Cornell), P. Raghavan (Verity), C. Papadimitriou (Berkeley).
Contact: Institute for Mathematics and its Applications, Univ. of Minnesota, 207 Church St. SE, 400 Lind Hall, Minneapolis, MN 55455; phone: 612-624-6066; e-mail: visit@ima.umn.edu; http://www.ima.umn.edu/optimization/spring/op7.html.

11-16 **International Conference on General Control Problems and Applications (GCP 2003): Dedicated to the 100th Anniversary of A. N. Kolmogorov**, Tambov State University, Tambov, Russia.
Scope: A. N. Kolmogorov's creative legacy; optimization theory and its prospects; approximation methods and stability in control; variation methods for nonlinear systems investigations and their applications; mathematical models of economic systems control; mathematical models of control in technical, natural sciences, and humanities.
Organizers: Moscow M. V. Lomonosov State Univ.; Steklov V. A. Inst. of Math. of the Russ. Acad. of Sci.; Ministry of Education of Russian Federation; Ministry of Industry, Science, and Technologies of Russian Federation; Tambov Region Administration; Tambov G. R. Derzhavin State Univ.
Program Committee: V. M. Filippov, A. B. Kurzhansky, Yu. S. Osipov, V. A. Sadovnichy, V. M. Tikhomirov (chairmen); A. I. Bulgakov (deputy); A. P. Afanasiev, A. V. Arutyunov, N. A. Bobylev, A. G. Chentsov, V. B. Demidovich, V. V. Dikusar, A. V. Dmitruk, I. V. Evstigneev, V. I. Levin, G. G. Magaril-Il'yaev, S. M. Nikol'sky, Yu. V. Pokorny, E. L. Tonkov, M. I. Zelikin; E. S. Zhukovsky (scientific secretary).
Languages of Conference: Russian, English.
Call for Papers: Authors are kindly invited to submit abstracts before November 1, 2002. Contributions must be prepared in LaTeX.
Information: Contacts: For up-to-date information, please visit our website, http://www.opu2003.narod.ru/, or contact the conference committee via e-mail: aib@tsu.tmb.ru, uaa@hmb.nnn.tstu.ru.

11-18 **Conference on Topological Algebras, Their Applications, and Related Topics**, Poznan, Poland.
Description: The conference will take place at the Mathematical Conference Center in Bedlewo, near Poznan, Poland, to celebrate the 70th birthday of Professor Wieslaw Zelazko.

Topics: General theory of Banach and topological algebras, Spectral theory of Banach and topological algebras, Operator theory, Topological algebras and complex analysis, Harmonic analysis, Homological methods in the theory of Banach algebras, Automatic continuity, Representations, structure and classification of topological algebras, Nonassociative topological algebras.
Information: http://main.amu.edu.pl/~ta2003/; e-mail: ta2003@amu.edu.pl; or write to A. Soltysiak, Faculty of Mathematics and Computer Science, Adam Mickiewicz University, 60-769 Poznan, Poland.

20-24 **Fourth Seminar on Stochastic Analysis, Random Fields and Applications, Fourth Minisymposium on Stochastic Methods in Financial Models**, Centro Stefano Franscini, Ascona, Switzerland. (May 2002, p. 608)
Organizer: R. Dalang EPFL (Switzerland), M. Dozzi (Univ. Nancy 2, France), and F. Russo (Univ. Paris 13, France).
Information: http://www-math.math.univ-paris13.fr/~russo/Ascona02.html.

20-24 **The 31st Annual Canadian Operator Theory and Operator Algebras Symposium**, UNB, Fredericton, New Brunswick, Canada. (Sept. 2001, p. 910)
Information: http://www.math.unb.ca/cos.html.

26-30 **SampTA03 (Sampling Theory and Applications 2003)**, Strobl, Salzburg, Austria.
Program: This conference will gather mathematicians, engineers, and applied scientists involved in modern data processing problems. It will cover the mathematical foundations of modern sampling theory, the numerical aspects and the development of efficient algorithms for sampling and reconstruction, and the practical applications of sampling techniques in a variety of applications.
Topics: Nonuniform sampling, numerical methods, frames and non-orthogonal expansions, greedy algorithms, radial basis functions, sampling topics related to wavelet and Gabor theory.
Organizers: H. G. Feichtinger and NuHAG (Numerical Harmonic Analysis Group), Department of Mathematics, University of Vienna, Strudlhofgasse 4, A-1090 Wien, Austria.
Information: http://www.univie.ac.at/NuHAG/SampTA03/.

27-31 **SIAM Conference on Applications of Dynamical Systems**, Snowbird Ski and Summer Resort, Snowbird, Utah. (May 2002, p. 608)
Information: Contact: meetings@siam.org.

June 2003

1-4 **2003 ASL Annual Meeting**, University of Illinois at Chicago, Chicago, Illinois.
Program Committee: A. Blass (Chair).
Organizing Committee: W. Blok, B. Hart (Chair), B. Howard, and D. Marker.

1-6 **International Conference on Group Theory: Combinatorial, Geometric, and Dynamical Aspects of Infinite Groups**, Gaeta, Italy.
Program: Geometric group theory; ergodic theory; groups acting on trees and boundaries; random walks; amenability; growth of groups, languages, and automata; groups and fractals; L^2-cohomology; bounded cohomology; branch groups; groups generated by finite automata; calculus of spectra; problems of Burnside type; combinatorics of words.
Organizers: L. Bartholdi, Univ. of Calif., Berkeley; T. Ceccherini-Silberstein, Univ. del Sannio di Benevento; T. Smirnova-Nagnibeda, Royal Inst. of Tech., Stockholm; A. Zuk, Ecole Normale Supérieure de Lyon.
Plenary Speakers: D. Anosov (Steklov Institute, Moscow); G. Baumslag (City Univ., New York); M. Burger (ETH Zürich); H. Furstenberg (Hebrew Univ., Jerusalem); E. Ghys (ENS Lyon); R. Grigorchuk (Steklov Institute, Moscow); M. Gromov (IHES, Paris); F. Grunewald (Univ. of Düsseldorf); P. de la Harpe (Univ. of Geneva); V. Jones (UC Berkeley); A. Lubotzky (Hebrew Univ., Jerusalem); W. Lück (Univ. of Münster); A. Ol'shanskii (Vanderbilt Univ., Nashville, and Moscow State Univ.); G. Pisier (Texas A&M and Univ. of Paris VI); S. Sidki (Univ. of Brasília); A. Valette (Univ. of Neuchâtel); A. Vershik (Steklov Institute, St. Petersburg); E. Zelmanov (Yale Univ., New Haven).
Information: e-mail: gaeta@mat.uniroma1.it or gaeta@math.kth.se; http://www.marth.kth.se/~gaeta/.

16-20 **2003 SIAM Annual Meeting**, Queen Elizabeth Hotel, Montreal, Quebec, Canada.
Information: Contact: meetings@siam.org.

*16-21 **International Conference: Kolmogorov and Contemporary Mathematics**, Moscow, Russia.
Description: In commemoration of the centennial of Andrei Nikolaevich Kolmogorov. The conference will cover the main areas of A.N. Kolmogorov's scientific interests with an emphasis on his vision of mathematics in its fundamental unity as recent developments in the fields of Dynamic Systems and Ergodic Theory, Theory of Functions and Functional Analysis, Theory of Probability and Mathematical Statistics, Turbulence and Hydrodynamics, Mathematical Logic and Theory of Complexity, Geometry and Topology.
Format: Invited one-hour speakers for the General Plenary Sessions (by invitation from the Organizing and Scientific Committee), invited 45-min. speakers for the Thematic Plenary Sessions (by invitation from the Organizers of the Thematic Sessions), and contributed 20-min. talks (by selection of the organizers of the Thematic Sessions). Poster presentations are also planned.
Languages: Russian, English.
Information: Kolmogorov-100 Conference, Steklov Mathematical Institute, Gubkin str. 8, 119991, Moscow, Russia; or Faculty of Mechanics and Mathematics, Moscow State University, Main Building, Leninskie Gory, 119992, Moscow, kolmogorov-100@mi.ras.ru. For further information (Plenary speakers, program, schedule, call for abstracts accommodations, social events, excursions, travel information, etc.), please visit: http://kolmogorov-100.mi.ras.ru/.

17-21 **Fourth Geoffrey J. Butler Memorial Conference**, University of Alberta, Edmonton, Alberta, Canada.
Description: A gathering for researchers and students in differential equations and mathematical biology.
Information: http://conley.math.ualberta.ca/butler.html.

18-21 **First Joint International Meeting between the American Mathematical Society and the Real Sociedad Matematica Espanola**, Seville, Spain.
Information: http://www.us.es/rsme-ams/.

*29 **The Role of Mathematics in XXI Century**, Novosibirsk University, Novosibirsk, Russia.
Organizers: Novosibirsk State University, Sobolev Institute of Mathematics, Institute of Discrete Mathematics and Informatics, MMD NSU Foundation.
Chairman of Program Committee: Yu. L. Ershov.
Contacts: e-mail: mmf@math.nsc.ru.
Information: http://mmfd.nsu.ru/fmmf/smmfe/workf/kongres.html.

July 2003

7-11 **ICIAM 2003, 5th International Congress on Industrial and Applied Mathematics**, Sydney, Australia.
Information: Visit the website at http://www.iciam.org/ for full information about speakers, registration, embedded submeetings, deadlines for minisymposia and abstracts, venue, accommodations, sponsors and the organizers.

15-19 **SIAM Conference on Applied Linear Algebra**, William and Mary College, Williamsburg, Virginia.
Information: Contact: meetings@siam.org.

27-August 9 (NEW DATE) **Banach Algebras and Their Applications: Banach Algebras 2003**, Edmonton, Alberta, Canada.
Description: This conference is the sixteenth in a series of conferences on Banach algebras that started in 1974 in Los Angeles. We expect that most specialists in Banach algebras as well as leading mathematicians from related areas will attend this conference. In the past, these conferences have always led to fruitful interaction between the participants, and we expect this tradition to continue. In addition to the regular conference program consisting of one-hour and half-hour talks by the participants, we also plan to hold five workshops on the following topics, each of which will be chaired by an internationally recognized specialist in the respective area: Banach algebras in harmonic analysis (to be held in honor of Eberhard Kaniuth on the occasion of his retirement), Chair: A. T.-M. Lau (Edmonton); Banach algebras in operator theory, Chair: M. M. Neumann (Starkville; USA); Banach algebras and operator spaces, Chair: Z.-J. Ruan (Urbana-Champaign; USA); K-theory of Banach algebras, Chair: J. Cuntz (Muenster, Germany); Topological homology, Chair: A. Ya. Helemskii (Moscow, Russia). Each workshop will occupy two afternoons. The chairs are completely free to decide on the format of their workshops.
Information: For more detailed information, including a list of invited speakers, see the conference website at http://www.math.ualberta.ca/~ba03/.

August 2003

14-20 **2003 ASL European Summer Meeting (Logic Colloquium '03)**, Helsinki, Finland.
Program Committee: P. Aczel, Z. Adamowicz, J. Baldwin, E. Bouscaren, M. Detlefsen, M. Gitik, L. Hella, T. Jech, R. Parikh, H. Schwichtenberg, T. Slaman, V. Stoltenberg-Hansen (Chair), and J. Vaananen.
Organizing Committee: T. Huuskonen, T. Hyttinen, J. Kennedy, K. Luosto, J. Oikkonen, J. Vaananen (Chair), and P. Vaisanen.

September 2003

*24-26 **International Conference on Differential Equations Devoted to the 100th Anniversary of K. P. Persidskii**, Institute of Mathematics of the ME&S of the RK, Almaty, Kazakhstan (CIS).
Background: The conference honors K. P. Persidskii, the academician of the Academy of Sciences of Kazakh Republic (1946), well known to mathematicians all over the world for his significant contribution to the theory of differential equations.
Workshop Topics: 1) Differential equations, 2) Dynamic systems, 3) Theory of stability, 4) Mathematical physics, 5) Related problems of mathematical analysis, 6) Applied and numerical mathematics.
Speakers: M. I. Imanaliev (Kyrgyzstan), V. M. Millionshchikov (Russia), M. I. Rakhimberdiev (Kazakhstan), R. Kh. Rozov (Russia), V. V. Rumyantsev (Russia), A. M. Samoilenko (Ukraine).
Deadlines: April 1, 2003: deadline for submission of applications; June 1, 2003: conformation of acceptance; July 1, 2003: fee payments for accepted participants.
Information: Z. G. Kozhakhmetovna; Tel.: +7(3272) 91-37-64; fax: +7(3272) 91-37-40; e-mail: zakir@math.kz, Institute of Mathematics of the ME&S of the RK, 125, Pushkin street, 480100 Almaty, Kazakhstan (CIS).

October 2003

11-12 **AMS Eastern Section Meeting**, SUNY-Binghamton, Binghamton, New York.
Information: http://www.ams.org/amsmtgs/sectional.html.

*15-20 **Von Neumann Centennial Conference: Linear Operators and Foundations of Quantum Mechanics**, Budapest, Hungary.
Description: The conference will cover many topics in linear operator theory and the mathematical foundations of quantum mechanics, including recent developments showing the broad and long-standing impact of von Neumann's work. In addition to a session devoted to historical and personal perspectives on von Neumann, the main subjects are: linear operators, especially Schrödinger and other unbounded operators, their role in mathematical physics; stochastics aspects of quantum mechanics, for example, probability and statistics in the Hilbert space formalism; quantum information theory and quantum entropy; algebras of operators, von Neumann algebras and their applications in quantum statistical mechanics and in field theory; formal approaches to quantum theory, such as quantum logics and quantum structures.
Advisory Board: H. Araki, A. Jaffe, P. D. Lax, J. Palis, W. Thirring.
Main Organizer: D. Petz.
Information: http://www.math.bme.hu/~vonneumann/.

*24-25 **AMS Southeastern Section Meeting**, University of North Carolina, Chapel Hill, North Carolina.
Information: G. Alsfeld; e-mail: gma@ams.org; http://www.ams.org/amsmtgs/sectional.html.

December 2003

17-20 **First Joint International Meeting between the American Mathematical Society and Various Indian Mathematical Societies**, Goa, India.
Information: http://www.ams.org/amsmtgs/internmtgs.html.

January 2004

7-10 **Joint Mathematics Meetings**, Phoenix Civic Plaza, Phoenix, Arizona.
Information: http://www.ams.org/amsmtgs/2004_phioeintro.html.

March 2004

*12-13 **AMS Southeastern Section Meeting**, Florida State University, Tallahassee, Florida.
Information: G. Alsfeld; gma@ams.org; http://www.ams.org/amsmtgs/sectional.html.

26-27 **AMS Central Section Meeting**, Ohio University, Athens, Ohio.
Information: http://www.ams.org/amsmtgs/sectional.html.

April 2004

*17-18 **AMS Eastern Section Meeting**, Rider University, Lawrenceville, New Jersey.
Information: G. Alsfeld; e-mail: gma@ams.org; http://www.ams.org/amsmtgs/sectional.html.

*6-7 **AMS Eastern Section Meeting**, University of Pittsburgh, Pittsburgh, Pennsylvania.
Information: G. Alsfeld; e-mail: gma@ams.org; http://www.ams.org/amsmtgs/sectional.html.

January 2005

5-8 **Joint Mathematics Meetings**, Hyatt Regency Atlanta & Atlanta Marriott Marquis, Atlanta, Georgia.
Information: http://www.ams.org/amsmtgs/national.html.

New Publications Offered by the AMS

Algebra and Algebraic Geometry

Recent Developments in Infinite-Dimensional Lie Algebras and Conformal Field Theory

Stephen Berman, *University of Saskatchewan, Saskatoon, SK, Canada*, **Paul Fendley** and **Brian Parshall**, *University of Virginia, Charlottesville*, **Yi-Zhi Huang**, *Rutgers University, Piscataway, NJ*, **Kailash Misra**, *North Carolina State University, Raleigh*, Editors

Because of its many applications to mathematics and mathematical physics, the representation theory of infinite-dimensional Lie and quantized enveloping algebras comprises an important area of current research. This volume includes articles from the proceedings of an international conference, "Infinite-Dimensional Lie Theory and Conformal Field Theory", held at the University of Virginia. Many of the contributors to the volume are prominent researchers in the field.

This conference provided an opportunity for mathematicians and physicists to interact in an active research area of mutual interest. The talks focused on recent developments in the representation theory of affine, quantum affine, and extended affine Lie algebras and Lie superalgebras. They also highlighted applications to conformal field theory, integrable and disordered systems.

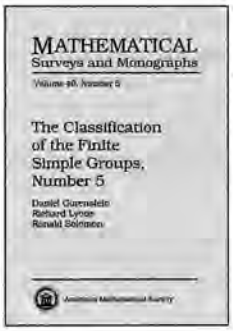
Some of the articles are expository and accessible to a broad readership of mathematicians and physicists interested in this area; others are research articles that are appropriate for more advanced readers.

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

Contents: **S. Berman**, **Y. Billig**, and **J. Szmigielski**, Vertex operator algebras and the representation theory of toroidal algebras; **V. Chari** and **M. Kleber**, Symmetric functions and representations of quantum affine algebras; **B. L. Cox**, Two realizations of toroidal $\mathfrak{sl}_2(\mathbb{C})$; **C. Dong**, **H. Li**, and **G. Mason**, Vertex Lie algebras, vertex Poisson algebras and vertex algebras; **A. J. Feingold** and **M. D. Weiner**, Type A fusion rules from elementary group theory; **J. Fuchs** and **C. Schweigert**, Lie algebra automorphisms in conformal field theory; **Y. Hara**, **M. Jimbo**, **H. Konno**, **S. Odake**, and **J. Shiraishi**, On Lepowsky-Wilson's $\mathcal{Z}$-algebra; **G. Hatayama**, **A. Kuniba**, **M. Okado**, **T. Takagi**, and **Y. Yamada**, Scattering rules in soliton cellular automata associated with crystal bases; **B. M. McCoy**, Algebra versus analysis in statistical mechanics and quantum field theory; **A. Milas**, Weak modules and logarithmic intertwining operators for vertex operator algebras; **A. Schilling** and **S. O. Warnaar**, Conjugate Bailey pairs; **M. Vazirani**, Irreducibility of affine Hecke algebra modules induced from Specht modules; **W. Wang**, Algebraic structures behind Hilbert schemes and wreath products; **W. Zhao**, Some generalizations of genus zero two-dimensional conformal field theory.

Contemporary Mathematics, Volume 297

September 2002, 334 pages, Softcover, ISBN 0-8218-2716-2, LC 2002071170, 2000 *Mathematics Subject Classification*: 17B10, 17B37, 17B65, 17B69, 17B80, 17B81; 81T40, 82B23, **Individual member $47**, List $79, Institutional member $63, Order code CONM/297N



The Classification of the Finite Simple Groups, Number 5

Daniel Gorenstein, **Richard Lyons**, *Rutgers University, Piscataway, NJ*, and **Ronald Solomon**, *Ohio State University, Columbus*

The classification of finite simple groups is a landmark result of modern mathematics. The original proof is spread over scores of articles by dozens of researchers. In this multivolume book, the authors are assembling the proof with explanations and references. It is a monumental task. The book, along with background from sections of the previous volumes, presents critical aspects of the classification.

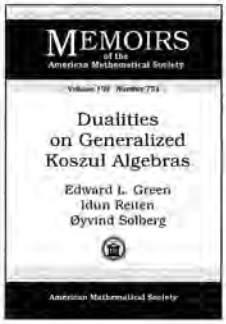
In four prior volumes (Surveys of Mathematical Monographs, Volumes 40.1, 40.2, 40.3, and 40.4), the authors began the proof of the classification theorem by establishing certain uniqueness and preuniqueness results. In this volume, they now begin the proof of a major theorem from the classification grid, namely Theorem C_7.

The book is suitable for graduate students and researchers interested in group theory.

Contents: Theorem C_7: General introduction; General group-theoretic results; Theorem C_7^*: Stage 1; Theorem C_7^*: Stage 2; Theorem C_7^*: Stage 3a; Properties of K-groups; Background references; Expository references; Glossary of symbols and terms.

Mathematical Surveys and Monographs, Volume 40

September 2002, 467 pages, Hardcover, ISBN 0-8218-2776-6, LC 94-23001, 2000 *Mathematics Subject Classification*: 20D06, 20D08; 20D05, 20E32, 20G40, **Individual member $57**, List $95, Institutional member $76, Order code SURV/40.5N



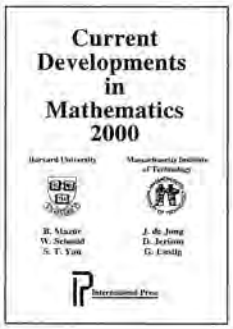
Dualities on Generalized Koszul Algebras

Edward L. Green, *Virginia Polytechnic Institute and State University, Blacksburg*, and **Idun Reiten** and **Øyvind Solberg**, *Norwegian University of Science and Technology, Trondheim, Norway*

Contents: Main results and examples; Proofs of main results; Generalized T-Koszul algebras; Further results and questions; Bibliography.

Memoirs of the American Mathematical Society, Volume 159, Number 754

September 2002, 67 pages, Softcover, ISBN 0-8218-2934-3, LC 2002025583, 2000 *Mathematics Subject Classification*: 16W50, 16S37, 16D90; 18E05, 16E05, **Individual member $28**, List $46, Institutional member $37, Order code MEMO/159/754N



Current Developments in Mathematics 2000

B. Mazur, W. Schmid, and **S. T. Yau**, *Harvard University, Cambridge, MA*, and **J. de Jong, D. Jerison**, and **G. Lustig**, *Massachusetts Institute of Technology, Cambridge*

A publication of the International Press.

