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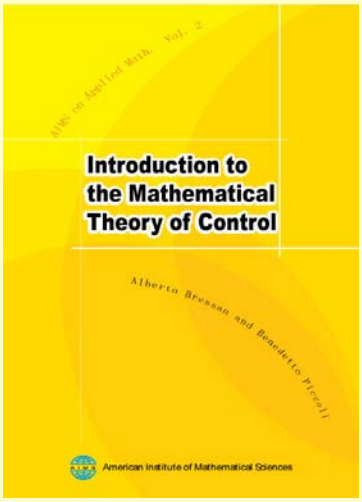

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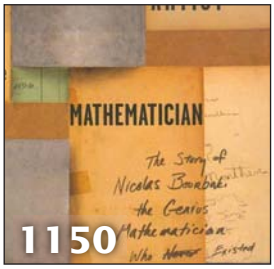

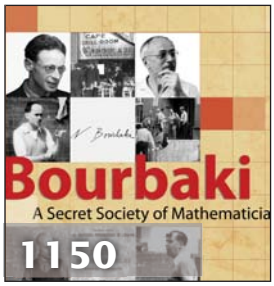

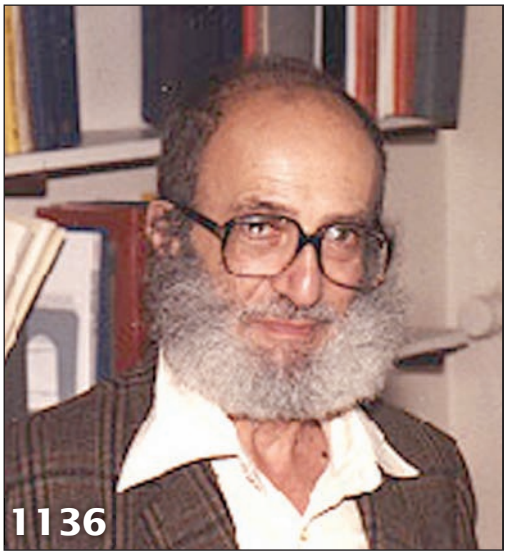

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of the American Mathematical Society

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Departments

From the AMS Secretary

Two Landmarks, Two Heroes

The experts have weighed in, the dust has settled, and we can all now celebrate the proof of the Poincaré Conjecture. And if you also raised a cheer for the proof of Thurston's Geometrization Conjecture, not many would try to shush you.

More than three years were needed for the experts to work carefully through the papers of Grigory Perelman. During this time the conviction gradually mounted that his work does indeed validate the vision of Richard Hamilton for attacking the conjectures. The climax came at the International Congress of Mathematicians in Madrid in August 2006, when experts stated publicly that Perelman had proved Poincaré (a bit more caution was expressed about Geometrization, but no doubts were voiced).

The saga of Perelman and his work catapulted mathematics into headlines in a way not seen since Andrew Wiles's proof of Fermat's Last Theorem in the mid-1990s. As with Fermat, the intense media blitz was followed by a period of silence during which books were written. Two have appeared recently: *The Poincaré Conjecture: In Search of the Shape of the Universe*, by Donal O'Shea (Walker, March 2007), and *Poincaré's Prize: The Hundred-Year Quest to Solve One of Math's Greatest Problems*, by George Szpiro (Dutton, June 2007).

Fermat's Last Theorem and the Poincaré Conjecture are similar in that they both inspired a great deal of mathematical development. Many special cases were established: for example, FLT was proved for large classes of exponents, and the Poincaré Conjecture was established for many special types of manifolds. Despite these similarities, as mathematical statements, FLT and Poincaré are quite different. FLT is a somewhat isolated statement that does not by itself have important implications that could be explored. By contrast, the Poincaré Conjecture captures a deep truth about the nature of three-dimensional shapes.

The importance of Poincaré was reinforced when it was shown to be a particular case of Thurston's sweeping Geometrization Conjecture, which has enormous implications in topology and geometry. For years many papers have appeared with careful caveats about how far the results could be pushed given the current status of the Geometrization Conjecture. Probably few papers have begun, "Assuming Fermat's Last Theorem, we prove…" Much more comparable to Geometrization is the deep conjecture that connected FLT to modern number theory, namely, the Taniyama-Shimura Conjecture, the centerpiece of Wiles's proof of FLT.

Another big difference between FLT and Poincaré is their fame outside of mathematics. How many among the general public had heard of the Poincaré Conjecture before Perelman's story became front-page news? I am guessing few. Being highlighted by the Clay Mathematics Institute as one of its seven Millennium Prize Problems raised the conjecture's profile a bit. But the Poincaré Conjecture is not a statement that is easily explained to those without mathematical background. Fermat's Last Theorem, of course, can be understood by schoolchildren and thus attracted the efforts of legions of amateur mathematicians—and continues to attract them, despite Wiles's proof. And who can blame them? Who can be 100 percent certain that there is not a really simple proof that has yet to be discovered?

One interesting similarity between the two results is that Perelman and Wiles both worked in isolation. Wiles confided in his Princeton colleague Nicholas Katz; it seems likely Perelman confided in no one at all. But the unveiling of their respective results could not have been more different. Wiles revealed his proof before a cheering crowd of his number theory colleagues, who had gathered at the Newton Institute in Cambridge, one of the world's major mathematics centers. By contrast, Perelman, having become increasingly isolated from the mathematical community, posted his preprints on the arXiv, let a few selected people know they were there, and then waited for the world to respond. Wiles attended the Berlin ICM in 1998 and collected his "special award" from the International Mathematical Union to thunderous applause from the audience gathered at the opening ceremonies. Perelman not only chose to skip the Madrid Congress in 2006, where he was to be awarded the Fields Medal, but he refused to accept the honor altogether.

These two landmark results are very different, but they both show how mathematics proceeds: It starts with a tantalizing question or a flash of insight compelling enough to spark the search for the *why*. This basic human desire for understanding is one reason Wiles and Perelman became heroes to the general public—and to many mathematicians as well.

—Allyn Jackson

Letters to the Editor

Review of *Shadows of Reality*

Thanks for so detailed a review of my book, *Shadows of Reality* [April 2007 issue]. But there are misrepresentation of arguments, mine and others.

Phillips says that I go too far with the influence of Jouffret on Picasso and says that even Henderson is more cautious. Her book on the subject was from her Ph.D. thesis in 1979, when as a young graduate student she had no choice but to offer a (single) caveat in her long book. In lectures and many subsequent writings, Henderson is far more forceful. To imply that she is wishy-washy on the proposition is to misrepresent her life's work. It is true that I have taken her argument further by giving other, more detailed examples from the Jouffret. Do I offer no proof, as Phillips contends? I show that Picasso had the means, motive, and opportunity. Also true, I looked for and could not find the letter in which Picasso says he did copy from the Jouffret, but written confessions are not the only form of proof. I invite readers to look at the comparisons and decide for themselves.

Phillips likewise misrepresents Minkowski in his reading of Minkowski that I quote. Minkowski says (rearranging his words a bit) that to project from spacetime to three dimensions "cast[s] only a very complicated projection". But we can not take that statement to mean that Minkowski is rejecting "projection". I argue that Minkowski states that these complications are exactly the distortions of special relativity. It is not fair to change Minkowski's meaning just to hammer me; Minkowski did not intend to dismiss projection here.

I have programmed both of the de Bruijn methods for generating foolproof quasicrystals, as well as written programs for assembling quasicrystal blocks. It took almost a year out of my life; it is not easy for an artist to learn enough linear algebra to do this. Although I did not give the complicated algorithms, in the text and my diagrams I clearly state that one does not project all the hypercubic cells to the plane (or space) of projection, but that there is a gate or test that each vertex must pass before they are projected. In one, but only one, of the two de Bruijn algorithms it is possible to call this test a "strip" or a "slice", or refer to a "cut and project method". But to point to this test slice and say that my exposition if fundamentally flawed is again to misrepresent what de Bruijn has done. He has seen that quasicrystals are projections of regular higher-dimensional cubic cells. Quasicrystals are quixotic because of the irrational angle at which this projection occurs. It is an almost unimaginable feat of mathematical visualization from de Bruijn; don't take this away from him because you are "disappointed" in me.

It is the last chapter that has made some mathematicians so mad. In this chapter I reject slices in favor of projections *as a model for spacetime physics*. Even the title of my book says as much. I agree that to be furious at squares while being in love with triangles, does make one sound like a nut. On the other hand, to accurately report on what physicists say and do is responsible journalism, and if they say that space + time is best modeled as a projection of spacetime, then *that* is responsible journalism. Did I unfairly characterize their work? Or do I bring up something that others have missed! That is the proper subject of criticism.

—*Tony Robbin*
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(Received April 20, 2007)

Referees

In his Opinion on "Should journals compensate referees?" (*Notices* **54** (2007), no. 5, p. 589) Michael Fried seems to answer that question by Yes. Will then referees be responsible for the errors in papers? Fried's opinion seems to be that they are responsible already now, without payment: "…it is my experience that over 50% of papers (yes, tough topics, but …) have very serious …errors. This reflects poorly on referees. Why referees and not authors?" I don't see a clear answer to that question in what follows there. I was always told and was convinced when actively editing journals that the authors not the referees are ultimately responsible for errors. (Of course the referee should do her/his best to notice them.) This seems to be supported by the following stanza in R. P. Boas's humorous but seriously meant ("Let me make it clear to you/This is what we'll never do") Retroactive Editorial Policy (*Amer. Math. Monthly* **89** (1982), p. 32; the other three stanzas are also worth reading): "We often note that authors, even those whose work is strong, They sometimes go too far and say a thing or two that's wrong. You needn't worry very much about a stray mistake: If you can fool the referee, what difference does it make? But not in my journal."

One more short note about deadlines for referees. There is almost nothing so annoying for (active) editors and editorial staff than a referee from whom, notwithstanding reminders, one does not hear for months and months, while the authors keep asking "What happened to my paper?" There may also be a slight chance of priority problems: while priority can be established from submission dates, people tend to quote where they first saw the result. Editors-in-chiefs and managing editors are usually patient when the referee informs them approximately how much more time they need but not if they get only silence.

Also referees should say (write) as soon as possible if they can not or would not referee the paper (e.g., for lack of time and certainly if it is "far from topics in which the prospective referee publishes papers"). Judging

from the reports we finally got, many editors (including me) got the impression that many referees (apparently not Fried and his #1 correspondent) were tardy not because they did a thorough job but because they delayed so long starting it.

—*János Aczél*
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(Received May 4, 2007)

Reply to Aczel

Aczel raises an issue of received wisdom: That it's not the referee's responsibility to vouch for the accuracy of an author's paper. He suggests I didn't make a case for this responsibility though I did say at least 50% of the papers I referee have serious errors.

Finding referees for new, not-yet-assimilated tools is one tough problem. It requires interdisciplinary refereeing expertise and editors who follow the analysis. Or else, it is rife for abuse.

An example from my early experience will help me address Aczel's concerns.

My first *Annals* paper solved a problem posed by Ax and Kochen. Prior to my result, someone well-connected to the area "proved" there could be no such theorem as mine.

My paper had five referees. Four called my office at Stony Brook, with the same technical questions. A fifth revealed himself years later. I did get a fair hearing from a rare fair editor—Armand Borel—to whom I lobbied for my paper during a two year postdoctoral at IAS.

My experience: Editors dominate in this process over referees.

Aczel also complains about tardy referees.

Correspondent #5 in my article asked, "Why do mathematicians referee without compensation?" He wondered, among the possibilities if it was "a fair trade for having their papers refereed?"

In my experience as an author, you may not even get that. Justification for this, responses from others who wrote me directly, and an expansion on Aczel's topic are on my website math.uci.edu/~mfried/proplist-ams.html, item #4.

Refereeing is a hard task, and too few do it well. I suggest, if there were incentives, more mathematicians would feel it worth developing the high skills that go with quick, quality refereeing.

—*Michael Fried*
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(Received July 2, 2007)

Journal Pricing

I was pleased to read the recent article "Jumping Ship: *Topology* Board Resigns" [May 2007 issue] in the AMS *Notices*, particularly the coverage of our launch of the LMS-owned *Journal of Topology* with a detailed account of recent history. The London Mathematical Society is delighted to be launching this new journal in a very important and exciting area of mathematics. We are very fortunate to have an excellent and world-renowned editorial board and the support of our publishers, Oxford University Press, in this venture. The signs are already encouraging, with substantial interest from all parts of the world.

I note your comments on the pricing of the new journal. The Society has worked hard to keep the price low. But in order to maintain its activities in support of mathematics nationally and internationally we must operate in a businesslike way, and it is essential that we work to a model for the new journal that at least breaks even in a reasonable period and does not disadvantage the Society financially in the long term.

The Society fully recognises the importance of the dissemination of mathematical knowledge and the threats of rising prices of journals and falling library budgets. In pursuing its objectives of increasing its support for mathematical activities, the Council of the Society will continue to seek to expand its activities in publishing but its policy is that the prices of its journals should not rise in real terms (against inflation) except in as far as there is added content or value.

The economics of learned societies and journal publishing work rather differently in Europe from in the USA—more than can be covered in this letter but perhaps worthy of further debate in your pages.

—*Kenneth Falconer*
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(Received June 20, 2007)

Librarians like Online *Notices*

I applaud *Notices*' move to complete online issues, mentioned in the June/July "Letter from the Editor". We librarians like online versions that contain everything found in the paper versions…and more, of course.

In the past, I have had difficulties with pictures missing from the online version of articles, and I hope that no longer happens now.

—*Martha Tucker, Librarian*
University of Washington
mtucker@u.washington.edu

(Received June 26, 2007)

AK-47 Memories

I read the "Letter from the Editor" in the June/July 2007 *Notices of the AMS* with great interest.

In Fall 1968, I was drafted during my first term in graduate school, so in January 1969 when Andy Magid began collecting the *Notices*, my parents were forwarding mine to me at Fort Dix, New Jersey, where I had been sent for basic training.

If I had had any idea that the *Notices* were capable of stopping an AK-47 round, you can be sure I would have started saving them, too. I certainly would have brought old issues with me to Vietnam, where I served as an infantryman near the Cambodian border from June 1969 to June 1970.

My mathematical background paid off in Vietnam. I was trained as a rifleman, but when I got to my company in the field, I was put in the (somewhat) safer mortar platoon to do the vector addition for firing and adjusting the fire of the 81mm mortar. For 37 years

I've felt this change of assignment may very well have saved my life.

Fortunately, I never stopped, or even slowed down, an AK-47 round. I returned to graduate school in 1971, and came to Georgia Tech in 1976.

—Fred Andrew
Georgia Institute of Technology
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(Received June 27, 2007)

Paper *Notices* Will Be Read More

While reading the editorial in the *Notices of the AMS* (June/July, 2007), I had the following thoughts. I feel the *Notices* would not be read as much if we all had to download it.

Individuals are innately lazy. I have a colleague who subscribes to the *Notices*, but is too lazy to open the wrapper; his issues are stacked in pristine condition with the cellophane still intact to keep the dust out. Will such individuals find downloading less of an effort?

Even if every reader downloaded the issue it would not be cost effective in time and paper. Who downloads on two sides? Just as those who use digital cameras say they will get the pictures to you immediately, either they never arrive or they arrive much later than those developed from film.

Perhaps the anticipation of a paper copy each month in the mail is best; it arrives bound and easy to handle. All that is required is to slit open the cellophane. Then the *Notices* can be read in the office, at home, or on the bus. Be bold: be conservative.

—Agnes M. Herzberg
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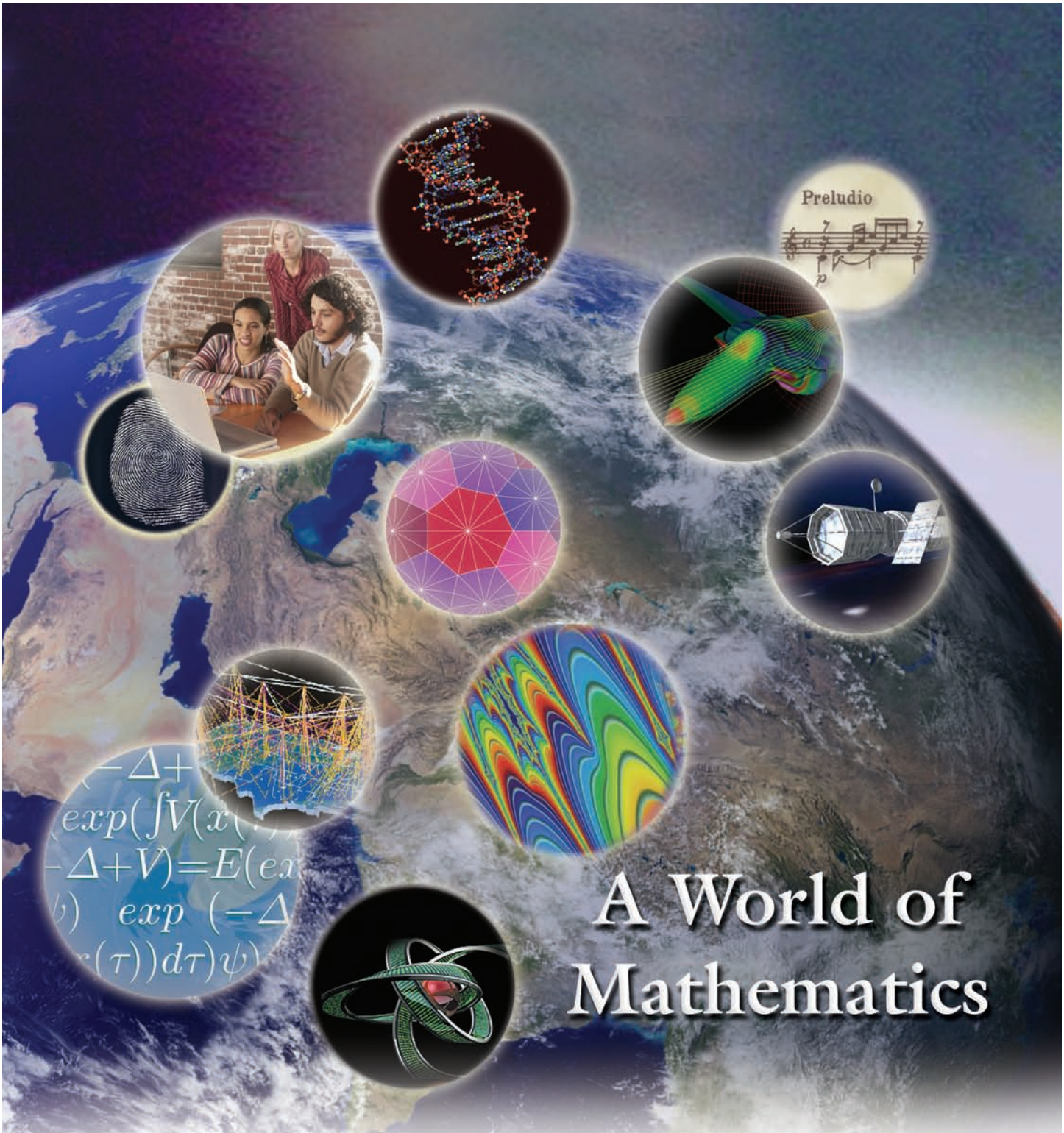

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The Character Table for E_8

David Vogan

On January 8, 2007, just before 9 in the morning, a computer finished writing to disk about sixty gigabytes of files containing the Kazhdan-Lusztig polynomials for the split real group G of type E_8. Values at 1 of these polynomials are coefficients in characters of irreducible representations of G; so all irreducible characters were written down. The biggest coefficient appearing was 11,808,808, in the polynomial

$$152q^{22} + 3472q^{21} + 38791q^{20} + 293021q^{19}$$

$$+1370892q^{18} + 4067059q^{17} + 7964012q^{16}$$

$$+11159003q^{15} + 11808808q^{14} + 9859915q^{13}$$

$$+6778956q^{12} + 3964369q^{11} + 2015441q^{10}$$

$$+906567q^{9} + 363611q^{8} + 129820q^{7}$$

$$+41239q^{6} + 11426q^{5} + 2677q^{4}$$

$$+492q^{3} + 61q^{2} + 3q.$$

Its value at 1 is 60,779,787.

This calculation is part of a larger project called the `atlas of Lie groups and representations`. In this article I'll try to explain the `atlas` project, what Kazhdan-Lusztig polynomials are, why one might care about them, and something about the nature of this calculation and the calculators.

David Vogan is professor of mathematics at the Massachusetts Institute of Technology. His email address is `dav@math.mit.edu`. *Supported in part by NSF FRG grant 0554278.*

What's E_8?

A *Lie group* is a group endowed with the structure of a smooth manifold, in such a way that group multiplication and inversion are smooth maps. Every finite group is a Lie group: the manifold structure is just the zero-dimensional discrete structure. For that reason the study of Lie groups is necessarily more complicated than the study of finite groups. But it's not unreasonable to concentrate on connected Lie groups. If you do that, a miracle happens: connected Lie groups are *less* complicated than finite groups. The reason is that a connected Lie group is almost completely determined by its *Lie algebra*. The Lie algebra is the tangent space to the group manifold at the identity element, endowed with a nonassociative product called the *Lie bracket*. Since the Lie algebra is a finite-dimensional vector space, it can be studied using linear algebra ideas. A typical method is to look at one element X of the Lie algebra, and to regard "Lie bracket with X" as a linear transformation from the Lie algebra to itself. This linear transformation has eigenvalues and eigenvectors, and those invariants can be used to describe the structure of the Lie algebra.

Just as finite groups are successive extensions of nonabelian simple groups (and $\mathbb{Z}/p\mathbb{Z}$), connected Lie groups are successive extensions of connected simple Lie groups (and the additive group $\mathbb{R}$). Many questions about general Lie groups can be reduced to the case of connected simple Lie groups, and so to questions about simple Lie algebras over the real numbers.

Many algebra problems are easier over algebraically closed fields, so it's natural to relate Lie algebras over $\mathbb{R}$ to Lie algebras over $\mathbb{C}$. If $k \subset K$ is any field extension, an n-dimensional Lie algebra

$\mathfrak{g}_k$ over the small field k gives rise naturally to an n-dimensional Lie algebra $\mathfrak{g}_K = \mathfrak{g}_k \otimes_k K$ over the large field K. The algebra $\mathfrak{g}_k$ is called a *k-form* of $\mathfrak{g}_K$. We can study real Lie algebras by first studying complex Lie algebras, and then studying their real forms.

Wilhelm Killing in 1887 was able to classify simple Lie algebras over the complex numbers. He found four infinite families of *classical Lie algebras* A_n, B_n, C_n, and D_n; and five *exceptional Lie algebras* G_2, F_4, E_6, E_7, and E_8. Each of these complex Lie algebras has a finite number of real forms; the real forms were described completely by Élie Cartan in the 1890s.

In each case there are two distinguished real forms: the *compact real form*, for which the corresponding Lie group is compact, and the *split real form*. The term "split" refers to factorization of certain characteristic polynomials. The split form has the property that there is an open set of Lie algebra elements X for which the linear transformation of Lie bracket with X has only real eigenvalues. If one works with simple Lie algebras over other fields, there is always an analogue of the split form. The compact form is special to the real field.

The Lie groups attached to classical Lie algebras are all related to classical linear algebra and geometry. A real Lie group of type B_n, for instance, is the group of linear transformations of $\mathbb{R}^{2n+1}$ preserving a nondegenerate quadratic form. These groups were already known in Lie's work, and in some sense they go back even to Euclid.

The great surprise in Killing's work was his discovery of the exceptional Lie algebras: five simple Lie algebras (of dimensions 14, 52, 78, 133, and 248) having no straightforward connection to classical geometry. Work in the twentieth century on the classification of finite simple groups shows that we should be delighted with such a short and tractable list of exceptions.

The `atlas` project is aimed at understanding the structure and representation theory of Lie groups. Each member of the project has a slightly different idea about what "understanding" means. Certainly it should include a thorough understanding of the exceptional groups.

There is an aesthetic in this subject according to which the best proof is one not referring to the Cartan-Killing classification. In practice, such a proof may be difficult to find. One of the most fundamental results is Cartan and Weyl's description of the finite-dimensional irreducible representations of a connected Lie group. This theorem was first proved in the 1930s using explicit constructions of representations of simple Lie groups, given separately in each case of the classification. Only twenty years later did Harish-Chandra give a construction independent of the classification. Even today, when Harish-Chandra's approach is well established as the "right" way to present the theory, the older explicit constructions continue to be a powerful tool.

What we are seeking is an understanding of Lie groups and (infinite-dimensional) representations of this aesthetically inferior sort: one that for the exceptional groups in particular may rely on explicit calculations. Always our goal is to find *formulations* of results that are as clean and simple and general as possible; but we allow for the possibility of verifying some results by long computations. The calculation we have done for E_8 is certainly long. I will say a few words in the last section about the kind of clean and simple results we are extracting from it.

A general warning about mathematical precision. I have tried to make the mathematical statements convey accurately our level of understanding; but I have deliberately omitted or obscured many important details. (Here is an example. In equation (D) below, I say that Harish-Chandra found a basis for the solutions of a system of differential equations. When certain eigenvalues for the system are zero, Harish-Chandra did *not* find all the solutions. The ones that he found suffice for the expression of irreducible characters: equation (E) remains true.) Undoubtedly the number of unintentional obscurities and omissions is equally large. For both categories, I apologize in advance.

The level of historical precision is perhaps even lower. I have omitted reference to many mathematicians whose work played a crucial role in the developments reported here. For these omissions I will not attempt to give an illustrative example but I will again apologize.

Unitary Representations and Their Disreputable Cousins

A *unitary representation* of a topological group G is a continuous action of G by automorphisms of a Hilbert space (preserving the inner product). Another way to say this is that a unitary representation is a realization of G as symmetries of a (possibly infinite-dimensional) Euclidean geometry. Because Hilbert spaces are the basic objects of quantum mechanics, one can also say that a unitary representation is a realization of G as symmetries of a quantum-mechanical system. A unitary representation is called *irreducible* if the Hilbert space has exactly two closed G-stable subspaces.

Because so many function spaces are closely related to Hilbert spaces, unitary representations are a fundamental tool for understanding actions of topological groups. To prepare this tool for use, we seek to understand arbitrary unitary representations of arbitrary topological groups.