This volume contains articles from lectures given at the annual joint mathematics meeting sponsored by Harvard and MIT (Cambridge, MA). The speakers are well-known research mathematicians who have been involved in some of the most important and interesting recent developments in mathematics for the year. These proceedings provide an unparalleled opportunity to stay abreast of current developments in mathematics.

This item will also be of interest to those working in mathematical physics, number theory, geometry and topology, and probability.

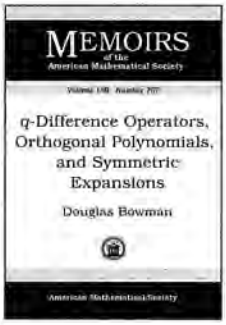
Distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: M. Broué, Reflection groups, braid groups, Hecke algebras, finite reduction groups; **W. E**, Stochastic hydrodynamics; **W. T. Gowers**, Arithmetic progressions in sparse sets; **J. Kollár**, The topology of real algebraic varieties; **O. Schramm**, Scaling limits of random processes and the outer boundary of planar Brownian motion.

International Press

December 2001, 253 pages, Hardcover, ISBN 1-57146-079-9, 2000 *Mathematics Subject Classification*: 00B20, **All AMS members $38**, List $48, Order code INPR/48N

Analysis



q-Difference Operators, Orthogonal Polynomials, and Symmetric Expansions

Douglas Bowman, *University of Illinois, Urbana*

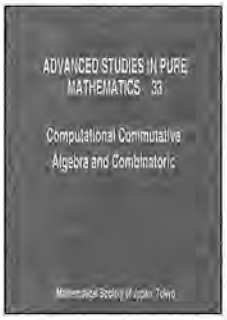
This item will also be of interest to those working in discrete mathematics and combinatorics.

Contents: Introduction and preliminaries; New results and connections with current research; Vector operator identities and simple applications; Bibliography.

Memoirs of the American Mathematical Society, Volume 159, Number 757

September 2002, 56 pages, Softcover, ISBN 0-8218-2774-X, LC 2002025581, 2000 *Mathematics Subject Classification*: 33D70, 05A30; 33D45, **Individual member $25**, List $42, Institutional member $34, Order code MEMO/159/757N

Discrete Mathematics and Combinatorics



Computational Commutative Algebra and Combinatorics

Takayuki Hibi, *Osaka University, Japan*, Editor

A publication of the Mathematical Society of Japan.

This volume constitutes the proceedings of the International Conference on "Computational Commutative Algebra and Combinatorics" held in Osaka, Japan. It contains excellent survey articles and research papers on various topics related to the theme of the conference. Of particular interest are two survey articles, "Algebraic Shifting" by Gil Kalai and "Generic Initial Ideals and Graded Betti Numbers" by Jürgen Herzog.

The volume is suitable for graduate students and research mathematicians interested in discrete mathematics.

Published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

Contents: W. Bruns and **J. Gubeladze**, Polyhedral algebras, arrangements of toric varieties, and their groups; **A. M. Duval**, Algebraic shifting and spectral sequences; **V. Gasharov**, **I. Peeva**, and **V. Welker**, Coordinate subspace arrangements and monomial ideals; **J. Herzog**, Generic initial ideals and graded Betti numbers; **G. Kalai**, Algebraic shifting; **K. Masuda**, Certain moduli of algebraic G-vector bundles over affine G-varieties; **M. Miyanishi**, Completely parametrized $\mathbf{A}^1_*$-fibrations on the affine plane; **M. Petkovšek**, **J. Pommersheim**, and **I. Swanson**, The Zarankiewicz problem via Chow forms; **C. Procesi**, Notes on the topology of hyperplane arrangements and braid groups; **V. Srinivas**, Some geometric methods in commutative algebra.

Advanced Studies in Pure Mathematics, Volume 33

March 2002, 276 pages, Hardcover, ISBN 4-931469-17-5, 2000 *Mathematics Subject Classification*: 05-06; 13-06, **All AMS members $69**, List $86, Order code ASPM/33N

Independent Study

The Steiner Tree Problem

A Tour Through Graphs, Algorithms, and Complexity

Hans-Jürgen Promel, *Humboldt University, Berlin, Germany*, and **Angelika Steger**, *Technische Universität München, Munich, Germany*

A publication of the Vieweg Verlag.

In recent years, algorithmic graph theory has become increasingly important as a link between discrete mathematics and theoretical computer science. This textbook introduces students of mathematics and computer science to the interrelated fields of graphs theory, algorithms and complexity. No specific prior knowledge knowledge is assumed.

The central theme of the book is a geometrical problem dating back to Jakob Steiner. This problem, now called the Steiner problem, was initially of importance only within the context of land surveying. In the last decade, however, applications as diverse as VLSI-layout and the study of phylogenetic trees have lead to a significant rise in the level of interest to this problem. The resulting progress has uncovered fascinating connections to and among graph theory, the study of algorithms, and complexity theory. This single problem thus serves to bind and motivate these areas. The book's topics include: exact algorithms, computational complexity, approximation algorithms, the use of randomness, limits of approximability.

A fundamental feature of the book is that each chapter ends with an "excursion" into some related area. These excursions reinforce the concepts and methods introduced for the Steiner problem by putting them in a broader context. The book is geared toward graduate students, research mathematicians, and computer scientists interested in discrete mathematics.

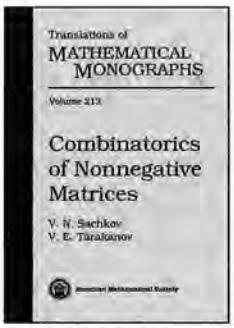
The AMS is exclusive distributor in North America. Vieweg Verlag Publications are available worldwide from the AMS outside of Germany, Switzerland, Austria, and Japan.

Contents: Basics I: Graphs; Basics II: Algorithms; Basics III: Complexity; Special terminal sets; Exact algorithms; Approximation algorithms; More on approximation algorithms; Randomness helps; Limits of approximability; Geometric Steiner problems; Bibliography; Index; Symbol index.

Vieweg Advanced Lectures in Mathematics

February 2002, 241 pages, Softcover, ISBN 3-528-06762-4, 2000 *Mathematics Subject Classification*: 05Cxx, 68Rxx, 68Wxx, 68Qxx, **All AMS members $27**, List $30, Order code VWALM/3N

Supplementary Reading



Combinatorics of Nonnegative Matrices

V. N. Sachkov and **V. E. Tarakanov**, *Steklov Institute of Mathematics, Moscow, Russia*

The variety of combinatorial properties of nonnegative matrices is widely discussed in the mathematical literature, and there are many papers on this topic. However, there are few monographs devoted to these properties of nonnegative matrices. This book fills that gap and presents a summary of the existing material. It provides a good entry point into the subject and includes exercises to aid students.

The authors focus on the relation of matrices with nonnegative elements to various mathematical structures studied in combinatorics. In addition to applications in graph theory, Markov chains, tournaments, and abstract automata, the authors consider relations between nonnegative matrices and structures such as coverings and minimal coverings of sets by families of subsets. They also give considerable attention to the study of various properties of matrices and to the classes formed by matrices with a given structure.

The authors discuss enumerative problems using both combinatorial and probabilistic methods. It also considers extremal problems related to matrices and problems where nonnegative matrices provide suitable investigative tools.

This book was developed for the most part as a theoretical research text, keeping in mind applications of nonnegative matrices. Among the applications, the most significant included are in the theory of Markov chains, in linear programming for constructing and analyzing economic models, and in information theory for designing reliable information devices. The book is suitable for specialists in these areas of engineering and the applied sciences.

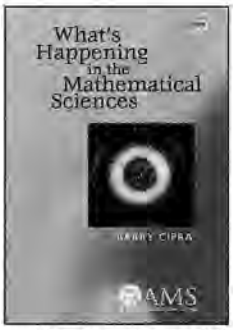
The book contains some classical theorems and a significant number of results not previously published in monograph form, including results obtained by the authors in the last few years. It is appropriate for graduate students and researchers interested in combinatorics and its applications.

Contents: Matrices and Configurations; Ryser classes; Nonnegative matrices and extremal combinatorial problems; Asymptotic methods in the study of nonnegative matrices; Totally indecomposable, chainable, and prime matrices; Sequences of nonnegative matrices; Bibliography; Index.

Translations of Mathematical Monographs, Volume 213

September 2002, 269 pages, Hardcover, ISBN 0-8218-2788-X, LC 2002074392, 2000 *Mathematics Subject Classification*: 05-02; 05C50, 15-02, 15A48, 93-02, **Individual member $59**, List $99, Institutional member $79, Order code MMONO/213N

General and Interdisciplinary



What's Happening in the Mathematical Sciences

Barry Cipra

Reviews of the Previous Volumes:

This lively presentation of an amazingly wide spectrum of happenings in mathematics is impressive ... [this book] should be presented to a wide audience even outside mathematics, which could be fascinated by the ideas, concepts and beauty of the mathematical topics.

—European Mathematical Society Newsletter

The articles are very well written, and usually include quotes from the mathematicians who were involved in the work in question, giving the whole thing a more "human" feel. This book offers professionals a way to keep abreast of what's going on in the field and also gives us a way to share with our students and colleagues some of the excitement of doing mathematics. Don't miss it.

—MAA Online

An excellent source of information. Through his writing, diagrams, and sidebars, Cipra offers historical background, mathematical connections, and insight into the world of research mathematics. Throughout the book, he connects modern mathematical ideas to important applications in computer science, physics, biology, security codes, and art. He also presents in each chapter an intriguing blend of historical and contemporary mathematics. An excellent resource for high school mathematics teachers and their students.

—Mathematics Teacher

The perennial task of bringing mathematics before the general public attracts expositors wielding a diversity of strategies who pursue goals that range from enticing further study and inducing appreciation to merely diminishing fear. Cipra's What's Happening in the Mathematical Sciences surveys late-breaking mathematical news. Though he includes material on such familiar topics as computer chess, chaos, Escher, and cryptosystems, he also discusses less familiar territory such as quantum computers, automated theorem provers, and algorithmic algebraic geometry. Here undergraduates might easily make their first acquaintance with a topic that could shape the course of their future studies and, beyond that, their professional lives. An essential acquisition.

—CHOICE

Stylish format ... largely accessible to laymen ... This publication is one of the snappier examples of a growing genre from scientific societies seeking to increase public understanding of their work and its societal value.

—Science & Government Report

The topics chosen and the lively writing fill a notorious gap-to make the ideas, concepts and beauty of mathematics more visible for the general public ... well-illustrated ... Congratulations to Barry Cipra.

—Zentralblatt MATH

Continued

Mathematicians like to point out that mathematics is universal. In spite of this, most people continue to view it as either mundane (balancing a checkbook) or mysterious (cryptography). This fifth volume of the What's Happening series contradicts that view by showing that mathematics is indeed found everywhere—in science, art, history, and our everyday lives.

Here is some of what you'll find in this volume:

- **Mathematics and Science**
  - **Mathematical biology:** Mathematics was key to cracking the genetic code. Now, new mathematics is needed to understand the three-dimensional structure of the proteins produced from that code.
  - **Celestial mechanics and cosmology:** New methods have revealed a multitude of solutions to the three-body problem. And other new work may answer one of cosmology's most fundamental questions: What is the size and shape of the universe?
- **Mathematics and Everyday Life**
  - **Traffic jams:** New models are helping researchers understand where traffic jams come from–and maybe what to do about them!
  - **Small worlds:** Researchers have found a short distance from theory to applications in the study of small world networks.
- **Elegance in Mathematics**
  - **Beyond Fermat's Last Theorem:** Number theorists are reaching higher ground after Wiles' astounding 1994 proof: new developments in the elegant world of elliptic curves and modular functions.
  - **The Millennium Prize Problems:** The Clay Mathematics Institute has offered a million dollars for solutions to seven important and difficult unsolved problems.

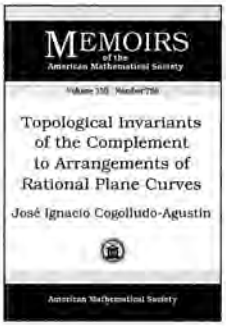
These are just some of the topics of current interest that are covered in this latest volume of What's Happening in the Mathematical Sciences. The book has broad appeal for a wide spectrum of mathematicians and scientists, from high school students through advanced-level graduates and researchers.

Contents: Introduction; New heights for number theory; Nothing to sphere but sphere itself; A mathematical twist to protein folding; Finite math; The mathematics of traffic jams; Rewriting history; It's a small, big, small, big world; A celestial *Pas de Trois*; Think and grow rich; Ising on the cake.

What's Happening in the Mathematical Sciences, Volume 5

August 2002, 95 pages, Softcover, ISBN 0-8218-2904-1, 2000 *Mathematics Subject Classification*: 00A06, **All AMS members $15**, List $19, Order code HAPPENING/5N

Geometry and Topology



Topological Invariants of the Complement to Arrangements of Rational Plane Curves

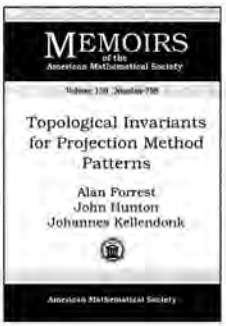
José Ignacio Cogolludo-Agustín, *Madrid, Spain*

This item will also be of interest to those working in algebra and algebraic geometry.

Contents: Preliminaries; Ring structure of $H^\bullet(\mathbb{P}^2\setminus\mathcal{R};\mathbb{C})$; Generalized Aomoto complexes; Characteristic varieties, local systems and rational arrangements; Examples; Bibliography.

Memoirs of the American Mathematical Society, Volume 159, Number 756

September 2002, 75 pages, Softcover, ISBN 0-8218-2942-4, LC 2002025580, 2000 *Mathematics Subject Classification*: 32S50, 14Q05, 14B05, 14F45, 14H30, 14H45, 55N25, 32Q55, 32S20, **Individual member $28**, List $46, Institutional member $37, Order code MEMO/159/756N



Topological Invariants for Projection Method Patterns

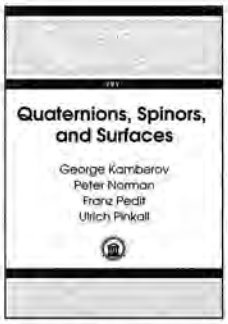
Alan Forrest, *Glasgow, Scotland*, **John Hunton**, *University of Leicester, England*, and **Johannes Kellendonk**, *Cardiff University, Wales*

Contents: General introduction; Topological spaces and dynamical systems; Groupoids, C^*-algebras, and their invariants; Approaches to Calculation I: Cohomology for codimension one; Approaches to Calculation II: Infinitely generated cohomology; Approaches to Calculation III: Cohomology for small codimension; Bibliography.

Memoirs of the American Mathematical Society, Volume 159, Number 758

September 2002, 120 pages, Softcover, ISBN 0-8218-2965-3, LC 2002025582, 2000 *Mathematics Subject Classification*: 52C23; 19E20, 37Bxx, 46Lxx, 55Txx, 82D25, **Individual member $30**, List $50, Institutional member $40, Order code MEMO/159/758N

Recommended Text



Quaternions, Spinors, and Surfaces

George Kamberov, *Stevens Institute of Technology, Hoboken, NJ*, **Peter Norman** and **Franz Pedit**, *University of Massachusetts, Amherst*, and **Ulrich Pinkall**, *Technische Universität, Berlin, Germany*

Many problems in pure and applied mathematics boil down to determining the shape of a surface in space or constructing surfaces with prescribed geometric properties. These problems range from classical problems in geometry, elasticity, and capillarity to problems in computer vision, medical imaging, and graphics. There has been a sustained effort to understand these questions, but many problems remain open or only partially solved. These include determining the shape of a surface from its metric and mean curvature (Bonnet's problem), determining an immersion from the projectivised Gauss map (Christoffel's problem) and its applications to the computer vision problem on recovering shape from shading, the construction of surfaces with prescribed curvature properties, constructing extremal surfaces and interfaces, and representing surface deformations. This book studies these questions by presenting a theory applying to both global and local questions and emphasizing conformal immersions rather than isometric immersions.

The book offers:

- A unified and comprehensive presentation of the quaternionic and spinor approach to the theory of surface immersions in three and four dimensional space.
- New geometric invariants of surfaces in space and new open problems.
- A new perspective and new results on the classical geometric problems of surface and surface shape recognition and surface representation.
- A source of problems to motivate research and dissertations.
- Applications in computer vision and computer graphics.
- Proofs of many results presented by the authors at colloquia, conferences, and congresses over the past two years.

The book describes how to use quaternions and spinors to study conformal immersions of Riemann surfaces into $\mathbb{R}^3$. The first part develops the necessary quaternionic calculus on surfaces, its application to surface theory and the study of regular homotopy classes of immersions, conformal immersions, spinor transforms, and the connection between extrinsic and intrinsic conformal geometry. The integrability conditions for spinor transforms lead naturally to Dirac spinors and their application to conformal immersions. The second part presents a complete spinor calculus on a Riemann surface, the definition of a conformal Dirac operator, and a generalized Weierstrass representation valid for all surfaces.

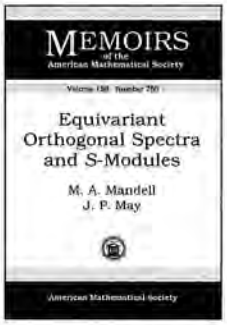
The book is geared toward graduate students and research mathematicians interested in differential geometry and geometric analysis and its applications, computer science, computer vision, and computer graphics.

This item will also be of interest to those working in applications.

Contents: *Conformal immersions via quaternions:* Quaternionic calculus and immersions; Applications; *Surfaces and Dirac spinors:* Spinor algebra; Dirac spinors and conformal immersions; Bibliography; Glossary of symbols; Index.

Contemporary Mathematics, Volume 299

October 2002, approximately 152 pages, Softcover, ISBN 0-8218-1928-3, 2000 *Mathematics Subject Classification*: 55-XX, **All AMS members $31**, List $39, Order code CONM/299N



Equivariant Orthogonal Spectra and S-Modules

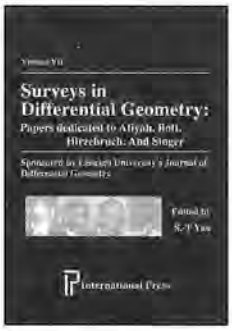
M. A. Mandell and **J. P. May**, *University of Chicago, IL*

This item will also be of interest to those working in algebra and algebraic geometry.

Contents: Introduction; Orthogonal spectra and S-modules; Equivariant orthogonal spectra; Model categories of orthogonal G-spectra; Orthogonal G-spectra and S_G-modules; "Change" functors for orthogonal G-spectra; "Change" functors for S_G-modules and comparisons; Bibliography; Index of notation.

Memoirs of the American Mathematical Society, Volume 159, Number 755

September 2002, 108 pages, Softcover, ISBN 0-8218-2936-X, LC 2002025579, 2000 *Mathematics Subject Classification*: 55P42, 55P43, 55P91; 18A25, 18E30, 55P48, 55U35, **Individual member $29**, List $49, Institutional member $39, Order code MEMO/159/755N



Surveys in Differential Geometry: Papers Dedicated to Atiyah, Bott, Hirzebruch, and Singer

S. T. Yau, *Harvard University, Cambridge, MA*

A publication of the International Press.

This volume arose from a conference dedicated to four remarkable mathematicians: M. Atiyah, R. Bott, F. Hirzebruch, and I. Singer. These men were a source of inspiration and mentors to the participants and speakers at the conference.

There are several articles included, among them are articles on the geometry of classical particles by Atiyah, Hirzebruch's research on singularities by E. Brieskorn, moment map and diffeomorphisms by Donaldson, dirac charge quantization by Daniel Freed, the fixed point theorem and number theory by Hirzebruch, complex Lagrangian submanifolds by Hitchin, Riemannian manifolds by Peter Li, the mirror principle by Lian, Liu, and Yau, Seiberg-Witten invariants by Taubes, topological

field theories by Vafa, and Yang-Mills and string theory by Witten.

The book is suitable for graduate students and research mathematicians interested in differential geometry.

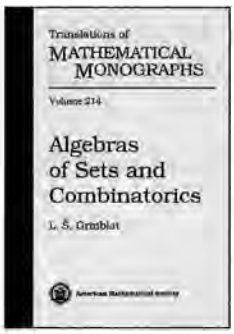
Distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: **M. Atiyah**, The geometry of classical particles; **E. Brieskorn**, Singularities in the work of Friedrich Hirzebruch; **C. Ciliberto** and **G. van der Geer**, The moduli space of abelian varieties and the singularities of the theta divisor; **R. L. Cohen**, **E. Lupercio**, and **G. B. Segal**, Holomorphic spheres in loop groups and Bott periodicity; **S. K. Donaldson**, Moment map and diffeomorphisms; **D. S. Freed**, Dirac charge quantization and generalized differential cohomology; **D. Goldfeld** and **S. Zhang**, The holomorphic kernel of the Rankin-Selberg convolution; **V. Guillemin** and **C. Zara**, Equivariant de Rham theory and graphs; **F. R. Harvey** and **H. B. Lawson, Jr.**, Morse theory and Stokes' theorem; **F. Hirzebruch**, The Atiyah-Bott-Singer fixed point theorem and number theory; **N. J. Hitchin**, The moduli space of complex Lagrangian submanifolds; **R. V. Kadison**, Which Singer is that?; **P. Li**, Curvature and function theory on Riemannian manifolds; **B. H. Lian**, **K. Liu**, and **S.-T. Yau**, Mirror principle. III; **B. H. Lian**, **K. Liu**, and **S.-T. Yau**, Mirror principle. IV; **Yu. I. Manin**, Three constructions of Frobenius manifolds: A comparative study; **R. Penrose**, On Ricci-flat twistor theory; **W. Schmid** and **K. Vilonen**, On the geometry of nilpotent orbits; **C. H. Taubes**, Seiberg-Witten invariants, self-dual harmonic 2-forms and the Hofer-Wysocki-Zehnder formalism; **C. Vafa**, Unifying themes in topological field theories; **E. Witten**, Noncommutative Yang-Mills theory and string theory.