An arbitrary unitary representation can often be written as a *direct integral* of irreducible unitary representations. The notion of direct integral

extends that of direct sum. If $\mathbb{T}$ is the unit circle, the Hilbert space $L^2(\mathbb{T})$ has a direct sum decomposition $L^2(\mathbb{T}) = \sum_{n\in\mathbb{Z}} \mathbb{C}\cdot e^{in\theta}$ given by Fourier series. The Hilbert space $L^2(\mathbb{R})$ has a direct integral decomposition $L^2(\mathbb{R}) = \int_{\xi\in\mathbb{R}} \mathbb{C}\cdot e^{ix\xi} d\xi$ given by the Fourier transform.

There is an extremely general theorem guaranteeing *existence* of a direct integral decomposition into irreducible representations: it suffices that the topological group have a countable dense subset. There are moderately general theorems guaranteeing *uniqueness* of direct integral decompositions. This uniqueness holds (for example) for all algebraic Lie groups—subgroups of $n \times n$ matrices defined by polynomial equations in the matrix entries. We therefore seek to understand irreducible unitary representations for algebraic Lie groups.

Work begun by George Mackey and completed by Michel Duflo describes irreducible unitary representations of algebraic Lie groups by a very concrete and explicit reduction to the case of *reductive algebraic groups*. (These are essentially direct products of simple and abelian Lie groups.) One of the goals of the `atlas` project is this:

to describe the set $\Pi_u(G)$ of irreducible unitary representations of each reductive algebraic Lie group G.

Since we haven't yet reached this goal, we want to identify steps that represent progress towards it.

Harish-Chandra in the 1950s, following a suggestion of Chevalley, began to study the larger class of irreducible representations that are not necessarily unitary. A *representation* of a topological group G means a continuous action of G on a complete locally convex topological vector space. We may write it as a group homomorphism

$$\pi\colon G \to \mathrm{Aut}(V_\pi),$$

with V_π the vector space. We say that π is *irreducible* if V_π has exactly two closed invariant subspaces. The study of irreducible representations in general is complicated by the existence of invertible linear operators on infinite-dimensional Banach spaces having no nontrivial closed invariant subspaces. Such operators define irreducible representations of the group $\mathbb{Z}$, but they have little to do with most problems of harmonic analysis. Harish-Chandra found a natural technical condition called *quasisimplicity* on irreducible representations of reductive Lie groups that excludes such pathological behavior. (The condition is that all operators commuting with the representation are assumed to be scalar. In the case of unitary irreducible representations, quasisimplicity is the theorem called Schur's Lemma.) If G is any reductive algebraic Lie group, we define

$$\Pi_q(G) = \text{equivalence classes of irreducible quasisimple representations of } G.$$

(The correct notion of equivalence—Harish-Chandra's *infinitesimal equivalence*—is a bit subtle, and involves unbounded operators. That causes difficulties with making precise statements in the rest of this section, but nothing insurmountable.) Quasisimple representations turn out to be easier to describe than unitary representations.

What is the relation to the original problem of describing unitary representations? A unitary representation is automatically quasisimple, so we want to understand when a quasisimple irreducible representation is actually unitary. That is, we want to know whether V_π admits a G-invariant Hilbert space structure. This question can be broken into two parts: whether there is a G-invariant Hermitian form, and whether this form is definite. We can therefore define

$$\Pi_h(G) = \text{equivalence classes of irreducible quasisimple Hermitian representations of } G,$$

and get inclusions

$$\Pi_u(G) \subset \Pi_h(G) \subset \Pi_q(G).$$

The `atlas` goal of understanding the irreducible unitary representations of a reductive algebraic Lie group G can now be divided into three steps:

- **describe $\Pi_q(G)$ (all representations);**
- **describe $\Pi_h(G)$ (hermitian representations) as a subset of $\Pi_q(G)$; and**
- **describe $\Pi_u(G)$ (unitary representations) as a subset of $\Pi_h(G)$.**

The first two steps of this program have been addressed by Langlands and by Knapp-Zuckerman; there is an excellent account in Knapp's book *Representation Theory of Semisimple Groups*. Here is an approximate statement.

"Theorem" 1 (Langlands, Knapp-Zuckerman). *Suppose G is a reductive algebraic Lie group. Then the set $\Pi_q(G)$ of equivalence classes of irreducible quasisimple representations of G is in natural bijection with a countable discrete collection of complex algebraic varieties $X_i(\mathbb{C})$. Each of these algebraic varieties is defined over $\mathbb{R}$, and the subset $\Pi_h(G)$ corresponds to the real points $X_i(\mathbb{R})$.*

Stated in this way, the "Theorem" is equally true for reductive algebraic groups over arbitrary local fields. The quotation marks correspond to some small and well-understood technical difficulties; for the experts, the magic words are "R-groups". Each subset $\Pi_u(G) \cap X_i(\mathbb{R})$ is defined by real algebraic inequalities; the difficulty is that we do not know a simple description of those inequalities.

Representations of Compact Lie Groups

What is the nature of the information provided by "Theorem" 1 above? The example of compact Lie groups (which is a special case!) is helpful. I will go into some detail about that classical theory, seeking to formulate results in a way that carries

over to general reductive algebraic Lie groups. An irreducible representation of a compact Lie group is automatically quasisimple, Hermitian, and unitary; so those distinctions will not appear at all.

Suppose K is a compact connected Lie group, and T is a maximal torus in K (a maximal connected abelian subgroup). Necessarily T is isomorphic to a product of ℓ circles, where ℓ is a nonnegative integer called the *rank* of K.

Any irreducible unitary representation of T must be one-dimensional. A one-dimensional unitary representation (of any topological group G) is a continuous homomorphism from G to the group $U(1)$ of 1×1 unitary matrices, which is again just the circle group. Any homomorphism from the circle to itself is given by raising to the mth power for some integer m. That is, $\Pi_u(\text{circle}) \simeq \mathbb{Z}$. Because T is a product of ℓ circles, it follows that $\Pi_u(T) \simeq \mathbb{Z}^\ell$. In a coordinate-free way, we say that $\Pi_u(T)$ is a lattice of rank ℓ.

The structure theory of compact Lie groups provides a finite collection $R^\vee(K,T)$ of nonzero $\mathbb{Z}$-linear maps $\alpha^\vee \colon \Pi_u(T) \to \mathbb{Z}$, called the *coroots of T in K*. The structure theory points also to certain natural subsets of the coroots, called *simple coroots*; we fix such a subset

$$S^\vee = \{\alpha_1^\vee, \dots \alpha_m^\vee\}. \qquad (A)$$

The simple coroots are linearly independent, so they define a nonempty cone

$$P = \{\mu \in \Pi_u(T) \mid \alpha^\vee(\mu) \geq 0 \quad (\alpha^\vee \in S^\vee)\}, \qquad (B)$$

called the *cone of dominant weights*.

It is a fundamental fact that everything about the structure of the compact Lie group K—and indeed of arbitrary reductive algebraic groups—is encoded by the lattice $\Pi_u(T)$ and the finite set of $\mathbb{Z}$-linear maps $S^\vee$. (To be precise, one needs also the simple roots $S \subset \Pi_u(T)$, introduced in (C) below.) In the hands of Chevalley and Grothendieck and others, this fact led to the theory of reductive groups over arbitrary fields (or even commutative rings). For the `atlas` project, it means that the structure of reductive groups can be described in terms of strings of integers and so is perfectly suited to exact computer calculation.

Theorem 2 (Cartan and Weyl). *Suppose K is a compact connected Lie group, and T is a maximal torus in K. Pick a set S of simple coroots for T in K as in (A) above, and define dominant weights P as in (B). Then there is a natural bijection between dominant weights and irreducible representations of K*

$$P \leftrightarrow \Pi_u(K).$$

In the language of the Langlands and Knapp-Zuckerman Theorem 1, P parametrizes the countable set of algebraic varieties X_i. Each X_i consists of a single point, so $X_i(\mathbb{C}) = X_i(\mathbb{R})$.

This theorem is very satisfactory as a parametrization of the irreducible representations of K, because the set P is very easy to compute and to manipulate. It is very unsatisfactory as a description of the irreducible representations, because it does not even explicitly describe the "natural bijection". In order to do that, we need a bit more structure theory. Attached to each coroot $\alpha^\vee$ there is a root $\alpha \in \Pi_u(T)$; the set of all roots is written

$$R(K,T) \subset \Pi_u(T).$$

The roots are by definition the nontrivial representations of T appearing in the "adjoint action" of T on the complexified Lie algebra of K. Corresponding to the simple coroots $S^\vee$ are simple roots

$$S = \{\alpha_1, \dots \alpha_m\} \subset R(K,T) \subset \Pi_u(T). \qquad (C)$$

Here is a description of the Cartan-Weyl bijection.

Theorem 3 (Cartan and Weyl). *In the setting of Theorem 2, an irreducible representation π of K corresponds to a dominant weight $\mu \in P$ if and only if the following conditions are satisfied: a) the weight μ appears in the restriction of π to T; and b) for every simple root $\alpha \in S$, the weight $\mu + \alpha$ does* not *appear in the restriction of π to T.*

Theorem 3 is in some sense a complete description of the irreducible representations of K, but it is still not completely satisfactory. It does not say how to calculate the dimension of a representation or its restriction to a compact subgroup of K. We will address those questions (and generalizations for noncompact groups) in the next section.

Character Tables for Lie Groups

Much of the content of the *Atlas of finite groups and representations* consists of character tables. In this section I'll recall what that means, how to extend the notion to Lie groups, and how it's possible to write character tables for reductive Lie groups in a finite form.

Suppose $\pi \colon G \to \mathrm{Aut}(V_\pi)$ is a representation of a topological group on a *finite-dimensional* complex vector space V_π. The *character of* π is a complex-valued function on G, defined by

$$\Theta_\pi(g) = \operatorname{tr} \pi(g).$$

It's very easy to see that Θ_π is a class function on G (that is, Θ_π is constant on conjugacy classes in G). What is not quite so obvious, but still elementary, is that *irreducible (finite-dimensional) representations having the same character are equivalent.*

In the case of a finite group G of order N, the eigenvalues of G are Nth roots of unity, so the values of characters of G are integer combinations of the N complex numbers $\exp(2\pi m i/N)$ (for m an integer between 0 and $N-1$). It is therefore possible to write a character of G precisely: for each conjugacy class in G, one can write the N integers that are the coefficients of these roots of unity. (Fortunately it is possible in practice to find far more compact representations of the

character values.) A *character table* for G is a list of all the character values of all the irreducible representations.

If G is a compact Lie group, the notion of character table still makes sense (since the irreducible representations are finite-dimensional). What is not so clear is whether it can be written down in a finite way. The values of each character Θ_π must be specified at each of the infinitely many conjugacy classes in G; and then this task must be repeated for each of the infinitely many π.

Hermann Weyl solved these problems. I'll write his solution completely in the simplest case and then say a few words about the general case.

Theorem 4 (Weyl). *Suppose*

$$G = \{a + bi + cj + dk \mid a^2 + b^2 + c^2 + d^2 = 1\}$$

is the group of unit quaternions, and

$$T = \{a + bi \mid a^2 + b^2 = 1\} = \{\exp(i\theta) \mid \theta \in \mathbb{R}\} \subset G$$

is a maximal torus. a) There is exactly one irreducible representation π_n of G for each strictly positive integer n. b) Every conjugacy class in G meets T, so a class function on G is determined by its restriction to T. c) The value of the character of π_n on T is $\Theta_{\pi_n}(\exp(i\theta)) = \sin(n\theta)/\sin(\theta)$.

We have in (c) an infinite character table presented in finite form. The infinitely many rows are indexed by n, and the infinitely many columns by θ (more precisely, by θ up to sign and addition of multiples of 2π).

In part (a) of the Theorem, one can think of the integer $n-1$ as corresponding to a one-dimensional representation of T, that is, to an element of $\Pi_u(T)$. A version of (a) for general compact Lie groups is provided by the Cartan-Weyl Theorem 2 in the last section. Part (b) makes sense as stated for a general compact connected Lie group and is true. The Weyl character formula for general G looks something like (c). There is a denominator (generalizing the function $\sin(\theta)$) that is a trigonometric polynomial on T, independent of the representation. The numerator (generalizing $\sin(n\theta)$) is a trigonometric polynomial built from the weight μ that parametrizes the representation.

For infinite-dimensional representations, the difficulties with character theory are more fundamental. The operators $\pi(g)$ are essentially never of trace class. Harish-Chandra understood that the character makes sense only after "regularization" in the sense of distribution theory. Each individual operator $\pi(g)$ does not have a trace: one first has to smooth the operator by averaging over a nice compact collection of values of g.

Here is how to do that. Recall that a *test density* on a smooth manifold M is a compactly supported complex-valued measure ξ on M, which in local coordinates is a smooth multiple of Lebesgue measure. A *generalized function* on M is a continuous linear functional on the space of test densities. Any continuous function f on M defines a generalized function by the formula

$$f(\xi) = \int_M f(m)d\xi(m).$$

The trace of a finite-dimensional representation of a Lie group G is a continuous function on G and therefore may be regarded as a generalized function. The following theorem of Harish-Chandra shows that the character of an irreducible quasisimple representation of a reductive algebraic Lie group G is a generalized function on G.

Theorem 5 (Harish-Chandra). *Suppose G is a reductive algebraic Lie group, π is an irreducible quasisimple representation of G on a Hilbert space, and ξ is a test density on G. The operator $\pi(\xi) = \int_G \pi(g)d\xi(g)$ is trace class, and defining $\Theta_\pi(\xi) = \operatorname{tr}\pi(\xi)$ makes Θ_π a generalized function on G.*

There is a conjugation-invariant open subset $G' \subset G$, whose complement has measure zero, so that the restriction of Θ_π to G' is a conjugation-invariant analytic function Θ'_π, locally integrable on G. The generalized function Θ_π is equal to integration against Θ'_π.

Writing a character table for the reductive algebraic Lie group G means writing down each of the functions Θ'_π, as π runs over the (infinite) family of irreducible quasisimple representations of G. The reason that each such function can be written down is that it turns out (just as in the case of compact groups) to be a quotient of finite integer combinations of exponential functions.

The possibility of handling infinitely many π is a consequence of the Jantzen-Zuckerman "translation principle". They partition all irreducible representations into finitely many *translation families.* In the formulas for the characters of representations in one translation family, only the exponential functions change: the coefficients in the formulas remain the same. In the case of a compact group, there is single translation family, with characters given by the Weyl character formula; all that varies with the representation are the exponents. For example, for the quaternion group described in Theorem 4, the parameter for the translation family is the integer n.

Here is a little more detail. The differential equations for the character Θ_π come from the center $\mathfrak{Z}$ of the universal enveloping algebra of the Lie algebra of G. They are eigenvalue equations; the eigenvalues are the complex scalars by which $\mathfrak{Z}$ acts in the representation π. (That $\mathfrak{Z}$ *does* act by scalars is exactly Harish-Chandra's definition of quasisimplicity.) The eigenvalues are encoded by an algebra homomorphism $\lambda\colon \mathfrak{Z} \to \mathbb{C}$ called the *infinitesimal character* of π.

After appropriate (very subtle!) changes of variables, the differential equations become (in local coordinates) systems of constant-coefficient

eigenvalue equations on $\mathbb{R}^n$. For each choice λ of eigenvalues, the solutions are finite linear combinations of exponential functions. Harish-Chandra was able to describe these solutions very explicitly and completely. (Much of the difficulty is understanding how solutions on different coordinate patches fit together.) For each choice of eigenvalues, he found an explicit basis

$$\Theta_1, \Theta_2, \ldots, \Theta_N \qquad (D)$$

for the global solutions of the differential equations. (It would be mathematically more precise but notationally more burdensome to write $\Theta_1^\lambda, \Theta_2^\lambda, \ldots, \Theta_{N(\lambda)}^\lambda$, indicating explicitly the fact that the equations being solved depend on the system λ of eigenvalues. I will choose the path of unburdened imprecision.) As a consequence, each irreducible character Θ_π has a unique expression

$$\Theta_\pi = \sum_{j=1}^{N} \overline{P}_{\pi,j}\Theta_j, \qquad (E)$$

for some complex numbers $\overline{P}_{\pi,j}$. (The reason for calling the coefficients $\overline{P}$ will emerge in the next section: the overline means the image in a quotient map, defined from polynomials to coefficients by evaluation at 1.) Writing down an irreducible character Θ_π is therefore equivalent to writing down the N complex numbers $\overline{P}_{\pi,j}$.

The last important fact is that the coefficients $\overline{P}_{\pi,j}$ are all *integers*. It is not quite clear to whom this observation should be attributed. At least with forty years of hindsight, it is easy to deduce from the work of Langlands and Knapp-Zuckerman on the classification of irreducible representations. Zuckerman may have been the first to recognize the existence and importance of character formulas (E) with integer coefficients. He wrote an explicit formula for the character of a finite-dimensional representation (ϕ, F) in his thesis; in that case the coefficients $\overline{P}_{\phi,j}$ are all ± 1 or zero.

How to Compute the Characters

Equation (E) above says that the character table for a real reductive Lie group G may be expressed as a matrix of integers $\overline{P}_{\pi,j}^\lambda$; here I have temporarily reinserted the dependence on the infinitesimal character λ. The index j runs over Harish-Chandra's solutions (D) to the differential equations (with fixed eigenvalues λ). The index π runs over irreducible representations of G (with fixed infinitesimal character λ).

The Jantzen-Zuckerman translation principle says (in a very explicit and computable way) that, as λ varies, there are only finitely many possibilities for $\overline{P}_{\pi,j}^\lambda$. Henceforth I will therefore drop the λ and speak only of computing one matrix $\overline{P}_{\pi,j}$. Thinking about this matrix is simplified by

Theorem 6 (Langlands and Knapp-Zuckerman). *There is a natural bijection between the set $\{\pi\}$ of irreducible representations of G and Harish-Chandra's solutions (D) to the differential equations for characters. Write π_i for the irreducible representation corresponding to the solution Θ_i. Then the (square) matrix $\overline{P}_{\pi_i,j}$ in (E) above is a lower triangular integer matrix with 1s on the diagonal.*

To say that the matrix is lower triangular requires an appropriate ordering of the solutions Θ_j. Harish-Chandra's construction of the solutions analyzes exponential terms of greatest possible growth at infinity on G. If we assume that the Θ_j are ordered so that the later ones have faster growth, then we get the lower triangularity. Another way to achieve it is explained after equation (F) below.

In this section I will say a bit about the mathematics underlying the computation of the matrix $\overline{P}_{\pi_i,j}$. The main tool is a geometric reinterpretation of the matrix introduced by Beilinson and Bernstein. It takes place in a smooth complex projective algebraic variety X (depending on the reductive group G) called the *complete flag variety* $X = X(G)$. One way to define X is as the variety of maximal solvable Lie subalgebras inside the complexified Lie algebra $\mathfrak{g}_{\mathbb{C}}$ of G.

The variety X is degenerate in some very interesting ways. Most algebraic varieties are not $\mathbb{P}^1$ bundles in any way. The variety X has a finite collection

$$\pi_s : X \to X_s \qquad (s \in S) \qquad (F)$$

of $\mathbb{P}^1$ fibrations. (That is, each π_s is a smooth submersion with fiber the Riemann sphere $\mathbb{CP}^1$.) The parametrizing set S is the set of simple roots introduced in (C) above.

In case G is $GL(n, \mathbb{R})$, the variety X may be identified with complete flags in $\mathbb{C}^n$: increasing chains of n linear subspaces F_j, with $\dim F_j = j$. There are $n-1$ $\mathbb{P}^1$ fibrations; for $1 \le j < n$, the jth fibration arises by throwing away the j-dimensional subspace F_j in a complete flag.

The ideas of Beilinson and Bernstein concern the equivariant geometry of X. One might expect that what ought to matter is the action of G on X. For technical reasons, however, what enters their work is equivariance with respect to $K(\mathbb{C})$, the complexification of a maximal compact subgroup $K \subset G$.

Theorem 7 (Beilinson and Bernstein) *Suppose G is a real reductive group with complete flag variety X, K is a maximal compact subgroup of G, and $K(\mathbb{C})$ is its complexification (an algebraic group acting on X).*

a) Harish-Chandra's solutions (D) to the differential equations are naturally in one-to-one correspondence with pairs $(Z_o, \mathcal{L})$ consisting of a $K(\mathbb{C})$ orbit Z_o on X and a $K(\mathbb{C})$-equivariant local system $\mathcal{L}$ on Z_o.

According to Theorem 6, exactly the same parameters index the irreducible representations of G.

b) Suppose π_i is an irreducible representation, corresponding to the pair $(Z_{i,o}, \mathcal{L}_i)$. Write Z_i for the closure of $Z_{i,o}$, a (possibly singular) algebraic subvariety of X. Suppose Θ_j is one of Harish-Chandra's solutions (D), corresponding to the pair $(Z_{j,o}, \mathcal{L}_j)$. Then the character formula coefficient $\overline{P}_{\pi_i,j}$ of (E) is equal to the Euler characteristic of the local intersection homology of Z_i with coefficients in the local system $\mathcal{L}_i$, evaluated at $(Z_{j,o}, \mathcal{L}_j)$.

Because Harish-Chandra solved systems of differential equations to get the Θ_j, and Beilinson and Bernstein work with derived categories of constructible sheaves, you may imagine that there is some work required to pass from what Beilinson and Bernstein proved to the statement of Theorem 7. This translation was one of my own contributions to the subject. The most difficult part was convincing some of the experts that the result was really not quite obvious.

Despite my promise at the beginning to be historically incomplete, I have been asked to interrupt the mathematics here to say a few words about the sources of the ideas in Theorem 7. Kazhdan and Lusztig in 1979 formulated a precise conjecture describing the characters of irreducible highest weight modules in terms of the combinatorics of the Weyl group. They observed that the first appearance in these characters of coefficients other than ± 1 can be empirically related to the first failures of local Poincaré duality for singular Schubert varieties. MacPherson suggested that their observations might be formalized using intersection homology. Kazhdan and Lusztig did this, proving that their combinatorial construction in the Weyl group actually calculated the intersection homology of Schubert varieties. This calculation is short but very deep, using the tools developed by Deligne to prove the Weil conjectures. It seems to have been an inspiration for the development by Beilinson, Bernstein, Deligne, and Gabber of the general theory of perverse sheaves, which has since become a basic tool in representation theory and algebraic geometry.

The Kazhdan-Lusztig conjectural character formula (still for highest weight modules) was now a statement involving intersection homology of Schubert varieties. In this form it was proved independently by Brylinski-Kashiwara and by Beilinson-Bernstein, using the algebraic theory of differential equations created by Sato, Kashiwara-Kawai, and Beilinson-Bernstein.

I will not try to describe "intersection homology" here. (The book *Introduction to Intersection Homology Theory* by Kirwan and Woolf is highly recommended by my colleagues who should know.) In order to understand the nature of the statement, what matters is that intersection homology is a topological invariant of the singular algebraic variety Z_i. It measures at the same time the nature of the singularity of Z_i (in the theorem, the singularity at points in $Z_{j,o}$) and the possibility of extending the local system $\mathcal{L}_i$ from the open subset $Z_{i,o}$ to all of Z_i.

As the term "Euler characteristic" suggests, intersection homology provides (for each i and j) not just a single integer but rather a finite collection of nonnegative integers p_{ij}^m, the ranks of individual local intersection homology groups. I will modify the indexing of the homology in order to arrange that the index m can run from 0 to the complex codimension of Z_j in Z_i. (One of the key properties of intersection homology is that the top degree can appear only if $Z_j = Z_i$.) A consequence of this reindexing is that the Euler characteristic of Theorem 7(b) is

$$(-1)^{\dim Z_i - \dim Z_j} \sum_m (-1)^m p_{ij}^m.$$

If Z_i is smooth and $\mathcal{L}_i$ is the trivial local system, then p_{ij}^m is equal to zero unless $m = 0$, Z_j is contained in Z_i, and the local system $\mathcal{L}_j$ is also trivial; in that case p_{ij}^0 is equal to 1.

The *Kazhdan-Lusztig polynomial* for the pair (i, j) is by definition

$$P_{i,j}(q) = \sum_m p_{ij}^m q^{m/2}.$$

The parameters i and j represent local systems on orbits of $K(\mathbb{C})$ on the complete flag variety X. The polynomial can be nonzero only if the orbit $Z_{j,o}$ is contained in the closure of the orbit $Z_{i,o}$; this explains the "lower triangular" result in Theorem 6. It turns out that the local groups vanish in odd degrees, so that $P_{i,j}$ is actually a polynomial in q (with nonnegative integer coefficients). (This is a special fact about the varieties Z_i, not a general fact about intersection homology.) The degree of $P_{i,j}$ is bounded by half the complex codimension of Z_j in Z_i; the bound is strict if $i \neq j$. (This is a general fact about intersection homology.) Because of the vanishing in odd degrees, the Euler characteristic is just the (nonnegative) value at $q = 1$, times the sign $(-1)^{\dim Z_i - \dim Z_j}$.

The point of Theorem 7 is that characters can be computed from Kazhdan-Lusztig polynomials and that these polynomials depend on the geometry of $K(\mathbb{C})$ orbit closures on the complete flag variety X. The next theorem describes the geometric tools needed to compute intersection homology for these orbit closures.

Theorem 8 (Wolf). *Suppose G is a real reductive group with complete flag variety X, K is a maximal compact subgroup of G, and $K(\mathbb{C})$ is its complexification (an algebraic group acting on X).*

a) The action of $K(\mathbb{C})$ on X has finitely many orbits.

Suppose Z_o is an orbit of $K(\mathbb{C})$ on X, and $s \in S$. Write Z for the closure of Z_o (a projective algebraic subvariety of X). Define $Z_s = \pi_s(Z)$ (cf. (F) above), a projective algebraic subvariety of X_s, which we call the s-flattening of Z. Define $Z^s = \pi_s^{-1}(Z_s)$, which we call the s-thickening of Z. The map π_s exhibits Z^s as a $\mathbb{P}^1$ bundle over Z_s.

b) The s-thickening Z^s is the closure of a unique $K(\mathbb{C})$ orbit Z_o^s.

c) There are two mutually exclusive possibilities. 1) The s-thickening Z^s is equal to Z, so that Z is a $\mathbb{P}^1$ bundle over Z_s. In this case $Z_o^s = Z_o$. 2) The map π_s from Z to Z_s is generically finite (and in particular is finite over the orbit Z_o). In this case $\dim Z_o^s = \dim Z_o + 1$; and $Z_s = (Z^s)_s$. In particular, the thickened orbit Z_o^s falls in case (1).

d) Every orbit of $K(\mathbb{C})$ on X arises by a finite succession of thickening operations applied to some closed orbit.