International Press

December 2001, 696 pages, Hardcover, ISBN 1-57146-069-1, 2000 *Mathematics Subject Classification*: 53Axx, **All AMS members $52**, List $65, Order code INPR/49N

Logic and Foundations



Algebras of Sets and Combinatorics

L. Š. Grinblat, *College of Judea and Samaria, Ariel, Israel*

An algebra A on a set X is a family of subsets of this set closed under the operations of union and difference of two subsets. The main topic of the book is the study of various algebras and families of algebras on an abstract set X. The author shows how this is related to famous problems by Lebesgue, Banach, and Ulam on the existence of certain measures on abstract sets, with corresponding algebras being algebras of measurable subsets with respect to these measures. In particular it is shown that for a certain algebra not to coincide with the algebra of all subsets of X is equivalent to the existence of a nonmeasurable set with respect to a given measure.

Although these questions don't seem to be related to mathematical logic, many results in this area were proved by "metamathematical" methods, using the method of forcing and other tools related to axiomatic set theory. However, in the present book, the author uses "elementary" (mainly combinatorial) methods to study properties of algebras on a set. Presenting new and original material, the book is written in a clear and readable style and illustrated by many examples and figures.

The book will be useful to researchers and graduate students working in set theory, mathematical logic, and combinatorics.

Contents: Introduction; Main results; The main idea; Finite sequences of algebras (1). Proof of Theorems 2.1 and 2.2; Countable sequences of algebras (1). Proof of Theorem 2.4; Proof of the Gitik-Shelah theorem, and more from set theory; Proof of Theorems 1.17, 2.7, 2.8; Theorems on almost σ-algebras. Proof of Theorem 2.9; Finite sequences of algebras (2). The function $\mathfrak{g}(n)$; A description of the class of functions Ψ_*^7; The general problem. Proof of Theorems 2.15 and 2.20; Proof of Theorems 2.21(1,3), 2.24; The inverse problem; Finite sequences of algebras (3). Proof of Theorems 2.27, 2.31, 2.36, 2.38; Preliminary notions and lemmas; Finite sequences of algebras (4). Proof of Theorems 2.39(1,2), 2.45(1,2); Countable sequences of algebras (2). Proof of Theorems 2.29, 2.32, 2.46; A refinement of theorems on σ-algebras. Proof of Theorems 2.34, 2.44; Semistructures and structures of sets. Proof of Theorem 2.48; Final comments. Generalization of Theorem 2.1; Appendix: On a question of Grinblat by S. Shelah; Bibliography; Index.

Translations of Mathematical Monographs, Volume 214

October 2002, approximately 264 pages, Hardcover, ISBN 0-8218-2765-0, 2000 *Mathematics Subject Classification*: 03E05; 28A05, 54D35, **Individual member $59**, List $99, Institutional member $79, Order code MMONO/214N

Mathematical Physics

XIIIth International Congress of Mathematical Physics

A. Fokas, **A. Grigoryan**, **T. Kibble**, and **B. Zegarlinski**, *Imperial College of Science and Technology, London, UK*

A publication of the International Press.

Looking at the programme, I can only state that mathematical physics is alive and exciting as ever with many novel facets added.

*—**Herbert Spohn, IAMP President***

This book presents material from the XIIIth International Congress of Mathematical Physics. It contains 13 plenary lectures and the invited session talks in biophysics, condensed matter physics, dynamical systems, equilibrium statistical mechanics, general relativity, nonequilibrium statistical mechanics, nonlinear partial differential equations and fluid dynamics, operator algebras and noncommutative geometry, quantum chaos and semiclassical approximations, quantum

field theory, quantum information and computation, quantum mechanics and spectral theory, and string theory, M-theory, and duality. Also included are laureates and citations, and addresses and presentations.

The book is suitable for graduate students and research mathematicians interested in mathematical physics.

Distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: *Plenary Talks:* **V. Bach**, Spectral analysis of nonrelativistic matter coupled to quantized radiation fields; **M. Berry**, Indistinguishable spinning particles; **D. Buchholz**, Algebraic quantum field theory: a status report; **R. H. Dijkgraaf**, The mathematics of M-theory; **S. Donaldson**, Planck's constant in complex and almost-complex geometry; **V. Gelfreich**, A century of separatrices splitting in Hamiltonian dynamical systems: perturbation theory, exponential smallness; **G. Huisken**, Energy inequalities for isolated gravitating systems; **S. Leibler**, On statistical mechanics of living bacteria; **E. Lieb**, The Bose gas: A subtle many-body problem; **E. Presutti**, Liquid-vapour phase transitions; **A. Schwarz**, Topological quantum field theories; **S. Shlosman**, Metastable states as continuations of Gibbs states; **P. W. Shor**, Quantum computing; *Invited Session Talks:* **G. Flierl**, Copepods and whales: fluid flow, behavior, and population dynamics; **G. Hinton**, From statistical physics to neural population codes; **L. A. Segel**, How the immune system works: theoretical thoughts; **G. B. West**, Fractals and hierarchical branching networks; the origin of universal scaling laws in biology from molecules & cells to whales; **V. Mastropietro**, Renormalization group analysis of one-dimensional systems; **S. Sachdev** and **M. Vojta**, Non-magnetic impurities as probes of insulating and doped Mott insulators in two dimensions; **K. Schoutens** and **E. Ardonne**, Non-abelian statistics in quantum Hall systems; **H. Schulz-Baldes**, Anomalous transport in aperiodic media; **G. Friesecke**, Solitary waves on Fermi-Pasta-Ulam lattices: existence, stability and rigorous passage to a continuum limit via renormalization group approach; **J. J. Abad**, **H. Koch**, and **P. Wittwer**, Renormalization group analysis of Hamiltonian flows; **M. Lyubich**, Renormalization and invariant measures in one-dimensional dynamics; **M. Kunze** and **H. Spohn**, Slow motion of charges interacting with the Maxwell field; **T. Bodineau**, A microscopic derivation of 3D equilibrium crystal shapes; **R. Kenyon**, Dominos and the Gaussian free field; **C. Maes**, Weakly Gibbsian fields, how strong?; **B. Nachtergaele**, Interfaces and droplets in quantum lattice models; **L. Andersson**, Quiescent cosmological singularities; **J. Baez**, Quantum geometry and black hole entropy; **J. Barrett**, State sum models and quantum gravity; **P. Bizoń**, On critical phenomena in gravitational collapse; **L. Erdős**, Long time dynamics of an electron in a weakly coupled phonon field; **M. Fannes** and **P. Spincemaille**, Statistical modelling of a quantum dynamical system; **R. Hudson** and **S. Pulmannová**, Explicit universal solutions of the quantum Yang-Baxter equation constructed as double product integrals; **F. Martinelli**, On the kinetic Ising model below the critical temperature; **Y. Brenier**, Volume preserving maps, Euler equations and Coulomb interaction; **A. Bressan**, Uniqueness and stability for one-dimensional hyperbolic systems of conservation laws; **H. Freistuehler**, Effects of dissipation on nonlinear waves; **P. Biane**, Free cumulants and representations of large symmetric groups; **P. Jorgensen**, Representations of Cuntz algebras, loop groups and wavelets; **A. Forrest**, **J. Hunton**, and **J. Kellendonk**, Cohomology groups for projection point patterns; **S. Vaes**, Examples of locally compact quantum groups through the bicrossed product construction; **M. D. Esposti**, Quantum maps: why and why not; **J. Marklof**, Level spacing statistics and integrable dynamics; **A. Voros**, Analytical resolution of polynomial 1D Schrödinger equation by exact quantization; **S. Zelditch**, From random polynomials to symplectic geometry; **J. Dimock**, Notes on $(QED)_3$; **D. S. Freed**, Chern-Simons theory revisited; **D. Kreimer**, Combinatorics of renormalization; **V. Petkova**, Chiral approach to the (non)-diagonal 2D conformal models; **D. DiVincenzo** and **B. Terhal**, Product bases in quantum information theory; **R. Cleve**, Quantum communication complexity; **A. S. Holevo**, Coding theorems of quantum information theory; **S. Jitomirskaya**, Nonperturbative analysis of quasiperiodic operators; **F. Klopp** and **T. Wolff**, Internal Lifshitz tails for random Schrödinger operators; **A. Sobolev**, Periodic operators and the Bethe-Sommerfeld conjecture; **P. Exner** and **T. Weidl**, Lieb-Thirring inequalities on trapped modes in quantum wires; **G. Hooft**, Tinier than the nucleus of an atom; **B. Julia**, Supergravity theories: from fields to branes; **W. Nahm**, Strings on K3; **A. Schwarz**, Gauge theories on noncommutative spaces; Contributed talks; Associated programme; Satellite meetings; List of participants.

International Press

December 2001, 508 pages, Hardcover, ISBN 1-57146-085-3, 2000 *Mathematics Subject Classification*: 00A79, **All AMS members $40**, List $50, Order code INPR/50N

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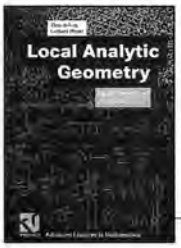
A History of Complex Dynamics
From Schröder to Fatou and Julia

Daniel S. Alexander, *Drake University, Des Moines, IA*

Vieweg Aspects of Mathematics; 1994; 165 pages; Hardcover; ISBN 3-528-06520-6; List $42; All AMS members $38; Order code VWAM/24NT209



Local Analytic Geometry
Basic Theory and Applications

Theo de Jong, *Universität des Saarlandes, Saarbrücken, Germany,* and **Gerhard Pfister,** *Universität Kaiserslautern, Germany*

Vieweg Advanced Lectures in Mathematics; 2000; 382 pages; Softcover; ISBN 3-528-03137-9; List $59; All AMS members $53; Order code VWALM/7NT209

Introduction to Markov Chains
With Special Emphasis on Rapid Mixing

Ehrhard Behrends, *Free University of Berlin, Germany*

Vieweg Advanced Lectures in Mathematics; 2000; 232 pages; Softcover; ISBN 3-528-06986-4; List $42; All AMS members $38; Order code VWALM/6NT209

Dynamics in One Complex Variable
Introductory Lectures, Second Edition

John Milnor, *State University of New York at Stony Brook, NY*

Vieweg Monographs; 1999; 257 pages; Softcover; ISBN 3-528-03130-6; List $29; All AMS members $26; Order code VW/9NT209

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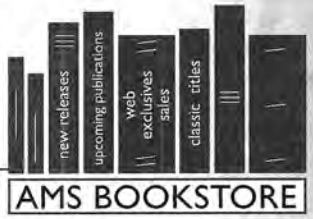

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7/02

Classified Advertisements

Positions available, items for sale, services available, and more

CALIFORNIA

HARVEY MUDD COLLEGE
Chair, Department of Mathematics

Harvey Mudd College invites applications for a permanent position in mathematics at the full professor level. Demonstrated excellence in teaching is absolutely essential for all candidates, as is an established record of scholarship in the mathematical sciences. The successful candidate will begin service as department chair shortly after the appointment and will possess demonstrated leadership skills to support and mentor a young, enthusiastic department. Candidates should also be willing to supervise undergraduate research and to work with others in the development of the undergraduate curriculum and other departmental programs.

Harvey Mudd College is a highly selective undergraduate institution of science, engineering, and mathematics, with a median SAT score approaching 1500 and one year of high school calculus required for admission. Each year there are about 25 graduates in mathematics, CS/math, and mathematical biology, with approximately half going to graduate school. Over 40% of mathematics alumni from HMC have entered Ph.D. programs. The college enrolls about 700 students and is a member of the Claremont College consortium, which consists of four other undergraduate colleges, the Claremont Graduate University, and the Keck Graduate Institute of Applied Life Sciences, forming together an academic community of about 5,000 students. There is an active and vital research community of over 40 mathematicians in the consortium.

Claremont is situated approximately 35 miles east of downtown Los Angeles at the foot of the San Gabriel Mountains. The community is known for its tree-lined streets and village charm. It is an easy drive from Claremont to the cultural attractions of the greater Los Angeles area, as well as the ocean, mountains, and deserts of southern California.

Applicants should send a curriculum vitae, a description of their teaching philosophy and accomplishments, a description of their current research program, and names and addresses of at least three persons as references. Only references of finalists for the position will be contacted. Applications will be reviewed as they are received, beginning September 15, and the position will remain open until filled. Harvey Mudd College is an Equal Opportunity Employer and is committed to the recruitment of candidates historically underrepresented on college faculties.

Further information about the college and department may be found at `http://www.math.hmc.edu/`.

Address for applications:

Professor Henry A. Krieger
Chair, Mathematics
Senior Search Committee
Department of Mathematics
Harvey Mudd College
Claremont, CA 91711-5990

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Charles B. Morrey Jr. Assistant Professorships

We invite applications for these special (non-tenure-track) positions, effective July 1, 2003. The terms of these appointments may range from two to three years. Applicants should have a recent Ph.D. or the equivalent in an area of pure or applied mathematics. Applicants should send a résumé, reprints, preprints and/or dissertation abstract, and ask three people to send letters of evaluation to the Vice Chair for Faculty Affairs at the above address. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found on our homepage, `http://math.berkeley.edu/`, by clicking on Available Teaching Position and then Confidentiality Policy. We request that applicants use the AMS standardized application form and indicate their subject area using the AMS subject classification numbers. The form is the Academic Employment in Mathematics, Application Cover Sheet, available courtesy of the American Mathematical Society.

Applications must be postmarked by De-

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 2002 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.

Upcoming deadlines for classified advertising are as follows: October 2002 issue–July 25, 2002; November 2002 issue–August 27, 2002; December 2002 issue–September 26, 2002; January 2003 issue–October 28, 2002; February 2003 issue–November 22, 2002; March 2003 issue–January 8, 2003.

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 (321-4267) 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 02904. Advertisers will be billed upon publication.

cember 1, 2002. Applications postmarked after the deadline will not be considered. The University of California is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Temporary Postdoctoral Positions

Several temporary positions beginning in fall 2003 are anticipated for new and recent Ph.D.'s of any age, in any area of pure or applied mathematics. The terms of these appointments may range from one to three years. Applicants for NSF or other postdoctoral fellowships are encouraged to apply for these positions. Mathematicians whose research interests are close to those of regular department members will be given some preference. Applicants should send a résumé and reprints, preprints, and/or dissertation abstract, and ask three people to send letters of evaluation to the Vice Chair for Faculty Affairs at the above address. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found on our homepage, `http://math.berkeley.edu/`, by clicking on Available Teaching Position and then Confidentiality Policy. We request that applicants use the AMS standardized application form and indicate their subject area using the AMS subject classification numbers. The form is the Academic Employment in Mathematics, Application Cover Sheet, available courtesy of the American Mathematical Society.

Applications must be postmarked by December 1, 2002. Applications postmarked after the deadline will not be considered. The University of California is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Tenured or Tenure-Track Position

Pending budget approval, we invite applications for one or more positions effective July 1, 2003, at either the tenure-track (assistant professor) or tenured (associate or full professor) level in the general areas of pure or applied mathematics.

Tenure-track applicants are expected to have demonstrated outstanding research potential, normally including major contributions beyond the doctoral dissertation. Such applicants should send a résumé, reprint, preprints, and/or dissertation abstract, and ask three people to send letters of evaluation to the Vice Chair for Faculty Affairs at the above address. It is the responsibility of the tenure-track applicants to make sure that letters of evaluation are sent. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found on our homepage, `http://math.berkeley.edu/`, by clicking on Available Teaching Positions.

Tenure applicants are expected to demonstrate leadership in research and should send a curriculum vitae, list of publications, a few selected reprints or preprints, and the names and addresses of three references to the Vice Chair for Faculty Affairs at the above address. Applicants should indicate whether they are applying for an associate professor or a full professor position. The department will assume responsibility to solicit letters of evaluation and will provide evaluators with a copy of the summary of policies on confidentiality of letters of evaluation.

All applicants are requested to use the AMS standardized application form and to indicate their subject area using the AMS subject classification numbers. The form is the Academic Employment in Mathematics, Application Cover Sheet, available courtesy of the American Mathematical Society.

Both tenure-track and tenure applications must be postmarked by November 15, 2002. Applications postmarked after the deadline will not be considered. The University of California is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA, LOS ANGELES
Department of Mathematics

Subject to availability of resources and administrative approval, the following positions are available for the 2003-04 academic year.

(1) Several tenure-track and senior positions in all areas of mathematics.

(2) Several E. R. Hedrick Assistant Professorships. Salary is $53,200. Three-year appointment. Teaching load: four quarter-courses per year, which may include one advanced course in the candidate's field.

(3) Several Research Assistant Professorships in Computational and Applied Mathematics (CAM). Salary is $53,200. Three-year appointment. Teaching load: normally reduced to two or three quarter-courses per year by research funding as available; may include one advanced course in the candidate's field.

(4) Several Adjunct Assistant Professorships or Lectureships in the Program in Computing (PIC). Applicants for the adjunct position must show very strong promise in teaching and research in an area related to computing. Teaching load: four one-quarter programming courses each year and one seminar every two years. One-year initial appointment, with the option of applying for renewal for a second year and possibly longer, up to a maximum service of four years. Salary is $56,800. 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 one-quarter programming courses per year. One-year appointment, probably renewable one or more times, depending on the needs of the program. Salary is $43,152 or more, depending on experience.

(5) Several VIGRE Assistant Professorships. Hedrick, CAM, or PIC applicants who are U.S. citizens or permanent residents may also apply for a VIGRE Assistant Professor position. Three-year appointment. Salary is $53,200. The successful recipient will receive a summer stipend of $6,500 for two summers and $2,500 per year for travel, equipment, and supplies for three years. Teaching load: 3 courses per year.

(6) Several Adjunct Assistant Professorships and Research Postdocs. Up to one-year appointment, with the possibility of renewal. Strong research and teaching background required. Salary $48,900-$53,200. Teaching load for adjuncts: five quarter-courses per year.

(7) Several visiting instructorships.

For more details, see `http://www.math.ucla.edu/~search/`. To apply, complete the application on the website, or send e-mail to `search@math.ucla.edu`, or write to: Staff Search, Department of Mathematics, University of California, Los Angeles, CA 90095-1555. Preference will be given to applications completed by January 6, 2003.

UCLA is an Equal Opportunity/Affirmative Action Employer. Under federal law, the University of California may employ only individuals who are legally authorized to work in the United States as established by providing documents specified in the Immigration Reform and Control Act of 1986.

CONNECTICUT

YALE UNIVERSITY
Department of Mathematics

Yale University applications accepted for Gibbs Instructorships/Assistant Professorships for Ph.D. with outstanding promise in research in pure mathematics. Appointments are for two/three years, starting July 2003. The teaching load for Gibbs Instructors/Assistant Professors will be kept light so as to allow ample time for research. This will consist of 3 one-semester courses per year. Part of the duties may consist of a one-semester course at the graduate level in the general area of the instructor's research. Applications and supporting materials must be received by January 1, 2003. Offers will be made

during February. Salary at least $51,800. Applications are available at: http://www.math.yale.edu/. Applications and supporting materials may be sent via U.S. mail to: The Gibbs Committee, Department of Mathematics, Yale University, P.O. Box 208283, New Haven, CT 06520-8283; or via email to: gibbs.committee@math.yale.edu. Applications from women and members of minority groups are welcome. Yale is an Affirmative Action/Equal Opportunity Employer.

GEORGIA

GEORGIA INSTITUTE OF TECHNOLOGY
School of Mathematics

The School of Mathematics at Georgia Tech expects to have several tenure-track and visiting positions available beginning fall 2003, and will consider applications in pure and applied mathematics and statistics at all ranks. Preference will be given to candidates who complement existing strengths in the School of Mathematics, while adding expertise in new areas consistent with the goals and directions of the school. Candidates should have strong research and teaching records or potential. The school will also consider applications for NSF VIGRE Postdoctoral Fellowships. These are non-tenure-track positions, normally renewable annually to a maximum of three years. Eligibility is limited to U.S. citizens, nationals, and permanent residents who will have a Ph.D. and not be beyond 18 months from the completion of their degree at the time of the appointment. The academic year salary for these positions is $45,000, with an additional $6,500 for research support in each of the first and second summers, and a $7,500 travel allowance over the term of the appointment. Preference will be given to applicants deemed likely to benefit from a mentoring relationship with one or more members of the current faculty of the school. Review of applications for all positions will begin in September 2002 and continue until all positions have been filled. Candidates 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, USA. Georgia Tech, an institution of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

MARYLAND

JOHNS HOPKINS UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for the Director of Undergraduate Studies at the non-tenure-track rank of lecturer beginning fall 2003. The position is renewable depending on performance. Required qualifications include an M.A. or Ph.D. in mathematics, creative teacher with college teaching experience, ability to work well with others and to play a leading role in curriculum development, and ability to use technology in teaching. The duties will involve administering the basic elementary mathematics courses: Pre-calculus; Calculus I, II, III; Linear Algebra; and Differential Equations. Responsibilities include supervision and training of teaching assistants, advising undergraduates, and coordinating course enrollment and scheduling with the registrar and Office of Academic Advising. Applicants should send a cover letter, curriculum vitae, and contact information for three professional references to: Department Chair, Lecturer Hiring, Johns Hopkins University, 3400 N. Charles Street, Krieger 404, Baltimore, MD 21218. First-round preference will be given to applications received by November 15, 2002. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer and actively encourages interest from minorities and women.

JOHNS HOPKINS UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for two positions at the associate or full professor level in the general areas of analysis, algebra, topology, number theory, and mathematical physics beginning fall 2003 or later. Targeted areas of hiring are number theory and mathematical physics. Applicants should send a cover letter, curriculum vitae, and contact information for three professional references to: Chair, Hiring Committee, Johns Hopkins University, 3400 N. Charles Street, Krieger 404, Baltimore, MD 21218. First-round preference will be given to applications received by January 1, 2003. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer and actively encourages interest from minorities and women.