Part (a) of this theorem is due to Wolf. The remaining assertions are quite easy, although it is more difficult (for me at least) to attribute them precisely. The idea of constructing and describing the orbits in this way has its roots in the theory of Schubert varieties and so is very old.

Theorem 8 describes the geometry of orbit closures and so leads to Kazhdan and Lusztig's algorithm for computing intersection homology by induction on the dimension. Here is a sketch. An orbit of minimal dimension is closed and is itself a complete flag variety for the algebraic group $K(\mathbb{C})$. Such varieties are smooth, so the local intersection cohomology is simple. According to part (d), any orbit W_o of greater than minimal dimension must arise by thickening: $W_o = Z_o^s$, with Z_o an orbit of dimension one less. Now the orbit closure Z is a ramified cover of the flattening Z_s (according to (c)(2)); so the intersection homology of Z_s is very close to that of Z, which is known by induction. Finally the orbit closure W is a $\mathbb{P}^1$ bundle over $W_s = Z_s$; so the intersection homology of W is made in a simple way from that of the flattened variety Z_s.

Making this sketch precise uses versions of the Weil conjectures for intersection homology, proved by Beilinson, Bernstein, and Deligne. The most subtle point is descent from Z to Z_s by the ramified covering map π_s. What happens there is that the intersection homology down on the flattening Z_s arises from that on the covering Z by removing something. Exactly what should be removed is determined by certain highest degree intersection homology of Z; that is, by top degree coefficients in Kazhdan-Lusztig polynomials.

In the setting of Kazhdan and Lusztig's original work, the orbits Z_o are simply connected, so the local systems involved are all trivial. For general real groups the orbits have fundamental groups of size up to $(\mathbb{Z}/2\mathbb{Z})^{\text{rank}}$ and therefore a wealth of local systems. Keeping track of these local systems under the maps π_s is subtle and was another of my contributions to this mathematics. (One ends up in some cases with inductive formulas not for individual Kazhdan-Lusztig polynomials, but for sums of two polynomials, corresponding to two local systems. Part of the difficulty is to find a way to solve the resulting collection of equations.)

A critical point is that the algorithm needs to know the highest degree coefficients and not just the values of the polynomials at $q = 1$. Even though we are interested (for character theory) only in values of the polynomials at 1, the algorithm does not allow us to *compute* only values at 1.

Once the algorithm has forced us to look at coefficients of the Kazhdan-Lusztig polynomials, it is very natural to ask for representation-theoretic interpretations of those coefficients. There is a great deal to say on this subject. I will mention only that the top degree coefficients mentioned above turn out to be dimensions of Ext^1 groups between irreducible representations.

The Atlas of Lie Groups and Representations

That brings the mathematical story up to about 1985. I'll now turn away from abstract mathematics, toward the story of the `atlas` project.

In 2002, Jeff Adams had the idea of getting computers to make interesting calculations about infinite-dimensional representations of reductive Lie groups: ultimately, he hoped, to calculate unitary representations. Of course as mathematicians we want completely general theorems, and it's by no means clear that there is a finite calculation to find the unitary duals of all reductive groups at once. But the work of Dan Barbasch (for example, his classification of the unitary duals of the complex classical groups) makes it possible to hope that one *can* find a finite description of the unitary duals of all classical Lie groups. The exceptional groups are finite in number, so treating them *is* a finite calculation. That became Jeff's standard for measuring the effectiveness of any piece of representation-theoretic software: could it treat the largest exceptional group E_8?

It was clear that the first problem was to write a program that could work with the Cartan subgroups, maximal compact subgroups, and Weyl groups of any real reductive group. Jeff recruited Fokko du Cloux to do this, and Fokko began to work in 2003. By 2004 his software could handle this structure theory (better than most mathematicians, at least).

The next step was less obvious, but Fokko and Jeff settled on computing Kazhdan-Lusztig polynomials for real groups. Fokko had written the best software in the world to do this for Coxeter groups; the algorithms for real groups are similar

in structure (although much more complicated in detail, because of the complications attached to local systems). Theorem 7 above says that knowing these polynomials provides formulas for irreducible characters; it is also a critical step in several computational approaches to classifying unitary representations.

So late in 2004, Fokko began to add to his software an implementation of the Kazhdan-Lusztig algorithm for real groups. The papers in which this algorithm is formulated are extremely dense, and written with no consideration for computational practice. An expert could easily spend many months just to understand the mathematical statements. Fortunately, Jeff Adams had been working on a new formulation of Theorem 6 (parametrizing irreducible representations), growing out of earlier work that he did with Dan Barbasch and me. Jeff's formulation seemed suited to computer implementation; he had been working with Fokko to make it more so.

Over the course of the next year, Fokko understood the Kazhdan-Lusztig algorithm for real groups, recasting it in the language that he and Jeff had developed. He wrote clear and efficient code to implement it. In November of 2005—incredibly soon!—he finished. Very quickly he and Jeff used the software to compute Kazhdan-Lusztig polynomials (and so character tables) for all of the real forms of F_4, E_6, and E_7, and for the non-split form of E_8.

The most complicated of these calculations is for the non-split form of E_8. There are 73,410 distinct (translation families of) irreducible representations, so the character table is a $73,410 \times 73,410$ matrix of integers. The integers are values at $q = 1$ of Kazhdan-Lusztig polynomials. These polynomials have degrees from 0 to 27. Their coefficients are nonnegative integers, of which the largest is 2545. The total number of distinct polynomials appearing (among the three billion or so entries below the diagonal in the matrix) is 10,147,581. Here is the polynomial with largest coefficient:

$$\begin{gathered} q^{13} + 30q^{12} + 190q^{11} \\ +682q^{10} + 1547q^9 + 2364q^8 \\ +2545q^7 + 2031q^6 + 1237q^5 \\ +585q^4 + 216q^3 + 60q^2 + 11q + 1 \end{gathered}$$

It's hard to say what constitutes a "typical" polynomial, but here is the one at the midpoint of the lexicographically ordered list:

$$\begin{gathered} q^9 + 7q^8 + 13q^7 + 6q^6 + 6q^5 \\ +14q^4 + 18q^3 + 16q^2 + 7q + 1. \end{gathered}$$

Fokko's software will calculate this character table on my laptop in about half an hour, using 1500 megabytes of RAM. (I bought a big memory chip at about the same time as I sold my soul to the silicon devil.)

Among the exceptional groups, that left the split form of E_8.

Warming Up for E_8

How big a computation is the character table for split E_8? Fokko's software told us that there were exactly 453,060 (translation families of) irreducible representations. According to Theorem 6 above, the character table can be described by a square matrix of integers, of size 453,060. The number of entries is therefore about 2×10^{11}, or 200 billion.

Fortunately the matrix is lower triangular, so we only need 100 billion entries.

Unfortunately we need to calculate not the entries directly, but rather the Kazhdan-Lusztig polynomials whose values at 1 are the entries. The degrees of the polynomials are bounded by 31; we expected an average degree of about 20, and therefore a total number of coefficients around 2 trillion.

Fortunately many of the matrix entries are easily seen to be equal. An example is Zuckerman's formula for the character of a finite-dimensional representation, where I said that all the coefficients are ± 1 or 0; this is the last row of the character matrix. In the case of E_8, there are 320,206 nonzero terms in this row. Fokko's software recognizes that all 320,206 of those Kazhdan-Lusztig polynomials are going to be equal and stores only the diagonal entry 1. In general one needs to store only one representative polynomial for each family of "obviously equal" entries. Fokko's software calculated how many such families there were: a bit more than 6 billion. So we were down to storing about 6 billion polynomials with about 120 billion coefficients.

Unfortunately we had no clear idea how big the (nonnegative integer) coefficients of these polynomials could be. In the case of split D_5, the largest is 5. For split E_6, the largest is 27, and for split E_7, it's 3583. This trend was not encouraging; it seemed clear that the coefficients would exceed $65,535 = 2^{16} - 1$, so that they could not be stored in two bytes (sixteen bits) of computer memory. The next practical size is four bytes.

Fortunately Fokko wrote the software to compute with four-byte integers and to test carefully for numeric overflow throughout the computation. If overflow happened, the plan was to switch to eight-byte integers and try again.

Unfortunately, 120 billion 4-byte integers require 480 billion bytes of RAM, or 480G. That's a lot of RAM. (The nature of the Kazhdan-Lusztig algorithm, which constantly looks at widely distributed results from earlier in the computation, makes storing results on disk impractically slow. We tried!)

Fortunately, some of the six billion polynomials are zero, and some of them are equal to others "by chance" (that is, for reasons that we have yet

to understand). So Fokko wrote the software to store only one copy of each distinct polynomial. He hoped that the number of distinct polynomials might be a few hundred million: so perhaps 6 billion coefficients, requiring 25G of RAM. The indexes keeping track of all these polynomials would also occupy a lot of memory: by the most optimistic estimates perhaps 45G, but quite possibly a lot more.

Unfortunately, we didn't have a computer with even 50G of RAM.

Fortunately computer science is often computer art, and even Fokko's work could be improved. Fokko worked on that constantly during 2006, and Marc van Leeuwen began to make serious contributions as well. The two of them rearranged the indexes and the code in some extraordinarily clever ways.

Unfortunately, tests running partway through the E_8 calculation (done mostly by Birne Binegar) revealed that Fokko's first hopes about the number of distinct polynomials were too optimistic. Even an optimistic reading of Birne's tests suggested more like 800 million distinct polynomials, meaning perhaps 60G or more to hold the coefficients.

Fortunately Dan Barbasch is now chair of the math department at Cornell, and in September of 2006 he managed to gain access to a machine with 128G of RAM and 128G of swap space. He used it to run the E_8 computation to the end. The fact that Fokko's overflow tests were not set off showed that all the coefficients really fit in four bytes.

Unfortunately he had no reasonable way to write the results to disk, so they disappeared. (Fokko's software was written to produce output in human-readable form. In the case of E_8, his output for the character table would have consisted of about fifty billion lines (one for each nonzero entry in the character table) averaging about 80 characters. As a disk file this would have been several terabytes.) Also unfortunately, Dan didn't have the improvements that Fokko and Marc had made to the code: Dan's computation used 224G of memory (half of it swap space). Because of the use of swap space, it took twelve days to finish.

Fortunately, by November of 2006, Fokko and Marc had trimmed memory use in the code a great deal. Through the persistence of Birne Binegar, and the generosity of number theorist William Stein, the `atlas` group got access to William Stein's computer `sage` at the University of Washington (with 64G of RAM and 75G of swap). On this machine we could finally do some large fraction of the E_8 character table computation. By late November, we believed that we could finish E_8 with about 150G of RAM.

Unfortunately, 150G is just a little more than `sage` has, even with swap.

(Not) Buying a Really Big Computer

Birne Binegar and Jeff Adams suggested that we start looking seriously at applying for an NSF grant to buy a machine with perhaps 256G of RAM: something that might cost US$150,000 or more. I asked a number of mathematicians whether they might be able to make use of such a computer.

Noam Elkies had a fascinating reply. First he explained some theoretical limits on the computations that could use a lot of memory.

> A computation that actually uses N bytes of storage must take time *at least* N. But once N gets as large as 256GB it might not be feasible to spend much *more* than N time: $N \cdot \log(N)$ or $N \cdot \log^2(N)$ is certainly OK (e.g., fast integer or polynomial arithmetic, and other applications of the Fast Fourier Transform; also solving $f(x) = f(x')$ by sorting N values of $f(x)$ and finding a consecutive match); maybe also $N^{3/2}$ (e.g., linear algebra with dense matrices of size $N^{1/2}$, or computing the first N coefficients of modular forms such as Δ without fast arithmetic); probably not N^2. So there might not be all that much room for making use of such a huge machine…

He went on to ask

> Is it clear that the E_8 computation cannot fit into "only" 128 or 64GB?

I explained the demands of polynomial storage:

> We know that the polynomial coefficients can exceed 2^{16} (by computation), and we hope that they don't exceed 2^{32}. Each polynomial is stored as a vector of 32-bit integers, of size exactly equal to its degree plus one. Assuming an average degree of 19, that's 80 bytes per polynomial.

On November 30, Noam replied

> Well 2^{32} is less than the product of the ten odd primes less than 2^5, so unless the computation requires divisions by numbers other than 2 you could reduce this from 80 bytes to something like $(5/32) \cdot 80 = 12.5$ bytes, at the cost of running the computation 9 times (counting once for mod $3 \cdot 5$).

In other words, we needed to stop thinking about intersection cohomology for a while and use the Chinese Remainder Theorem. Noam's suggestion was to compute the Kazhdan-Lusztig polynomials modulo m for several small values of m and to store the results to disk. A second program

could (for each polynomial) read in these several mod m reductions; apply the Chinese Remainder Theorem to compute the polynomial modulo the least common multiple of all the moduli; and write the result to disk. This second program would need to have only a handful of polynomials in RAM at the same time, so it could run on a much smaller computer.

I started to compose a reply explaining why modular reduction of the Kazhdan-Lusztig algorithm doesn't work, but I had to throw it away: the algorithm works perfectly over $\mathbb{Z}/m\mathbb{Z}$. Fokko's code was beautifully compartmentalized, and Marc van Leeuwen is amazing, so by December 4 we were getting character table entries mod m for any m up to 256. In these calculations, we needed just one byte of memory for each polynomial coefficient. A billion polynomials of degree 20 could live in 20G of RAM.

Computing Characters Mod m

On December 6 Marc's modifications of Fokko's code on `sage` computed about three-fourths of the entries in the E_8 character table mod 251, finding almost 700 million distinct polynomials and using 108G of memory. Since 90% of that was indexes, working on their structure became worthwhile. Marc redesigned the indexes rather completely (replacing 8-byte pointers by 4-byte counters several billion times, for example). In the end he reduced the size of the indexes to about 35G; they would have required more than 100G for the original code. He also added code to output the answers to (small machine-readable) disk files.

Meanwhile Birne Binegar ran various versions of the code on `sage`. Among other things he established for certain that there were more than one billion distinct polynomials.

Early on December 19, Marc's modified code began a computation for E_8 mod 251, with the possibility of actually writing the result usefully at the end. Essentially it worked, finishing the computation in about 17 hours. From diagnostic output of the software, we learned that there were exactly 1,181,642,979 distinct Kazhdan-Lusztig polynomials mod 251. (That turned out to be the number over $\mathbb{Z}$ as well.) The calculation used only 65G of memory; the improvement over 108G on December 6 was because of Marc's redesigned indexing system.

But writing the answer to disk took two days. Marc and I went over Marc's output code to see why. We figured it out, and Marc improved the speed. But we found at the same time a bug: he wrote `size()` in one line where he meant `capacity()`. The result was that, even though the polynomials were all correctly written to disk, the index files (explaining which polynomial was stored where) were missing something like half their contents.

Marc fixed things instantly, and on Thursday evening December 21 we started a calculation mod 256 on `sage`. This computed 452,174 out of 453,060 rows of the character table in 14 hours, then `sage` crashed. We tried again starting late Friday afternoon, and actually finished with good output: the character table mod 256 was written to disk! Because we used multi-threading to speed up the computation, this run took just eleven hours.

On Saturday December 23 we started a calculation mod 255. This time `sage` crashed a third of the way through the computation. There was no one physically present to reboot it (apparently some kind of holiday in Seattle) so we retired for a bit (still having mod 256 as our only good output files).

Meanwhile Marc van Leeuwen had written code to combine Kazhdan-Lusztig polynomials from several moduli $m1, m2, \ldots$ into Kazhdan-Lusztig polynomials modulo $\mathrm{lcm}(m1, m2, \ldots)$. We tested the code on the first hundred million entries of the E_8 character table modulo 253, 255, and 256 (which we could calculate on smaller computers than `sage`), and it worked fine. When `sage` came back up on December 26, we got a character table mod 255 written to disk. At 1 a.m. on December 27, we started a run mod 253. About halfway through, `sage` crashed.

The experts I consulted assured me that the `atlas` software couldn't possibly be crashing `sage`. My own opinions about the causes of the crashes wavered between black helicopters from the NSA and Sasquatch. We resolved to keep our hands off `sage` until we were older and wiser: say for a year.

On Wednesday January 3 we were all one year older, which made perhaps thirty years of additional wisdom counting all the `atlas` people. This factor of thirty seemed like a suitable margin of safety, so that afternoon we started another computation mod 253. This finished in twelve hours.

The Chinese Remainder Calculation

By 4 a.m. Thursday January 4th we had output for three moduli (253, 255, and 256) with least common multiple 16,515,840: bigger (we had some hope) than all the coefficients of the Kazhdan-Lusztig polynomials. Marc van Leeuwen took unfair advantage of the time difference in Europe to start running his Chinese Remainder Theorem utility on the results. Its first task was to correlate the indices of the three output files, to determine which (of 1.1 billion) polynomials mod 253 corresponded to which mod 255. That finished in nine hours.

At that point we encountered another speed problem. The first version of Marc's software had a counter displaying the number of the polynomial to which the Chinese Remainder Theorem was being applied, to allow for monitoring progress.

Since there are more than a billion polynomials, this meant writing several billion characters to the display. It turns out that takes a (very) long time. So we started over on Friday morning January 5, with a counter that updates only every 4096 polynomials. Everything went nicely until `sage` crashed.

William Stein identified `sage`'s problem as a flaky hard drive. The situation for `atlas` was this: sitting on `sage`'s flaky hard drive were 100 gigabytes of output files, the Kazhdan-Lusztig polynomials modulo 253, 255, and 256 for E_8. Each of these files represented something like twelve hours of (multi-threaded) computation; the hundreds of hours of *unsuccessful* computations made them feel a great deal more valuable.

William Stein replaced the bad hard drive with a good one, on which he had made daily backups of all the work on `sage`. He did this more or less instantly: we still had our data files. I was already deeply indebted to his generosity in allowing the `atlas` group access to `sage`, but this raised him even higher in my esteem.

We restarted the Chinese Remainder calculation late Friday afternoon January 5.

Early Saturday morning, the disk file of polynomial coefficients mod 16515840 had grown to be about 7 billion bytes larger than it was supposed to be. Since it was a day with a *y* in it, I assumed that Marc van Leeuwen would be working. I asked him to find out what was wrong. He was visiting his family in the Netherlands for the weekend and had extremely limited access to the Internet.

The bug was (to my eyes) unbelievably subtle. Since the number of polynomials is about a billion, Marc's code represented the index of a polynomial by a 4-byte integer (perfectly good up to 4,294,967,295). At some point this integer needs to be multiplied by 5 (the number of bytes in the index entry for one polynomial); the result is put into an 8-byte integer, where it fits nicely. But when the polynomial number exceeds 858,993,459, and the multiplication is done in four bytes, it overflows. The result was that the code worked perfectly in any reasonable test (like the one we ran with a hundred million polynomials).

To complicate Marc's task further, the bug was not present in his most recent version of the code; what I was running on `sage` was a couple of days older.

So he was looking for a subtle bug that wasn't there, without Internet access to the machine where the problem occurred. It took him almost twenty hours to find and fix it (here of course I assume that he neither slept nor ate nor spoke to his family).

Marc's analysis showed that the bug came into play only around polynomial number 858 million; so all the coefficients (modulo 16,515,840) calculated before that were correct. The largest of these coefficients was 11,808,808, at polynomial number 818,553,156. (That is the polynomial displayed at the beginning of this article.) I was convinced that we'd find larger coefficients among the 350 million polynomials that were not correctly evaluated the first time and that we'd need a larger modulus than 16,515,840 to get them all.

So at 6 a.m. on Sunday January 7th I was able to restart Marc's current (and correct) Chinese Remainder Theorem utility, this time adding modulus 251. Of course nothing went wrong (because what could go wrong?), and the last polynomial was written to disk just before 9 a.m. Eastern time on Monday January 8.

What Next?

Sixty gigabytes is too much information to look at, even for nineteen mathematicians working in seamless harmony.[1] Here are some of the "clean and simple results" that I promised in the introduction. Attached to any representation are many beautiful geometric invariants. Knowledge of the character table allows us to compute some of them. We have computed the *Gelfand-Kirillov dimension* of each irreducible representation of E_8. This is an integer between 0 and 120 that measures how infinite-dimensional the representation is. Finite-dimensional representations are those of GK dimension 0, and *generic* representations (in a technical sense coming from the theory of automorphic forms) are those of GK dimension 120. The finite-dimensional representations were identified by Cartan and Weyl (Theorem 2 above) around 1930, and the generic representations by Kostant in 1978 (in both cases for all real reductive groups).

Now we can say for E_8 exactly what happens between these extremes. For instance, of the 453,060 (translation families of) representations we studied, there are exactly 392 of GK dimension 57. We can say which ones they are. (I chose 57 because it's the smallest possible dimension of a nontrivial homogeneous space Z_{57} for E_8. These 392 families of representations appear in sections of vector bundles over Z_{57}.) In the same way we can identify James Arthur's *special unipotent representations*, which conjecturally play a fundamental role in the theory of automorphic forms. There are 111 of these among the 453,060 representations.

In the longer term, our goal is to determine completely the unitary irreducible representations for the exceptional Lie groups. Our hope is that knowledge of the character table will allow us to make a computation of these unitary representations. Armed with a list of unitary representations, we can try to explain (most of) it using the Kirillov-Kostant orbit method, or Langlands' ideas about

[1] *This is a theoretical assertion. I have no practical experience with a team of nineteen mathematicians working in seamless harmony.*

functoriality, or perhaps even something entirely new.

Despite the length of this article, I have left out a great deal. I have said nothing about the meetings of the `atlas` group, where the insights of all of the mathematicians involved contributed to the shape of the software that Fokko was writing, and to our evolving understanding of the mathematics beneath it.

The greatest omission is the personal story of Fokko du Cloux. He was diagnosed with ALS (a progressive neurological disease) just after finishing the Kazhdan-Lusztig computation software in November of 2005. By February 2006 he had little use of his hands, and by May he was entirely paralyzed below his neck. But he continued to share his skills and insights into the mathematics and the programming—and his great joy at meeting a formidable mathematical challenge—with Jeff Adams and with Marc van Leeuwen and with me, until his death on November 10, 2006.

The `atlas` has introduced me to great mathematicians I barely knew, like Marc van Leeuwen and John Stembridge, and it has shown entirely new depths in people I knew well, like Jeff Adams and Dan Barbasch. So it's a very high bar…but what has been best of all, mathematically and personally, has been spending time with Fokko. It's *still* the best: every minute I spend on this project is a chance to think about him, and that's always good for a smile.

So thank you to Fokko, who did this all by himself.

Thank you to everyone who helped him—Marc van Leeuwen did more of that than anybody, but there were a lot of indispensable people.

I haven't had a *boss* since I worked in a lumberyard in the summer of 1972, until Jeff Adams. Thank you, boss!

I hope to be back here when we have some unitary representations to share.

Members of the Atlas of Lie Groups and Representations

Jeffrey Adams
Dan Barbasch
Birne Binegar
Bill Casselman
Dan Ciubotaru
Fokko du Cloux
Scott Crofts
Tatiana Howard
Marc van Leeuwen
Alfred Noel
Alessandra Pantano
Annegret Paul
Siddhartha Sahi
Susana Salamanca
John Stembridge
Peter Trapa
David Vogan
Wai-Ling Yee
Jiu-Kang Yu

We are very grateful to Brian Conrey and the American Institute of Mathematics, which provided financial support and a wonderful mathematical meeting place from the beginning of the `atlas` project; and to the National Science Foundation, which has provided support through FRG grant 0554278.

—D.V.

Paul Halmos: In His Own Words

John Ewing

Paul Halmos died on October 2, 2006, at the age of 90. After his death, many people wrote about his career and praised both his mathematical and his expository skills. Paul would have complained about that: He often said he could smell great mathematicians, and he himself was not one of them.

But he was wrong. He was a master of mathematics in multiple ways, and he influenced mathematicians and mathematical culture throughout his career. Unlike most other master mathematicians, Paul's legacy was not merely mathematics but rather advice and opinion about mathematical life—writing, publishing, speaking, research, or even thinking about mathematics. Paul wrote about each of these topics with an extraordinary mixture of conviction and humility. Mathematicians paid attention to what he wrote, and they often quoted it (and still do—"every talk ought to have one proof"). They disagreed and frequently wrote rebuttals. They passed along his wisdom to their students, who passed it along to theirs. Paul Halmos's writing affected the professional lives of nearly every mathematician in the latter half of the twentieth century, and it will continue to influence the profession for years to come.

How does one write about great writing? Explanations of great exposition always fall flat, like analyses of great poems or elucidations of famous paintings. Art is best exhibited, not explained.

And so here is a collection of excerpts from the writing of Paul Halmos, giving advice, offering opinions, or merely contemplating life as a mathematician—all in his own words.

—*J. E.*

On Writing

Excerpts from:

"How to write mathematics", *Enseign. Math.* (2) 16 (1970), 123–152.

…I think I can tell someone how to write, but I can't think who would want to listen. The ability to communicate effectively, the power to be intelligible, is congenital, I believe, or, in any event, it is so early acquired that by the time someone reads my wisdom on the subject he is likely to be invariant under it. To understand a syllogism is not something you can learn; you are either born with the ability or you are not. In the same way, effective exposition is not a teachable art; some can do it and some cannot. There is no usable recipe for good writing.

Then why go on? A small reason is the hope that what I said isn't quite right; and, anyway, I'd like a chance to try to do what perhaps cannot be done. A more practical reason is that in the other arts that require innate talent, even the gifted ones who are born with it are not usually born with full knowledge of all the tricks of the trade. A few essays such as this may serve to "remind" (in the sense of Plato) the ones who want to be and are destined to be the expositors of the future of the techniques found useful by the expositors of the past.

The basic problem in writing mathematics is the same as in writing biology, writing a novel, or writing directions for assembling a harpsichord: the problem is to communicate an idea. To do so, and to do it clearly, you must have something to say, and you must have someone to say it to, you must organize what you want to say, and you must arrange it in the order you want it said in, you must write it, rewrite it, and re-rewrite it several times, and you must be willing to think hard about and work hard on mechanical details such as diction, notation, and punctuation. That's all there is to it.…

It might seem unnecessary to insist that in order to say something well you must have something to say, but it's no joke. Much bad writing, mathematical and otherwise, is caused by a violation of that first principle. Just as there are two ways for a sequence not to have a limit (no cluster points or

This article was prepared and edited by John Ewing, executive director of the AMS. His email address is `jhe@ams.org`.

too many), there are two ways for a piece of writing not to have a subject (no ideas or too many).

The first disease is the harder one to catch. It is hard to write many words about nothing, especially in mathematics, but it can be done, and the result is bound to be hard to read. There is a classic crank book by Carl Theodore Heisel [*The Circle Squared Beyond Refutation*, Heisel, Cleveland, 1934] that serves as an example. It is full of correctly spelled words strung together in grammatical sentences, but after three decades of looking at it every now and then I still cannot read two consecutive pages and make a one-paragraph abstract of what they say; the reason is, I think, that they don't say anything.

The second disease is very common: there are many books that violate the principle of having something to say by trying to say too many things. …

The second principle of good writing is to write for someone. When you decide to write something, ask yourself who it is that you want to reach. Are you writing a diary note to be read by yourself only, a letter to a friend, a research announcement for specialists, or a textbook for undergraduates? The problems are much the same in any case; what varies is the amount of motivation you need to put in, the extent of informality you may allow yourself, the fussiness of the detail that is necessary, and the number of times things have to be repeated. All writing is influenced by the audience, but, given the audience, the author's problem is to communicate with it as best he can.…

Everything I've said so far has to do with writing in the large, global sense; it is time to turn to the local aspects of the subject.

The English language can be a beautiful and powerful instrument for interesting, clear, and completely precise information, and I have faith that the same is true for French or Japanese or Russian. It is just as important for an expositor to familiarize himself with that instrument as for a surgeon to know his tools. Euclid can be explained in bad grammar and bad diction, and a vermiform appendix can be removed with a rusty pocket knife, but the victim, even if he is unconscious of the reason for his discomfort, would surely prefer better treatment than that.…

My advice about the use of words can be summed up as follows. (1) Avoid technical terms, and especially the creation of new ones, whenever possible. (2) Think hard about the new ones that you must create; consult Roget; and make them as appropriate as possible. (3) Use the old ones correctly and consistently, but with a minimum of obtrusive pedantry.…

Everything said about words, applies, mutatis mutandis, to the even smaller units of mathematical writing, the mathematical symbols. The best notation is no notation; whenever possible to avoid the use of a complicated alphabetic apparatus, avoid it. A good attitude to the preparation of written mathematical exposition is to pretend that it is spoken. Pretend that you are explaining the subject to a friend on a long walk in the woods, with no paper available; fall back on symbolism only when it is really necessary.

On Speaking

Excerpts from:

"How to talk mathematics", *Notices of AMS* 21 (1974), 155–158.

What is the purpose of a public lecture? Answer: to attract and to inform. We like what we do, and we should like for others to like it too; and we believe that the subject's intrinsic qualities are good enough so that anyone who knows what they are cannot help being attracted to them. Hence, better answer: the purpose of a public lecture is to inform, but to do so in a manner that makes it possible for the audience to absorb the information. An attractive presentation with no content is worthless, to be sure, but a lump of indigestible information is worth no more.…

Less is more, said the great architect Mies van der Rohe, and if all lecturers remember that adage, all audiences would be both wiser and happier.

Have you ever disliked a lecture because it was too elementary? I am sure that there *are* people who would answer yes to that question, but not many. Every time I have asked the question, the person who answered said no, and then looked a little surprised at hearing the answer. A public lecture should be simple and elementary; it should not be complicated and technical. If you believe and can act on this injunction ("be simple"), you can stop reading here; the rest of what I have to say is, in comparison, just a matter of minor detail.

To begin a public lecture to 500 people with "Consider a sheaf of germs of holomorphic functions…" (I have heard it happen) loses people and antagonizes them. If you mention the Künneth formula, it does no harm to say that, at least as far as Betti numbers go, it is just what happens when you multiply polynomials. If you mention functors, say that a typical example is the formation of the duals of vector spaces and the adjoints of linear transformations.

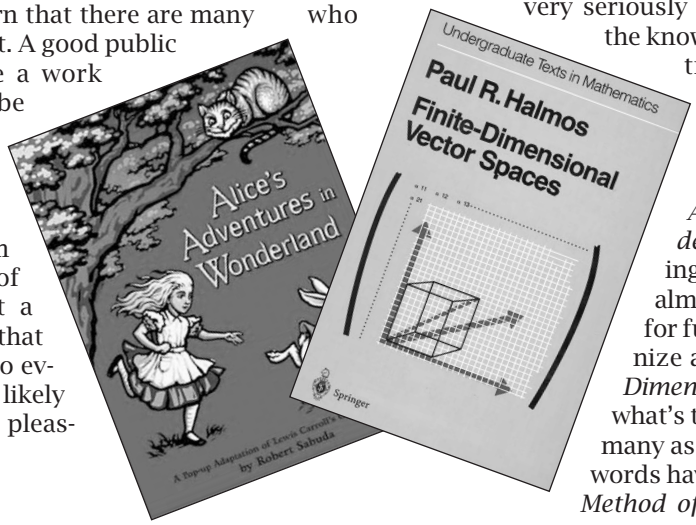
Be simple by being concrete. Listeners are prepared to accept unstated (but hinted) generalizations much more than they are able, on the spur of the moment, to decode a precisely stated abstraction and to re-invent the special cases that motivated it in the first place. Caution: being concrete should not lead to concentrating on the trees and missing the woods. In many parts of mathematics a generalization is simpler and more incisive than its special parent. (Examples: Artin's solution of Hilbert's 17th problem about definite forms via formally real fields; Gelfand's proof of

Wiener's theorem about absolutely convergent Fourier series via Banach algebras.) In such cases there is always a concrete special case that is simpler than the seminal one and that illustrates the generalization with less fuss; the lecturer who knows his subject will explain the complicated special case, and the generalization, by discussing the simple cousin.

Some lecturers defend complications and technicalities by saying that that's what *their* subject is like, and there is nothing they can do about it. I am skeptical, and I am willing to go so far as to say that such statements indicate incomplete understanding of the subject and of its place in mathematics. Every subject, and even every small part of a subject, if it is identifiable, if it is big enough to give an hour talk on, has its simple aspects, and they, the simple aspects, the roots of the subject, the connections with more widely known and older parts of mathematics, are what a non-specialized audience needs to be told.

Many lecturers, especially those near the foot of the academic ladder, anxious to climb rapidly, feel under pressure to say something brand new—to impress their elders with their brilliance and profundity. Two comments: (1) the best way to do that is to make the talk simple, and (2) it doesn't really have to be done. It may be entirely appropriate to make the lecturer's recent research the focal point of the lecture, but it may also be entirely appropriate not to do so. An audience's evaluation of the merits of a talk is not proportional to the amount of original material included; the explanation of the speaker's latest theorem may fail to improve his chance of creating a good impression.

An oft-quoted compromise between trying to be intelligible and trying to seem deep is this advice: address the first quarter of your talk to your high-school chemistry teacher, the second to a graduate student, the third to an educated mathematician whose interests are different from yours, and the last to the specialists. I have done my duty by reporting the formula, but I'd fail in my duty if I didn't warn that there are many who do not agree with it. A good public lecture should be a work of art. It should be an architectural unit whose parts reinforce each other in conveying the maximum possible amount of information—not a campaign speech that offers something to everybody, and more likely than not, ends by pleasing nobody.



Make It Simple, and You Won't Go Wrong.…

Excerpt from:

***I Want to Be a Mathematician*, p. 401, Springer-Verlag, New York (1985).**

…As for working hard, I got my first hint of what that means when Carmichael told me how long it took him to prepare a fifty-minute invited address. Fifty hours, he said: an hour of work for each minute of the final presentation. When many years later, six of us wrote our "history" paper ("American mathematics from 1940…"), I calculated that my share of the work took about 150 hours; I shudder to think how many man-hours the whole group put in. A few of my hours went toward preparing the lecture (as opposed to the paper). I talked it, the whole thing, out loud, and then, I talked it again, the whole thing, into a dictaphone. Then I listened to it, from beginning to end, six times—three times for spots that needed polishing (and which I polished before the next time), and three more times to get the timing right (and, in particular, to get the feel for the timing of each part.) Once all that was behind me, and I had prepared the transparencies, I talked the whole thing through one final rehearsal time (by myself—no audience). That's work.…

On Exposition

Excerpt from:

Response from Paul Halmos on winning the Steele Prize for Exposition (1983).

Not long ago I ran across a reference to a publication titled *A Method of Taking Votes on More Than Two Issues*. Do you know, or could you guess, who the author is? What about an article titled "On automorphisms of compact groups"? Who wrote that one? The answer to the first question is C. L. Dodgson, better known as Lewis Carroll, and the answer to the second question is Paul Halmos.

Lewis Carroll and I have in common that we both called ourselves mathematicians, that we both strove to do research, and that we both took very seriously our attempts to enlarge the known body of mathematical truths. To earn his living, Lewis Carroll was a teacher, and, just for fun, because he loved to tell stories, he wrote *Alice's Adventures in Wonderland*. To earn my living, I've been a teacher for almost fifty years, and, just for fun, because I love to organize and clarify, I wrote *Finite Dimensional Vector Spaces*. And what's the outcome? I doubt if as many as a dozen readers of these words have ever looked at either *A Method of Taking Votes…* or "On

automorphisms…" but Lewis Carroll is immortal for the Alice stories, and I got the Steele Prize for exposition. I don't know what the Reverend Mr. C. L. Dodgson thought about his fame, but, as for me, I was brought up with the Puritan ethic: if something is fun, then you shouldn't get recognized and rewarded for doing it. As a result, while, to be sure, I am proud and happy, at the same time I can't help feeling just a little worried and guilty.

I enjoy studying, learning, coming to understand, and then explaining, but it doesn't follow that communicating what I know is always easy; it can be devilishly hard. To explain something you must know not only what to put in, but also what to leave out; you must know when to tell the whole truth and when to get the right idea across by telling a little white fib. The difficulty in exposition is not the style, the choice of words—it is the structure, the organization. The words are important, yes, but the arrangement of the material, the indication of the connections of its parts with each other and with other parts of mathematics, the proper emphasis that shows what's easy and what deserves to be treated with caution—these things are much more important. …

On Publishing

Excerpts from:

"Four panel talks on publishing", *American Mathematical Monthly* 82 (1975), 14–17.

…Let me remind you that most laws (with the exception only of the regulatory statutes that govern traffic and taxes) are negative. Consider, as an example, the Ten Commandments. When Moses came back from Mount Sinai, he told us what to be by telling us, eight out of ten times, what not to do. It may therefore be considered appropriate to say what not to publish. I warn you in advance that all the principles that I was able to distill from interviews and from introspection, and that I'll now tell you about, are a little false. Counterexamples can be found to each one—but as directional guides the principles still serve a useful purpose.

First, then, do not publish fruitless speculations: do not publish polemics and diatribes against a friend's error. Do not publish the detailed working out of a known principle. (Gauss discovered exactly which regular polygons are ruler-and-compass constructible, and he proved, in particular, that the one with 65537 sides—a Fermat prime—is constructible; please do not publish the details of the procedure. It's been tried.)

Do not publish in 1975 the case of dimension 2 of an interesting conjecture in algebraic geometry, one that you don't know how to settle in general, and then follow it by dimension 3 in 1976, dimension 4 in 1977, and so on, with dimension $k-3$ in 197k. Do not, more generally, publish your failures: I tried to prove so-and-so; I couldn't; here it is—see?!

Adrian Albert used to say that a theory is worth studying if it has at least three distinct good hard examples. Do not therefore define and study a new class of functions, the ones that possess left upper bimeasurably approximate derivatives, unless you can, at the very least, fulfill the good graduate student's immediate request: show me some that do and show me some that don't.

A striking criterion for how to decide not to publish something was offered by my colleague John Conway. Suppose that you have just finished typing a paper. Suppose now that I come to you, horns, cloven hooves, forked tail and all, and ask: if I gave you $1,000.00, would you tear the paper up and forget it? If you hesitate, your paper is lost—do not publish it. That's part of a more general rule: when in doubt, let the answer be no.…

On Research

Excerpt from:

***I Want to Be a Mathematician*, pp. 321–322, Springer-Verlag, New York (1985).**

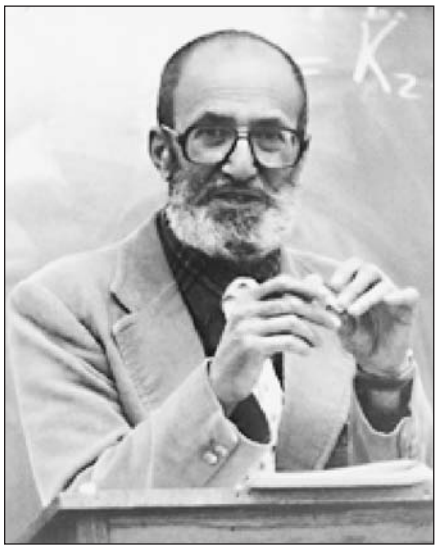
Can anyone tell anyone else how to do research, how to be creative, how to discover something new? Almost certainly not. I have been trying for a long time to learn mathematics, to understand it, to find the truth, to prove a theorem, to solve a problem—and now I am going to try to describe just how I went about it. The important part of the process is mental, and that is indescribable—but I can at least take a stab at the physical part.

Mathematics is not a deductive science—that's a cliché. When you try to prove a theorem, you don't just list the hypotheses, and then start to reason. What you do is trial and error, experimentation, guesswork. You want to find out what the facts are, and what you do is in that respect similar to what a laboratory technician does, but it is different in the degree of precision and information. Possibly philosophers would look on us mathematicians the same way we look on the technicians, if they dared.

I love to do research, I want to do research, I have to do research, and I hate to sit down and begin to do research—I always try to put it off just as long as I can.

It is important to me to have something big and external, not inside myself, that I can devote my life to. Gauss and Goya and Shakespeare and Paganini are excellent, their excellence gives me pleasure, and I admire and envy them. They were also dedicated human beings. Excellence is for the few but dedication is something everybody can have—and should have—and without it life is not worth living.

Despite my great emotional involvement in work, I just hate to start doing it; it's a battle and a wrench every time. Isn't there something I can (must?) do first? Shouldn't I sharpen my pencils, perhaps? In fact I never use pencils, but pencil sharpening has



From the Paul Halmos Collection.

Paul Halmos

become the code phrase for anything that helps to postpone the pain of concentrated creative attention. It stands for reference searching in the library, systematizing old notes, or even preparing tomorrow's class lecture, with the excuse that once those things are out of the way I'll really be able to concentrate without interruption.

When Carmichael complained that as dean he didn't have more than 20 hours a week for research I marveled, and I marvel still. During my productive years I probably averaged 20 hours of concentrated mathematical thinking a week, but much more than that was extremely rare. The rare exception came, two or three times in my life, when long ladders of thought were approaching their climax. Even though I never was dean of a graduate school, I seemed to have psychic energy for only three or four hours of work, "real work", each day; the rest of the time I wrote, taught, reviewed, conferred, refereed, lectured, edited, traveled, and generally sharpened pencils all the ways I could think of. Everybody who does research runs into fallow periods. During mine the other professional activities, down to and including teaching trigonometry, served as a sort of excuse for living. Yes, yes. I may not have proved any new theorems today, but at least I explained the law of sines pretty well, and I have earned my keep.

Why do mathematicians do research? There are several answers. The one I like best is that we are curious—we need to know. That is almost the same as "because we want to," and I accept that—that's a good answer too. There are, however, more answers, ones that are more practical.

On Teaching

Excerpt from:

"The problem of learning to teach", *American Mathematical Monthly* 82 (1975), 466–476.

The best way to learn is to do; the worst way to teach is to talk.

About the latter: did you ever notice that some of the best teachers of the world are the worst lecturers? (I can prove that, but I'd rather not lose quite so many friends.) And, the other way around, did you ever notice that good lecturers are not necessarily good teachers? A good lecture is usually systematic, complete, precise—and dull; it is a bad teaching instrument. When given by such legendary outstanding speakers as Emil Artin and John von Neumann, even a lecture can be a useful tool—their charisma and enthusiasm come through enough to inspire the listener to go forth and do something—it looks like such fun. For most ordinary mortals, however, who are not so bad at lecturing as Wiener was—not so stimulating!—and not so good as Artin—and not so dramatic!—the lecture is an instrument of last resort for good teaching.

My test for what makes a good teacher is very simple: it is the pragmatic one of judging the performance by the product. If a teacher of graduate students consistently produces Ph.D.'s who are mathematicians and who create high-quality new mathematics, he is a good teacher. If a teacher of calculus consistently produces seniors who turn into outstanding graduate students of mathematics, or into leading engineers, biologists, or economists, he is a good teacher. If a teacher of third-grade "new math" (or old) consistently produces outstanding calculus students, or grocery store check-out clerks, or carpenters, or automobile mechanics, he is a good teacher.

For a student of mathematics to hear someone talk about mathematics does hardly any more good than for a student of swimming to hear someone talk about swimming. You can't learn swimming techniques by having someone tell you where to put your arms and legs; and you can't learn to solve problems by having someone tell you to complete the square or to substitute sin u for y.

Can one learn mathematics by reading it? I am inclined to say no. Reading has an edge over listening because reading is more active—but not much. Reading with pencil and paper on the side is very much better—it is a big step in the right direction. The very best way to read a book, however, with, to be sure, pencil and paper on the side, is to keep the pencil busy on the paper and throw the book away.

Having stated this extreme position, I'll rescind it immediately. I know that it is extreme, and I don't really mean it—but I wanted to be very emphatic about not going along with the view that learning means going to lectures and reading books. If we had longer lives, and bigger brains, and enough dedicated expert teachers to have a student/teacher ratio of 1/1, I'd stick with the extreme views—but we don't. Books and lectures don't do a good job of transplanting the facts and techniques of the past into the bloodstream of the scientist of the future—but we must put up with a second best job in order to save time and money. But, and this is the text of my sermon today, if we rely on lectures and books only, we are doing our students and their students, a grave disservice. ...

Excerpt from:

"The heart of mathematics", *American Mathematical Monthly* 87 (1980), 519–524.

... How can we, the teachers of today, use the problem literature? Our assigned task is to pass on the torch of mathematical knowledge to the technicians, engineers, scientists, humanists, teachers, and, not least, research mathematicians of tomorrow: do problems help?

Yes, they do. The major part of every meaningful life is the solution of problems; a considerable part of the professional life of technicians, engineers, scientists, etc., is the solution of mathematical problems. It is the duty of all teachers, and of teachers of mathematics in particular, to expose their students to problems much more than to facts. It is, perhaps, more satisfying to stride into a classroom and give a polished lecture on the Weierstrass *M*-test than to conduct a fumble-and-blunder session that *ends* in the question: "Is the boundedness assumption of the test necessary for its conclusion?" I maintain, however, that such a fumble session, intended to motivate the student to search for a counterexample, is infinitely more valuable.

I have taught courses whose entire content was problems solved by students (and then presented to the class). The number of theorems that the students in such a course were exposed to was approximately half the number that they could have been exposed to in a series of lectures. In a problem course, however, exposure means the acquiring of an intelligent questioning attitude and of some technique for plugging the leaks that proofs are likely to spring; in a lecture course, exposure sometimes means not much more than learning the name of a theorem, being intimidated by its complicated proof, and worrying about whether it would appear on the examination.

... Many teachers are concerned about the amount of material they must cover in a course. One cynic suggested a formula; since, he said, students on the average remember only about 40% of what you tell them, the thing to do is to cram into each course 250% of what you hope will stick. Glib as that is, it probably would not work.

Problem courses do work. Students who have taken my problem courses were often complimented by their subsequent teachers. The compliments were on their alert attitude, on their ability to get to the heart of the matter quickly, and on their intelligently searching questions that showed that they understood what was happening in class. All this happened on more than one level, in calculus, in linear algebra, in set theory, and, of course, in graduate courses on measure theory and functional analysis.

Why must we cover everything that we hope students will ultimately learn? Even if (to stay with an example already mentioned) we think that the Weierstrass *M*-test is supremely important, and that every mathematics student must know that it exists and must understand how to apply it—even then a course on the pertinent branch of analysis might be better for omitting it. Suppose that there are 40 such important topics that a student must be exposed to in a term. Does it follow that we must give 40 complete lectures and hope that they will all sink in? Might it not be better to give 20 of the topics just a ten-minute mention (the name, the statement, and an indication of one of the directions in which it can be applied), and to treat the other 20 in depth, by student-solved problems, student-constructed counterexamples, and student-discovered applications? I firmly believe that the latter method teaches more and teaches better. Some of the material doesn't get *covered* but a lot of it gets *discovered* (a telling old pun that deserves to be kept alive), and the method thereby opens doors whose very existence might never have been suspected behind a solidly built structure of settled facts. As for the Weierstrass *M*-test, or whatever was given short shrift in class—well, books and journals do exist, and students have been known to read them in a pinch. ...

On Mathematics

Excerpt from:

"Mathematics as a creative art", *American Scientist* 56 (1968), 375–389.

Do you know any mathematicians—and, if you do, do you know anything about what they do with their time? Most people don't. When I get into a conversation with the man next to me in a plane, and he tells me that he is something respectable like a doctor, lawyer, merchant or dean, I am tempted to say that I am in roofing and siding. If I tell him that I am a mathematician, his most likely reply will be that he himself could never balance his check book, and it must be fun to be a whiz at math. If my neighbor is an astronomer, a biologist, a chemist, or any other kind of natural or social scientist, I am, if anything, worse off—this man *thinks* he knows what a mathematician is, and he is probably wrong. He thinks that I spend my time (or should) converting different orders of magnitude, comparing binomial coefficients and powers of 2, or solving equations involving rates of reactions.

C. P. Snow points to and deplores the existence of two cultures; he worries about the physicist whose idea of modern literature is Dickens, and he chides the poet who cannot state the second law of thermodynamics. Mathematicians, in converse with well-meaning, intelligent, and educated laymen (do you mind if I refer to all nonmathematicians as laymen?) are much worse off than physicists in converse with poets. It saddens me that educated people don't even know that my subject exists. There is something that they call mathematics, but they neither know how the professionals use the

word, nor can they conceive why anybody should do it. It is, to be sure, possible that an intelligent and otherwise educated person doesn't know that egyptology exists, or haematology, but all you have to tell him is that it does, and he will immediately understand in a rough general way why it should and he will have some empathy with the scholar of the subject who finds it interesting.

Usually when a mathematician lectures, he is a missionary. Whether he is talking over a cup of coffee with a collaborator, lecturing to a graduate class of specialists, teaching a reluctant group of freshman engineers, or addressing a general audience of laymen—he is still preaching and seeking to make converts. He will state theorems and he will discuss proofs and he will hope that when he is done his audience will know more mathematics than they did before. My aim today is different—I am not here to proselytize but to enlighten—I seek not converts but friends. I do not want to teach you what mathematics is, but only *that* it is.

I call my subject mathematics—that's what all my colleagues call it, all over the world—and there, quite possibly, is the beginning of confusion. The word covers two disciplines—many more, in reality, but two, at least two, in the same sense in which Snow speaks of two cultures. In order to have some words with which to refer to the ideas I want to discuss, I offer two temporary and ad hoc neologisms. Mathematics, as the work is customarily used, consists of at least two distinct subjects, and I propose to call them *mathology* and *mathophysics*. Roughly speaking, mathology is what is called pure mathematics, and mathophysics is called applied mathematics, but the qualifiers are not emotionally strong enough to disguise that they qualify the same noun. If the concatenation of syllables I chose here reminds you of other words, no great harm will be done; the rhymes alluded to are not completely accidental. I originally planned to entitle this lecture something like "Mathematics is an art," or "Mathematics is not a science," and "Mathematics is useless," but the more I thought about it the more I realized that I mean that "Mathology is an art," "Mathology is not a science," and "Mathology is useless." When I am through, I hope you will recognize that most of you have known about mathophysics before, only you were probably calling it mathematics; I hope that all of you will recognize the distinction between mathology and mathophysics; and I hope that some of you will be ready to embrace, or at least applaud, or at the very least, recognize mathology as a respectable human endeavor.

In the course of the lecture I'll have to use many analogies (literature, chess, painting), each imperfect by itself, but I hope that in their totality they will serve to delineate what I want delineated. Sometimes in the interest of economy of time, and sometimes doubtless unintentionally, I'll exaggerate; when I'm done, I'll be glad to rescind anything that was inaccurate or that gave offense in any way. ...

Mathematics is abstract thought, mathematics is pure logic, mathematics is creative art. All these statements are wrong, but they are all a little right, and they are all nearer the mark than "mathematics is numbers" or "mathematics is geometric shapes". For the professional pure mathematician, mathematics is the logical dovetailing of a carefully selected sparse set of assumptions with their surprising conclusions via a conceptually elegant proof. Simplicity, intricacy, and above all, logical analysis are the hallmark of mathematics.

The mathematician is interested in extreme cases—in this respect he is like the industrial experimenter who breaks lightbulbs, tears shirts, and bounces cars on ruts. How widely does a reasoning apply, he wants to know, and what happens when it doesn't? What happens when you weaken one of the assumptions, or under what conditions can you strengthen one of the conclusions? It is the perpetual asking of such questions that makes for broader understanding, better technique, and greater elasticity for future problems.