MICHIGAN

MICHIGAN STATE UNIVERSITY
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Industrial Mathematics
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NEW YORK

CORNELL UNIVERSITY
Department of Mathematics

The Department of Mathematics at Cornell University invites applications for the position of tenure-track assistant professor (or higher rank). We expect to have two or more positions. Start date July 1, 2003. For information about fields of interest and application requirements, refer to our website: http://www.math.cornell.edu/Positions/positions.html. Deadline is November 1, 2002. Early applications will be regarded favorably. Send application and supporting materials to: Recruiting Committee, Department of Mathematics, Malott Hall, Cornell University, Ithaca, NY 14853-4201; e-mail: math_recruit@cornell.edu. Cornell University is an Affirmative Action/Equal Opportunity Employer.

CORNELL UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for the following positions beginning July 1, 2003: (1) one H. C. Wang Assistant Professor, nonrenewable, 3-year term; (2) three VIGRE Postdoctoral Associates (contingent upon funding), nonrenewable, 3-year term, beginning August 16, 2003: (3) visiting positions, academic-year or one-semester teaching positions (any rank). For information about our positions and application requirements, see: http://www.math.cornell.edu/Positions/positions.html. Applicants will be automatically considered for all eligible positions. Deadline December 1, 2002. Early applications will be regarded favorably. Send application and supporting materials to: Recruiting Committee, Department of Mathematics, Malott Hall, Cornell University, Ithaca, NY 14853-4201; e-mail: math_recruit@cornell.edu. Cornell University is an Affirmative Action/Equal Opportunity Employer.

CORNELL UNIVERSITY
Department of Mathematics

The Cornell University Department of Mathematics invites applications for our Teaching Program Visiting Faculty Positions beginning August 16, 2003. Two or more half-time visiting positions (any rank) for mathematics professors on sabbatical/other leaves from colleges, universities, and engineering schools. Candidates with substantial experience teaching undergraduate mathematics and with teaching and research interests compatible with current faculty are sought. Successful candidates are expected to pursue a program of study and/or research at Cornell. For information about

these positions and application requirements, see: http://www.math.cornell.edu/Positions/positions.html. Deadline is December 1, 2002. Send application and supporting materials to: Linda Clasby, Department of Mathematics, 320 Malott Hall, Cornell University, Ithaca, NY 14853-4201. Cornell University is an Affirmative Action/Equal Opportunity Employer.

PENNSYLVANIA

LA SALLE UNIVERSITY
Department of Mathematics & Computer Science
Tenure-Track Position

La Salle University invites applications for a tenure-track position at the assistant professor level beginning in August 2003. A Ph.D. in mathematics is required by the commencement of the appointment. The successful candidate will possess a strong commitment to excellence in teaching and continued scholarly activity. Duties include teaching a wide variety of undergraduate courses (12 hours each semester), student advising, curriculum development, and committee work.

La Salle University is a Roman Catholic university in the tradition of the La Salle Christian Brothers and welcomes applicants from all backgrounds who can contribute to its unique educational mission. For a complete mission statement, please visit our website at http://www.lasalle.edu/.

Please submit a curriculum vitae, statement of teaching philosophy, and three letters of recommendation, at least one of which addresses the applicant's teaching experience and effectiveness, to: Linda J. Elliott, Chair, Department of Mathematics and Computer Science, La Salle University, 1900 West Olney Avenue, Philadelphia, PA 19141-1199 (elliott@lasalle.edu). Priority will be given to applications received by November 1, 2002. Women and minorities are strongly encouraged to apply. AA/EOE.

CANADA

UNIVERSITY OF ALBERTA
Department of Mathematical and Statistical Sciences
Senior Canada Research Chair in Algebra (SPF-02)

The Department of Mathematical and Statistical Sciences, University of Alberta, invites applications for a Tier 1 Canada Research Chair position in algebra (SPF-02). The appointment will be at the full professor level and will commence on July 1, 2003. Candidates should primarily be algebraists, but individuals whose interests cross number theory or other areas of mathematics/mathematical physics are also welcome to apply. We are looking for candidates with an outstanding research and leadership record and excellent communication and teaching skills. The successful applicant will join a large and diverse algebra group of faculty and graduate students at the University of Alberta. For more information about the department and our university, please see our website, http://www.math.ualberta.ca/. For information about the Canadian Research Chair program, please visit http://www.chairs.gc.ca/. All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. Applications should include a curriculum vitae, including a list of research and teaching activities. Candidates should arrange for at least three confidential letters of reference to be sent to: Anthony To-Ming Lau, Chair, Department of Mathematical and Statistical Sciences, University of Alberta, Edmonton, Alberta, T6G 2G1, Canada. The records arising from this competition will be managed in accordance with provisions of the Alberta Freedom of Information and Protection of Privacy Act (FOIPP). The University of Alberta hires on the basis of merit. We are committed to the principle of equity in employment. We welcome diversity and encourage applications from all qualified women and men, including persons with disabilities, members of visible minorities, and aboriginal persons.

CARLETON UNIVERSITY
School of Mathematics and Statistics

Applications are invited for tenure-track positions at the assistant professor level starting July 1, 2003. Successful candidates should have a Ph.D. in mathematical or statistical sciences, be research oriented, and have excellent teaching skills. Candidates engaged in research in applied areas of mathematics or statistics (or outstanding in other areas) should apply. For full advertisement and instructions for submitting an application, see: http://www.math.carleton.ca/. Deadline: October 2, 2002. Employment equity is university policy. Priority will be given to Canadian citizens and permanent residents of Canada.

GERMANY

UNIVERSITY OF MANNHEIM
Department of Mathematics and Computer Science

The Department of Mathematics and Computer Science invites applications for a chair (C4 Professor) in differential equations and dynamical systems. Successful applicants must have a strong research interest and expertise in the area, and a strong commitment to teaching. Send applications before October 31, 2002, to: Dekan der Fakultaet fuer Mathematik und Informatik, Universitaet Mannheim, D-68131 Mannheim, Germany.

HONG KONG

THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department of Mathematics

The Department of Mathematics invites applications for faculty positions at the rank of associate professor or assistant professor from all areas of mathematics, with preference for statistics and applied mathematics.

Exceptionally strong research and teaching experience are required. Applicants must demonstrate excellence in teaching and proven ability to teach effectively in English.

Starting rank and salary will depend on qualifications and experience. Benefits include medical and dental benefits; assistance in housing will be provided where applicable. Initial appointment will be on a three-year contract. A gratuity will be payable upon successful completion of the contract.

Applicants should send a curriculum vitae and ask at least three referees to send letters of recommendation directly, preferably before January 31, 2003, to the Personnel Office, HKUST, Clear Water Bay, Kowloon, Hong Kong (fax: 852 2358 0700). More information about the university is available on the university's homepage, http://www.ust.hk/.

(Information provided by applicants will be used for recruitment and other employment-related purposes.)

LEBANON

THE AMERICAN UNIVERSITY OF BEIRUT
Center for Advanced Mathematical Sciences (CAMS)
Director

The American University of Beirut, Beirut, Lebanon, seeks a senior research scholar to fill the position of director for its Center for Advanced Mathematical Sciences (CAMS).

CAMS is a multidisciplinary interfaculty research center that promotes advanced research and graduate study in the mathematical sciences broadly defined, fosters collaborative research and aids in professional training and development among scientists and mathematicians in Lebanon and the Middle East, creates and maintains a network of relations with equivalent centers internationally, and serves as a focal

point for generating funds for its activities in Lebanon and the Middle East.

The position provides a unique opportunity for a senior scholar to play a crucial and pivotal role in advancing the scientific infrastructure of the Middle East by drawing together research specialists in such calibrative sciences as mathematics, physics, economics, engineering, and business.

The director of CAMS is appointed by the university's president and reports directly to the provost. The center's activities are, in addition, overseen by an eminent international advisory committee chaired by Sir Michael Atiyah of Edinburgh University. The director also enjoys an academic appointment in the department of his/her specialization and is expected to engage in teaching and other departmental duties at an appropriate level.

Compensation is competitive.

All interested applicants may send a letter of application and arrange for three letters of reference to be addressed to: Provost, American University of Beirut, c/o New York Office, 850 Third Avenue, 18th Floor, New York, NY 10022-6297; or Provost, American University of Beirut, Lebanon. Electronic submission may be sent to: `pheath@aub.edu.lb`. Applications will be considered until the position is filled.

The American University of Beirut is an Affirmative Action/Equal Opportunity Employer. AUB's homepage is `http://www.aub.edu.lb/`.

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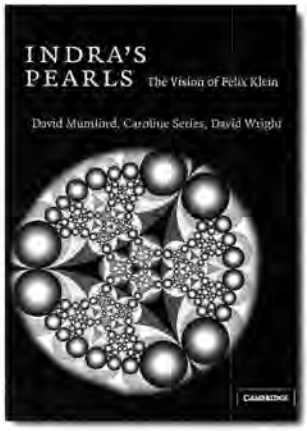

Felix Klein, a great geometer of the 19th century, rediscovered an idea from Hindu mythology in mathematics: the heaven of Indra in which the whole Universe was mirrored in each pearl in a net of pearls. In the 1980s the authors embarked on the first computer investigation of Klein's vision. Here, they explore the path from basic mathematical ideas to the simple algorithms that create delicate fractal filigrees, most appearing in print for the first time. Step-by-step instructions for writing computer programs allow beginners to generate the images.
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Discrete and Continuous Dynamical Systems (Series A) is a leading journal in analysis, differential equations and dynamical systems. As an SCI journal, it is with a high impact factor and ranked recently by **ISI** the top 63rd among the 161 SCI journals of mathematics. Accepted papers may appear in 6 months. Recent contributors include Jerry Bona, Jean Bourgain, Alberto Bressan, Haim Brezis, Xavier Cabré, Alice Chang, Ciprian Foias, Victor A. Galaktionov, Thomas Hou, Anatole Katok, David Kinderlehrer, Fanghua Lin, P.-L. Lions, John Mallet-paret, Frank Merle, Michael Shub, Walter Strauss, Roger Temam, Jeff Xia. The journal is edited by

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P.E. Kloeden,
Yang Kuang,
Yoshiki Kuramoto,
Yanping Lin,
Philip Maini,
Olli Martio,
Hiroshi Matano,
Alexander Mikhailov,
Hans Othmer,
Benoit Perthame,
Mary Pugh,
Jean-Michel Roquejoffre,
Bjorn Sandstede,
Jie Shen,
Hal Smith,
Katepalli R. Sreenivasan,
Jaroslav Stark,
Sebastian van Strien,
Roger Temam,
Kok Lay Teo,
Roberto Triggiani,
Ka-Kit Tung,
Shouhong Wang,
Glenn Webb,
Enrique Zuazua

Communications on Pure and Applied Analysis is a journal of the highest quality focused on analysis and its applications, jointly issued with Shanghai Jiao Tong University. The journal is particularly focused on the high quality and rapid publication. **CPAA** is edited by a group of energetic leaders in analysis and applied analysis, to guarantee the journal's highest standard and closest link to the scientific communities. Accepted papers may appear in 3 months. The Board of Editors consists of

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Dynamical Systems and Differential Equations is an biannual international Conference Series, organized by **AIMS** and sponsored by NSF, taking place in different regions (countries) to benefit most people. The recent conference took place at Wilmington, NC, May 24-27, 2002, which attracted over 430, a record number, prominent mathematicians and scientists from over forty countries. Two expanded (hard-covered) volumes of DCDS will be published in early 2003 for this meeting, with all contributions refereed rigorously. Detailed information can be found at **http://AIMsciences.org**.

The fifth conference will be held at Los Angeles in 2004.

NLS-NET is a free net service for the non linear science community, launched jointly by AIMS and University of Barcelona. Its purpose is to distribute e-mail updates of broad interest related to non linear sciences. To become a registered member (free of charge), visit http://AIMsciences.org

A special volume of DCDS, dedicated to the 80th birthday of Professor Mark Vishik, will appear soon. More than 30 unequivocally established leaders in dynamics and differential equations have contributed. Visit http://AIMsciences.org for details.

Full texts of recent publications in all the three journals can be viewed at **http://AIMsciences.org**.

To submit a paper, send a copy of a pdf or ps file of no more than 2M to the member of the Editorial Board, whose area is most closely related to the topic of the paper, or to the Central Office at shh209f@smsu.edu. Qualifications and special requirements should be consulted at the website of AIMS, before submitting.

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AMERICAN MATHEMATICAL SOCIETY

JANUARY—DECEMBER

WWW.AMS.ORG/MEMBERSHIP

Please read the "Membership Categories" section of this form to determine the membership category for which you are eligible. Then fill out this application and return it as soon as possible.

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Place of Birth: _____
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Date of Birth: _____
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If formerly a member of AMS, please indicate dates _____

Check here if you are now a member of either ☐ MAA or ☐ SIAM

Degrees, with institutions and dates _____

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Present position _____

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City State Zip/Country

Primary Fields of Interest (choose five from the list at right)

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Fields of Interest

If you wish to be on the mailing lists to receive information about publications in fields of mathematics in which you have an interest, please consult the list of major headings below. These categories will be added to your computer record so that you will be informed of new publications or special sales in the fields you have indicated.

00 General
01 History and biography
03 Mathematical logic and foundations
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General algebraic 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
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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
37 Dynamical systems and ergodic theory
39 Difference 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
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
74 Mechanics of deformable 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 Operations research, mathematical programming,
91 Game theory, economics, social and behavioral sciences
92 Biology and other natural sciences
93 Systems theory; control
94 Information and communication, circuits
97 Mathematics Education

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Please read the following to determine what membership category you are eligible for, and then indicate below the category for which you are applying.

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Introductory ordinary member rate applies to the first five ***consecutive*** years of ordinary membership. Eligibility begins with the first year of membership in any category other than student and nominee. Dues are $52.

For ***ordinary members*** whose annual professional income is below $75,000, the dues are $105; for those whose annual professional income is $75,000 or more, the dues are $140.

Minimum dues for ***contributing members*** are $210. The amount paid which exceeds the higher ordinary dues level and is purely voluntary may be treated as a charitable contribution.

For a ***joint family membership,*** one member pays ordinary dues, based on his or her income; the other pays ordinary dues based on his or her income, less $20. (Only the member paying full dues will receive the *Notices* and the *Bulletin* as a privilege of membership, but both members will be accorded all other privileges of membership.)

The annual dues for ***reciprocity members*** who reside outside the U.S. are $70. To be eligible for this classification, members must belong to one of those foreign societies with which the AMS has established a reciprocity agreement. Annual verification is required. Reciprocity members who reside in the U.S. must pay ordinary member dues ($105 or $140).

The annual dues for ***category-S members,*** those who reside in developing countries, are $16. Members can chose only one privilege journal. Please indicate your choice below.

For either ***students*** or ***unemployed individuals,*** dues are $35, and annual verification is required.

2002 Dues Schedule (January through December)

Ordinary member, introductory rate			☐$52
Ordinary member	☐$105		☐$140
Joint family member (full rate)	☐$105		☐$140
Joint family member (reduced rate)	☐$85		☐$120
Contributing member (minimum $210)			☐
Student member (please verify)[1]			☐$35
Unemployed member (please verify)[2]			☐$35
Reciprocity member (please verify)[3]	☐$70	☐$105	☐$140
Category-S member [4]			☐$16

Multi-year membership .....$.....for.....years

[1] ***Student Verification*** (sign below)
I am a full-time student at _____

_____ currently working toward a degree.

[2] ***Unemployed Verification*** (sign below) I am currently unemployed and actively seeking employment.

[3] ***Reciprocity Membership Verification*** (sign below) I am currently a member of the society indicated on the right and am therefore eligible for reciprocity membership.

_____
Signature

[4] ☐ ***send*** **NOTICES** ☐ ***send*** **BULLETIN**

Reciprocating Societies

- ☐ Allahabad Mathematical Society
- ☐ Australian Mathematical Society
- ☐ Azerbaijan Mathematical Society
- ☐ Balkan Society of Geometers
- ☐ Belgian Mathematical Society
- ☐ Berliner Mathematische Gessellschaft
- ☐ Calcutta Mathematical Society
- ☐ Canadian Mathematical Society
- ☐ Croatian Mathematical Society
- ☐ Cyprus Mathematical Society
- ☐ Danish Mathematical Society
- ☐ Deutsche Mathematiker-Vereinigung
- ☐ Edinburgh Mathematical Society
- ☐ Egyptian Mathematical Society
- ☐ European Mathematical Society
- ☐ Gesellschaft für Angewandte Mathematik und Mechanik
- ☐ Glasgow Mathematical Association
- ☐ Hellenic Mathematical Society
- ☐ Icelandic Mathematical Society
- ☐ Indian Mathematical Society
- ☐ Iranian Mathematical Society
- ☐ Irish Mathematical Society
- ☐ Israel Mathematical Union
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- ☐ Sociedad de Matemática de Chile
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- ☐ Sociedad Matemática Mexicana
- ☐ Sociedad Uruguaya de Matemática y Estadística
- ☐ Sociedade Brasileira Matemática
- ☐ Sociedade Brasileira de Matemática Aplicada e Computacional
- ☐ Sociedade Paranaense de Matemática
- ☐ Sociedade Portuguesa de Matemática
- ☐ Societat Catalana de Matemàtiques
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- ☐ Societatea Matematicienilor din Romania
- ☐ Société Mathématique de France
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- ☐ Société Mathématique Suisse
- ☐ Société Mathématiques Appliquées et Industrielles
- ☐ Society of Associations of Mathematicians & Computer Science of Macedonia
- ☐ Society of Mathematicians, Physicists, and Astronomers of Slovenia
- ☐ South African Mathematical Society
- ☐ Southeast Asian Mathematical Society
- ☐ Suomen Matemaattinen Yhdistys
- ☐ Svenska Matematikersamfundet
- ☐ Ukrainian Mathematical Society
- ☐ Union Mathemática Argentina
- ☐ Union of Bulgarian Mathematicians
- ☐ Union of Czech Mathematicians and Physicists
- ☐ Union of Slovak Mathematicians and Physicists
- ☐ Unione Matematica Italiana
- ☐ Vijnana Parishad of India
- ☐ Wiskundig Genootschap

CMS Winter Meeting 2002

Ottawa Marriott Hotel, Ottawa, Ontario, December 8–10, 2002

On behalf of the University of Ottawa, the Department of Mathematics and Statistics invites all researchers, educators, and students to the Winter 2002 Meeting of the Canadian Mathematical Society (CMS).

The department is pleased to once again welcome colleagues back to the nation's capital. Following the usual format, the meeting will include twelve symposia, contributed papers, four plenary speakers, as well as the Coxeter-James and Doctoral Prize lecturers and the awarding of the 2002 Adrien Pouliot Prize. There will also be a public lecture delivered by Robert Zuccherato of Entrust.

All premeeting activities and scientific talks will be held at the Ottawa Marriott Hotel, 100 Kent Street, steps away from Parliament Hill and Ottawa's downtown core.

The most up-to-date information concerning the programmes, including detailed schedules, will be made available at the following website:

`http://www.cms.math.ca/Events/winter02/`

Meeting registration forms and hotel accommodation forms are published in the September 2002 issue of the *CMS Notes* and are also available on the website, along with online forms for registration and submission of abstracts.

Public Lecture

Robert Zuccherato (Entrust).

Plenary Speakers

James Arthur (University of Toronto), **Rene Carmona** (Princeton University), **Victor Guillemin** (MIT), **Maciej Zworski** (Berkeley University).

Prizes and Awards

The **CMS Coxeter-James Lecture** will be given by **Lisa Jeffrey**, University of Toronto. The **Doctoral Prize** and the **Adrien Pouliot Prize** will also be awarded during this meeting.

Symposia

By invitation of the Meeting Committee, there will be symposia in the following areas. This is a preliminary list of speakers. If you are interested in being an invited speaker in one of the symposia, contact one of the organizers of that symposium.

Financial Mathematics (Org: **Luis Seco**, University of Toronto)

Robert Almgren (Toronto), Abel Cadenillas (Alberta), Tahir Choulli (Alberta), Matt Davison (UWO), Tom Hurd (McMaster), Ali Lavassani (Calgary), Eric Renault (Montréal), Tom Salisbury (York), Dave Saunders (Pittsburgh), Agnes Tourin (McMaster), Tony Ware (Calgary).

Finite Elements (Org: **Roger Pierre**, Laval University)

François Bertrand (École Polytechnique de Montréal), Yves Bourgault (Ottawa), Alain Charbonneau (UQAH), Kokou Dossou (ICIP, Hull), Mohammed Farhloul (Moncton), Peter A. Forsyth (Waterloo), André Fortin (GIREF, Laval), Robert Guenette (GIREF, Laval), P. D. Minev (Alberta), Dominique Pelletier (École Polytechnique de Montréal), Leila Slimane (GIREF, Laval), Azzedine Soulaimani (École de Technologie Supérieure).

History of Mathematics (Org: **Richard O'Lander** and **Ronald Sklar**, St. John's University, NY)

Michael Barr (McGill), Jonathan Borwein (Simon Fraser), Florin Diacu (Victoria), Hardy Grant (Carleton), François Major (Montréal), Michael Makkai (McGill), John McKay (Concordia), Angelo Mingarelli (Carleton), Gregory Moore (McMaster), Christiane Rousseau (Montréal), Luis Seco (Toronto), Walter Whiteley (York), Peter Zvengrowski (Calgary).