Mathematics—this may surprise or shock you some—is never deductive in its creation. The mathematician at work makes vague guesses, visualizes broad generalizations, and jumps to unwarranted conclusions. He arranges and rearranges his ideas, and he becomes convinced of their truth long before he can write down a logical proof. The conviction is not likely to come early—it usually comes after many attempts, many failures, many discouragements, many false starts. It often happens that months of work result in the proof that the method of attack they were based on cannot possibly work and the process of guessing, visualizing, and conclusion-jumping begins again. A reformulation is needed and—and this too may surprise you—more experimental work is needed. To be sure, by "experimental work" I do not mean test tubes and cyclotrons. I mean thought-experiments. When a mathematician wants to prove a theorem about an infinite-dimensional Hilbert space, he examines its finite-dimensional analogue, he looks in detail at the 2-and 3-dimensional cases, he often tries out a particular numerical case, and he hopes that he will gain thereby an insight that pure definition-juggling has not yielded. The deductive stage, writing the result down, and writing down its rigorous proof are relatively trivial once the real insight arrives; it is more like the draftsman's work, not the architect's. ...

The mathematical fraternity is a little like a self-perpetuating priesthood. The mathematicians of today train the mathematicians of tomorrow and, in effect, decide whom to admit to the priesthood. Most people do not find it easy to join—mathematical talent and genius are apparently exactly as rare

as talent and genius in paint and music—but anyone can join, everyone is welcome. The rules are nowhere explicitly formulated, but they are intuitively felt by everyone in the profession. Mistakes are forgiven and so is obscure exposition—the indispensable requisite is mathematical insight. Sloppy thinking, verbosity without content, and polemic have no role, and—this is to me one of the most wonderful aspects of mathematics—they are much easier to spot than in the nonmathematical fields of human endeavor (much easier than, for instance, in literature among the arts, in art criticism among the humanities, and in your favorite abomination among the social sciences).

Although most of mathematical creation is done by one man at a desk, at a blackboard, or taking a walk, or, sometimes, by two men in conversation, mathematics is nevertheless a sociable science. The creator needs stimulation while he is creating and he needs an audience after he has created. Mathematics is a sociable science in the sense that I don't think it can be done by one man on a desert island (except for a very short time), but it is not a mob science, it is not a team science. A theorem is not a pyramid; inspiration has never been known to descend on a committee. A great theorem can no more be obtained by a "project" approach than a great painting: I don't think a team of little Gausses could have obtained the theorem about regular polygons under the leadership of a rear admiral anymore than a team of little Shakespeares could have written Hamlet under such conditions. ...

On Pure and Applied

Excerpt from:

"Applied mathematics is bad mathematics", pp. 9–20, appearing in *Mathematics Tomorrow*, edited by Lynn Steen, Springer-Verlag, New York (1981).

It isn't really (applied mathematics, that is, isn't really bad mathematics), but it's different.

Does that sound as if I had set out to capture your attention, and, having succeeded, decided forthwith to back down and become conciliatory? Nothing of the sort! The "conciliatory" sentence is controversial, believe it or not; lots of people argue, vehemently, that it (meaning applied mathematics) is not different at all, it's all the same as pure mathematics, and anybody who says otherwise is probably a reactionary establishmentarian and certainly wrong.

If you're not a professional mathematician, you may be astonished to learn that (according to some people) there are different kinds of mathematics, and that there is anything in the subject for anyone to get excited about. There are; and there is; and what follows is a fragment of what might be called the pertinent sociology of mathematics: what's the difference between pure and applied, how do mathematicians feel about the rift, and what's likely to happen to it in the centuries to come. ...

The pure and applied distinction is visible in the arts and in the humanities almost as clearly as in the sciences: witness Mozart versus military marches, Rubens versus medical illustrations, or Virgil's *Aeneid* versus Cicero's *Philippics*. Pure literature deals with abstractions such as love and war, and it tells about imaginary examples of them in emotionally stirring language. Pure mathematics deals with abstractions such as the multiplication of numbers and the congruence of triangles, and it reasons about Platonically idealized examples of them with intellectually convincing logic.

There is, to be sure, one sense of the word in which all literature is "applied". Shakespeare's sonnets have to do with the everyday world, and so does Tolstoy's *War and Peace*, and so do Caesar's commentaries on the wars he fought; all start from what human beings see and hear, and all speak of how human beings move and feel. In that same somewhat shallow sense all mathematics is applied. It all starts from sizes and shapes (whose study leads ultimately to algebra and geometry), and it reasons about how sizes and shapes change and interact (and such reasoning leads ultimately to the part of the subject that the professionals call analysis).

There can be no doubt that the fountainhead, the inspiration, of all literature is the physical and social universe we live in, and the same is true about mathematics. There is no doubt that the physical and social universe daily affects each musician, and painter, and writer, and mathematician, and that therefore a part at least of the raw material of the artist is the work of facts and motions, sights and sounds. Continual contact between the work and art is bound to change the latter, and perhaps even to improve it.

The ultimate goal of "applied literature", and of applied mathematics, is action. A campaign speech is made so as to cause you to pull the third lever on a voting machine rather than the fourth. An aerodynamic equation is solved so as to cause a plane wing to lift its load fast enough to avoid complaints from the home owners near the airport. These examples are crude and obvious; there are subtler ones. If the biography of a candidate, a factually correct and honest biography, does not directly mention the forthcoming election, is it then pure literature? If a discussion of how mathematically idealized air flows around moving figures of various shapes, a logically rigorous and correct discussion, does not mention airplanes or airports, is it then pure mathematics? And what about the in-between cases: the biography that, without telling lies, is heavily prejudiced; and the treatise on aerodynamics that, without being demonstrably incorrect, uses cost-cutting rough approximations—are they pure or applied? ...

To confuse the issue still more, pure mathematics can be practically useful and applied mathematics can be artistically elegant. Pure mathematicians, trying to understand involved logical and geometrical interrelations, discovered the theory of convex sets and the algebraic and topological study of various classes of functions. Almost as if by luck, convexity has become the main tool in linear programming (an indispensable part of modern economic and industrial practice), and functional analysis has become the main tool in quantum theory and particle physics. The physicist regards the applicability of von Neumann algebras (a part of functional analysis) to elementary particles as the only justification of the former; the mathematician regards the connections as the only interesting aspect of the latter. *De gustibus non disputandum est?*

Just as pure mathematics can be useful, applied mathematics can be more beautifully useless than is sometimes recognized. Applied mathematics is not engineering; the applied mathematician does not design airplanes or atomic bombs. Applied mathematics is an intellectual discipline, not a part of industrial technology. The ultimate goal of applied mathematics is action, to be sure, but, before that, applied mathematics is a part of theoretical science concerned with the general principles behind what makes planes fly and bombs explode. ...

The deepest assertion about the relation between pure and applied mathematics that needs examination is that it is symbiotic, in the sense that neither can survive without the other. Not only, as is universally admitted, does the applied need the pure, but, in order to keep from becoming inbred, sterile, meaningless, and dead, the pure needs the revitalization and the contact with reality that only the applied can provide. ...

On Being a Mathematician

Excerpt from:

***I Want to Be a Mathematician*, p. 400, Springer-Verlag, New York (1985)**

It takes a long time to learn to live—by the time you learn your time is gone. I spent most of a lifetime trying to be a mathematician—and what did I learn? What does it take to be one? I think I know the answer: you have to be born right, you must continually strive to become perfect, you must love mathematics more than anything else.

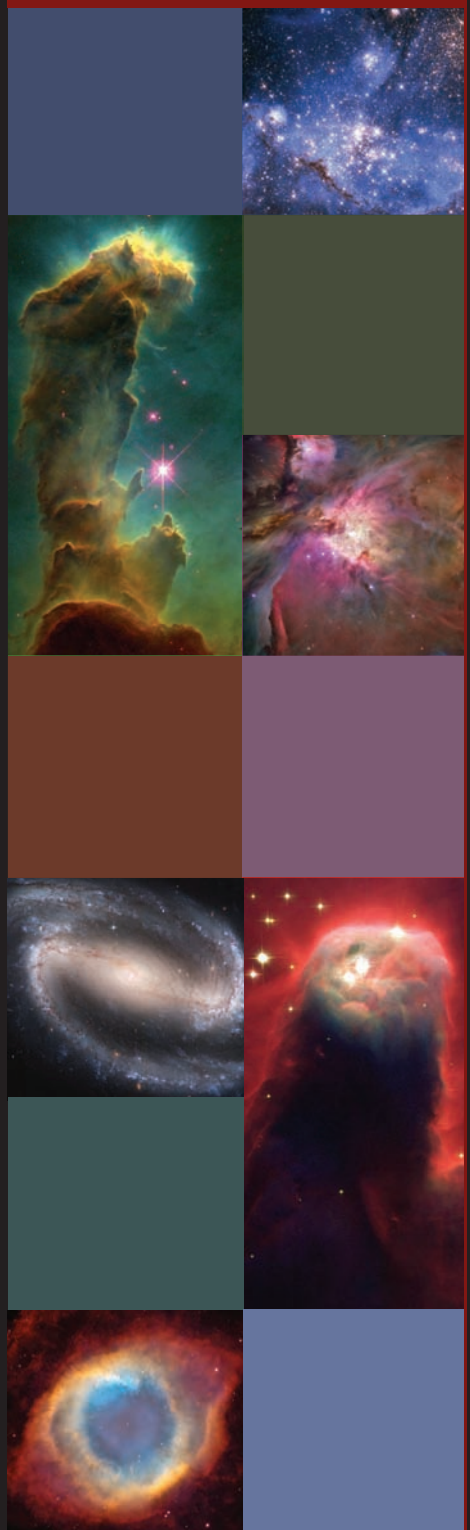
Born right? Yes. To be a scholar of mathematics you must be born with talent, insight, concentration, taste, luck, drive, and the ability to visualize and guess. For teaching you must in addition understand what kinds of obstacles learners are likely to place before themselves, and you must have sympathy for your audience, dedicated selflessness, verbal ability, clear style, and expository skill. To be able, finally, to pull your weight in the profession with the essential clerical and administrative jobs, you must be responsible, conscientious, careful, and organized—it helps if you also have some qualities of leadership and charisma.

You can't be perfect, but if you don't try, you won't be good enough.

To be a mathematician you must love mathematics more than family, religion, money, comfort, pleasure, glory. I do not mean that you must love it to the exclusion of family, religion, and the rest, and I do not mean that if you do love it, you'll never have any doubts, you'll never be discouraged, you'll never be ready to chuck it all and take up gardening instead. Doubts and discouragements are part of life. Great mathematicians have doubts and get discouraged, but usually they can't stop doing mathematics anyway, and, when they do, they miss it very deeply. ...

The American Mathematical Society presents

The AMS Einstein Public Lecture in Mathematics



Sir Roger Penrose

Spacetime Conformal Geometry, and a New Extended Cosmology

Saturday, October 6

8:00 P.M.

Scott Hall, Room 123

Rutgers University

Sir Roger Penrose,
Emeritus Rouse Ball
Professor of Mathematics,
University of Oxford

Sir Roger Penrose is known worldwide for his work in mathematics and mathematical physics. He has written many books, received numerous awards, and was knighted in 1994 for his outstanding contributions to science. In this lecture, Sir Roger will speak about a new view of the universe that unites three of the most puzzling aspects of cosmology: dark energy, dark matter, and the extreme specialness of the Big Bang.

"I certainly believe in the importance of conveying to the general public, as far as this is possible, something of the real nature of mathematics, not only for its increasing utility across so many areas of importance to modern society, but also for its beauty and for the inner satisfaction that it brings."

www.ams.org/meetings/einstein-lect.html

This event is part of the AMS 2007 Fall Eastern Sectional at Rutgers, October 6-7.

Sponsored by the American Mathematical Society. Hosted by the Rutgers University Mathematics Department.

Top: NASA, ESA and A. Nota (STScI/ESA); Second row, left: NASA, ESA, STScI, J. Hester and P. Scowen (Arizona State University); Second row, right: NASA, ESA, M. Robberto (STScI/ESA) and the Hubble Space Telescope Orion Treasury Project Team; Third row, left: NASA, ESA, and The Hubble Heritage Team (STScI/AURA); Third row, right: NASA, H. Ford (JHU), G. Illingworth (UCSC/LO), M.Clampin (STScI), G. Hartig (STScI), the ACS Science Team, and ESA; Bottom: NASA, ESA, C.R. O'Dell (Vanderbilt University), M. Meixner and P. McCullough (STScI)

WHAT IS...

a Woodin Cardinal?

John R. Steel

All mathematical statements can be expressed in the *language of set theory* (LST), whose variables are understood as ranging over sets, and whose only non-logical symbol $\in$ stands for the membership relation. The vast majority of mathematical proofs require no more than the axioms of Zermelo-Fraenkel set theory with Choice, or ZFC. In this way, set theory provides a foundation for all of mathematics. Nevertheless, a surprising number of basic questions about sets in general are not decided by the axioms of ZFC; moreover many of the more abstract questions of analysis, algebra, and topology are left similarly undecided. Perhaps the most famous of the undecided questions is Cantor's Continuum Problem: what is the cardinality of the set of all real numbers? Another more concrete such question is whether all sets of real numbers that are projective are Lebesgue measurable. (A set is projective if and only if it can be built up from a countable intersection of open sets by taking continuous images and complements finitely many times.)

The most fruitful way to extend ZFC so as to remove some of this incompleteness is to strengthen its axiom asserting that there are infinite sets. Large cardinal hypotheses do this.

For α an ordinal number, we define V_α by transfinite induction: $V_0 = \emptyset$, $V_{\alpha+1} = \{x \mid x \subseteq V_\alpha\}$, and $V_\lambda = \bigcup_{\alpha<\lambda} V_\alpha$ for λ a limit ordinal. Thus V_α consists of those sets that can be built up in $< \alpha$ stages by taking sets of objects previously formed. Each V_α is transitive (i.e., if $x \in V_\alpha$, then $x \subseteq V_\alpha$), and $\alpha \leq \beta \Rightarrow V_\alpha \subseteq V_\beta$. It follows from the Axiom of Foundation of ZFC that every set is in some V_α. We write V for the union of all the V_α, the universe of all sets. V is not itself a set, but rather what is sometimes called a *proper class*.

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Large cardinal hypotheses attempt to capture the idea that there are more sets than one can possibly imagine, by means of the following informal *reflection principle*: suitable properties of V reflect to some V_α. For one example, V is infinite, and the ordinary Axiom of Infinity asserts that some V_α shares this property. For another, V is a model of second-order ZFC (also called *Kelley-Morse set theory*), so our informal principle leads to the assertion that some V_κ satisfies second-order ZFC. This is equivalent to κ being an inaccessible cardinal.

The stronger large cardinal hypotheses assert the existence of elementary embeddings $j: V \to M$ that are nontrivial, i.e., not the identity. Here M is a transitive class. Elementarity means that whenever $\varphi(v_1, ..., v_n)$ is a formula of LST with the displayed free variables, and $a_1, ..., a_n$ are sets, then

$$V \models \varphi[a_1, ..., a_n] \Leftrightarrow M \models \varphi[j(a_1), ..., j(a_n)].$$

(For N a transitive set or class, and $b_1, ..., b_n \in N$, we say $N \models \varphi[b_1, ..., b_n]$ if and only if $\varphi(v_1, ..., v_n)$ is true when its quantifiers are understood as ranging over N, its variable v_i is understood as naming b_i, and the $\in$ symbol of LST is understood as standing for set-membership.) For such a j, the *critical point* of j, or $\mathrm{crit}(j)$, is the least ordinal κ such that $j(\kappa) \neq \kappa$. Since j is order-preserving, this implies $\kappa < j(\kappa)$. The reflection here occurs at κ: if $\varphi(\kappa)$ holds in V, and M resembles V enough that $M \models \varphi[\kappa]$, then $M \models \exists\alpha < v_1 \varphi(\alpha)[j(\kappa)]$, so by the elementarity of j, there is an $\alpha < \kappa$ such that $\varphi(\alpha)$ holds in V. The more M resembles V, the more reflection we have. By a result of K. Kunen, $M = V$ is impossible, but weaker conditions on M lead to plausible and useful principles.

For example, κ is *measurable* if and only if there is any transitive M and nontrivial embedding $j: V \to M$ with $\mathrm{crit}(j) = \kappa$. If there is such a j, M with $V_\beta \subseteq M$, we say κ is *β-strong*, and we say κ is *strong* if and only if κ is β-strong for all β. If there is such a j, M such that every λ-sequence

of elements of M belongs to M, then we say κ is λ-*supercompact*, and we say κ is *supercompact* if and only if κ is λ-supercompact for all λ. We have listed these properties in order of increasing strength; indeed, if κ is strong, then $V_\kappa \models$ "there is a measurable cardinal", and if κ is supercompact, then $V_\kappa \models$ "there is a strong cardinal".

S. Ulam first isolated a property equivalent to measurability in 1930: κ is measurable if and only if there is a κ-additive, 2-valued measure defined on all subsets of κ that gives singletons measure 0. (To get a measure from an elementary embedding, set $\mu(A) = 1 \Leftrightarrow \kappa \in j(A)$, for $A \subseteq \kappa$. Conversely, one gets elementary embeddings from measures using the ultrapower construction.) Embeddings corresponding to stronger large cardinal properties can be captured in a similar way by systems of measures.

Let $\kappa < \delta$ be cardinals, and $A \subseteq V_\delta$; then κ is *A-strong in* δ if and only if for all $\beta < \delta$ there is an elementary $j: V \to M$ such that $\mathrm{crit}(j) = \kappa$ and $j(A) \cap V_\beta = A \cap V_\beta$. (The case $A = V_\delta$ implies κ is β-strong for all $\beta < \delta$.) We say δ is *A-Woodin* if and only if there is a $\kappa < \delta$ that is A-strong in δ, and we say δ is Woodin in case it is A-Woodin for all $A \subseteq V_\delta$. The hypothesis that there are Woodin cardinals is strictly between the existence of strong and supercompact cardinals in strength.

Woodin cardinals were discovered by W. H. Woodin in 1984. New techniques due to M. Foreman, M. Magidor, and S. Shelah had just shown that the Lebesgue measurability of projective sets of real numbers follows from large cardinal hypotheses much weaker than had been previously suspected. Woodin showed that in fact the existence of infinitely many Woodin cardinals implies all projective sets of reals are Lebesgue measurable. About a year later, in 1985, D. A. Martin and the author showed that the existence of infinitely many Woodin cardinals implies all projective subsets of the Baire space $\mathbb{N}^{\mathbb{N}}$ are *determined* (PD), a stronger regularity property that, by work of many people in the 1960s and 1970s, is the basis for a thorough and detailed structure theory for projective sets. (By itself, ZFC decides very little about the projective sets.)

Of course, it follows that any large cardinal hypothesis that implies there are infinitely many Woodin cardinals also implies PD. In fact, building on work of Martin, Woodin had already shown (just before the work of Foreman, Magidor, and Shelah) that one such hypothesis implies PD. The continuing importance of Woodin cardinals is related to the fact that they provide the minimal large cardinal hypothesis needed for PD. To make this precise, let us say a sentence φ belongs to the *language of second-order arithmetic* (LSA) if and only if φ refers only to natural numbers and sets of natural numbers, but not objects of higher type (like sets of sets of natural numbers). A set B is projective if and only if membership in B can be defined within LSA from some real parameter. Most questions about projective sets of reals can be phrased in LSA; for example, the Lebesgue measurability and determinacy of projective sets can be expressed using sentences in LSA. Then, by work of Martin, Woodin, and the author, we have that the following are equivalent:

(a) PD,
(b) for each n, every consequence in LSA of the theory ZFC plus "there are n Woodin cardinals" is true.

Thus PD is precisely the "instrumentalist's trace" of Woodin cardinals in the language of second-order arithmetic.

Underlying the proof that Woodin cardinals imply PD is a structure known as the *iteration tree*. Roughly speaking, an iteration tree on M is a tree of models with root M that is generated by a certain process. This process involves using a system of measures coding an embedding in one model to generate an embedding with domain in some other model, and thus equips the tree with commuting elementary embeddings from the models earlier on a given branch to those later on that branch. A simple example is an *alternating chain* on M, an iteration tree having two distinct branches, the "even" branch consisting of models M_n for n even (with $M_0 = M$), and the "odd" branch consisting of M_0 together with the M_n for n odd. If B is a subset of the Baire space, then an *alternating chain representation* of B is a continuous function $\mathcal{A}$ on $\mathbb{N}^{\mathbb{N}}$ such that for each $x \in \mathbb{N}^{\mathbb{N}}$, $\mathcal{A}(x)$ is an alternating chain on some V_δ, and $x \in B$ if and only if the direct limit along the even branch of $\mathcal{A}(x)$ is wellfounded. If B has an alternating chain representation, then B is determined. The proof of PD from Woodin cardinals goes by showing that if δ is Woodin, and there are infinitely many Woodin cardinals above δ, then every projective set has an alternating chain representation on V_δ.

In general, an iteration tree may have transfinite length. The construction of iteration trees, and the analysis of the properties of arbitrary iteration trees, is at the heart of many basic open problems in pure large cardinal theory. The extent to which δ is Woodin (that is, the complexity of those sets $A \subseteq V_\delta$ such that δ is A-Woodin) is mirrored in the complexity of the iteration trees one can generate on V_δ. This correspondence is behind the equivalence mentioned in the paragraph before last, and is one reason Woodin cardinals continue to be important in set theory.

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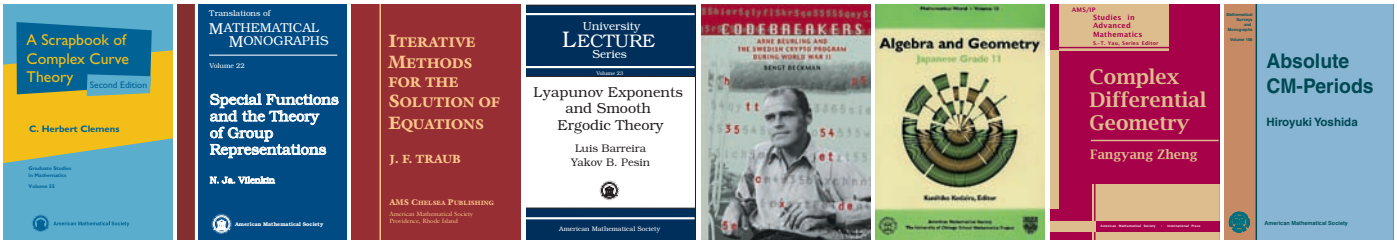

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Book Review

Bourbaki, A Secret Society of Mathematicians and *The Artist and the Mathematician*

Reviewed by Michael Atiyah

Bourbaki, A Secret Society of Mathematicians
Maurice Mashaal
AMS, June 2006
US$29.00, 260 pages
ISBN-13: 978-0821839676

The Artist and the Mathematician: The Story of Nicolas Bourbaki, the Genius Mathematician Who Never Existed
Amir D. Aczel
Thunder's Mouth Press, August 2006
US$23.95, 272 pages
ISBN-13: 978-1560259312

All mathematicians of my generation, and even those of subsequent decades, were aware of Nicolas Bourbaki, the Napoleonic general whose reincarnation as a radical group of young French mathematicians was to make such a mark on the mathematical world. His memory may now have faded, the books are old and yellowed, but his influence lives on. Many of us were enthusiastic disciples of Bourbaki, believing that he had reinvigorated the mathematics of the twentieth century and given it direction. But others believed that Bourbaki's influence had been pernicious and narrow, confining mathematics behind walls of rigour, and cutting off its external sources of inspiration.

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Now that we are in the twenty-first century it is perhaps the right time to look back and try to assess the overall impact of Bourbaki, before all the principal players leave the scene. The basic historical facts are well known and are set out in both the books under review. France had lost a whole generation of intellectuals in the 1914–18 war, and the young mathematicians of Paris, in the interwar period of the 1920s and 1930s, were looking for new guidance and inspiration. Only Hadamard and Élie Cartan of the older generation still commanded respect. Talented youth, unconstrained by higher authority, is a powerful force and, whatever one's views about Bourbaki, there is no doubt that the talent was quite exceptional. The list of the early members of Bourbaki is truly impressive: André Weil, Henri Cartan, Claude Chevalley, Jean Dieudonné, Laurent Schwartz… Later recruits were of similar calibre: Jean-Pierre Serre, Armand Borel, Alexandre Grothendieck… Harnessing the powers of such a formidable group was not an easy task. There were fierce debates, some serious quarrels, and much passion. The remarkable fact is that the group, by and large, stayed together and kept Bourbaki alive and active over several decades. This was a tribute to the idealistic vision that they shared, that of remoulding the shape of mathematics in the twentieth century.

Much of the atmosphere of the early days is brought vividly to life by the many informal photographs in the Mashaal book. It is fascinating to see pictures of the young André Weil, relaxing in a deck chair, though Henri Cartan was always

impeccably dressed in jacket and tie, resisting trendy fashion.

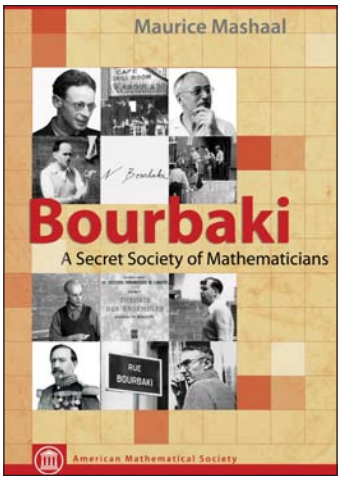
I myself attended a Bourbaki conference in my youth and can attest to the lively experience of debating vigorously (and usually critically) the latest version of the next book. Summer sunshine in the south of France and the friendly and casual atmosphere did much to prevent arguments developing into armed conflict. To paraphrase Winston Churchill, "never in the course of human argument has so much been spoken by so many on so little." It appeared a miracle that books, many of them, actually emerged from this process, a result undoubtedly due to the diligence and energy of Dieudonné. If Weil was the prime inspiration behind Bourbaki, it was Dieudonné who carried it to fruition.

So what were the basic aims of Bourbaki, and how much was achieved? Perhaps one can pick out two central objectives. One was that mathematics needed new and broad foundations, embodied in a series of books that would replace the old-fashioned textbooks. The other was that the key idea of the new foundations lay in the notion of "structure", illustrated by the now common word "isomorphism".

There is no doubt that, with its clear emphasis on "structure", Bourbaki produced the right idea at the right time and changed the way most of us thought. Of course it fitted in well with Hilbert's approach to mathematics and the subsequent development of abstract algebra. But structure was not confined to algebra, and it was particularly fruitful in topology and associated areas of geometry, all of which were to see spectacular developments in the period following World War II. Here the impact of Bourbaki was decisive, and, in the hands of Serre and Grothendieck, algebraic geometry rose to incredible heights.