Lie Algebras and Moonshine (Org: **Abdellah Sebbar** and **Erhard Neher**, University of Ottawa)

Bruce Allison (Alberta), Yuri Bahturin (Memorial), Georgia Benkart (Wisconsin-Madison), Nantel Bergeron (York), Stephen Berman (Saskatchewan), Yuly Billig (Carleton), Chris Cummins (Concordia), Drajomir Djokovic (Waterloo), Chongying Dong (California-Santa Cruz), Terry Gannon (Alberta), Yun Gao (York), Haisheng Li (Rutgers), John McKay (Concordia), Adrian Ocneanu (Penn State), Arturo Pianzola (Alberta), Yoji Yoshii (Wisconsin-Madison), Noriko Yui (Queen's).

Mathematical Education: Now I See!!!! Dynamic Visualisations in Canadian Mathematics Education (Org: **Thomas Steinke**, OCCDSB)

Keynote Speaker: Walter Whiteley (York).

Number Theory (Org: **Damien Roy**, University of Ottawa, and **Kenneth Williams**, Carleton University)

Peter Borwein (Simon Fraser), Douglas C. Bowman (Illinois, Urbana-Champaign), Kwok-Kwong Stephen Choi (Simon Fraser), Henri Darmon (McGill), Chantal David

(Concordia), John Friedlander (Toronto), Eyal Goren (McGill), Manfred Kolster (McMaster), Greg Martin (British Columbia), David McKinnon (Waterloo), Yiannis Petridis (CUNY), Cameron L. Stewart (Waterloo), Jeffrey Lin Thunder (Northern Illinois), Michel Waldschmidt (Paris VI).

Operator Algebras (Org: **Thierry Giordano** and **David Handelman**, University of Ottawa)

Berndt Brenken (Calgary), Ken Davidson (Fields/Toronto), Man Duen Choi (Toronto), George Elliott (Toronto), Nigel Higson (Penn State), Mahmood Khoshkam (Saskatchewan), Claus Koestler (Queen's), Dan Kucerovsky (UNB), Marcelo Laca (Victoria), Jamie Mingo (Queen's), Vladimir Pestov (Ottawa), John Phillips (Victoria), Ian Putnam (Victoria), Roland Speicher (Queen's).

Partial Differential Equations (Org: **Victor Ivrii** and **John Toth**, University of Toronto)

Richard Beals (Yale), Jim Colliander (Toronto), Andrew Comech (North Carolina-Chapel Hill), Walter Craig (McMaster), Alan Greenleaf (Rochester), Peter Greiner (Toronto), Victor Guillemin (MIT), Victor Ivrii (Toronto), Vojkan Jaksksic (McGill), Kate Okikiolu (California-San Diego), Chris Sogge (Johns Hopkins), Catherine Sulem (Toronto), John Toth (McGill), Guenter Uhlmann (Washington), Andras Vasy (MIT), Jared Wunsch (SUNY-Stony Brook), Steve Zelditch (Johns Hopkins), Maciej Zworski (Berkeley).

"Real-World" Problems in Search of Solutions (Org: **André Dabrowski**, University of Ottawa)

Xiaoyi Bao (Ottawa), Mary Hefford (Health Canada), Donal Hickey (Ottawa), André Longtin (Ottawa), Rejean Munger (Ottawa Hospital Research Institute – Eye Institute), Michael Rudnicki (Ottawa Hospital Research Institute).

Representation Theory of Real and p-Adic Groups (Org: **Jason Levy** and **Monica Nevins**, University of Ottawa)

Heather Betel (Toronto), Clifton Cunningham (Calgary), Stephen DeBacker (Harvard), Julee Kim (Institute for Advanced Study), Jason Levy (Ottawa), Fiona Murnaghan (Toronto), Monica Nevins (Ottawa), Alfred Noël (Massachusetts-Boston), Eric Sommers (Massachusetts-Amherst), Yuanli Zhang (Montréal).

Symplectic Geometry (Org: **Lisa Jeffrey** and **Eckard Meinrenken**, University of Toronto)

Anton Alekseev (Geneva), Henrique Bursztyn (Toronto), Rebecca Goldin (George Mason), Megumi Harada (California-Berkeley), Tara Holm (MIT), Yael Karshon (Toronto), Ely Kerman (Toronto), Askold Khovanskii (Toronto), Misha Kogan (Northeastern), François Lalonde (Québec-Montréal), Eugene Lerman (Illinois, Urbana-Champaign), David Metzler (Florida), Jonathan Weitsman (California-Santa Cruz), Siye Wu (Colorado-Boulder), Ping Xu (Penn State), Carmen Young (Fields Institute), Catalin Zara (Yale).

Theory and Applications of Point Processes (Org: **Gail Ivanoff** and **David McDonald**, University of Ottawa)

François Baccelli (École Normale Supérieure), Raluca Balan (Sherbrooke), Gail Ivanoff (Ottawa), Reg Kulperger (Western Ontario), David McDonald (Ottawa), Richard Serfozo (Georgia Institute of Technology), Yiqiang Q. Zhao (Carleton).

Contributed Papers Session (Org: **To be announced**)

Contributed papers of 15 minutes' duration are invited. Abstracts for CMS contributed papers should be prepared as specified below. To better assist organizers, please include the primary 2000 Mathematics Subject Classification.

For an abstract to be eligible the abstract must be received before **October 15, 2002.** The abstract must be accompanied by its contributor's registration form and payment of the appropriate fees.

Travel Grants for Graduate Students

Limited funds are available to partially fund the travel and accommodation costs for graduate students. For more information please contact the Meeting Committee at `http://gradtravel-winter02@cms.math.ca/`. Further details regarding deadlines and application procedures are available on our website.

Social Events and Exhibits

A **welcoming reception** will be held Saturday, December 7, from 7:00 p.m. to 9:00 p.m. in the Victoria North Ballroom of the Ottawa Marriott Hotel. A **Public Lecture Reception** will be held in connection with the talk by Robert Zuccherato (Entrust). More details will be posted on our website as they become available. The **Delegates' Luncheon** will be held on Sunday, December 8, from 12:30 p.m. to 2:00 p.m. in the Victoria North/South Ballrooms of the Ottawa Marriott Hotel. A ticket to this luncheon is included in all registration fee categories. A **banquet** will be held on Sunday, December 8, at 7:30 p.m. in the Victoria North/South Ballrooms of the Ottawa Marriott Hotel, preceded by a cash bar at 6:30 p.m. Tickets to this event are available at $50 each. Coffee and juice will be available during the **scheduled breaks**. Exhibits will be open in the Victoria Gallery of the Ottawa Marriott Hotel during specified hours during the conference.

Business Meetings

The CMS will be holding business meetings during the course of the meeting. Additional information will be provided in later announcements and may be found on our website.

Submission of Abstracts

Abstracts for all talks will be published in the meeting programme and will also be available at `http://cms.math.ca/Events/winter02/abs/`.

Detailed instructions on the submission of abstracts may be found on the website.

Important deadline for submission of abstracts: October 15, 2002.

Registration

The registration form will appear in the **September 2002** issue of the *CMS Notes.* **Electronic preregistration** is also available at `http://www.cms.math.ca/Events/winter02/forms.html`.

Payment for preregistration may be made by cheque or by VISA or MasterCard. Although registration fees are

given in Canadian dollars, delegates may send cheques in U.S. dollars by contacting their financial institution for the current exchange rate.

Please note that **payment must be RECEIVED IN OTTAWA on or before November 1 in order to qualify for reduced rates.** In order for your payment to be processed before the meeting, it should be received by November 30.

	Before Nov 1	After Nov 1
Delegate's Luncheon included		
Plenary speakers/prize lecturers	$ 0	$ 0
Session speakers	215	215
Organizers	145	145
Nonmembers	430	560
CMS/AMS/MAA members with grants	290	375
CMS/AMS/MAA members without grants	145	190
One-day fee	195	255
Postdocs, retired	110	145
Teachers (K–12, CEGEP), students, unemployed	55	70
Banquet (free for plenary/prize speakers)	50	50

CMS = Canadian Mathematical Society
AMS = American Mathematical Society
MAA = Mathematical Association of America

Why Preregister?

Wondering whether to preregister or wait until you arrive? Here are some advantages to preregistering.

—Many can take advantage of reduced fees until the early registration deadline (see above).

—Your name will appear on the list of participants on our website.

—Your meeting kit will be waiting for you at the reception on Saturday evening.

—No waiting in line early Sunday morning to process your registration!

—Banquet tickets are available now but may no longer be available on site.

For all these reasons we encourage you to preregister, whether it be before or after the early registration deadline. If you'd like to preregister and enjoy the above benefits, please visit our website to use our online forms.

Refund Policy

Delegates wishing to cancel their registration must notify the CMS Executive Office **in writing before November 30** to receive a refund less a $40 processing fee. Those whose contributed paper has not been accepted will be fully refunded upon request.

Do You Qualify for Free CMS Membership?

An AMS or MAA member who registers at a semiannual meeting of the CMS and who is not a member of the CMS is eligible for a one-time only, one-year free membership in the CMS. If you qualify, please visit the CMS booth to complete a membership application form. Please provide proof of current AMS or MAA membership. This offer applies to new members only.

Accommodations

It is recommended that those attending the conference book early to avoid disappointment. Blocks of rooms have been reserved at the locations given below and will be held until the deadlines specified. Reservations not made by that date will be on a request-only, space-available basis. Rates are per room, per night and are quoted in Canadian dollars.

Ottawa Marriott Hotel
100 Kent Street, Ottawa (Ontario), Canada K1P 5R7
Check-In: 3:00 p.m.; Check-Out: 1:00 p.m.
Applicable taxes: GST (7%), hotel tax (5%)
Deadline: November 6, 2002
Group Code: CMS Winter Meeting 2002
Phone: 613-238-1122; toll-free: 800-853-8463
Fax: 613-783-4238
E-mail: genevieve.harding@ottawamarriott.com
Parking: $15 daily (self-parking), $20 daily (valet parking)
Rates: $128 single/double occupancy
(Children 19 years old and under sharing parents' accommodations are complimentary.)
All reservations must be guaranteed with first night's deposit.

Travelodge Hotel by Parliament Hill
402 Queen Street, Ottawa (Ontario), Canada K1R 5A7
Check-In: 3:00 p.m.; Check-Out: 12:00 noon
Applicable taxes: GST (7%), hotel tax (5%)
Deadline: November 6, 2002
Group Code: Cdn Mathematical Society
Phone: 613-236-1133; toll-free: 800-578-7878
Fax: 613-236-2317
E-mail: salestlph@whgca.com
Parking: $9 daily (self-parking) plus taxes (in-and-out privileges)
Rates: $89, standard room, single/double occupancy;
$105, deluxe rooms, single/double occupancy;
$15 additional where a cot may be required.
(Children 17 years old and under sharing parents' accommodations are complimentary.)

In all cases, delegates must make their own reservations. The conference rate is extended up to two days pre- and postconvention. Where applicable, and in order for your room to be applied against our block, please quote the group code. Please refer to our website for more information regarding accommodation reservations and cancellations.

Child Care

The following information was provided by the meeting hotels. Advance research and arrangements are recom-

mended. The Ottawa Marriott Hotel offers on site a fully equipped, unsupervised Children's Activity Centre, complete with Playstations, a variety of toys and games for all ages. For individual child care the hotel recommends Gigi's Childcare, 613-749-1295. The Travelodge Hotel by Parliament Hill will also provide recommendations. Please contact the hotel directly to make enquiries. Updates will be posted to the meeting website as they become available.

Travel and Parking

The nation's capital has much to explore during winter or summer. The festival of lights on Parliament Hill is a must-see for anyone visiting in December. We hope you'll take the opportunity to bring your family, explore the city, and take in some great attractions and shopping. Detailed information regarding the University of Ottawa and the city of Ottawa, including links to tourism information, are available on our website.

Guests at the Ottawa Marriott Hotel may park for a daily fee of $15 for self-parking or $20 for valet parking, both including full in-and-out privileges. Guests at the Travelodge Hotel by Parliament Hill may park for a daily fee of $9, including full in-and-out privileges.

Acknowledgements

Support from the following is gratefully acknowledged:

—University of Ottawa, Department of Mathematics and Statistics

—The National Programme Committee (a joint funding body of the Centre de Recherches Mathématiques, The Fields Institute for Research in Mathematical Sciences, and The Pacific Institute for the Mathematical Sciences)

Meeting Committee

Programme

Meeting Director: Daniel Daigle (Ottawa)

André Dabrowski (Ottawa), Thierry Giordano (Ottawa), David Handelman (Ottawa), Gail Ivanoff (Ottawa), Victor Ivrii (Toronto), Lisa Jeffrey (Toronto), Jason Levy (Ottawa), David McDonald (Ottawa), Eckard Meinrenken (Toronto), Erhard Neher (Ottawa), Monica Nevins (Ottawa), Richard O'Lander (St. John's, NY), Roger Pierre (Laval), Damien Roy (Ottawa), Abdellah Sebbar (Ottawa), Luis Seco (Toronto), Ronald Sklar (St. John's, NY), Thomas Steinke (OCCDSB), John Toth (Toronto), Kenneth Williams (Carleton), Graham Wright (CMS ex-officio).

Local Arrangements

Chairs: Walter D. Burgess (Ottawa) and André Dabrowski (Ottawa), Monique Bouchard (CMS ex-officio).

Mathematical Sciences Employment Center

Baltimore Convention Center, Baltimore, Maryland
January 15, 16, 17, and 18, 2003

2003 Employment Center Schedule

Wednesday, January 15

7:30 a.m.–4:00 p.m. Registration and materials pick-up.

9:00 a.m.–9:30 a.m. Short (optional) orientation session.

9:30–4:00 p.m. Submission of Scheduled Employment Register interview request forms for both Thursday and Friday interviews. No request forms can be accepted after 4:00 p.m. Wednesday.

9:30 a.m.–6 p.m. Interview Center open.

No Scheduled Employment Register interviews are held on Wednesday.

Thursday, January 16

7:00 a.m.–8:15 a.m. Distribution of interview schedules for both Thursday and Friday for those participating in the Scheduled Employment Register.

8:15 a.m.–4:40 p.m. Scheduled Employment Register interviews in 4 sessions: *Session 1:* 8:15 a.m.–9:50 a.m., *Session 2:* 10:00 a.m.–11:35 a.m., *Session 3:* 1:00 p.m.–2:35 p.m., *Session 4:* 3:00 p.m.–4:35 p.m.

8:00 a.m.–7:30 p.m. Interview Center open (doors open at 7:30 a.m.; do not schedule before 8:00 a.m.).

Friday, January 17

8:15 a.m.–4:40 p.m. Scheduled Employment Register interviews in 4 sessions: *Session 5:* 8:15 a.m.–9:50 a.m., *Session 6:* 10:00 a.m.–11:35 a.m., *Session 7:* 1:00 p.m.–2:35 p.m., *Session 8:* 3:00 p.m.–4:35 p.m.

8:00 a.m.–7:30 p.m. Interview Center open (doors open at 7:30 a.m.; do not schedule before 8:00 a.m.).

Saturday, January 18

9:00 a.m.–12 noon Interview Center open.

Note: Any participant who plans to use the Scheduled Employment Register must appear at the Employment Center on Wednesday by 4:00 p.m. to turn in the Interview Request/Availability Form. If unexpected delays occur while travelling, contact the AMS at 800-321-4267, ext. 4107.

Overview of the Employment Center

The Employment Center (formerly the Employment Register) serves as a meeting place and information center for employers and Ph.D.-level job seekers attending the Joint Mathematics Meetings. Most applicants and employers began the search process in the fall and are looking for an opportunity to meet in person with those with whom they've already had communication. Some, however, use the Employment Center as a way to make some initial contacts, gather information, and distribute their own information. This is a less effective, but common, use of the program. The Employment Center allows everyone to choose a comfortable level of participation by seeking interviews for any of the open hours or by limiting schedules to certain days or hours.

The Employment Center is a three-day program which takes place on the Wednesday, Thursday, Friday, and Saturday (morning only) of the Joint Meetings. Most participants register in advance (by the October 25 deadline), and their brief résumé or job description is printed in a booklet which is mailed to participants in advance.

The Employment Center houses two services: the computer-scheduled interview tables (the Scheduled Employment Register) and the employer-scheduled interview tables (the Interview Center). Use of the center overall by employers has gone up in recent years. At the 2002 Employment Center, 370 candidates and 151 employers participated, giving an overall applicant-to-employer ratio of 2.4:1 (compared with 341 applicants and 139 employers in 2001, a ratio of 2.5:1). Each applicant ends up with roughly 5 to 15 interviews of various types. Those with the most interviews are those requested most by employers, usually as a result of a careful application process during the months before the Employment Center takes place.

At the January 2003 Employment Center, job candidates will be able to choose how to participate. Two forms of participation will be available:

> All Employment Center services (computer-scheduling system, form posted in *Winter List of Applicants, Winter List of Employers* received by mail, use of Employment Message Center,

availability for employer-scheduled Interview Center).

Message Center and *Winter Lists* only (form posted in *Winter List of Applicants*, *Winter List of Employers* received by mail, use of Employment Message Center, availability for employer-scheduled Interview Center, BUT NOT use of the computer-scheduling system).

No matter which option is chosen, advance registration works best so that the Applicant Form (received by October 25, 2002) can be printed in the *Winter List* distributed to employers.

Employer forms submitted by registered employers have no connection with the AMS online job ads (EIMS). Submitted forms are not available for browsing on the Web. They are reproduced in the *Winter List* booklet for use by Employment Center participants.

The Mathematical Sciences Employment Center is sponsored by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics; it is managed by members of the AMS staff, with the general guidance of the AMS-MAA-SIAM Committee on Employment Opportunities.

Employers: Choose one or both of these tables:

Computer-scheduled Employment Register table

Employer-scheduled Interview Center table

The Employment Register Computer-Scheduling System

Employers register in advance by the October 25 deadline, and their job listings ("Employer Forms") are printed and distributed in mid-December to applicants. Employers receive the book of brief, numbered applicant résumés in mid-December. Participants decide on Wednesday, January 15, which of the eight sessions (of five interviews each) they will participate in and submit their Availability/Interview Request Forms by 4:00 p.m. Wednesday. Employers can reserve time for other Joint Meetings events by marking "unavailable" for one or more of the eight sessions. Employers can request ten specific applicants per day, assuming they are available for all four sessions that day. Usually those requests will be filled by the scheduling algorithm, provided the applicants are present, except in the case of the few most-requested applicants. The rest of their interviews will be with applicants who ask to see them. Employers should be specific about their requirements on the Employer Form to avoid interviews with inappropriate candidates.

Schedules are distributed for all Thursday and Friday interviews on Thursday morning. The schedule allows 15-minute interviews, with 5 minutes between for note taking. One or more interviewers for the same position(s) may interview at the table separately, together, or in shifts. For follow-up interviews, the scheduled tables will also be available for use until 7:30 p.m. on Thursday and Friday and on Saturday morning from 9:00 a.m. to noon.

Participation in the scheduling program has become optional for applicants, so employers will notice some applicant résumés in the *Winter List of Applicants* with no applicant number. An employer can arrange to interview such an applicant outside of the scheduled interview sessions—for instance, between 4:40 p.m. and 7:30 p.m. Thursday or Friday, or on Saturday morning—or during sessions which they left unscheduled.

Employers who are interviewing for two distinct positions may wish to pay for two tables. See the instructions under "How to Register". Employers should bring school catalogs, corporate reports, or more lengthy job descriptions to the Employment Center early on Wednesday for perusal by applicants prior to interviews.

The Employer-Scheduled Interview Center

The Interview Center allows any employer to reserve a table in an area adjacent to the Employment Center. Employers will arrange their own schedule of interviews, either in advance or on site, by using the Employment Message Center. Employers who have never used the Employment Center before might want to try conducting interviews at this convenient location. Since they will be setting their own schedules, employers will have complete control over whom they'll see, for how long, and when they'll be interviewing. This allows employers to pursue other activities at the Joint Meetings.

The center will be open only during the following hours:

Wednesday, January 15, 2003, 9:30 a.m.–6:00 p.m.
Thursday, January 16, 2003, 8:00 a.m.–7:30 p.m.
Friday, January 17, 2003, 8:00 a.m.–7:30 p.m.
Saturday, January 18, 2003, 9:00 a.m.–noon

The fee for use of this area is the same as the normal employer fee, $220. It is requested that all employers fill out an Employer Form for inclusion in the *Winter List*. This should clarify to Employment Center applicants what type of position is being filled. If an employer is unable to accept new applicants because the deadline has passed, that should be stated on the form.

The *Winter List of Applicants*, containing information about the candidates present at the Employment Center, will be mailed to all employers in advance of the meeting.

Employers scheduling interviews in advance should tell applicants to find the table with the institution's name in the Interview Center (not the numbered-table area). Employers can schedule any time during the open hours listed above. To schedule interviews after arriving in Baltimore, leave messages for Employment Center applicants in the Employment Message Center. Paper forms will be provided to help speed the invitation process. Each employer will be provided with a box in the Message Center where applicants can leave items.

Employers should have at most two interviewers per table at any time due to space limitations. There will be no outlets or electricity available at the interviewing tables.

About the *Winter List of Applicants*

This booklet contains hundreds of résumés of applicants registered by October 25 for the Employment Center. It will be mailed to all employers who register by October 25 who indicate on their Joint Meetings registration form that they would like their materials mailed. Employers should be aware that there will be hundreds of brief résumés to look through and should be sure to obtain the *Winter List of Applicants* as early as possible.

Employers Not Planning to Interview

Employers who do not plan to participate in the Employment Center at all may place a job description in the book of employers. This description must be submitted on the Employer Form, which appears in the back of this issue, with the appropriate box checked indicating that no interviews will take place. A fee of $50 is charged for this service (paid through the Joint Meetings registration form). The form must be received in the Providence office (with payment or purchase order) by the October 25 deadline to appear in the *Winter List of Employers*. Forms received in the Providence office after that deadline will be displayed at the meeting. Those wishing to bring a one-page job description to the Employment Center desk for display during the meetings may do so at no charge.