Laying universal foundations is another matter. Each time it is tried it inevitably gets bogged down by the sheer scale and ambition of the operation. The "ne plus ultra" in this direction was the *Éléments de Géométrie Algébrique* of Grothendieck and Dieudonné, which expanded voluminously both forward and backward and was in danger of sinking under its own weight.

Laying ambitious foundations is not only a dangerous delusion, it can also be a didactic disaster. Encyclopaedias are not textbooks, and much of the critique directed against Bourbaki is that it was used, or perhaps misused, to reform school education. This may be unfair, since many of the great mathematicians in Bourbaki were excellent lecturers and knew well the difference between formal exposition and the conveying of ideas. But, as so often happens, the disciples are more extreme and fanatical than their masters, and education in France and elsewhere suffered from a dogmatic and ill-informed attempt at reform. Jesus Christ is not responsible for the excesses perpetrated in the name of Christianity.

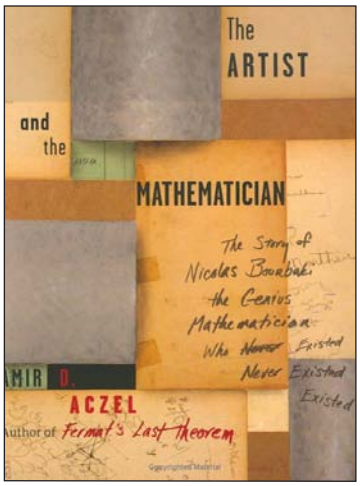


Bourbaki was to some extent the victim of its own success. The original aim had been the modest one of writing a modern replacement for Goursat's *Cours d'Analyse* but, buoyed up by enthusiasm and the success of recruiting many of the leading mathematicians of the time, horizons broadened. All of mathematics was to be included, analysis, algebra, and geometry. For obvious reasons algebra lent itself best to the Bourbaki treatment. The volumes on commutative algebra and particularly on Lie groups were excellent and became standard references, due in large part to the personal contribution of Serre, whose influence and taste guided this whole area.

The formal aspects of analysis, as exemplified in functional analysis, also had success, though Bourbaki's treatment of probability came in for severe criticism from the experts who argued that important parts of the theory were excluded by the restriction to locally compact spaces. A concern for elegance had led to too great a price being paid.

But this little battle over probability was a mere sideshow in the Bourbaki approach to analysis, a subject too varied, complex, and untidy to be taken over by Bourbaki. Glimmerings of these problems already appear in differential geometry, a subject at the interface between analysis and geometry, where structure, though present, is a less dominating concept. Though Riemann surface theory, after a century of active development, could conceivably be given a coherent Bourbaki treatment, the same could hardly be said for the current work of Thurston-Perelman in three dimensions. Another severe limitation of Bourbaki, no doubt conscious, was the restriction to pure mathematics. Applied mathematics is too messy and disparate to be included, and theoretical physics hovers on an uncertain borderline. One distinguishing feature of Bourbaki was the emphasis on clear and unambiguous definitions and on rigorous proofs. This was, as in algebraic geometry, a reaction against some sloppy treatments of the past, and it served a purpose in creating a firm platform for the future. Unfortunately, when taken to extremes, the requirement for total rigour excludes large areas of mathematics which are in their early creative stages. Had Euler worried too much about rigour, mathematics would have suffered.

Over the past thirty years, arguably in the declining years of Bourbaki, some of the most exciting developments in mathematics have arisen from the interface with physics and particularly quantum



field theory. New concepts and explicit results have emerged from this interaction, notably Donaldson's work on four-manifolds, mirror symmetry in algebraic geometry, and quantum cohomology. Much of this came directly from very heuristic work by physicists such as Edward Witten. Most of it, though by no means all, has now been given a cloak of respectability involving rigorous proofs.

Clarity and rigour have a vital place in mathematics but they must not be used as a barrier to new ideas from other fields. Free trade is a benefit to us all and should not be inhibited by excessive attachment to national sovereignty.

Although Bourbaki recruited most of the famous French mathematicians of the time (and several from outside France), there were some notable exceptions, the most obvious being Jean Leray (who left very early) and René Thom. In retrospect it is clear that neither fitted the Bourbaki role. The fact that they were also two of the most original mathematicians of the time does perhaps suggest that such originality has difficulty flourishing in a constrained atmosphere. Both were also closer to applied mathematics than their colleagues.

Of the two books under review, the first by Maurice Mashaal might be described as "authorized". It has the sanction of the AMS and was first published several years ago in French. It seems clear that the author knew many of the French mathematicians personally and derived his information and in particular the photographs from this source. It is reliable on the history, the personalities, and the mathematics. It is also highly readable and noncontroversial.

The other book by Amir Aczel is totally different. It has a more ambitious aim, which is to examine the Bourbaki influence on "structure" in the social sciences. It is also highly controversial in its extensive treatment of the Grothendieck story. I was not convinced of the total reliability of its sources, nor of its philosophical credentials.

Although written in English this book is permeated by French intellectual ideas and will probably seem strange to those not part of that scene. A slightly tenuous link between André Weil and the sociologist Claude Levi-Strauss is used to claim that Bourbaki made a major impact on sociology and related fields such as psychology, anthropology, and linguistics. This grand aim is clearly set out by the title, and I have no expertise in any of these fields. It may be that the author is a polymath, an intellectual colossus, who straddles the entire scene from mathematics to the social sciences. The only place where I can examine the evidence for this and make an informed comment, is in his treatment of mathematics and the people in it. Here I have profound misgivings, which relate mainly to Grothendieck, who occupies a central place in the author's pantheon.

There is no doubt that Grothendieck was an exceptional figure in the mathematical world and that he deserves a scholarly full-length biography, preferably written by a mathematician who knew him personally. I believe such a book is in preparation, and I look forward to reading it. Aczel's book does not measure up to the level of the subject, because of his uncritical acceptance of Grothendieck as the great prophet, spurned eventually by his people (including Bourbaki).

I knew Grothendieck well when he was in his prime. I greatly admired his mathematics, his prodigious energy and drive, and his generosity with ideas, which attracted a horde of disciples. But his main characteristic, both in his mathematics and in social life, was his uncompromising nature. This was, at the same time, the cause both of his success and of his downfall. No one but Grothendieck could have taken on algebraic geometry in the full generality he adopted and seen it through to success. It required courage, even daring, total self-confidence and immense powers of concentration and hard work. Grothendieck was a phenomenon.

But he had his weaknesses. He could navigate like no one else in the stratosphere, but he was not sure of his ground on earth—examples did not appeal to him and had to be supplied by his colleagues.

Aczel is right when he identifies Grothendieck as someone who took the new Bourbaki philosophy seriously and made a tremendous success of it. Where I part company with Aczel is in his assertion that Bourbaki made a fatal mistake in not taking Grothendieck's advice and rewriting its foundations in the new language of category theory. Aczel believes that Bourbaki had turned its face away from the future in not following Grothendieck. I doubt whether history will come to this verdict. Grothendieck's own *EGA*, as well as the general fate of over-confident universalists, might suggest otherwise. Moreover, given Grothendieck's uncompromising nature and supreme self-confidence, it is difficult to see how, with him at the helm, Bourbaki could have continued as a collegial enterprise.

Aczel's total endorsement of Grothendieck leads him to make such fatuous statements as: "Weil was a somewhat jealous person who clearly saw that Grothendieck was a far better mathematician than he was." Subtle balanced judgement is clearly not Aczel's forte, and it hardly encourages the reader to take seriously his confident and sweeping assertions in the social sciences.

NSF Proposal Preparation: The View of an Ex-Program Officer

Joseph Brennan

This article is the third in an occasional series intended for graduate students and young mathematicians. The series is coordinated by *Notices* Associate Editor Lisa Traynor.

The task of obtaining external funding to support research has become a critical point in the career of the young mathematician. Obtaining funding can have a profound effect on the recipient's career as the imprimatur of external funding provides in the eyes of many a confirmation of the importance of the recipient's research activity. While the reality is that the research proposals that are funded tend to be the ones that are excellent, there are very many excellent research proposals that are not funded. This note is intended to provide some insight into the process of funding at the National Science Foundation (NSF) based on my two years' experience as a program officer in the Division of Mathematical Sciences. While the advice I give is directed to the applicant for NSF funding, the basic principles are applicable to funding proposals to any external funding source.

It is important to recognize that the agenda for the process is established by the National Science Foundation. This agenda is not ordinarily established by mathematicians but is instead the consequence of intellectual, political, and cultural concerns of the government. The immediate consequence of this is that the direction and employment of funds as well as the criteria for awarding them is established in order to satisfy the NSF's own purposes rather than an agenda established by the mathematical community. It is important to be alert to the agenda of the NSF and to understand its needs in the process of supporting mathematics. The mission statement of the NSF calls for it "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…". Although the objectives of the mission statement are not usually explicitly addressed in the proposal submission, it may be useful to contemplate how the proposal addresses these issues—most particularly for mathematics—in promoting the progress of science.

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Applications to the NSF for funding are made in response to a Program Solicitation. That solicitation might be the program's description of the area program; it might be an explicit solicitation for proposals for the particular program; it might take the form of a "Dear Colleague letter". A prospective applicant should examine the range of solicitations to find the solicitation that best fits the proposed work. A typical solicitation contains a detailed description of the program, the method by which the proposals are to be evaluated, criteria by which proposals are to be evaluated, budgetary guidelines, and contact information for program officials. **Proposals sent in response to a solicitation need to be responsive to the solicitation**. In particular the solicitation should be carefully and fully read and the issues that are raised by the solicitation need to be fully addressed in explicit detail by the proposal.

The statement in bold of the previous paragraph may seem to follow immediately from the definitions. Observation would seem to indicate however that it is not obvious. Every solicitation is an effort to direct funding to accomplish or encourage activity that the foundation views as important to the furthering of the NSF's agenda. Funding success depends on meeting the criteria specified in the solicitation, so proposals should explicitly address those criteria. Having identified a potential source of funding, the next step is to **read the guides for the format and submission of proposals and to follow the criteria established for the program**. Agencies have established guides for proposals. The NSF Grant Proposal Guide covers general procedures for grant submission to NSF (`http://www.nsf.gov/pubs/gpg/nsf04_23/`). It is revised periodically. Individual solicitations at NSF will indicate the procedures to be followed for that solicitation and deviations from the general procedures of the Grant Proposal Guide.

Some programs permit the submission of a proposal at any time. Others restrict the submission to certain windows. This can be expressed in two principal ways. One is an explicit time window with (sometimes) an opening date and a deadline for proposal submission. The other is a target date for submission. These windows for proposals are dictated by the beginning of budget years, staff workload requirements, as well as other factors. Proposals for funding should be sent

within the proposal window. This is absolutely necessary in the presence of deadlines. **Failure to adhere to the deadlines for proposal submission may lead to a proposal being returned without being reviewed**. On the other hand, target dates are indicators to the eligible that proposals should be sent in proximity to that time. Target dates are principally used by area programs at NSF, but not all such programs have target dates rather than deadlines. The use of target dates allows for more efficient budgetary planning and staff resource allocation. Proposals that arrive after the target date will be considered but proposals that are submitted long after the target date has passed may find that, by the time they are reviewed, the budget for the program has already been allocated.

Some programs have a pre-proposal phase. The pre-proposal may be required or optional. The character of such a pre-proposal can vary from a letter of intent to submit a proposal to a full scale mini-proposal. There are usually managerial requirements that necessitate a pre-proposal phase. The pre-proposal phase may be used to limit the number of proposals to those most likely to be successful, or the pre-proposal phase may be used only to determine the number and composition of the reviewing panels. The fact that the purpose of the pre-proposal phase is proposal management does not mean it is not important. The pre-proposal may undergo as complete a review process as any full proposal.

The NSF has established two review criteria that are used in virtually all proposal evaluations. The first review criterion is

What Is the Intellectual Merit of the Proposed Activity?

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

In short, the first criterion is to evaluate the proposal based on the intellectual merit. Consequent to this review criterion: **The proposal must address the problem of what goals are to be accomplished and what the impact of attainment of those goals would mean**. While it might appear that this requirement is self-evident the failure to meet this requirement is the leading cause for proposals to fail. There are two parts to this requirement. The first is that the proposal must relate what goals are to be accomplished. If the proposal is in response to a solicitation those goals must match the agenda set forth by the solicitation. In all cases, the stated goals should match the objectives of the funding agency. The goals should be presented in a manner that would permit the decision makers in the funding process (reviewing panel, study session, program manager) to understand what the objectives of the proposal are.

Furthermore it is extremely important to tell the decision makers why they should fund the proposal. Each proposal asks someone to invest limited resources into a particular project. The motivation for doing so varies amongst funding organizations but every funding entity looks to justify their investment. If the proposer is unable to articulate a reason for investment of funds in a particular project, there is little likelihood that the decision makers will find a reason to invest in the project.

The proposer should take it for granted that all (or virtually all) of the proposals that are submitted to the program to which they are applying are in some very real sense excellent. The competition for funding is amongst these excellent proposals. In this competition, the ones that stand out are those that provide a strong and compelling case in response to the funding announcement to the question as to why they should be funded.

This requires explaining in some considerable detail to an informed but not necessarily specialist mathematician reader what real impact the proposed research will have and what insight is being provided to attack the problem. It is however not sufficient to merely explain the mathematical content of the proposal. What is required is to place the mathematics that is being proposed in a context that indicates its importance in mathematics or in a broader context. This is the answer to the question: Why would one wish to know the consequences of the proposal's research?

Some careful consideration should be given to the preparation and delivery of this material in the proposal. A typical failing of an excellent but unfunded proposal is a dismissive attitude towards the context of the proposal. The NSF funds all types of research in the mathematical sciences, from foundational issues in logic to the modeling of ice in the Antarctic. The issue is not the type of research that is being proposed; the issue is why the research being proposed is important. This requires more than a one-sentence comment that says that the topic is connected to research in another field and hence is important. If the proposer of the research is not able to put the importance of the work in context, is not able to explain why the work is an important element in the "progress of science" or important in advancing "the national health, prosperity, and welfare" or in "securing the national defense", then why is the work important enough to rise to the level where it should be funded over other proposals that do make that argument?

One also needs to establish why the proposer has the ability to perform the work that is being proposed. It is not sufficient to propose the solution of one of the millennium problems; it is necessary to provide a reasonably educated mathematical reviewer with a clear indication of the new idea that is to be exploited in the project. This does not require the presentation of a proof but does require a detailed exploration of the ideas and difficulties in obtaining the goals of the proposed work.

To summarize, there is a key but sometimes forgotten distinction between excellent proposals and excellent proposals that get funded: The latter provide, by exploring the intellectual consequences of the proposed work, compelling reasons why the work should be funded.

The second review criterion is:

What Are the Broader Impacts of the Proposed Activity?

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

The NSF in the second review criterion also demands that the proposal explicitly address the broader impact of the proposed work.

In short, the second criterion at NSF asks how this proposal will aid in the furtherance of the mission, objectives, or goals of the National Science Foundation. This criterion was written to make it clear that proposals in which the NSF is providing funding address not only scientific research objectives but also the broader national needs whose accomplishment is charged to the foundation.

The proposer might wish to look at the sample broader impacts provided by the NSF at `http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf`. These are not however to be regarded without consideration of what are the actual accomplishments to be obtained by the proposed work. What outcomes can be seen as emanating from the proposed award? Are graduate students, undergraduate students, K–12 students (future scientific workforce) being supported in the proposal? Is the scientific education infrastructure benefiting from the award—in what manner is this accomplished? Will the award have benefit to the crucial problem of addressing mathematics and science in secondary education?

It is a mistake to think that the proposal should address all of these issues or that these comments or the listing at the above website is an exhaustive list of what is sought. What is required by the criterion is to address the question of how the individual proposal addresses the broad national interest that the NSF represents.

One should also consider the process in which the proposal will be reviewed. At NSF, depending on the program, the proposal will be reviewed by a combination of panels and/or individual non-interacting (ad hoc) reviewers. Each of these processes has its own peculiar aspects that may dictate differing approaches by the investigator in the presentation of the proposed work. Each of these review processes will present particular challenges to the aspiring investigator.

Panel reviewers are drawn from established researchers in the general field of the proposal. They are less likely to have direct knowledge of a particular subfield than individual non-interacting reviewers. The proposal will be sent to three or more of the panelists to review for the panel. These reviewers need not be experts in the particular subfield of the proposal. In fact it is highly likely that at least one of the panel reviewers will be deliberately chosen outside the particular subfield of the proposal. This may necessitate writing more material to describe the setting of the proposed research and require considerably more detail on the importance of the intellectual merit of the proposal to give context to the proposal to the reviewers. The panel members each will review considerably more proposals than are reviewed by typical non-interacting individual reviewers and therefore tend to be in a better position to establish the relative placement of proposals. Panel reviewers have a considerable amount of reading to do, so proposal-writers will want to establish early and often in the proposal the value of their proposed work. The panel reviewers will meet and discuss each proposal individually. The discussion is led by the panelists that reviewed the proposal prior to the panel's meeting.

Individuals who review the proposals "ad hoc" or reviewers from within the NSF are usually in a better position to understand the requirements of the funding entity but are less likely to have an understanding of the intrinsic value of a proposal.

Beyond the requirement of addressing the issues raised by the required format of the proposal there is one central requirement that must be addressed by every submission. How will this work benefit the mission of NSF? Congress exercises considerable oversight of federal programs, and it is routine for senior executives of federal agencies to be called to explain funding decisions—even at the level of funding decisions for individual proposals. This was part of the motivation for the recent NSF decision to require that proposals submitted to the

NSF explicitly address two criteria for funding decisions. The second criterion examines the broader impact of the proposal. Simply put this asks for the consequences that funding the proposal will have on the broader community of science. These will vary from proposal to proposal but might include training of students in the techniques of the area or applications of the work to questions in another area of science. Mission oriented agencies such as the Office of Naval Research express this in a more direct manner: asking that proposals explain "Potential contributions of the effort to the agency's specific mission." The requirement is the same, however, across all funding agencies: Explain why giving the money to this project furthers the aims of the funding entity.

It is very important to remember one of the first statements of this article: that it is important to recognize that the agenda for the funding process is established by the entity that is doing the funding. The agenda of the entity will be reflected in the funding criteria; proposals need to address the issues raised by the criteria.

The budget is simultaneously the simplest and the most complex part of any proposal. The simple solution to the question of budgeting is: **The budget should be sufficient to attain all of the objectives of the proposal**. There is an additional caveat. **The amount requested should conform to the pre-established award sizes, or be comparable to program awards of similar complexity**. Some agencies and some programs provide pre-established award sizes. These provide guidance as to the level of complexity expected of an award. Many funding entities provide examples of previously funded awards to provide budgetary guidance.

It is most important to note that the funds requested should be sufficient to fulfill the objectives of the proposal. Proposals are not funded because they request "just a small amount of funds". Proposals are funded because the objectives of the proposal meet the requirements of the funding entity. Some agencies restrict application of funds to redirect the investigators' activity from one aspect of their job to work on the project—others encourage such buyout. The proposer/investigator needs to work with the sponsored program officer at his or her eligible institution to design a budget that conforms to the requirements of the funding entity.

It is important to find mechanisms to support students with external funding. This is an important issue for our profession and in addressing the national need for a well-trained scientific workforce. When grants support undergraduates, they encourage these and other undergraduates to see mathematics as a viable career choice. Funds that support graduate students, and particularly funds that support graduate students directly in their objective to obtain a degree, offer an opportunity to sharply reduce the time to obtain a degree. They enable a more focused direction of the students' work on their thesis. Graduate student support can also offer a means to increase the success in obtaining the scientific goals of the proposal. The presence of support for graduate students on a proposal also has the potential to indirectly broaden the objectives of the proposal by addressing the issue of training a scientific workforce for future requirements of the United States. Different funding entities and programs have different requirements for the support of students. It is important, however, to be able to give an indication of the student's identity at the time of funding.

One should not neglect the potential for funding teachers and K–12 students. The direct scientific impact of funding the participation of these groups may not be significant; however, there are significant indirect benefits of encouraging and strengthening mathematical activity at these early levels of education.

The budget returns our attention to the institution, as with the possible exception of some fellowships, individuals do not receive awards. Individuals do not in general have the ability to handle the financial reporting requirements imposed by governments and foundations. Awards are made to institutions. Budgets reflect this reality. Federal relations with educational institutions are governed by Office of Management and Budget Circular A-21 Principals for determining costs applicable to grants, contracts, and other agreements with educational institutions (`http://www.whitehouse.gov/omb/circulars/a021/a021.html`). The provisions of the circular require that a cognizant federal agency (usually the Office of Cost Allocation of the Program Support Center of the Department of Health and Human Services) enter into an agreement to provide for "costs that are incurred for common or joint objectives and, therefore, cannot be identified readily and specifically with a particular sponsored project, an instructional activity, or any other institutional activity." These are known as Facilities and Administration Costs (F&A). These are usually computed as a percentage of the Modified Total Direct Costs. The percentage of the Modified Total Direct Costs allocated to F&A depends on the nature and location of the activities supported. This percentage is negotiated between the government and the institution and may change as institutional costs are reevaluated. The modification of the direct costs eliminates certain costs as direct costs for calculation of the F&A as specified in the agreement between the institution and the government. For example, tuition costs for supported students and costs of conference and workshop participants are not included in the Modified

Total Direct Costs. Proposers should also be alert that some proposals specifically exclude certain participant support costs from the total direct costs or provide for an alternative computation of the F&A.

At some point in the award process, proposers might be asked to reduce the requested budget. A significant reduction of a budget submitted to a federal agency will trigger a requirement to reduce the scope of the project. This means that the agency acknowledges that the funds will not be sufficient to obtain all the objectives that were established in the proposal and calls upon the investigators to reduce the level of activity of the project and the corresponding objectives to be obtained. The reduction in scope of the project should be correlated with the change in the budget.

Receipt of an award does not end the responsibility of the investigator. There is an obligation to spend the funds in accord with the objectives of the project. One might review the semiannual reports to Congress of the Inspector General of NSF (`http://www.nsf.gov/oig/pubs.jsp`) to provide an indication of the degree of seriousness the federal government takes in auditing its expenditures. There is also an obligation to fulfill the conditions upon which the award has been made, from promoting seat belt use to periodic reporting on the accomplishments of the project. One should remember that the obligation remains upon the funding entity, the program, and the program's employees to justify the expenditure. In particular, programs need success stories. These provide programs with the opportunity to increase base funding levels while programs unable to document successful accomplishment of their goals may face below-average increases or even decrease of base funding levels.

Having funding from a program or funding entity does not preclude seeking additional funding from the same or different programs or entities to support other projects. (Note that seeking funding for the same project would be unethical and potentially criminal.) One should not become dependent on a single funding source to support our students or our objectives.

A wise man said to me: "Don't ask me how to obtain funding; rather present to me a good idea and a source will be found to fund it." Ultimately the test of whether a proposal will be funded is if the idea presented in the proposal is found meritorious in the marketplace of ideas. It is incumbent upon us as mathematicians to provide evidence that support of our discipline is essential to the development of science. Exploring and finding vehicles for support of mathematics and mathematics students is essential in that quest.

2007 Joint Meeting of the AMS-NZMS

Victoria University of Wellington, New Zealand

December 12–15, 2007

AMS
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Plenary Speakers

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Rodney Downey, *Victoria University of Wellington*

Michael Freedman, *Microsoft Research*

Bruce Kleiner, *Yale University*

Gaven Martin, *Massey University*

Assaf Naor, *Courant Institute of Mathematical Sciences*

Theodore Slaman, *University of California, Berkeley*

Matt Visser, *Victoria University of Wellington*

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For accommodations, travel, and the scientific program, go to:
www.ams.org/amsmtgs/internmtgs.html
or **www.mcs.vuw.ac.nz/%7Emathmeet/amsnzms2007/index.shtml**

Interview with Congressman Jerry McNerney

Jerry McNerney, a Ph.D. mathematician, was elected to the U.S. House of Representatives in November 2006 and represents California's eleventh district. McNerney received his Ph.D. in mathematics from the University of New Mexico in 1981 and has been an AMS member since 1977. Before his election to Congress, he worked at Sandia National Laboratories and at US Windpower, and also served as an energy consultant for utility companies. Prior to his election he was chief executive officer of a start-up company that will manufacture wind turbines. In the following article, Congressman McNerney provides written responses to questions posed to him by the *Notices*. Samuel M. Rankin III, director of the AMS Washington Office, helped prepare the questions and facilitated communication with Congressman McNerney.

—*Allyn Jackson*

Notices: *Tell us about your personal experience in mathematics.*

McNerney: Like many mathematicians, my first math experience was with an inspiring teacher. I was a sophomore in high school, and like many young adults at that age, I was a little rebellious. I was taking college prep courses, but on the first day of class the geometry teacher began talking about "mommy and daddy triangles". I immediately transferred to a different geometry class. Ron Black was the teacher. It was in Mr. Black's class that I started to become fascinated by proofs with congruence theorems. My interest was piqued. I just ate the class up, immediately taking to the material. From that point on, math was always an important part of my life. High school science and math classes were a breeze after that.

I didn't take calculus until college. But seeing derivatives and integrals pop out by passing to the limit was mind boggling—the proverbial light bulb turning on in my head. We were using infinity to solve real finite problems.

Of course differential equations and all the undergraduate math courses I took were great, but the next really big thing for me was real analysis in graduate school. Getting into the real basics and proving things with absolute rigor was outstanding to see after years of hearing that the details of the proofs were to be left for later. It became clear in graduate school. I loved the certainty and the beauty of a simple proof and of the concepts involved. I loved the connection to philosophy. I loved teaching and helping younger students. I also loved the community of math. The members of the department at the University of New Mexico and the graduate students were a family.

My father was an engineer and I developed an early interest in applications. In fact, I majored in chemical engineering as an undergraduate, but transferred to the math department as a senior undergraduate. There was an engineering professor at UNM who told me that a mathematician who understood applications would have engineers knocking on his or her door. This made an impression, and motivated me to take physics and keep in touch with applications even though I stayed in differential geometry, a field that many considered to be pure mathematics.

Eventually, I graduated with a Ph.D. and decided to go into industry instead of staying in academia. I felt that several years of applied experience in industry would make me a better mathematician. However, I came to understand later that decision pretty much disqualified me from returning to academia for a number of reasons. The most prominent of those was that while working in industry I didn't publish any research papers in math journals. Also, most mathematics departments want to hire academic postdoctoral mathematicians right out of graduate school or out of other postdoctoral programs. I'm not sure if this is good or bad. There's no doubt that the very top mathematicians should spend their careers in academia. For the rest of us merely good mathematicians, I believe that some outside experience, or perhaps an academic requirement for graduate students to take graduate courses in other areas such as neuroscience or sociology, would be beneficial.

Notices: *How does your world-view as a mathematician play a role in your work as a congressman—assessing legislation, dealing with constituents, etc.*

McNerney: What I love about mathematics is its precision and beauty. But mathematics is about more than just solving problems and proving theorems. It gives practitioners an insight into the relation between the mind and the world. If content and meaning is taken away, becoming abstract, it is possible to find the form of a solution. This gives hope that even the most intractable problems can be approached and that true progress can be made. It means that the struggle in and of itself is worthwhile and that if we can approach problems rationally, we can find solutions and make the world a better place.

Notices: *Do you think members of Congress understand the value of mathematical research and the role it plays in innovation?*

McNerney: Most members of Congress appreciate that mathematical research is important, though some members appreciate it more than others. There is general recognition that increasing scientific and mathematical achievement will help keep the United States competitive internationally. Within the Science and Technology Committee, on which I sit, there is strong support for Science, Technology, Engineering, and Mathematics (STEM) education and for the doubling of the National Science Foundation budget over the next ten years. Though frankly, I think that is too little and over too long a period of time.

We need to restore the Office of Technology Assessment, which was eliminated in the mid-1990s. The goal of OTA was to provide members of Congress and Congressional committees with objective and authoritative analysis of complex scientific and technical issues.

Notices: *How can we better educate members of Congress as to the value of mathematics research and its contribution to innovation?*

McNerney: Most members of Congress have constituent meetings of one form or another in their districts and in Washington. Mathematicians should request individual meetings or form advisory groups that meet regularly with their representative. Getting to know your representative is key. Nothing works in politics like personal relationships. When you meet, if it's in an office appointment, take maybe three mathematicians who can effectively convey the message and bring some concrete examples of how their work benefits the member's district. It's important to educate the member how mathematics research will benefit his or her district. I would also emphasize the importance of mathematics and education to the nation's security and prosperity.

If you can't get an office appointment, then go to the member's announced town hall meetings and ask relevant but not embarrassing questions. If you can't schedule a meeting directly with the member of Congress, ask to meet with a member of his or her staff. Don't view meeting with staff as a missed opportunity. Staffers serve as the "eyes and ears" of the member of Congress, making recommendations and providing members with research and information about a wide variety of issues.

Congressman Jerry McNerney

Notices: *What do you consider to be the main national issues where mathematics and mathematicians can make decisive contributions?*

McNerney: This is the million dollar question: how can someone or even a group have a positive impact on human destiny? Mathematics has raw power, but to have an impact, this power has to be harnessed and exploited for the greater human good. This is where creativity and real brain power comes into play. Mathematicians have shown they have the brain power, and the next step is to harness this power to do good. Napoleon was a mathematician who used his power to win wars for France, then became the emperor and ultimately found himself exiled for his excesses. One of the best qualities about mathematicians is that, by and large, we are unassuming. This is a quality that people love. We simply have to understand the perils we face and the enormous responsibility we have to use our power to meet those challenges head on.

Notices: *What contributions can mathematicians make to the debates on global environmental issues?*

McNerney: I am, of course, very concerned about global warming. But there are other issues that are equally threatening, such as nuclear proliferation. We can model the climate, and eventually, engineer or control it. Mathematics offers the tools to move forward. We have all studied the achievements of past mathematicians. In the early twentieth century, mathematicians were also engineers, but today, mathematicians are often pure practitioners. This change has certain advantages, but the world is in desperate need of technical guidance at the highest levels. Specialization is not what's needed right now, but people who can bridge the specialties and derive concrete solutions. Mathematicians are well poised to fill this need.

Notices: *How would you assess the state of mathematics education in the U.S.?*

McNerney: Education in the U.S. is in need of major improvement, and mathematics education is certainly not the exception. We have not invested enough in infrastructure and education, and the results will become more apparent as time goes on. Dollars invested in education are repaid tenfold

later on. We must make the need to invest in education clear to the American people, and we need to help young people appreciate and take advantage of the educational opportunities being offered to them. Too many young people do not recognize the value of getting a good education. Getting a degree in engineering, science, or mathematics takes hard work that begins well before college, and students may not recognize the importance of making the sacrifice necessary to meet that kind of goal. A good education takes work, but the reward is plentiful. We have to do a better job of helping our young people see the benefit of that work. Some of that responsibility lies at the federal level in helping to set national priorities.

Notices: *Some mathematicians refuse to accept U.S. military funding for research. As both a mathematician and a congressman, how do you look at the issue?*

McNerney: Mathematics is an amoral exercise. Moral and ethical considerations are external to real math. But the impact of the math we do cannot be divorced from the research process. I don't judge individuals who choose not to work on military projects, and I do not judge those who accept such assignments. We have to look into ourselves and answer that question individually. I simply ask that we all do take the time to ask the questions.

Notices: *Do you see the recent discussion of immigration affecting the entrance of foreign graduate students and professionals into U.S. mathematics?*

McNerney: Certainly. Just the discussion has an impact, not to mention the laws that may get passed. Mathematics does not have political bias. There isn't a Republican or Democratic theorem. There aren't American theorems versus Chinese theorems. Mathematics is a tool for all to use to confront the problems ahead. I would be disappointed to see this country adopt policies that will unintentionally prevent the advance of mathematics.

Notices: *If you could give a mathematical lecture to a joint session of Congress, what would the subject be?*

McNerney: There are some pretty good theorems out there, such as the free will theorem, that would be fun to present and would "wow" members of Congress. However, since this is a hypothetical question, I would work with sociologists and other behavioral experts to develop models that accurately predict societal behavior. I would develop present models to provide us rational tools to use in making difficult and consequential decisions, such as accurately predicting what the societal consequences of ignoring global warming will be or the likely outcome of applying military options in a variety of different scenarios.

You often hear the saying, "Do the math." If the mathematics shows a strong result about possible futures, then maybe we could discuss what it would take to avoid catastrophic outcomes.

Notices: *What do you think the future of mathematics will be?*

McNerney: Mathematics is an ancient and venerable discipline. It has been shaped by necessity, by people attracted to its challenge, and by its utility and beauty. Human beings have not changed in a fundamental way since the Egyptians used math to build the pyramids. Our civilization is more sophisticated and the challenges have grown. Hard boiled analysis will be needed on many fronts to enable mankind to grow and prosper.

Will the nature of mathematics change? Certainly it will. The change is already under way, from the mathematics of physics to the mathematics of biology, from individuals working alone with pencil and paper to collaborative efforts involving telecommunications and digital computers. Mathematics will change with the needs and with the tools available. New problems will challenge new generations of mathematicians. Mathematics will provide tools to answer questions and will be an integral part of the evolution of society. I believe that mathematics will ultimately be called upon to analyze and understand large-scale social interactions such as war and famine. It will map out the human brain and the universe. Mathematics will be with us and will provide the tools necessary to define our destiny as we move toward an unknown future.

Bass Receives National Medal of Science

On July 18, 2007, President George W. Bush announced the recipients of the 2006 National Medal of Science. Among the eight medalists is Hyman Bass, Roger Lyndon Collegiate Professor of Mathematics and of Mathematics Education at the University of Michigan. Bass was cited for "his fundamental contributions to pure mathematics, especially in the creation of algebraic K-theory, his profound influence on mathematics education, and his service to the mathematics research and education communities. With his unique combination of gifts he has had enormous impact over the course of a half century."

President Bush presented the awards to the 2006 and 2005 National Medal of Science recipients in a White House ceremony on July 27, 2007. (Among the 2005 recipients is Stanford University statistician Bradley Efron; an announcement about that award appeared in the September 2007 issue of the *Notices*.)

Hyman Bass

The accompanying sidebar provides a brief account of Bass's research in mathematics. He has also worked extensively in mathematics education, primarily in collaboration with Deborah Ball of the University of Michigan. This work has centered on subject-matter knowledge entailed in teaching, practice-based research on teaching and learning, teacher education, reasoning and proof in school mathematics, and analysis of curriculum materials. Bass was a member of the Mathematical Sciences Education Board of the National Research Council from 1991 until

The Mathematical Work of Hyman Bass

Hyman Bass's wide-ranging research in algebra has featured a conceptual clarity and generality that not only powerfully addressed deep questions but provided the tools and framework for others who followed in his pioneering footsteps. His early work considered commutative rings of finite injective dimension, and his recognition of their "ubiquity" resulted in one of the most often-cited papers in commutative algebra. Bass's interest in projective modules led to his project to systematically translate topological K-theory into algebra, and in particular to the definition of K_1 of a ring and the analysis of the latter, including a complete description in the important case of rings of algebraic integers. The answer, as well as the analysis, is connected to the Congruence Subgroup Problem, another area where Bass made fundamental contributions.

One of the techniques used in the Congruence Subgroup Problem led to the consideration of groups acting on trees and generalizations and in turn to considerations of locally compact automorphism groups of trees and the lattices in them. As with algebraic K-Theory, Bass's work not only solved basic problems in the theory of tree lattices but formulated the foundations for the subject. Along with his genius for setting the stage and systematizing subjects, Bass has many technically demanding achievements, including subtle and significant examples delineating the boundaries of the representation theory of finitely generated groups.

No brief summary can do more than suggest the range of topics on which Hyman Bass's work has made an impact. For a fuller account covering Bass's work up to 1997, we refer the reader to [1].

—T. Y. Lam, University of California, Berkeley
and
—A. R. Magid, University of Oklahoma

Reference

[1] *Algebra, K-Theory, Groups, and Education*, Contemp. Math. **243** (1999), Amer. Math. Soc., Providence, RI.

2000 (chair, 1993–2000). From 1998 until 2006 he was president of the International Commission on Mathematics Instruction, which operates under the auspices of the International Mathematical Union.

Born on October 5, 1932, in Houston, Texas, Hyman Bass received his Ph.D. from the University of Chicago in 1959 under the direction of Irving Kaplansky. Bass was on the faculty of Columbia University before moving to the University of Michigan in 1999. He has held numerous visiting positions, including at the Institute for Advanced Study in Princeton, the Tata Institute for Fundamental Research in Mumbai, and at the Institut des Hautes Études Scientifiques in Paris. He has served on the AMS Council and on many AMS committees, including the *Notices* Editorial Board. He was president of the Society during 2001 and 2002. His honors include the AMS Cole Prize in Algebra (1975) and the Gung and Hu Award for Distinguished Service to Mathematics of the Mathematical Association of America (2006). Bass was elected as a member of the American Academy of Arts and Sciences (1980), as a fellow of the American Association for the Advancement of Science (1980), and as a member of the U.S. National Academy of Sciences (1982). He was an invited speaker at the International Congress of Mathematicians in Moscow (1966) and in Vancouver (1974), and he delivered a plenary address at the International Congress on Mathematical Education in Copenhagen (2004). He was a member of Bourbaki from 1970 until 1982.

The National Medal of Science is the country's highest distinction for contributions to scientific research. According to a news release from the Office of Science and Technology Policy, "The National Medal of Science honors individuals for pioneering scientific research in a range of fields, including physical, biological, mathematical, social, behavioral, and engineering sciences, that enhances our understanding of the world and leads to innovations and technologies that give the United States its global economic edge." The National Science Foundation administers the award, which was established by the Congress in 1959.

—Allyn Jackson

Mathematics People

SIAM Prizes Awarded

The Society for Industrial and Applied Mathematics (SIAM) awarded several prizes at recent meetings.

The SIAM Conference on Applications of Dynamical Systems was held in Snowbird, Utah, from May 28 through June 1, 2007. LAI-SANG YOUNG of the Courant Institute of Mathematical Sciences, New York University, was awarded the AWM-SIAM Sonia Kovalevsky Lectureship for her fundamental contributions in the field of ergodic theory and dynamical systems. Her pioneering research has had a significant impact in the investigation of dynamical complexity, strange attractors, and probabilistic laws of chaotic systems. The lectureship is intended to highlight significant contributions of women to applied or computational mathematics.

SALVATORE TORQUATO of the Princeton Institute for the Science and Technology of Materials, Princeton University, was awarded the Ralph E. Kleinman Prize for his contributions to the modeling, analysis, and computational study of heterogeneous materials.

ANDREW STUART of the University of Warwick received the J. D. Crawford Prize of the SIAM Activity Group on Dynamical Systems (SIAG/DS) for his contributions to the fields of stochastic ordinary and partial differential equations, including mathematical theory, algorithm development, and the application of stochastic differential equations to physical models and the dynamics of inertial partials in random fields. The prize is awarded for recent outstanding work on a topic in nonlinear science, including dynamical systems theory and its applications, as well as experiments and computations/simulations.

HARRY L. SWINNEY of the University of Texas, Austin, was awarded the Jürgen Moser Lectureship of the SIAG/DS for his elegant and incisive laboratory experiments that have elucidated the nonlinear dynamics of systems far from equilibrium.

The SIAM Conference on Control and Its Applications was held in San Francisco in July 2007. HÉCTOR J. SUSSMANN of Rutgers University was awarded the W. T. and Idalia Reid Prize for his fundamental contributions to nonlinear control, especially in the area of differential-geometric control theory. The prize is awarded for research in or other contributions to the broadly defined areas of differential equations and control theory.

MURAT ARCAK of the Rensselaer Polytechnic Institute received the SIAM Activity Group on Control and Systems Theory Prize for his fundamental contributions to the study of large networked systems and for his accomplishments in developing a novel passivity approach to large-scale networks, such as communication, power, and biological systems, and deriving fundamental results for increasing their robustness and performance.

—From a SIAM announcement

Prizes of the London Mathematical Society

The London Mathematical Society (LMS) has awarded several prizes for 2007.

BRYAN BIRCH of the University of Oxford has been awarded the De Morgan Medal in recognition of his influential contributions to modern number theory. Birch worked with Peter Swinnerton-Dyer of the University of Cambridge to create a new area of arithmetic algebraic geometry, formulating the Birch–Swinnerton-Dyer conjectures. These conjectures are among seven classic unsolved mathematical problems identified by the Clay Mathematics Institute in Cambridge, Massachusetts, for proofs of which the institute is offering US$1 million prizes. In addition, Birch's work on Heegner points has led to huge advances in the arithmetic of elliptic curves.

BÉLA BOLLOBÁS of the University of Cambridge has been awarded the Senior Whitehead Prize for his fundamental contributions to almost every aspect of combinatorics. He has written a large number of research papers and influential textbooks, many of which have defined or redefined whole areas of research.

MICHAEL GREEN of the University of Cambridge received the Naylor Prize and Lectureship in Applied Mathematics in recognition of his founding work in superstring theory, which has dominated theoretical physics over the past twenty years. His contributions to the subject have profoundly influenced both pure and applied mathematics.

Four Whitehead Prizes were awarded. NIKOLAY NIKOLOV of the University of Oxford and Imperial College, London, was recognized for several important advances in group theory, especially in profinite groups and asymptotic aspects of arithmetic groups and finite simple groups. OLIVER RIORDAN of the University of Cambridge was honored for his contributions to graph polynomials, random graphs, extremal combinatorics, models of large-scale real-world graphs, and percolation theory. IVAN SMITH of the University of Cambridge was recognized for his work on symplectic topology, in which he often blends ideas from algebraic geometry and topology in novel ways. CATHARINA STROPPEL of the University of Glasgow was honored for her contributions to representation theory, in particular in the framework of categorifications and its applications to low-dimensional topology.

—From an LMS announcement

Royal Society of Canada Elections

The following mathematical scientists have been elected to the Royal Society of Canada: DAVID C. BRYDGES, University of British Columbia; WALTER CRAIG, McMaster University; and LISA JEFFREY, University of Toronto at Scarborough. Chosen as a Specially Elected Fellow was PETER HACKETT of the Alberta Ingenuity Fund.

—From a Royal Society of Canada announcement

News from the IMA

The Institute for Mathematics and its Applications (IMA) has announced the appointment of Fadil Santosa of the University of Minnesota as its next director. His appointment will begin on July 1, 2008. He will replace Douglas Arnold, who has been director since 2001 and who will remain a professor of mathematics at the University of Minnesota.

Santosa has taught at the University of Minnesota since 1995. He previously held positions at Cornell University and the University of Delaware. He currently serves as director of the Minnesota Center for Industrial Mathematics. He was associate director for industrial programs at the IMA from 1997 until 2001 and deputy director from 2001 to 2004. His research interests are in the areas of photonics, inverse problems, optimal design, and financial data analysis.

—From an IMA announcement

Mathematics Opportunities

NSF Postdoctoral Research Fellowships

The National Science Foundation (NSF) awards Mathematical Sciences Postdoctoral Research Fellowships (MSPRF) for appropriate research in areas of the mathematical sciences, including applications to other disciplines. A revised program announcement is available from the website `http://www.nsf.gov/pubs/2007/nsf07573/nsf07573.htm`. The deadline for proposals is **October 17, 2007**.

—From an NSF announcement

AMS Epsilon Fund

The AMS Epsilon Fund awards grants to summer mathematics programs that support and nurture mathematically talented high school students in the United States. The deadline for application for funding for summer 2008 programs is **December 15, 2007**. Application materials are available at `http://www.ams.org/outreach/epsilon.html` or by mail: Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; telephone 800-321-4267, ext. 4170; email: `prof-serv@ams.org`.

—AMS announcement

AMS-AAAS Mass Media Summer Fellowships

The American Association for the Advancement of Science (AAAS) sponsors the Mass Media Science and Engineering Summer Fellows Program, through which graduate students work during the summer in major media outlets. The AMS provides support each year for one or two graduate students in the mathematical sciences to participate in the program. In past years the AMS-sponsored fellows have held positions at *Scientific American*, *Business Week*, Voice of America, Discovery Channel Online, National Geographic Television, *Popular Science*, *The Chicago Tribune*, and *Time* magazine.

Fellows receive a weekly stipend of US$450, plus travel expenses, to work for ten weeks during the summer as reporters, researchers, and production assistants in media organizations. They observe and participate in the process by which events and ideas become news, improve their ability to communicate about complex technical subjects in a manner understandable to the public, and increase their understanding of editorial decision making and of how information is effectively disseminated. Each fellow attends an orientation and evaluation session in Washington, D.C., and begins the internship in mid-June. Fellows submit interim and final reports to the AAAS. A wrap-up session is held at the end of the summer.

Mathematical sciences faculty are urged to make their graduate students aware of this program. The deadline to apply for fellowships for the summer of 2008 is **January 15, 2008**. Further information about the fellowship program and application procedures is available online at `http://www.aaas.org/programs/education/MassMedia/`; or applicants may contact Stacey Pasco, Director, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone 202-326-6645; fax 202-371-9849; email: `spasco@aaas.org`.

Further information is also available at `http://www.ams.org/government/massmediaann.html` and through the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone 202-588-1100; fax 202-588-1853; email: `amsdc@ams.org`.

—Elaine Kehoe

Enhancing the Mathematical Sciences Workforce in the Twenty-First Century

The long-range goal of the Enhancing the Mathematical Sciences Workforce in the Twenty-First Century (EMSW21)

program of the National Science Foundation (NSF) is to increase the number of well-prepared U.S. citizens, nationals, and permanent residents who pursue careers in the mathematical sciences and in other NSF-supported disciplines. This program builds on the Vertical Integration of Research and Education (VIGRE) program and includes a broadened VIGRE activity, an additional component for Research Training Groups (RTG), and another for Mentoring through Critical Transition Points (MCTP) in the Mathematical Sciences.

The VIGRE program supports projects that involve entire departments in the training process, from the start of the undergraduate career through the completion of a postdoctoral fellowship. The RTG program involves a group of researchers based in a subarea of the mathematical sciences or linked by a multidisciplinary theme and supports training at educational levels from undergraduate to postdoctoral within that focus. The MCTP program supports projects, either departmentally based or conducted by a large group of faculty members, that are aimed at critical transition points in the educational careers of students and junior researchers.

The DMS expects to make between nine and fifteen awards under this program in 2008. The deadline for proposals is **June 10, 2008**. For more information about the program and all of its components, see the website `http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05595`.

—From an NSF announcement

Joint DMS/NIGMS Initiative in Mathematical Biology

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) and the National Institute of General Medical Sciences (NIGMS) of the National Institutes of Health (NIH) have announced an Initiative to Support Research in the Area of Mathematical Biology. This competition is designed to support research on mathematical problems related to biological problems in areas supported by NSF/DMS and NIH/NIGMS. A direct relationship between a biological application and the mathematics is expected. Proposals from research teams that include scientists from both the life sciences community and the mathematical sciences community are encouraged. Both new and existing collaborations will be supported. Proposals from individual investigators will need to make the case that the individual has expertise in both areas.

Successful proposals will identify innovative mathematics or statistics needed to solve an important biological problem. Research that would apply standard mathematics or statistics to solving biological problems is not appropriate for this competition and should be submitted directly to NIH. Similarly, proposals with research in mathematics or statistics that is not tied to a specific biological problem should be submitted to the appropriate DMS program at NSF. Proposals designed to create new software tools based on existing models and methods will not be accepted in this competition.

The deadline for full proposals is **October 1, 2007**. See the website `http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5300` for more information.

—From an NSF announcement

News from PIMS

The Pacific Institute for the Mathematical Sciences (PIMS) invites nominations of outstanding young researchers in the mathematical sciences for Postdoctoral Fellowships for the year 2008–2009. Candidates must be nominated by one or more scientists affiliated with PIMS or by a department (or departments) affiliated with PIMS. The fellowships are intended to supplement support made available through such a sponsor. PIMS expects to support up to 20 fellowships tenable at any of its Canadian member universities: Simon Fraser University, the University of Alberta, the University of British Columbia, the University of Calgary, and the University of Victoria, as well as its affiliated universities, the University of Lethbridge and the University of Regina.

For the 2008–2009 competition, the amount of the award is CA$20,000, and the sponsor(s) is (are) required to provide additional funds to finance a minimum stipend of CA$40,000 (including benefits).

Award decisions are made by the PIMS PDF Review Panel based on excellence of the candidate, potential for participation in PIMS programs, and potential for involvement with PIMS partners. PIMS Postdoctoral Fellows will be expected to participate in all PIMS activities related to the fellow's area of expertise and will be encouraged to spend time at other sites. To ensure that PIMS Postdoctoral Fellows are able to participate fully in institute activities, they may not teach more than two single-term courses per year.

Nominees must have a Ph.D. or equivalent (or expect to receive a Ph.D. by December 31, 2008) and be within three years of the Ph.D. at the time of the nomination (i.e., the candidate must have received her or his Ph.D. on or after January 1, 2005). The fellowship may be taken up at any time between April 1, 2008, and January 1, 2009. The fellowship is for one year and is renewable for at most one additional year.

Nominations must include: 1) curriculum vitae, 2) statement of research interests, 3) three letters of reference (including one from a sponsoring professor), and 4) statement of anticipated support from the sponsor.

Nominations must be received by **December 15, 2007**. Complete information on Postdoctoral Fellowship nominations, including contact information and submission guidelines, is available at `http://www.pims.math.ca/fellowships`.

—PIMS announcement

Teach For America Accepting Applications for the 2008 Corps

The United States needs to provide students with a high-quality mathematics education in order to build a robust and diverse pipeline of future mathematicians, engineers, and other technical professionals. Nowhere is this need more pressing than in our low-income communities and among students of color.

By the time they enter eighth grade, students in low-income communities are on average three grade levels behind their peers in high-income communities in mathematics and are three times less likely than their high-income peers to perform at or above a proficient level in mathematics (as defined by the National Assessment of Educational Progress). In twelfth grade, African American students are nearly five times less likely and Hispanic students nearly four times less likely than white students to be at or above proficient level in mathematics. Teach For America is seeking mathematics majors to use their content knowledge to help us address this academic achievement gap.

Teach For America is the national corps of outstanding recent college graduates of all academic majors who commit two years to teach in urban and rural public schools, working to lead students to the kinds of academic gains that change life trajectories. Alumni then use the insights and experience gained from their corps experience to develop ways to work subsequently as educators, mathematicians, analysts, consultants, and leaders in other fields to address the underlying problems affecting education in low-income areas.

Edward F. Burger, chair of the Department of Mathematics and Statistics at Williams College, said: "Every mathematics major I've known who has participated in the Teach For America program came away from the experience with a renewed appreciation for mathematics, education, and the world around them. It is a challenging but exciting opportunity that can change lives."

Notices readers are encouraged to make their undergraduate students aware of Teach For America. To hear about the experiences of our corps members and alumni, to learn how one can join the network of emerging leaders to make a difference, and to read about our relationships with graduate programs and employers, visit our website, `http://www.teachforamerica.org`.

—Teach For America announcement

Call for Nominations for ICMI Awards

The Executive Committee of the International Commission on Mathematical Instruction (ICMI) some time ago created two awards in mathematics education research: the Hans Freudenthal Award, for a major program of research on mathematics education; and the Felix Klein Award, for lifelong achievement in mathematics education research. Previous recipients of the Freudenthal Award are Celia Hoyles (2003) and Paul Cobb (2005), and previous recipients of the Klein Award are Guy Brousseau (2003) and Ubiratan D'Ambrosio (2005).

An ICMI Awards Committee, chaired by Mogens Niss of Roskilde University in Denmark, has been appointed for selecting the awardees. The committee is now entering a third cycle of selecting awardees for 2007. The result of this process will be known by the end of 2007. The 2007 awards, together with the 2005 awards, will be presented to the recipients at the 11th International Congress on Mathematical Education in Monterrey, Mexico, in July 2008.

As was the case for the first two cycles, the ICMI Awards Committee welcomes suggestions coming from the mathematics education community. Nominations of candidates for the Felix Klein or the Hans Freudenthal Awards have to be accompanied by summaries presenting the persons nominated and the reasons for the nomination. Moreover, nominations also have to include the names and coordinates of two or three persons whom the committee may contact for further information.