Employers: How to Register

The interviewer should register and pay for the Joint Mathematics Meetings. They should register for the Employment Center by completing the following steps:

Indicate on the Joint Meetings registration form (available either electronically after September 2, 2002, at `www.ams.org/amsmtgs/2074_intro.html` or in the back of the October issue of the *Notices*) that you are also paying the Employment Center employer fee. Indicate your choice of tables. Mark all that apply.

Submit an Employer (job listing) Form electronically at www.ams.org/emp-reg, or use the print version in the back of this issue. Be sure the form indicates which type or types of tables will be used. This form will be printed in the *Winter List of Employers*.

It is important to register by the October 25 deadline in order for your form to be included in the *Winter List of Employers*. However, registration will be accepted up to December 19 for the normal fees or on site in Baltimore at the on-site rates. Call 800-321-4267, ext. 4105, with any questions or deadline problems.

Any number of interviewers can sit at a table together or in shifts (however, the limit is two at one time), and their names should be listed on the Employer Form as a reference point for the applicants. Employment Center fees should be paid only for each table required, not for each person.

In a few unusual cases an institution will be conducting interviews in the Employment Center for two or more distinct positions and will not want to conduct these interviews at one table. In that case, two or more Employer Forms should be submitted, and separate tables and employer numbers will be provided. Applicants will then be able to request interviews for the appropriate job by employer number. First and second table fees should be paid.

The fee for all employers to register in advance is $220 for the first table and $65 for each additional table. On-site registration fees (any registrations after 12/19/02) are $300 for the first table and $100 for each additional table. Employers must also register for the Joint Meetings and pay the appropriate Joint Meetings fee.

Employers: Registration on Site

Employers who do not register for the Joint Mathematics Meetings and the Employment Center by December 19 may register on site in Baltimore at the Joint Meetings registration desk. They must bring their receipt to the Employment Center desk between 7:30 a.m. and 4:00 p.m. on Wednesday, January 15, to receive their materials. A typed copy of the Employer Form (found in the back of this issue) can be brought to the Employment Center for posting on site (or the form can be handwritten on site). If registering for the employer-scheduled Interview Center only, registration on Thursday is possible.

Applicants: Use of the computer-scheduled program is now optional

In 2003 applicants will be given flexibility in deciding how to participate in the Employment Center. There are two options:

All Employment Center services (computer-scheduling system, form posted in *Winter List of Applicants*, *Winter List of Employers* received by mail, use of Employment Message Center, availability for employer-scheduled Interview Center).

Message Center and *Winter Lists* only (form posted in *Winter List of Applicants*, *Winter List of Employers* received by mail, use of Employment Message Center, availability for employer-scheduled Interview Center, BUT NOT use of the computer-scheduling system). This option is available at a slightly lower price.

Applicants who participate in the 2003 Employment Center will find themselves talking with employers in two different settings:

1. A computer-scheduling program sets 15-minute interviews at the Employment Register numbered tables. This is the choice that has now become optional for applicants. Applicants do not have to hand in a computer-scheduling form at all.

2. There is also an Interview Center, where employers set their own schedules. These employers do not participate in the scheduling program, so applicants have no

automatic access to interviews with them. They determine their own schedules and make their own appointments privately, either in advance or on site using the Employment Message Center. These interviews have always been "optional" for applicants, since they may turn down any written invitation they receive. Applicants are reminded to respond to all invitations promptly.

The Schedule

For applicants using all services there is a certain scheduling burden placed on them to juggle these simultaneous services. However, computer-scheduled sessions are in small blocks, for a total of eight sessions over the two days of interviews (Thursday and Friday). This allows applicants, once they receive invitations to interview in the Interview Center, to accept, knowing that when they submit the computer schedule request on Wednesday they can mark that they are unavailable for one or more of these sessions without seriously jeopardizing their chances of obtaining scheduled interviews. Likewise, applicants who are scheduled to give a talk can avoid interviews for that time. Applicants are encouraged to schedule their time in advance in this manner and not wait for the computer schedule to be distributed Thursday morning.

Interviews

Applicants should understand that the Employment Center provides no guarantees of interviews or jobs. It is simply a convenient meeting place for candidates and employers who are attending the Joint Meetings. Those who have not yet begun their job search efforts may go unnoticed at the Employment Center (although applicants will likely receive a minimum of between one and three interviews in the scheduled program). Attention generally goes to candidates who already have applied for open positions or to those who are well suited for teaching positions at liberal arts colleges.

Data from recent Employment Centers show that women represent about half of the most sought-after applicants, although they make up less than half of the total Employment Center applicant pool. Those without permanent authorization to work in the United States will find themselves far less requested than U.S. citizens or permanent residents. Newer Ph.D.'s tend to be invited for more interviews than those who have been working longer. Most jobs listed require a doctorate.

Preparations

Candidates just beginning a job search should realize that employers have no method to judge their credentials other than the brief résumé form, and they should make an effort to make it distinct and interesting.

Applicants who register in advance will receive the *Winter List of Employers* in mid-December. If time permits, they should apply for suitable open positions they notice in the *Winter List of Employers* after they receive it. Applicants are advised to bring a number of copies of their vita or résumé so that they may leave them with prospective employers. It is a good idea in the fall for applicants to alert any employer to whom applications are made that they plan to be present at the Joint Meetings. Also, they should bring enough materials with them to accompany requests for interviews they may want to leave in the Message Center boxes of the Interview Center employers.

Applicants are also encouraged to leave some extra copies of their résumés in their own message folders so that interested employers may find them there. Photocopying costs at a convention are high, so applicants should come prepared with a reasonably large number of copies. A brightly colored form in each folder gives applicants an opportunity to present for public perusal some information about their availability during the meetings.

The *Winter List of Applicants* is mailed to all employers in advance, so it is vital that the Joint Meetings registration form, applicant résumé form, and payments be received by the October 25 deadline so the Applicant Form can be printed in the book. This greatly increases an applicant's chances of being invited to the Interview Center.

Applicants should keep in mind that interviews arranged by the Employment Center represent only an initial contact with the employers and that hiring decisions are not ordinarily made during or immediately following such interviews.

Applicants: Register Early

Applicants need to complete the following steps by the advance deadline of October 25, 2002.

1. Pay fees

Register for the Joint Mathematics Meetings (see form in the back of the October issue of the *Notices* or the electronic information available after September 2, 2002, at www.ams.org/amsmtgs/2074_intro.html). You cannot participate in the Employment Center unless you are a meetings participant. Mark one of the two "Employment Center Applicant Fee" boxes on the Joint Meetings registration form and make payments. The fee in advance for applicants is $40; "Message Center and *Winter List* ONLY" registration is $20.

2. Send form

Submit the Applicant Form (a brief résumé form) electronically at `www.ams.org/emp-reg/`, or use the print version in the back of this issue.

After Registration

Submission of the Applicant Form electronically will result in an email acknowledgement almost immediately. For registration and payments, the Meetings Service Bureau acknowledges all payments. When payments AND the Applicant Form have been received, another acknowledgement will go out by email, if possible, or by mail. Please allow a week or so for processing, but after that contact staff (AMS 800-321-4267, ext. 4105) if you do not receive acknowledgement from the Employment Center.

Around December 15 the *Winter List of Employers* will be mailed to all registered applicants unless they request otherwise.

Registering after the Deadline

After October 25 applicants can still register for the Employment Center at the same prices until the final deadline of December 19. However, the Applicant Form will NOT be included in the *Winter List of Applicants* but will be posted on site at the Employment Center (a serious disadvantage). Those who do not register by December 19 must register on site at the Joint Meetings registration desk and pay higher fees ($75 Employment Center fee; however, the "Message Center and *Winter List* ONLY" fee is always just $20).

It is worthwhile to submit the applicant form even if you miss the October 25 deadline. An unexpected delay in publishing may allow your late form to get into the book. At the very least, your printed-out form will be brought to the meetings by staff and displayed there (after all the fees have been paid).

When to Arrive

All participants in the scheduled section of the Employment Center must submit their Interview Request/Availability forms in person between 9:30 a.m. and 4:00 p.m. on Wednesday, January 15, 2003, or they will not be included when the interview-scheduling program runs Wednesday night. Should unexpected delays occur while travelling, contact the AMS at 800-321-4267, ext. 4107. Be sure to keep Employment Center materials with you, because in an emergency you can report your interview requests over the phone.

Applicants: Registering on Site

Feel free to enter the Employment Center area first to consult staff about the decision to register on site and to check on which employers are participating. Full registration on site early Wednesday is allowed for a higher fee but is severely discouraged. Most employers will not notice an Applicant Form which arrives on Wednesday. Therefore, these individuals will receive only a couple of computer-scheduled interviews. Registration on site is advisable only for those who know they will be interviewed in the Interview Center and would like a Message Center folder for employers to leave messages in. This year registering on site for a mailbox only is possible, at the $20 rate, on Wednesday and Thursday.

Instructions for Applicant and Employer Forms

Applicant forms submitted for the Employment Center by the October 25 deadline will be reproduced in a booklet titled *Winter List of Applicants*. Employer forms submitted by the October 25 deadline will be reproduced for the *Winter List of Employers*.

Please use the electronic versions of Applicant and Employer forms (`http://www.ams.org/emp-reg/`). Paper forms should be submitted only by those who do not have access to the AMS website.

If submitting a paper form, please type carefully. **Do not type outside the box or beyond the lines indicated. Extra type will be omitted.**

All forms must be received by the Society by **October 25, 2002**, in order to appear in the *Winter List*. However, meeting registration (and payment of fees) is required before the forms can be processed.

00 General
01 History and biography
03 Mathematical logic and foundations
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General algebraic 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
37 Dynamical systems and ergodic theory
39 Difference 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
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
74 Mechanics of deformable 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 Operations research, mathematical programming
91 Game theory, economics, social and behavioral sciences
92 Biology and other natural sciences
93 Systems theory; control
94 Information and communication, circuits
97 Mathematics education

EMPLOYER FORM
MATHEMATICAL SCIENCES EMPLOYMENT CENTER
JANUARY 15–18, 2003
BALTIMORE, MARYLAND

1. Forms should be accessed and submitted electronically if possible. The URL for accessing Employment Center information and forms is `http://www.ams.org/emp-reg/`.
2. Paper or electronic forms are due, along with payment and your Advance Registration/ Housing Form, by October 25 (to AMS, P. O. Box 6887, Providence, RI 02940) in order to be included in the *Winter List of Employers*.
3. Please list all potential interviewers, for reference by applicants, but pay fees only for each separate table.
4. Forms will not be processed until registration and payment of fees have been received.

EMPLOYER CODE:

Institution _____

Department _____

Mailing address _____

_____

E-mail address (one only) _____

URL (or other contact info) _____

Name(s) of Interviewer(s) 1. _____

2. _____

3. _____

4. _____

Specialties sought _____

_____

Title(s) of position(s) _____

Number of positions _____

Starting date _____ (Month) / _____ (Year)

Term of appointment _____ (Years)

Renewal ☐ Possible ☐ Impossible

Tenure-track position ☐ Yes ☐ No

Teaching hours per week _____

Degree preferred _____

Degree accepted _____

Duties _____

_____

_____

Experience preferred _____

_____

_____

Significant other requirements, needs, or restrictions which will influence hiring decisions _____

_____

_____

This position will be subject to a security clearance which will require U.S. citizenship: ☐ Yes ☐ No

THE EMPLOYER PLANS TO USE THE FOLLOWING SERVICES (check all that apply):

☐ One or more computer-scheduled Interview Tables

☐ One or more self-scheduled Interview Tables

☐ Placing this form for information only (not using a table)

APPLICANT RÉSUMÉ FORM

MATHEMATICAL SCIENCES EMPLOYMENT CENTER
JANUARY 15–18, 2003
BALTIMORE, MARYLAND

1. Forms should be accessed and submitted electronically if possible. The URL for accessing Employment Center information and forms is `http://www.ams.org/emp-reg/`.
2. Paper or electronic forms are due, along with payment and your Advance Registration/ Housing Form, by October 25 (to AMS, P. O. Box 6887, Providence, RI 02940) in order to be included in the *Winter List of Applicants*.
3. Forms will not be processed until registration and payment of fees have been received.

APPLICANT CODE:

Last name _____ First name _____

Mailing address (include zip code) _____

_____

E-mail address (one only) _____

URL (or other contact info) _____

Specialties _____

_____

(use MR classification codes plus text if possible; applicants will be indexed by first number only)

DESIRED POSITION:

Academic: ☐ Research ☐ University Teaching College Teaching: ☐ 4-year ☐ 2-year

Would you be interested in nonacademic employment? ☐ Yes ☐ No Available mo. _____ /yr. _____

Computer skills _____

Significant requirements (or restrictions) which would limit your availability for employment _____

_____

PROFESSIONAL ACCOMPLISHMENTS:

Significant achievements, research or teaching interests _____

_____

_____

_____

_____

Paper to be presented at this meeting or recent publication _____

_____

Degree	Year (expected)	Institution
_____	_____	_____
_____	_____	_____
_____	_____	_____

Number of refereed papers accepted/published _____

PROFESSIONAL EMPLOYMENT HISTORY:

	Employer	Position	Years
1.	_____	_____	_____ to _____
2.	_____	_____	_____ to _____
3.	_____	_____	_____ to _____

References (Name and Institution only)

_____

_____

_____

_____

Work authorization status: (check one) ☐ U.S. Citizen ☐ Non-U.S. Citizen, authorized to work permanently in U.S. ☐ Other

This applicant will be using: ☐ ALL Employment Center services ☐ Message Center and Winter List ONLY

Meetings & Conferences of the AMS

IMPORTANT INFORMATION REGARDING MEETINGS PROGRAMS: AMS Sectional Meeting programs do not appear in the print version of the *Notices*. However, comprehensive and continually updated meeting and program information with links to the abstract for each talk can be found on the AMS website. See `http://www.ams.org/meetings/`. Programs and abstracts will continue to be displayed on the AMS website in the Meetings and Conferences section until about three weeks after the meeting is over. Final programs for Sectional Meetings will be archived on the AMS website in an electronic issue of the *Notices* as noted below for each meeting.

Boston, Massachusetts

Northeastern University

October 5–6, 2002

Meeting #979

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: August 2002
Program first available on AMS website: August 22, 2002
Program issue of electronic *Notices*: October 2002
Issue of *Abstracts*: Volume 23, Issue 4

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: August 13, 2002

Invited Addresses

Lou P. van den Dries, University of Illinois, Urbana-Champaign, *Title to be announced.*

Hillel Furstenberg, Einstein Institute of Mathematics, *Title to be announced* (Erdős Memorial Lecture).

Diane Henderson, Pennsylvania State University, *Mathematical modelling and experiments on water waves.*

Christopher K. King, Northeastern University, *Information capacity of quantum channels.*

Xiaobo Liu, University of Notre Dame, *Solving universal equations in Gromov-Witten invariants.*

Special Sessions

Convex Geometry (Code: AMS SS N1), **Daniel A. Klain**, University of Massachusetts, Lowell, and **Elisabeth Werner**, Case Western Reserve University.

Developments and Applications in Differential Geometry (Code: AMS SS C1), **Chuu-Lian Terng**, Northeastern University, and **Xiaobo Liu**, University of Notre Dame.

Elliptic Operators on Noncompact Manifolds (Code: AMS SS M1), **Maxim Braverman**, Northeastern University, **Victor Nistor**, Pennsylvania State University, and **Mikhail A. Shubin**, Northeastern University.

Ergodic Theory and Dynamical Systems (Code: AMS SS B1), **Stanley J. Eigen**, Northeastern University, and **Vidhu S. Prasad**, University of Massachusetts, Lowell.

Geometric Group Theory (Code: AMS SS P1), **Sean T. Cleary**, City College, CUNY, **Murray Elder**, Tufts University, and **Jennifer Taback**, University of Albany.

Hilbert Schemes (Code: AMS SS G1), **Mark De Cataldo**, SUNY at Stony Brook, and **Anthony A. Iarrobino**, Northeastern University.

Modern Schubert Calculus (Code: AMS SS A1), **Frank Sottile**, University of Massachusetts, Amherst, and **Christopher T. Woodward**, Rutgers University.

Number Theory and Arithmetic Geometry (Code: AMS SS D1), **Matthew A. Papanikolas**, Brown University, and **Siman Wong**, University of Massachusetts, Amherst.

Quantum Information Theory (Code: AMS SS J1), **Christopher K. King**, Northeastern University, and **Mary Beth Ruskai**, University of Massachusetts, Lowell.

Quivers and Their Generalizations (Code: AMS SS E1), **Alex Martsinkovsky**, **Gordana G. Todorov**, **Jerzy M. Weyman**, and **Andrei V. Zelevinsky**, Northeastern University.

Recent Developments in the Orbit Method for Real and p-Adic Groups (Code: AMS SS F1), **Donald R. King**,

Northeastern University, and **Alfred G. Noel**, University of Massachusetts, Boston.

Singularities in Algebraic and Analytic Geometry (Code: AMS SS H1), **Terence Gaffney** and **David B. Massey**, Northeastern University, and **Caroline Grant Melles**, U. S. Naval Academy.

The History of Mathematics (Code: AMS SS L1), **Adrian C. Rice**, Randolph-Macon College, and **Amy E. Shell-Gellasch**, U. S. Military Academy.

The Mathematics of Water Waves (Code: AMS SS K1), **Diane Henderson**, Pennsylvania State University, and **Gene Wayne**, Boston University.

Madison, Wisconsin

University of Wisconsin-Madison

October 12–13, 2002

Meeting #980

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: August 2002
Program first available on AMS website: August 29, 2002
Program issue of electronic *Notices*: October 2002
Issue of *Abstracts*: Volume 23, Issue 4

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: August 20, 2002

Invited Addresses

Lawrence Ein, University of Illinois at Chicago, *Title to be announced.*

Eleny Ionel, University of Wisconsin, *Title to be announced.*

Mikhail Safonov, University of Minnesota, *Title to be announced.*

John Sullivan, University of Illinois, Urbana-Champaign, *Title to be announced.*

Special Sessions

Arithmetic Algebraic Geometry (Code: AMS SS A1), **Ken Ono** and **Tonghai Yang**, University of Wisconsin-Madison.

Arrangements of Hyperplanes (Code: AMS SS E1), **Daniel C. Cohen**, Louisiana State University, **Peter Orlik**, University of Wisconsin-Madison, and **Anne Shepler**, University of California Santa Cruz.

Biological Computation and Learning in Intelligent Systems (Code: AMS SS S1), **Shun-ichi Amari**, RIKEN, **Amir Assadi**, University of Wisconsin-Madison, and **Tomaso Poggio**, Massachusetts Institute of Technology.

Characters and Representations of Finite Groups (Code: AMS SS U1), **Martin Isaacs**, University of Wisconsin-Madison, and **Mark Lewis**, Kent State University.

Combinatorics and Special Functions (Code: AMS SS T1), **Richard Askey** and **Paul Terwilliger**, University of Wisconsin-Madison.

Dynamical Systems (Code: AMS SS P1), **Sergey Bolotin** and **Paul Rabinowitz**, University of Wisconsin-Madison.

Effectiveness Questions in Model Theory (Code: AMS SS J1), **Charles McCoy**, **Reed Solomon**, and **Patrick Speissegger**, University of Wisconsin-Madison.

Geometric Methods in Differential Equations (Code: AMS SS H1), **Gloria Mari Beffa**, University of Wisconsin-Madison, and **Peter Olver**, University of Minnesota.

Geophysical Waves and Turbulence (Code: AMS SS M1), **Paul Milewski**, **Leslie Smith**, and **Fabian Waleffe**, University of Wisconsin-Madison.

Group Cohomology and Homotopy Theory (Code: AMS SS G1), **Alejandro Adem**, University of Wisconsin-Madison, and **Jesper Grodal**, Institute for Advanced Study.

Harmonic Analysis (Code: AMS SS C1), **Alex Ionescu** and **Andreas Seeger**, University of Wisconsin-Madison.

Hyperbolic Differential Equations and Kinetic Theory (Code: AMS SS K1), **Shi Jin**, **Marshall Slemrod**, and **Athanassios Tzavaras**, University of Wisconsin-Madison.

Lie Algebras and Related Topics (Code: AMS SS N1), **Georgia Benkart** and **Arun Ram**, University of Wisconsin-Madison.

Lie Groups and Their Representations (Code: AMS SS W1), **R. Michael Howe**, University of Wisconsin-Eau Claire, and **Gail D. Ratcliff**, University of Missouri, St. Louis.

Multiresolution Analysis and Data Presentation (Code: AMS SS F1), **Amos Ron**, University of Wisconsin-Madison.

Optimal Geometry of Curves and Surfaces (Code: AMS SS V1), **Jason H. Cantarella**, University of Georgia, and **John M. Sullivan**, University of Illinois, Urbana-Champaign.

Partial Differential Equations and Geometry (Code: AMS SS D1), **Sigurd Angenent** and **Mikhail Feldman**, University of Wisconsin-Madison.

Probability (Code: AMS SS R1), **David Griffeath** and **Timo Seppalainen**, University of Wisconsin-Madison.

Ring Theory and Related Topics (Code: AMS SS L1), **Don Passman**, University of Wisconsin-Madison.

Several Complex Variables (Code: AMS SS B1), **Pat Ahern**, **Xianghong Gong**, **Alex Nagel**, and **Jean-Pierre Rosay**, University of Wisconsin-Madison.

Salt Lake City, Utah

University of Utah

October 26–27, 2002

Meeting #981

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2002
Program first available on AMS website: September 16, 2002

Program issue of electronic *Notices*: October 2002
Issue of *Abstracts*: Volume 23, Issue 4

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: September 4, 2002

Invited Addresses

Yakov Eliashberg, Stanford University, *Comparing symplectic and contact topologies.*

Hart F. Smith, University of Washington, *The wave equation and harmonic analysis.*

Michael Ward, University of British Columbia, *The dynamics and stability of localized patterns for a reaction-diffusion system.*

Amie Wilkinson, Northwestern University, *Partially hyperbolic dynamics on 3-manifolds.*

Special Sessions

Analytic Number Theory (Code: AMS SS B1), **Roger Baker**, **Xian-Jin Li**, and **Andrew D. Pollington**, Brigham Young University.

Area-Minimization and Minimal Surfaces (Code: AMS SS A1), **Michael Dorff**, **Denise Halverson**, and **Gary R. Lowler**, Brigham Young University.

Geometry and Topology (Code: AMS SS F1), **Mladen Bestvina**, **Michael Kapovich**, and **Grigory Mikhalkin**, University of Utah.

Nonlinear Elliptic Partial Differential Equations (Code: AMS SS C1), **David A. Hartenstine**, University of Utah, and **Jon T. Jacobsen**, Pennsylvnia State University.

Numerical Solutions of Modeling Problems (Code: AMS SS H1), **Sun Chow**, Brigham Young University, and **Joseph V. Koebbe**, Utah State University.

Recent Trends in Algebraic Geometry (Code: AMS SS E1), **Aaron J. Bertram**, University of Utah, and **Christopher Derek Hacon**, University of California Riverside.

Representation Theory of Semisimple Lie Groups (Code: AMS SS D1), **Dragan Milicic** and **Peter Trapa**, University of Utah.

Time Series, Heavy Tails, and Applications (Code: AMS SS G1), **Davar Khoshnevisan**, University of Utah, and **Piotr Kokozska**, Utah State University.

Orlando, Florida

University of Central Florida

November 9–10, 2002

Meeting #982

Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of *Notices*: September 2002
Program first available on AMS website: September 26, 2002
Program issue of electronic *Notices*: November 2002
Issue of *Abstracts*: Volume 23, Issue 4

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: September 17, 2002

Invited Addresses

Steven J. Cox, Rice University, *Decoding the dance of your dendritic spines.*

James Haglund, University of Pennsylvania, *The q,t-Catalan numbers and the space of diagonal harmonics.*

Marius Mitrea, University of Missouri-Columbia, *Elliptic and parabolic boundary problems in Sobolev-Besov spaces on nonsmooth domains.*

Ricardo H. Nochetto, University of Maryland, College Park, *Title to be announced.*

Special Sessions

Algebraic and Enumerative Combinatorics (Code: AMS SS A1), **James Haglund**, University of Pennsylvania, and **Jeff B. Remmel**, University of California San Diego.

Asymptotics of Integrable Partial Differential Equations, Riemann-Hilbert Problem and Related Topics (Code: AMS SS M1), **Ken T. R. McLaughlin**, University of North Carolina at Chapel Hill and University of Arizona, and **Alexander Tovbis**, University of Central Florida.

Commutative Algebra (Code: AMS SS B1), **Heath M. Martin**, University of Central Florida, and **Stephanie A. Fitchett**, Florida Atlantic University.

Computational Mathematics (Code: AMS SS C1), **Ricardo H. Nochetto**, University of Maryland, and **Bernardo Cockburn**, University of Minnesota.

Computational Methods in Analysis (Code: AMS SS P1), **George A. Anastassiou**, University of Memphis.

Financial Mathematics (Code: AMS SS D1), **Craig A. Nolder** and **Alec N. Kercheval**, Florida State University.

Function Spaces, Singular Integrals and Applications to PDEs (Code: AMS SS N1), **Marius Mitrea** and **Dorina Mitrea**, University of Missouri-Columbia.

Functional and Harmonic Analysis of Wavelets, Frames and Their Applications (Code: AMS SS E1), **Deguang Han**, University of Central Florida, and **Manos I. Papadakis**, University of Houston.

Graph Theory (Code: AMS SS F1), **Robert C. Brigham**, University of Central Florida, **Cun-Quan Zhang**, West Virginia University, and **Yue Zhoa**, University of Central Florida.

Homotopy Theory and Geometric Topology (Code: AMS SS J1), **Alexander N. Dranishnikov**, **James E. Keesling**, and **Yuli B. Rudyak**, University of Florida.

Invariants of Knots and Low-Dimensional Manifolds (Code: AMS SS H1), **J. Scott Carter**, University of South Alabama, and **Masahico Saito**, University of South Florida.

Mathematical Neuroscience (Code: AMS SS G1), **Steve J. Cox**, Rice University, and **Richard Bertram**, Florida State University.

Nonlinear Waves (Code: AMS SS L1), **Min Chen**, Purdue University, and **Roy Choudhury** and **David J. Kaup**, University of Central Florida.

The Likelihood Inferences in Statistics (Code: AMS SS K1), **Jian-Jian Ren**, University of Central Florida.

Accommodations

Participants should make their own arrangements directly with a hotel of their choice as early as possible. Special rates have been negotiated with the hotels listed below. Rates quoted do not include sales tax of 11%. The AMS is not responsible for rate changes or for the quality of the accommodations. When making a reservation, participants should state that they are with the **American Mathematical Society meeting group**. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

Holiday Inn UCF, 12125 High Tech Ave., Orlando, FL 32817; 407-275-9000, fax: 407-381-0019; $69/single or double, restaurant on premises; across the street from the campus.

Hampton Inn & Suites, 3450 Quadrangle Blvd., Orlando, FL 32828; 407-282-0029, fax: 407-206-3001; $79/single or double, includes complimentary breakfast bar; an easy five-minute walk to campus.

Food Service

There is a food court containing a variety of fast food and other restaurants located in the student union adjacent to the meeting areas. Hours vary, but generally speaking, on Saturdays most restaurants are open from 11:00 a.m. until at least 7:00 p.m. and on Sundays from 11:00 a.m. to 6:00 p.m.

There are numerous other restaurants, ranging from fast food to family dining, located within relatively easy walking distance of the campus and near the area hotels. Most of these are on University Boulevard just west of campus. A handout with more detailed information will be provided at the meeting.

Local Information

The Math Department's webpage is located at `http://www.math.ucf.edu/`; the University's homepage is `http://www.ucf.edu/`.

Other Activities

Book Sales: Examine the newest titles from the AMS!. Many of the AMS books will be available at a special 50% discount available only at the meeting. Complimentary coffee will be served courtesy of AMS Membership Services.

AMS Editorial Activity: An acquisitions editor from the AMS book program will be present to speak with prospective authors. If you have a book project that you would like to discuss with the AMS, please stop by the book exhibit.

Parking

Parking is available in a lot and a parking garage adjacent to the Business Adminstration building. These facilities are available at all hours. A permit is normally required and may be purchased from an automated machine at the lot or garage for a fee of approximately $2 per day.

Registration and Meeting Information

The meeting is on the main campus of the University of Central Florida in Orlando, Florida. Sessions and registration will take place in the Business Adminstration building and adjoining Engineering building.

The registration desk will be in the atrium area of the Business Administration building and will be open Saturday, November 9, 7:30 a.m.–4:30 p.m. and Sunday, November 10, 8:00 a.m.–noon. Fees are $40 for AMS or CMS members; $60 for nonmembers; and $5 for students/unemployed/emeritus; payable on site by cash, check, or credit card.

Travel

The nearest major airport is Orlando International Airport, about 20 miles away. Cabs and shuttle services are located in the ground transportation area of the airport, adjacent to baggage claim. The fare to the UCF campus area is approximately $25 to $30.

Participants who travel by car from the airport should go north on Semoran Boulevard (Route 436) 12 miles to University Boulevard and then east 5 miles to the campus.

Car rental: Special rates have been negotiated with Avis Rent A Car for the period November 2 to November 17, 2002, beginning at $31.99/day for a subcompact car at the daily rate. All rates include unlimited free mileage. Rates do not include state or local surcharges, tax, optional coverages, or gas refueling charges. Renter must meet Avis's age, driver, and credit requirements, and must return to the same renting location. Make reservations by calling 800-331-1600 or online at `http://www.avis.com/`. Higher weekend rates may apply. Please quote **Avis Discount Number B159266** when making reservations.

Participants traveling by car from the north on I-75 should take the Florida Turnpike (toll) from Wildwood and exit on the East-West Expressway (Toll 408). Go east to Alafaya Trail, and exit north to the UCF campus.

Travelers from the south should take the Florida Turnpike (toll) and Exit I-4 East. Then exit to the East-West Expressway (Toll 408), and go east to the Alafaya Trail exit and north on Alafaya Trail to the UCF campus.

Traveling west on I-4 from Daytona Beach, you should exit on Route 434 and go east to the UCF campus.

Traveling east on I-4 from Tampa, you should exit on the East-West Expressway (Toll 408) and go east to the Alafaya Trail exit and then north to the UCF campus.

Weather

Weather conditions in central Florida during November are usually sunny and very pleasant, with lows in the upper

50s and highs in the middle 70s. Rainy conditions are generally not expected.

Baltimore, Maryland

Baltimore Convention Center

January 15–18, 2003

Meeting #983

Joint Mathematics Meetings, including the 109th Annual Meeting of the AMS, 86th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: October 2002
Program first available on AMS website: November 1, 2002
Program issue of electronic *Notices*: January 2003
Issue of *Abstracts*: Volume 24, Issue 1

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: October 1, 2002
For summaries of papers to MAA organizers: September 10, 2002

Joint Invited Addresses

Noam D. Elkies, Harvard University, *Title to be announced* (AMS-MAA Invited Address).

Edward R. Scheinerman, Johns Hopkins University, *Title to be announced* (AMS-MAA Invited Address).

Joint Special Sessions

Computability and Models (Code: AMS SS T1), **Douglas Cenzer**, University of Florida, and **Valentina S. Harizanov**, The George Washington University (AMS-ASL).

Dynamical Systems and Oceanography (Code: AMS SS H1), **Reza Malek-Madani** and **Peter A. McCoy**, U.S. Naval Academy (AMS-SIAM).

Interactions between Logic, Group Theory and Computer Science (Code: AMS SS Q1), **Alexandre V. Borovik**, UMIST, and **Alexei Myasnikov**, City College of CUNY (AMS-ASL).

Mathematics and Education Reform (Code: AMS SS N1), **Naomi Fisher**, University of Illinois at Chicago, **William H. Barker**, Bowdoin College, **Jerry L. Bona**, University of Illinois at Chicago, and **Kenneth C. Millett**, University of California Santa Barbara (AMS-MAA-MER).

Research in Mathematics by Undergraduates (Code: AMS SS P1), **Darren A. Narayan**, **Carl V. Lutzer**, and **Tamara A. Burton**, Rochester Institute of Technology (AMS-MAA-SIAM).

The History of Mathematics (Code: AMS SS S1), **Joseph W. Dauben**, Lehman College, and **David E. Zitarelli**, Temple University (AMS-MAA).

AMS Invited Addresses

Weinan E, Princeton University, *Title to be announced.*

David B. Mumford, Brown University, *Title to be announced* (AMS Josiah Willard Gibbs Lecture).

Andrei Okounkov, University of California Berkeley, *Title to be announced.*

Charles C. Pugh, University of California Berkeley, *Title to be announced.*

Dana Randall, Georgia Institute of Technology, *Title to be announced.*

Peter Sarnak, Courant Institute and Princeton University, *Spectra of hyperbolic surfaces and applications* (AMS Colloquium Lectures).

Vladimir Voevodsky, Institute for Advanced Study, *Motivic homotopy theory.*

AMS Special Sessions

Advances in Spherical Designs and Codes (Code: AMS SS A1), **Béla Bajnok**, Gettysburg College, and **Neil J. A. Sloane**, AT&T Shannon Labs.

Algebraic Topology Based on Knots (Code: AMS SS F1), **Mark E. Kidwell**, U.S. Naval Academy, and **Jozef H. Przytycki** and **Yongwu Rong**, The George Washington University.

Algebras, Actions, and Algorithms (Code: AMS SS CC1), **Edward S. Letzter** and **Martin Lorenz**, Temple University.

Banach Space Theory and Convex Geometry (Code: AMS SS L1), **Teck-Cheong Lim**, Mason University, and **Mikhail Ostrovskii**, The Catholic University of America.

C-Extensions and Classifications of C*-Algebras* (Code: AMS SS C1), **Shuang Zhang**, University of Cincinnati, and **Huaxin Lin**, University of Oregon.

Computational Algebraic and Analytic Geometry for Low-Dimensional Varieties (Code: AMS SS G1), **Mika K. Seppälä**, Florida State University, and **Emil J. Volcheck**, Baltimore, Maryland.

Discrete Dynamics and Difference Equations (Code: AMS SS D1), **Saber N. Elaydi**, Trinity University, and **Gerasimos Ladas**, University of Rhode Island.

Discrete Models (Code: AMS SS K1), **Cris Moore**, University of New Mexico and Santa Fe Institute, and **Dana Randall**, Georgia Institute of Technology.

Dynamics, Physics, and Probability: The Work of the 2002 Nemmers Prize Winner, Yakov Sinai (Code: AMS SS W1), **John M. Franks** and **Jeff Xia**, Northwestern University.

Highlights of Recent Workshops Held by the Board on Mathematical Sciences and Their Applications (Code: AMS SS DD1), **David Eisenbud**, Mathematical Sciences Research Institute, and **Scott T. Weidman**, National Research Council.

Homotopy Theory (Code: AMS SS E1), **Kristine Baxter Bauer**, **J. Michael Boardman**, **Nitu Kitchloo**, **Jean-Pierre Meyer**,

Jack Morava, and **W. Stephen Wilson**, Johns Hopkins University.

Inverse Problems and Sampling Theory in Signal Analysis (Code: AMS SS Z1), **M. Zuhair Nashed**, University of Delaware.

Mathematical Current Events: Expository Reports (Code: AMS SS Y1), **David Eisenbud**, Mathematical Sciences Research Institute.

Modular Forms, Elliptic Curves, and Related Topics (Code: AMS SS J1), **Cristina M. Ballantine** and **Sharon M. Frechette**, College of the Holy Cross, and **Holly J. Rosson**, St. Mary's College of Maryland.

Nonstandard Models of Arithmetic and Set Theory (Code: AMS SS X1), **Ali Enayat**, American University, and **Roman Kossak**, CUNY Graduate Center.

Operator Algebras, Quantization, and Noncommutative Geometry: A Centennial Celebration in Honor of J. v. Neumann and M. H. Stone (Code: AMS SS U1), **Robert S. Doran**, Texas Christian University, and **Richard V. Kadison**, University of Pennsylvania.

Primes and Knots (Code: AMS SS R1), **Jack Morava**, Johns Hopkins University, **Stavros Garoufalidis**, Georgia Institute of Technology, and **Masanori Morishita**, Kanazawa University.

Quantum Computation and Information. (Code: AMS SS EE1), **Samuel J. Lomonaco Jr.**, University of Maryland, Baltimore County, **Howard E. Brandt**, Army Research Laboratory, and **Louis H. Kauffman**, University of Illinois at Chicago.

Recent Advances in Riemannian and Lorentzian Geometries (Code: AMS SS M1), **Krishan L. Duggal**, University of Windsor, and **Ramesh Sharma**, University of New Haven.

Special Functions and q-Series (Code: AMS SS V1), **Mourad E. H. Ismail**, University of South Florida.

Stochastic and Multiscale Problems in the Sciences (Code: AMS SS AA1), **Weinan E**, Princeton University, **Shiyi Chen**, Johns Hopkins University, and **Eric Vanden-Eijnden**, New York University, Courant Institute.

The Many Lives of Lattice Theory and the Theory of Ordered Sets, with Connections to Combinatorics (Code: AMS SS BB1), **Jonathan D. Farley**, University of Oxford, and **Stefan E. Schmidt** and **Alex J. Pogel**, New Mexico State University.

Wavelets, Frames and Operator Theory (Code: AMS SS B1), **Christopher Heil**, Georgia Institute of Technology, **Palle Jorgensen**, University of Iowa, and **David Larson**, Texas A&M University.

Baton Rouge, Louisiana

Louisiana State University

March 14–16, 2003

Meeting #984

Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of *Notices*: January 2003
Program first available on AMS website: January 30, 2003
Program issue of electronic *Notices*: March 2003
Issue of *Abstracts*: Volume 24, Issue 2

Deadlines

For organizers: August 14, 2002
For consideration of contributed papers in Special Sessions: November 26, 2002
For abstracts: January 22, 2003

Bloomington, Indiana

Indiana University

April 4–6, 2003

Meeting #985

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: February 2003
Program first available on AMS website: February 20, 2003
Program issue of electronic *Notices*: April 2003
Issue of *Abstracts*: Volume 24, Issue 2

Deadlines

For organizers: September 4, 2002
For consideration of contributed papers in Special Sessions: December 17, 2002
For abstracts: February 11, 2003

Invited Addresses

Daniel J. Allcock, University of Texas, *Title to be announced.*

Brian D. Conrad, University of Michigan, *Title to be announced.*

Robin A. Pemantle, Ohio State University, *Title to be announced.*

Sijue Wu, University of Maryland, *Title to be announced.*

Special Sessions

Applications of Teichmueller Theory to Dynamics and Geometry (Code: AMS SS K1), **Christopher M. Judge** and **Matthias Weber**, Indiana University.

Differential Geometry (Code: AMS SS L1), **Jiri Dadok, Bruce Solomon**, and **Ji-Ping Sha**, Indiana University.

Ergodic Theory and Dynamical Systems (Code: AMS SS A1), **Roger L. Jones** and **Ayse A. Sahin**, DePaul University.

Geometric Topology (Code: AMS SS D1), **Paul A. Kirk** and **Charles Livingston**, Indiana University.

Harmonic Analysis in the 21st Century (Code: AMS SS E1), **Winston C. Ou** and **Alberto Torchinsky**, Indiana University.

Holomorphic Dynamics (Code: AMS SS B1), **Eric D. Bedford** and **Kevin M. Pilgrim**, Indiana University.

Mathematical and Computational Problems in Fluid Dynamics and Geophysical Fluid Dynamics (Code: AMS SS H1), **Roger Temam** and **Shouhong Wang**, Indiana University.

Operator Algebras and Free Probability (Code: AMS SS J1), **Hari Bercovici**, Indiana University, and **Marius Dadarlat**, Purdue University.

Particle Models and Their Fluid Limits (Code: AMS SS F1), **Robert T. Glassey** and **David C. Hoff**, Indiana University.

Probability (Code: AMS SS G1), **Russell D. Lyons**, Indiana University, and **Robin A. Pemantle**, Ohio State University.

Recent Trend in the Analysis and Computations of Functional Differential Equations (Code: AMS SS M1), **Paul W. Eloe** and **Qin Sheng**, University of Dayton.

Weak Dependence in Probability and Statistics (Code: AMS SS C1), **Richard C. Bradley** and **Lanh T. Tran**, Indiana University.

New York, New York

Courant Institute

April 12–13, 2003

Meeting #986

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: February 2003
Program first available on AMS website: February 27, 2003
Program issue of electronic *Notices*: April 2003
Issue of *Abstracts*: Volume 24, Issue 3

Deadlines

For organizers: September 12, 2002
For consideration of contributed papers in Special Sessions: December 24, 2002
For abstracts: February 18, 2003

Invited Addresses

Matthias Aschenbrenner, University of California Berkeley, *Title to be announced.*

John Etnyre, University of Pennsylvania, *Title to be announced.*

Hans Foellmer, Humboldt University, Berlin, *Title to be announced.*

Wilfrid Gangbo, Georgia Institute of Technology, *Title to be announced.*

Special Sessions

Combinatorial and Statistical Group Theory (Code: AMS SS B1), **Alexei Myasnikov** and **Vladimir Shpilrain**, City College, New York.

Hopf Algebras and Quantum Groups (Code: AMS SS A1), **M. Susan Montgomery**, University of Southern California, **Earl J. Taft**, Rutgers University, and **Sarah J. Witherspoon**, Amherst College.

San Francisco, California

San Francisco State University

May 3–4, 2003

Meeting #987

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: March 2003
Program first available on AMS website: March 20, 2003
Program issue of electronic *Notices*: May 2003
Issue of *Abstracts*: Volume 24, Issue 3

Deadlines

For organizers: October 3, 2002
For consideration of contributed papers in Special Sessions: January 14, 2003
For abstracts: March 11, 2003

Invited Addresses

Joe P. Buhler, Reed College, *Title to be announced.*

Raymond C. Heitmann, University of Texas at Austin, *Title to be announced.*

Alexei Y. Kitaev, California Institute of Technology, *Title to be announced.*

Arkady Vaintrob, University of Oregon, *Title to be announced.*

Seville, Spain

June 18–21, 2003

Meeting #988

First Joint International Meeting between the AMS and the Real Sociedad Matematica Española (RSME).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: Not applicable
Program issue of electronic *Notices*: Not applicable
Issue of *Abstracts*: Not applicable

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Xavier Cabre, Universidad Politécnica de Cataluña, Barcelona, *Title to be announced.*

Charles Fefferman, Princeton University, *Title to be announced.*

Michael Hopkins, Massachusetts Institute of Technology, *Title to be announced.*

Ignacio Sols, Universidad Complutense, Madrid, *Title to be announced.*

Luis Vega, Universidad del Pais Vasco, Bilbao, *Title to be announced.*

Efim Zelmanov, Yale University, *Title to be announced.*

Special Sessions

Affine Algebraic Geometry, **Jaime Gutierrez**, University of Cantabria, **Vladimir Shpilrain**, City College of New York, and **Jie-Tai Yu**, University of Hong Kong.

Algebraic Geometry, **Felix Delgado**, Universidad de Valladolid, and **Andrey N. Todorov**, University of California Santa Cruz.

Algebraic Topology, **Alejandro Adem**, University of Wisconsin, **J. Aguade**, Universitat Autónoma de Barcelona, and **Eric M. Friedlander**, Northwestern University.

Banach Spaces of Analytic Functions, **Daniel Girela**, University of Malaga, and **Michael Stessin**, SUNY at Albany.

Biomolecular Mathematics, **Thomas J. Head** and **Fernando Guzman**, SUNY at Binghamton, **Mario Perez**, Universidad de Sevilla, and **Carlos Martin-Vide**, Rovira i Virgili University.

Classical and Harmonic Analysis, **Nets Katz**, Washington University, **Carlos Perez**, Universidad de Sevilla, and **Ana Vargas**, Universidad Autonoma de Madrid.

Combinatorics, **Joseph E. Bonin**, George Washington University, and **Marc Noy**, Universitat Politecnica de Catalunya.

Commutative Algebra: Geometric, Homological, Combinatorial and Computational Aspects, **Alberto Corso**, University of Kentucky, **Philippe Gimenez**, Universidad de Valladolid, and **Santiago Zarzuela**, Universitat de Barcelona.

Computational Methods in Algebra and Analysis, **Eduardo Cattani**, University of Massachusetts, Amherst, and **Francisco Jesus Castro-Jimenez**, Universidad de Sevilla.

Constructive Approximation Theory, **Antonio Duran**, University de Sevilla, and **Edward B. Saff**, Vanderbilt University.

Control and Geometric Mechanics, **Manuel de Leon**, Instituto de Matemáticas y Física Fundamental, **Alberto Ibort**, Universidad Carlos III, and **Francesco Bullo**, University of Illinois, Urbana-Champaign.

Differential Galois Theory, **Teresa Crespo** and **Zbigniew Hajto**, Universitat de Barcelona, and **Andy R. Magid**, University of Oklahoma.

Differential Structures and Homological Methods in Commutative Algebra and Algebraic Geometry, **Gennady Lyubeznik**, University of Minnesota, and **Luis Narvaez-Macarro**, Universidad de Sevilla.

Discrete and Computational Geometry, **Ferran Hertado**, Universitat Politècnica de Catalunya, and **William Steiger**, Rutgers University.

Dynamical Systems, **George Haller**, Massachusetts Institute of Technology, **Zbigniew H. Nitecki**, Tufts University, **Enrique Ponce**, Universidad de Sevilla, **Tere M. Seara**, Universitat Politècnica de Catalunya, and **Xavier Jarque**, Universitat Autónoma de Barcelona.

Effective Analytic Geometry over Complete Fields, **Luis-Miguel Pardos**, Universidad de Cantabria, and **J. Maurice Rojas**, Texas A&M University.

Geometric Methods in Group Theory, **José Burillo**, Universitat Politècnica de Catalunya, **Jennifer Tayback**, University of Albany, and **Enric Ventura**, Universitat Politècnica de Catalunya.

History of Modern Mathematics—Gauss to Wiles, **Jose Ferreiros**, Universidad de Sevilla, and **David Rowe**, Universitat Mainz.

Homological Methods in Banach Space Theory, **Jesus M. F. Castillo**, Universidad de Extremadura, and **N. J. Kalton**, University of Missouri.

Homotopy Algebras, **Pedro Real**, Universidad de Sevilla, **Thomas J. Lada**, North Carolina State University, and **James Stasheff**, University of North Carolina.

Interpolation Theory, Function Spaces and Applications, **Fernando Cobos**, University Complutense de Madrid, and **Pencho Petrushev**, University of South Carolina.

Lorentzian Geometry and Mathematical Relativity, **Luis J. Alias**, Universidad de Murcia, and **Gregory James Galloway**, University of Miami.

Mathematical Aspects of Semiconductor Modeling and Nano-Technology, **Irene Martinez Gamba**, University of Texas, Austin, and **Jose Antonio Carrillo**, Universidad de Granada.

Mathematical Fluid Dynamics, **Diego Cordoba**, CSIC, Madrid, and Princeton University, **Susan Friedlander**, University of Illinois, Chicago, and **Marcos Antonio Fontelos**, Universidad Rey Juan Carlos.

Mathematical Methods in Finance and Risk Management, **Santiago Carrillo Menendez**, Universidad Autonoma de Madrid, **Antonio Falcos Montesinos**, Universidad Cardenal Herrera CEU, **Antonio Sanchez-Calle**, Universidad Autonoma de Madrid, and **Luis A. Seco**, University of Toronto at Mississauga.

Moduli Spaces in Geometry and Physics, **Steven B. Bradlow**, University of Illinois, Urbana-Champaign, and **Oscar Garcia-Prada**, Universidad Autonoma de Madrid.

Nonassociative Algebras and Their Applications, **Efim I. Zelmanov**, Yale University, **Santos Gonzalez**, Universidad de Oviedo, and **Alberto Elduque**, Universidad de Zaragoza.

Nonlinear Dispersive Equations, **Gustavo Ponce**, University of California Santa Barbara, and **Luis Vega**, Universidad del Pais Vascos.

Numerical Linear Algebra, **Lothar Reichel**, Kent State University, and **Francisco Marcellan**, University Carlos III de Madrid.

Operator Theory and Spaces of Analytic Functions, **Jose Bonet**, Universidad Politecnica de Valencia, **Pedro Paul**, Universidad de Sevilla, and **Cora S. Sadosky**, Howard University.

PDE Methods in Continuum Mechanics, **Juan L. Vazquez**, Universidad Autonoma de Madrid, and **J. W. Neuberger**, University of North Texas.

Polynomials and Multilinear Analysis in Infinite Dimensions, **Richard M. Aron**, Kent State University, **J. A. Jaramillo** and **Jose G. Llavona**, Universidad Complutense de Madrid, and **Andrew M. Tonge**, Kent State University.

Quantitative Results in Real Algebra and Geometry, **Carlos Andradas** and **Antonio Diaz-Cano**, Universidad Complutense, **Victoria Powers**, Emory University, and **Frank Sottile**, University of Massachusetts, Amherst.

Recent Developments in the Mathematical Theory of Inverse Problems, **Russell Brown**, University of Kentucky, **Alberto Ruiz**, Universidad Autonoma de Madrid, and **Gunther Uhlmann**, University of Washington.

Riemannian Foliations, **Jesus Antonio Alvarez Lopez**, Universidade de Santiago de Compostela, and **Efton L. Park**, Texas Christian University.

Ring Theory and Related Topics, **Jose Gomez-Torrecillas**, University of Granada, **Pedro Antonio Guil Asensio**, University of Murcia, **Sergio R. Lopez-Permouth**, Ohio University, and **Blas Torrecillas**, University of Almeria.

The Mathematics of Electronmicroscopic Imaging, **Jose-Maria Carazo**, Centro Nacional de Biotecnologia-CSIC, and **Gabor T. Herman**, City University of New York.

Variational Problems for Submanifolds, **Frank Morgan**, Williams College, and **Antonio Ros**, Universidad de Granada.

Boulder, Colorado

University of Colorado

October 2–4, 2003

Meeting #989

Joint Central/Western Section
Associate secretary: Susan J. Friedlander and Michel L. Lapidus
Announcement issue of *Notices*: August 2003
Program first available on AMS website: August 21, 2003
Program issue of electronic *Notices*: October 2003
Issue of *Abstracts*: Volume 24, Issue 4

Deadlines

For organizers: March 3, 2003
For consideration of contributed papers in Special Sessions: June 6, 2003
For abstracts: August 12, 2003

Invited Addresses

J. Brian Conrey, American Institute of Mathematics, *Title to be announced.*

Giovanni Forni, Northwestern University, *Title to be announced.*

Juha M. Heinonen, University of Michigan, *Title to be announced.*

Joseph D. Lakey, New Mexico State University, *Title to be announced.*

Albert Schwarz, University of California Davis, *Title to be announced.*

Avi Wigderson, Institute for Advanced Study, *Title to be announced* (Erdős Memorial Lecture).

Binghamton, New York

SUNY-Binghamton

October 11–12, 2003

Meeting #990

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: August 2003
Program first available on AMS website: August 28, 2003
Program issue of electronic *Notices*: October 2003
Issue of *Abstracts*: Volume 24, Issue 4

Deadlines

For organizers: March 10, 2003
For consideration of contributed papers in Special Sessions: June 24, 2003
For abstracts: August 19, 2003

Invited Addresses

Zlil Sela, Einstein Institute of Mathematics, *Title to be announced.*

Zoltan Szabo, University of Michigan, Ann Arbor, *Title to be announced.*

Jeb F. Willenbring, Yale University, *Title to be announced.*

Special Sessions

Biomolecular Mathematics (Code: AMS SS A1), **Thomas J. Head** and **Dennis G. Pixton**, SUNY at Binghamton, **Mitsunori Ogihara**, University of Rochester, and **Carlos Martin-Vide**, Universitat Rovira i Virgili.

Chapel Hill, North Carolina

University of North Carolina at Chapel Hill

October 24–25, 2003

Meeting #991

Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of *Notices*: August 2003
Program first available on AMS website: September 11, 2003
Program issue of electronic *Notices*: October 2003
Issue of *Abstracts*: Volume 24, Issue 4

Deadlines

For organizers: March 24, 2003
For consideration of contributed papers in Special Sessions: July 19, 2003
For abstracts: September 3, 2003

Bangalore, India

India Institute of Science

December 17–20, 2003

Meeting #992

First Joint International Meeting with various Indian mathematical societies.
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: Not applicable
Program issue of electronic *Notices*: Not applicable
Issue of *Abstracts*: Not applicable

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Phoenix, Arizona

Phoenix Civic Plaza

January 7–10, 2004

Joint Mathematics Meetings, including the 110th Annual Meeting of the AMS, 87th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL).
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2003
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2004
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 2, 2003
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

Tallahassee, Florida

Florida State University

March 12–13, 2004

Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: August 13, 2003
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Athens, Ohio

Ohio University

March 26–27, 2004

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: August 26, 2003
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Lawrenceville, New Jersey

Rider University

April 17–18, 2004

Eastern Section
Associate secretary: Lesley M. Sibner

Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 17, 2003
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Pittsburgh, Pennsylvania

University of Pittsburgh

November 6–7, 2004

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 7, 2004
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Atlanta, Georgia

Atlanta Marriott Marquis and Hyatt Regency Atlanta

January 5–8, 2005

Joint Mathematics Meetings, including the 111th Annual Meeting of the AMS, 88th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association of Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association of Symbolic Logic (ASL).
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: October 2004
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2005
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 5, 2004
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

San Antonio, Texas

Henry B. Gonzalez Convention Center

January 12–15, 2006

Joint Mathematics Meetings, including the 112th Annual Meeting of the AMS, 89th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL).
Associate secretary: John L. Bryant
Announcement issue of *Notices*: October 2005
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2006
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 12, 2005
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

New Orleans, Louisiana

New Orleans Marriott and Sheraton New Orleans Hotel

January 4–7, 2007

Joint Mathematics Meetings, including the 113th Annual meeting of the AMS, 90th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: October 2006
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2007
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 4, 2006
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

Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: Michel L. Lapidus, Department of Mathematics, University of California, Sproul Hall, Riverside, CA 92521-0135; e-mail: lapidus@math.ucr.edu; telephone: 909-787-3113.

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.nwu.edu; telephone: 312-996-3041.

Eastern Section: Lesley M. Sibner, Department of Mathematics, Polytechnic University, Brooklyn, NY 11201-2990; e-mail: lsibner@duke.poly.edu; telephone: 718-260-3505.

Southeastern Section: John L. Bryant, Department of Mathematics, Florida State University, Tallahassee, FL 32306-4510; e-mail: bryant@math.fsu.edu; telephone: 850-644-5805.

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. **Information in this issue may be dated. Up-to-date meeting and conference information** at www.ams.org/meetings/.

Meetings:

Important Information regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 175 in the January 2002 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 LaTeX is necessary to submit an electronic form, although those who use LaTeX may submit abstracts with such coding, and all math displays must be typeset in LaTeX. 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; 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 Meetings & Conferences Department, AMS, P.O. Box 6887, Providence, RI 02940. There is a $20 processing fee for each paper abstract. There is no charge for electronic abstracts. 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.)

February 13-18, 2003: AAAS Annual Meeting, Denver, Colorado.

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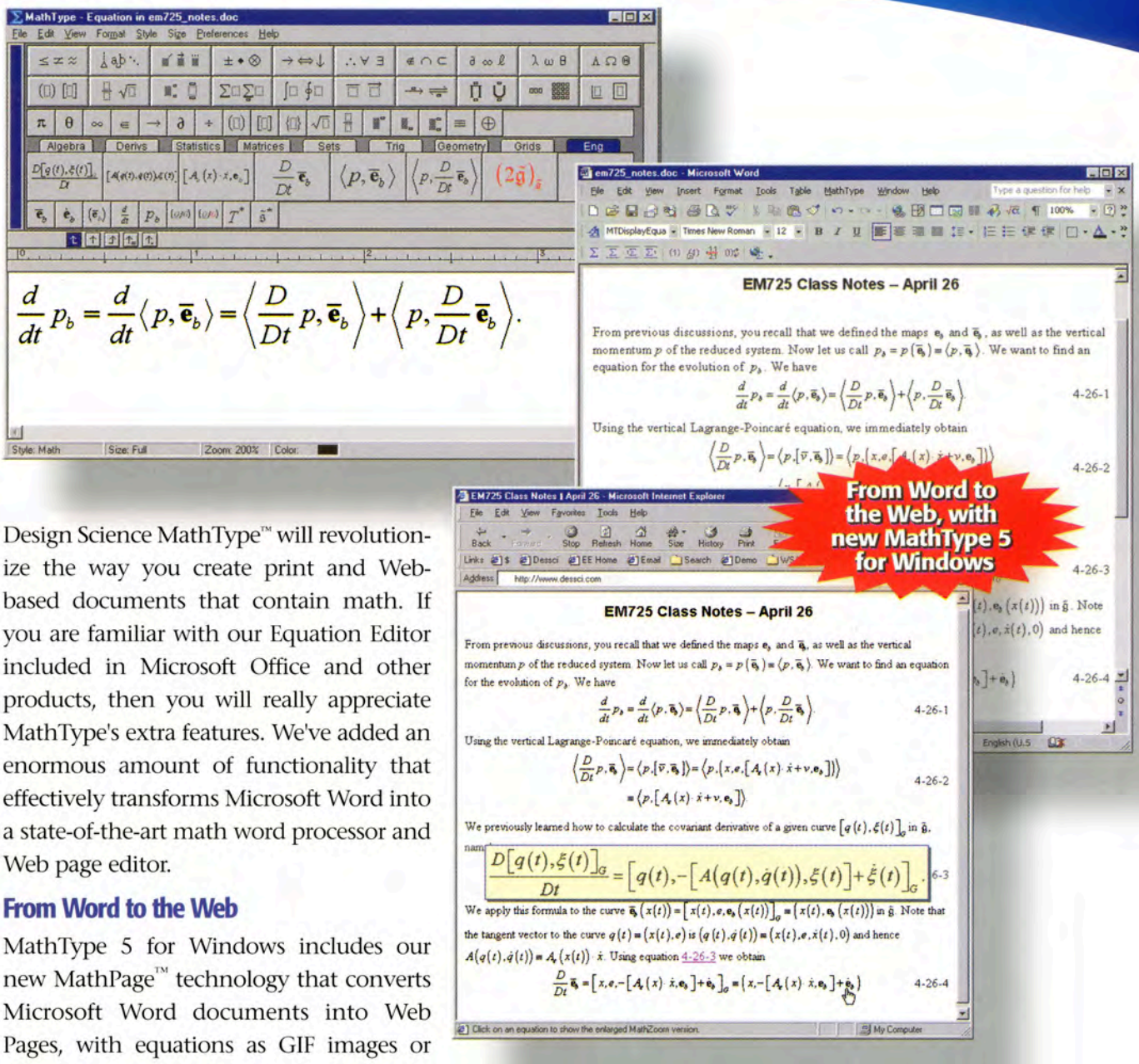

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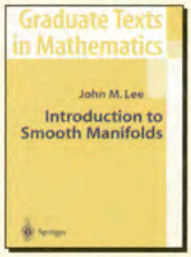
SPRINGER FOR MATHEMATICS

INTRODUCTION TO SMOOTH MANIFOLDS

J.M. LEE, University of Washington, Seattle, WA



This book is an introductory graduate-level textbook on the theory of smooth manifolds. Its goal is to familiarize students with the tools they will need in order to use manifolds in mathematical or scientific research—smooth structures, tangent vectors and covectors, vector bundles, immersed and embedded submanifolds, tensors, differential forms, de Rham cohomology, vector fields, flows, foliations, Lie derivatives, Lie groups, Lie algebras, and more. The book is aimed at students who already have a solid acquaintance with general topology, the fundamental group, and covering spaces, as well as basic undergraduate linear algebra and real analysis.

2002/648 PP., 157 ILLUS.
SOFTCOVER/ISBN 0-387-95448-1/$49.95
HARDCOVER/ISBN 0-387-95495-3/$79.95
GRADUATE TEXTS IN MATHEMATICS, VOLUME 218

SHAPE INTERROGATION FOR COMPUTER AIDED DESIGN AND MANUFACTURING

N.M. PATRIKALAKIS and **T. MAEKAWA,** both, Massachusetts Institute of Technology, Cambridge, MA

Shape interrogation is the process of extraction of information from a geometric model. It is a fundamental component of Computer Aided Design and Manufacturing (CAD/CAM) systems. The authors focus on shape interrogation of geometric models bounded by free-form surfaces. Free-form surfaces, also called sculptured surfaces, are widely used in the bodies of ships, automobiles and aircraft, which have both functionality and attractive shape requirements.

2002/424 PP., 165 ILLUS./HARDCOVER/$44.95
ISBN 3-540-42454-7

INTEREST RATE MANAGEMENT

R. ZAGST, RiskLab GmbH, Munich, Germany

This book addresses the needs of both researchers and practitioners. It combines a rigorous overview of the mathematics of financial markets with an insight into the practical application of these models to the risk and portfolio management of interest rate derivatives. It can also serve as a valuable textbook for graduate and Ph.D. students in mathematics who want to get some knowledge about financial markets.

2002/356 PP./HARDCOVER/$59.95
ISBN 3-540-67594-9
SPRINGER FINANCE

INTRODUCTION TO NUMERICAL ANALYSIS

Third Edition

J. STOER, Institute for Applied Mathematics, Würzburg, Germany; and **R. BULIRSCH,** Institute for Mathematics, Munich, Germany

This book combines the modern mathematical standards of numerical analysis with an understanding of the needs of the computer scientist working on practical applications. Among its many particular features are: fully worked-out examples; many carefully selected and formulated problems; fast Fourier transform methods; a thorough discussion of some important minimization methods; solution of stiff or implicit ordinary differential equations and of differential algebraic systems; modern shooting techniques for solving two-point boundary value problems; and basics of multigrid methods.

2002/752 PP., 39 ILLUS./HARDCOVER
WITH CD-ROM/$69.95/ISBN 0-387-95452-X
TEXTS IN APPLIED MATHEMATICS, VOLUME 12

A SINGULAR INTRODUCTION TO COMMUTATIVE ALGEBRA

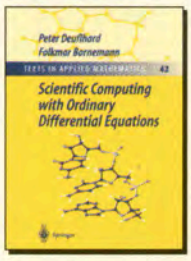
G.-M. GREUEL and **G. PFISTER,** both, University of Kaiserslautern, Germany

This book can be understood as a model for teaching commutative algebra, taking into account modern developments such as algorithmic and computational aspects. The computations are exemplified with the computer algebra system *SINGULAR* developed by the authors. The book includes a CD with a version of *SINGULAR* for various platforms (Unix/ Linux, Windows, Macintosh), including all examples and procedures explained in the book.

2002/APPROX. 606 PP./SOFTCOVER
WITH CD-ROM/$44.95 (TENT.)
ISBN 3-540-42897-6

SCIENTIFIC COMPUTING WITH ORDINARY DIFFERENTIAL EQUATIONS

P. DEUFLHARD, Konrad Zuse Center for Scientific Computing, Berlin, Germany; and **F. BORNEMANN,** Munich Institute of Technology, Munich, Germany



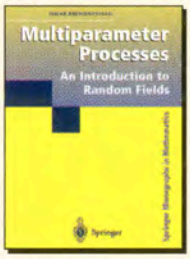
This textbook provides a fundamental introduction to the mathematical and numerical aspects of discretization methods for solving initial value problems in ordinary differential equations. It would be a useful and timely text for a graduate course in numerical analysis of Ordinary Differential Equations. It is written at a level that is accessible to such an audience, covers a wide variety of topics, both classical and modern, and contains a generous supply of homework exercises at the end of each chapter.

2002/504 PP., 37 ILLUS./HARDCOVER/$59.95
ISBN 0-387-95462-7
TEXTS IN APPLIED MATHEMATICS, VOLUME 42

MULTIPARAMETER PROCESSES

An Introduction to Random Fields

D. KHOSHNEVISAN, University of Utah, Salt Lake City, UT



Multiparameter processes extend the existing one-parameter theory of random processes in an elegant way, and have found connections to diverse disciplines such as probability theory, real and functional analysis, and group renormalization in mathematical physics, to name a few.

This book lays the foundation of aspects of the rapidly developing subject of random fields, and is designed for a second graduate course in probability and beyond. Its intended audience is pure, as well as applied, mathematicians.

2002/606 PP./HARDCOVER/$79.95
ISBN 0-387-95459-7
SPRINGER MONOGRAPHS IN MATHEMATICS

MODEL THEORY

An Introduction

D. MARKER, University of Illinois, Chicago, IL

This book is a modern introduction to model theory, which stresses applications to algebra. The first half of the book includes classical material on model construction techniques, type spaces, prime models, saturated models, countable models, and indiscernibles and their applications. The author then goes on to illustrate how these ingredients are used in Hrushovski's applications to diophantine geometry. One significant aspect of this text is the inclusion of chapters on important topics not covered in other introductory texts, such as omega-stable groups and the geometry of strongly minimal sets.

2002/360 PP./HARDCOVER/$59.95
ISBN 0-387-98760-6
GRADUATE TEXTS IN MATHEMATICS, VOLUME 217

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