All proposals must be sent by email to Mogens Niss, `mn@ruc.dk`, no later than **November 15, 2007**.

—ICMI Awards Committee

Clay Research Fellow Nominations

The Clay Mathematics Institute (CMI) is currently accepting nominations for the position of Clay Research Fellow. Fellows are employed for a period of two to five years and may conduct their research at whatever location or combination of locations best suits their research. In addition to a generous salary, the fellow receives support for travel and research expenses, as well as provisions for collaboration.

The primary selection criteria are the exceptional quality of the candidate's research and the candidate's promise to become a mathematical leader. At the time of their selection, most recent appointees were graduating Ph.D. students. However, mathematicians under age thirty have sometimes been appointed. Selection decisions are made by CMI's Scientific Advisory Board.

To nominate a candidate, please send the following items by **October 30, 2007**: (1) letter of nomination, (2) names and contact information of two other references, (3) curriculum vitae, and (4) publication list for the nominee. Nominations should be sent to: Clay Mathematics Institute, One Bow Street, Cambridge, MA 02138. Electronic submissions are also accepted at `nominations@claymath.org`. Address nominations to the attention of Christa Carter.

Information about Clay Research Fellows is also available on the CMI website at `http://www.claymath.org/fas/research_fellows/`. Additional information

may be obtained by calling 617-995-2600 or by email: nominations@claymath.org.

—From a CMI announcement

Call for Nominations for André Aisenstadt Mathematics Prize

The Centre de Recherches Mathématiques (CRM) solicits nominations for the André Aisenstadt Mathematics Prize. The prize recognizes outstanding research achievement by a young Canadian mathematician in pure or applied mathematics.

Candidates must be Canadian citizens or permanent residents of Canada and must have received the Ph.D. within the preceding seven years. The recipient is invited to deliver a lecture at CRM and to write a brief article on his or her work for publication in the CRM's *Bulletin*.

Nominations must be submitted by at least two sponsors and include the following information: a curriculum vitae, a list of publications, a cover letter explaining the basis of the nomination, up to four reprints, and a maximum of four letters of support. The deadline for nominations is **October 1, 2007**. Nominations must be submitted to the director of the CRM, Université de Montréal, C.P. 6128, Succursale Centre-ville, Montréal, QC H3C 3J7 Canada; fax: 514-343-2254; email: directeur@crm.umontreal.ca.

—From a CRM announcement

AWM Essay Contest

To increase awareness of women's ongoing contributions to the mathematical sciences, the Association for Women in Mathematics (AWM) is holding an essay contest for biographies of contemporary women mathematicians and statisticians in academic, industrial, and government careers.

The essays will be based primarily on interviews with women who are currently working in mathematical sciences careers. The contest is open to students in the following categories: 6th–8th grades, 9th–12th grades, and college undergraduates. At least one winning submission will be chosen from each category. Winners will receive a prize, and their essays will be published online at the AWM website. A grand prize winner will have his or her submission published in the *AWM Newsletter* as well. The deadline for entries is **November 2, 2007**.

In addition to student entries, organizers are currently seeking women mathematicians to volunteer as the subjects of these essays. For more information, see http://www.awm-math.org/biographies/contest.html.

—From an AWM announcement

Inside the AMS

AMS Department Chairs Workshop

This annual one-day workshop for chairs and leaders of departments of mathematical sciences will be held a day before the start of the San Diego Joint Mathematics Meetings, on Saturday, January 5, 2008, from 8:00 a.m. to 6:30 p.m. The workshop format is intended to stimulate discussion among attending chairs and workshop leaders. Sharing ideas and experiences with peers provides a form of department chair therapy, creating an environment that enables attending chairs to address departmental matters from new perspectives.

Past workshop sessions have focused on a range of issues facing departments today, including personnel issues (staff and faculty), long-range planning, hiring, promotion and tenure, budget management, assessments, outreach, stewardship, junior faculty development, communication, and departmental leadership.

There is a registration fee for the workshop, which is in addition to and separate from the Joint Meetings registration. An invitation to attend the workshop will be sent to department chairs this fall. Information will also be posted on the AMS website. For further information, please contact the AMS Washington Office by telephone, 202-588-1100, or by email: `amsdc@ams.org`.

—AMS Washington Office

Undergraduate Research Conference Proceedings Available

In 2006, with funding from the National Security Agency (NSA), the AMS organized the conference "Promoting Undergraduate Research in Mathematics" (PURM), which took place on September 28–30, 2006, in Rosemont, IL. PURM continued the work of the 1999 conference (see below) by bringing together a diverse group of people who are actively involving undergraduates in research programs of all types in order that they might share their experiences and explore ways of creating more such opportunities, with the goal of bringing the most talented students into research-level mathematics.

The proceedings volume for the PURM conference, *Proceedings of the Conference on Promoting Undergraduate Research in Mathematics*, was published in June 2007 and is available as a PDF document at `http://www.ams.org/outreach/PURMproceedings.pdf`.

In 1999 the AMS brought together mathematicians from across the country who have been involved in summer mathematics programs for undergraduates. The purpose of the conference was to exchange ideas, discuss issues of common concern, establish contacts, and gather information that would be of use to those in the mathematical community who are interested in establishing summer mathematics programs for undergraduates. The workshop was held September 30–October 2, 1999, at Crystal City, Arlington, Virginia, with support from the National Security Agency.

The proceedings volume for the 1999 conference was published in June 2000 and is available as a PDF document *Proceedings of the Conference on Summer Undergraduate Mathematics Research Programs* at `http://www.ams.org/outreach/REUproceedings.pdf`.

A list of summer REU programs is also maintained on the AMS website at `http://www.ams.org/outreach/reu.html`.

—AMS Professional Programs and Services Department

Deaths of AMS Members

William T. Alford, associate professor, from Louisville, KY, died on May 29, 2003. Born on July 21, 1937, he was a member of the Society for 41 years.

Bengt G. Carlson, from Santa Fe, NM, died on June 14, 2007. Born on December 26, 1915, he was a member of the Society for 67 years.

John G. Harvey, professor emeritus, University of Wisconsin, Madison, died on May 5, 2007. Born on August 10, 1934, he was a member of the Society for 49 years.

John Arnold Kalman, professor, University of Auckland, New Zealand, died on June 11, 2007. Born on November 19, 1928, he was a member of the Society for 36 years.

Masasuke Kawasaki, from Slidell, LA, died on June 8, 2007. Born on March 21, 1925, he was a member of the Society for 14 years.

John C. Mairhuber, from Bangor, ME, died on June 13, 2007. Born on December 14, 1922, he was a member of the Society for 55 years.

Kyungho Oh, assistant professor, University of Missouri at St. Louis, died on June 11, 2007. Born on May 24, 1959, he was a member of the Society for 25 years.

Roy F. Reeves, professor emeritus, from Granville, OH, died on May 5, 2007. Born on July 8, 1922, he was a member of the Society for 57 years.

Jean B. Richmond, assistant professor emeritus, Southern Methodist University, died on December 27, 1998. Born on October 13, 1925, she was a member of the Society for 32 years.

Felice L. L. Ronga, professor, University of Geneva, Switzerland, died on May 22, 2007. Born on November 23, 1942, he was a member of the Society for 34 years.

John Todd, professor, California Institute of Technology, died on June 21, 2007. Born on May 16, 1911, he was a member of the Society for 59 years.

Azelle B. Waltcher, from New York, NY, died on June 5, 2007. Born on March 27, 1925, she was a member of the Society for 61 years.

Cun Zheng Wang, research professor and engineer, Chengdu Engine Company, People's Republic of China, died on July 10, 2006. Born on August 8, 1938, he was a member of the Society for 18 years.

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.ou.edu` in the case of the editor and `notices@ams.org` in the case of the managing editor. The fax numbers are 405-325-7484 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

Upcoming Deadlines

September 13, 2007: Applications for NSF Research Experiences for Undergraduates (REU) program sites. See `http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf07569`.

September 15, 2007: Nominations for Sloan Research Fellowships. See `http://www.sloan.org/programs/fellowship_brochure.shtml`.

September 21, 2007: Full proposals for NSF Focused Research Groups. See `http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5671&org=DMS`.

September 30, 2007: Applications for Math in Moscow for spring 2008. See `http://www.mccme.ru/mathinmoscow` or write to: Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax: +7095-291-65-01; email: `mim@mccme.ru`; or contact Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201

Where to Find It

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

Charles Street, Providence RI 02904-2294; email: student-serv@ams.org.

September 30, 2007: Applications for travel grants to ICME-11. See http://www.nctm.org/icme.aspx or contact Margaret Iding, 116 North Kedzie, Division of Science and Mathematics Education, Michigan State University, East Lansing, MI 48824; telephone: 517-355-1708, ext. 105; fax: 517-432-9868; email: idingm@msu.edu.

October 1, 2007: Nominations for André Aisenstadt Mathematics Prize. See "Mathematics Opportunities" in this issue.

October 1, 2007: Proposals for Joint DMS/NIGMS Initiative to Support Research in the Area of Mathematical Biology. See "Mathematics Opportunities" in this issue.

October 1, 2007: Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@math.umd.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

October 5, 2007: Full proposals for NSF IGERT competition. See http://www.nsf.gov/pubs/2007/nsf07540/nsf07540.htm.

October 10, 2007: Proposals for NSF Distinguished International Postdoctoral Research Fellowships. See http://www.nsf.gov/pubs/2001/nsf01154/nsf01154.txt.

October 15, 2007: Proposals for NSA Mathematical Sciences Program grants. See http://www.nsa.gov/msp/index.cfm or contact the program staff: MSP Director Michelle D. Wagner (mdwagn4@nsa.gov) or MSP Program Administrator Rosalie (Jackie) Smith (rjsmit2@nsa.gov). To obtain brochures or for questions, please call 301-688-0400 or write to: Mathematical Sciences Program, National Security Agency, Suite 6557, Fort Meade, MD 20755-6557.

October 15, 2007: Preferred deadline for January entrance in junior-year program at the Smith College Center for Women in Mathematics. See http://www.math.smith.edu/center.

October 17, 2007: Proposals for NSF Mathematical Sciences Postdoctoral Research Fellowships. See http://www.nsf.gov/pubs/2007/nsf07573/nsf07573.htm.

October 17, 2007: Full proposals for NSF Computational Science Training for Undergraduates in the Mathematical Sciences (CSUMS). See http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf06559.

October 30, 2007: Nominations for Clay Research Fellowships. See "Mathematics Opportunities" in this issue.

November 2, 2007: Entries for AWM Essay Contest. See "Mathematics Opportunities" in this issue.

November 15, 2007: Applications for NSA Mathematics Sabbatical program. See http://www.nsa.gov/msp/index.cfm or contact the program staff: MSP Director Michelle D. Wagner (mdwagn4@nsa.gov) or MSP Program Administrator Rosalie (Jackie) Smith (rjsmit2@nsa.gov). To obtain brochures or for questions, please call 301-688-0400 or write to: Mathematical Sciences Program, National Security Agency, Suite 6557, Fort Meade, MD 20755-6557.

December 1, 2007: Applications for AMS Centennial Fellowships. See http://www.ams.org/employment/centflyer.html or write to the Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; email: prof-serv@ams.org; telephone 401-455-4107.

December 15, 2007: Applications for AMS Epsilon Fund grants. See "Mathematics Opportunities" in this issue.

January 5, 2008: Applications for IMA postdoctoral and New Directions program. See http://www/ima.umn.edu.

February 1, 2008: Applications for AWM Travel Grants and AWM Mentoring Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@awm-math.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

April 15, 2008: Applications for Math in Moscow for fall 2008. See http://www.mccme.ru/mathinmoscow or write to: Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax: +7095-291-65-01; email: mim@mccme.ru; or contact Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence RI 02904-2294; email: student-serv@ams.org.

May 1, 2008: Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@awm-math.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

June 10, 2008: Proposals for Enhancing the Mathematical Sciences Workforce in the Twenty-First Century. See "Mathematics Opportunities" in this issue.

August 18, 2008: Applications for NSF Research Experiences for Undergraduates (REU) program sites. See http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf07569.

October 1, 2008: Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@awm-math.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

DoD Mathematics Staff

Five agencies of the Department of Defense fund research in the mathematical sciences. The names, addresses, and telephone numbers of the pertinent staff members are listed below.

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Book List

The Book List highlights books that have mathematical themes and are aimed at a broad audience potentially including mathematicians, students, and 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* notices-booklist@ams.org.

*Added to "Book List" since the list's last appearance.

An Abundance of Katherines, by John Green. Dutton Juvenile Books, September 2006. ISBN 0-525-47688-1.

Alfred Tarski: Life and Logic, by Anita Burdman Feferman and Solomon Feferman. Cambridge University Press, October 2004. ISBN 0-521-80240-7. (Reviewed September 2007.)

Analysis and Probability: Wavelets, Signals, Fractals, by Palle E. T. Jorgensen. Springer, September 2006. ISBN 0-387-29519-4.

Ants, Bikes, and Clocks: Problem Solving for Undergraduates, by William Briggs. Society for Industrial and Applied Mathematics, 2005. ISBN 0-89871-574-1.

The Archimedes Codex, by Reviel Netz and William Noel. Weidenfeld and Nicolson, May 2007. ISBN-13: 978-0-29764-547-4.

The Art of Mathematics: Coffee Time in Memphis, by Béla Bollobás. Cambridge University Press, September 2006. ISBN-13: 978-0-52169-395-0.

Arthur Cayley: Mathematician Laureate of the Victorian Age, by Tony Crilly. Johns Hopkins University Press, December 2005. ISBN 0-801-88011-4.

The Artist and the Mathematician: The Story of Nicolas Bourbaki, the Genius Mathematician Who Never Existed, by Amir D. Aczel. Thunder's Mouth Press, August 2006. ISBN 1-560-25931-0. (Reviewed in this issue.)

A Beautiful Math: John Nash, Game Theory, and the Modern Quest for a Code of Nature, by Tom Siegfried. Joseph Henry Press, October 2006. ISBN 0-309-10192-1.

The Best of All Possible Worlds: Mathematics and Destiny, by Ivar Ekeland. University of Chicago Press, October 2006. ISBN-13: 978-0-226-19994-8.

Bourbaki, a Secret Society of Mathematicians, by Maurice Mashaal. AMS, June 2006. ISBN-13: 978-0-8218-3967-6. (Reviewed in this issue.)

The Cat in Numberland, by Ivar Ekeland. Cricket Books, April 2006. ISBN-13: 978-0-812-62744-2.

A Certain Ambiguity: A Mathematical Novel, by Gaurav Suri and Hartosh Singh Bal. Princeton University Press, June 2007. ISBN-13: 978-0-691-12709-5.

Chases and Escapes: The Mathematics of Pursuit and Evasion, by Paul J. Nahin. Princeton University Press, May 2007. ISBN-13: 978-0-69112-514-5.

Descartes: A Biography, by Desmond Clarke. Cambridge University Press, March 2006. ISBN 0-521-82301-3.

Einstein's Heroes: Imagining the World through the Language of Mathematics, by Robyn Arianrhod. Oxford

University Press, July 2006. ISBN-13: 978-0-195-30890-7.

Ernst Zermelo: An Approach to His Life and Work, by Heinz-Dieter Ebbinghaus. Springer, April 2007. ISBN-13: 978-3-540-49551-2.

The Essential Turing, edited by B. Jack Copeland. Oxford University Press, September 2004. ISBN 0-198-25080-0. (Reviewed November 2006.)

Evolutionary Dynamics: Exploring the Equations of Life, by Martin Nowak. Belknap Press, September 2006. ISBN 0-674-02338-2.

The Fabulous Fibonacci Numbers, by Alfred S. Posamentier and Ingmar Lehmann. Prometheus Books, February 2007. ISBN 1-591-02475-7.

Fearless Symmetry: Exposing the Hidden Patterns of Numbers, by Avner Ash and Robert Gross. Princeton University Press, May 2006. ISBN 0-691-12492-2. (Reviewed January 2007.)

Fly Me to the Moon: An Insider's Guide to the New Science of Space Travel, by Edward Belbruno. Princeton University Press, January 2007. ISBN-13: 978-0-691-12822-1.

From Cosmos to Chaos: The Science of Unpredictability, by Peter Coles. Oxford University Press, August 2006. ISBN 0-198-56762-6.

From Zero to Infinity: What Makes Numbers Interesting, by Constance Reid. Fiftieth anniversary edition, A K Peters, February 2006. ISBN 1-568-81273-6. (Reviewed February 2007.)

Gödel's Theorem: An Incomplete Guide to Its Use and Abuse, by Torkel Franzen. A K Peters, May 2005. ISBN 1-568-81238-8. (Reviewed March 2007.)

Great Feuds in Mathematics: Ten of the Liveliest Disputes Ever, by Hal Hellman. Wiley, September 2006. ISBN 0-471-64877-9.

The Great π/e Debate: Which Is the Better Number?, DVD by Colin Adams and Thomas Garrity. Mathematical Association of America, 2007. ISBN 0-88385-900-9.

How Mathematics Happened, by Peter S. Rudman. Prometheus Books, October 2006. ISBN 1-591-02477-3.

How to Cut a Cake: And Other Mathematical Conundrums, by Ian Stewart. Oxford University Press, November 2006. ISBN 0-199-20590-6.

I Am a Strange Loop, by Douglas R. Hofstadter. Basic Books, March 2007. ISBN-13: 978-0-46503-078-1. (Reviewed August 2007.)

John von Neumann: Selected Letters, edited by Miklós Rédei. AMS, November 2005. ISBN 0-8218-3776-1. (Reviewed June/July 2007.)

Karl Pearson: The Scientific Life in a Statistical Age, by Theodore M. Porter. Princeton University Press, new edition, December 2005. ISBN-13: 978-0-69112-635-7.

Leonhard Euler, by Emil A. Fellmann. Birkhäuser, 2007. ISBN-13: 978-3-7643-7538-6.

Leonhard Euler, a Man to Be Reckoned With, by Andreas K. Heyne and Alice K. Heyne. Birkhäuser, 2007. ISBN-13: 978-3-7643-8332-9.

Letters to a Young Mathematician, by Ian Stewart. Perseus Books, April 2006. ISBN-13: 978-0-465-08231-5. (Reviewed May 2007.)

A Madman Dreams of Turing Machines, by Janna Levin. Knopf, August 2006. ISBN 1-400-04030-2.

The Man Who Knew Too Much: Alan Turing and the Invention of the Computer, by David Leavitt. Great Discoveries series, W. W. Norton, December 2005. ISBN 0-393-05236-2. (Reviewed November 2006.)

**The Math behind the Music*, by Leon Harkleroad. Cambridge University Press, August 2006. ISBN-13: 978-0-521-00935-5.

Mathematical Illustrations: A Manual of Geometry and PostScript, by Bill Casselman. Cambridge University Press, December 2004. ISBN 0-521-54788-1. (Reviewed January 2007.)

**The Mathematician's Brain*, by David Ruelle. Princeton University Press, July 2007. ISBN-13: 978-0-691-12982-2.

Mathematics and Common Sense: A Case of Creative Tension, by Philip J. Davis. A K Peters, October 2006. ISBN 1-568-81270-1.

Measuring the World, by Daniel Kehlmann. Pantheon, November 2006. ISBN 0-375-42446-6.

**The Mind of the Mathematician*, by Michael Fitzgerald and Ioan James. Johns Hopkins University Press, May 2007. ISBN-13: 978-0-801-88587-7.

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

More Sex Is Safer Sex: The Unconventional Wisdom of Economics, by Steven E. Landsburg. Free Press, April 2007. ISBN-13: 978-1-416-53221-7.

The Motion Paradox: The 2,500-Year Old Puzzle behind All the Mysteries of Time and Space, by Joseph Mazur. Dutton Adult, April 2007. ISBN-13: 978-0-52594-992-3.

**Music: A Mathematical Offering*, by David J. Benson. Cambridge University Press, December 2006. ISBN-13: 978-0-521-61999-8.

**Music and Probability*, by David Temperley. MIT Press, January 2007. ISBN-13: 978-0-262-20166-7.

**Musimathics: The Mathematical Foundations of Music*, by Gareth Loy. MIT Press, June 2006 and June 2007. Volume 1: ISBN-13: 978-0-262-12282-5. Volume 2: ISBN-13: 978-0-262-12285-6.

Negative Math: How Mathematics Rules Can Be Positively Bent, by Alberto A. Martinez. Princeton University Press, November 2005. ISBN-13: 978-0-691-12309-7.

**New Theories of Everything*, by John D. Barrow. Oxford University Press, July 2007. ISBN-13: 978-0-192-80721-2.

Nonplussed! Mathematical Proof of Implausible Ideas, by Julian Havil. Princeton University Press, May 2007. ISBN-13: 978-0-691-12056-0.

Once upon Einstein, by Thibault D'Amour. A K Peters, March 2006. ISBN 1-568-81289-2.

Out of the Labyrinth: Setting Mathematics Free, by Robert Kaplan and Ellen Kaplan. Oxford University Press, January 2007. ISBN-13: 978-0-19514-744-5.

Piano Hinged Dissections: Time to Fold!, by Greg Frederickson. A K Peters, October 2006. ISBN 1-568-81299-X.

Piero della Francesca: A Mathematician's Art, by J. V. Field. Yale University Press, August 2005. ISBN 0-300-10342-5. (Reviewed March 2007.)

The Poincaré Conjecture: In Search of the Shape of the Universe, by Donal O'Shea. Walker, March 2007. ISBN-13: 978-08027-1532-6.

**Poincaré's Prize: The Hundred-Year Quest to Solve One of Math's Greatest Puzzles*, by George Szpiro.

Dutton Adult, June 2007. ISBN-13: 978-0-525-95024-0.

Prince of Mathematics: Carl Friedrich Gauss, by M. B. W. Tent. A K Peters, January 2006. ISBN 1-568-81261-2.

Project Origami: Activities for Exploring Mathematics, by Thomas Hull. A K Peters, March 2006. ISBN 1-568-81258-2. (Reviewed May 2007.)

Pursuit of Genius: Flexner, Einstein, and the Early Faculty at the Institute for Advanced Study, by Steve Batterson. A K Peters, June 2006. ISBN 1-568-81259-0.

Pythagoras: His Life, Teaching and Influence, by Christoph Riedweg. Translated by Steven Rendall. Cornell University Press, March 2005. ISBN-13: 978-0-80144-240-7.

Pythagoras: The Mathemagician, by Karim El-koussa. Cloonfad Press, September 2005. ISBN-13: 978-0-97694-042-5.

Shadows of Reality: The Fourth Dimension in Relativity, Cubism, and Modern Thought, by Tony Robbin. Yale University Press, March 2006. ISBN 0-300-11039-1. (Reviewed April 2007.)

The Shoelace Book: A Mathematical Guide to the Best (and Worst) Ways to Lace Your Shoes, by Burkard Polster. AMS, June 2006. ISBN 0-8218-3933-0. (Reviewed December 2006.)

Solving Mathematical Problems: A Personal Perspective, by Terence Tao. Oxford University Press, September 2006. ISBN-13: 978-0-199-20560-8.

The Square Root of 2: A Dialogue Concerning a Number and a Sequence, by David Flannery. Springer, December 2005. ISBN-13: 978-0-38720-220-4.

Superior Beings: If They Exist, How Would We Know? Game-Theoretic Implications of Omnipotence, Omniscience, Immortality, and Incomprehensibility, by Steven Brams. Springer, second edition, November 2007. ISBN-13: 978-0-387-48065-7.

Symmetry and the Monster: The Story of One of the Greatest Quests of Mathematics, by Mark Ronan. Oxford University Press, May 2006. ISBN 0-192-80722-6. (Reviewed February 2007.)

The Triumph of Numbers: How Counting Shaped Modern Life, by I. B. Cohen. W. W. Norton, July 2006. ISBN-13: 978-0-393-32870-7.

The Trouble with Physics: The Rise of String Theory, The Fall of a Science, and What Comes Next, by Lee Smolin. Joseph Henry Press, October 2006. ISBN 0-309-10192-1. (Reviewed September 2007.)

Useless Arithmetic: Why Environmental Scientists Can't Predict the Future, by Orrin Pilkey and Linda Pilkey-Jarvis. Columbia University Press, February 2007. ISBN 0-231-13212-3.

**The Volterra Chronicles: The Life and Times of an Extraordinary Mathematician*, by Judith R. Goodstein. AMS, February 2007. ISBN-13: 978-0-8218-3969-0.

Why Beauty Is Truth: The Story of Symmetry, by Ian Stewart. Perseus Books Group, April 2007. ISBN-13: 978-0-46508-236-0.

Yearning for the Impossible: The Surprising Truths of Mathematics, by John Stillwell. A K Peters, May 2006. ISBN 1-568-81254-X. (Reviewed June/July 2007.)

You Failed Your Math Test, Comrade Einstein: Adventures and Misadventures of Young Mathematicians, or Test Your Skills in Almost Recreational Mathematics, edited by M. Shifman. World Scientific, June 2005. ISBN-13: 978-9-812-56279-1.

About the Cover

The Mission Basilica San Diego de Alcala, known as Calfornia's first church, was founded on July 16, 1769, by Father Junipero Serra. The watercolor of the mission was painted for the *Notices* cover by Stephen J. Pomerenke.

San Diego, California, is the site of the Joint Mathematics Meetings, January 6–9, 2008.

About the Cover

The Mission Basilica San Diego de Alcala, known as Calfornia's first church, was founded on July 16, 1769, by Father Junipero Serra. The watercolor of the mission was painted for the *Notices* cover by Stephen J. Pomerenke.

San Diego, California, is the site of the Joint Mathematics Meetings, January 6–9, 2008.

Officers and Committee Members

Numbers to the left of headings are used as points of reference in an index to AMS committees which follows this listing. Primary and secondary headings are:

1. Officers
   1.1. Liaison Committee
2. Council
   2.1. Executive Committee of the Council
3. Board of Trustees
4. Committees
   4.1. Committees of the Council
   4.2. Editorial Committees
   4.3. Committees of the Board of Trustees
   4.4. Committees of the Executive Committee and Board of Trustees
   4.5. Internal Organization of the AMS
   4.6. Program and Meetings
   4.7. Status of the Profession
   4.8. Prizes and Awards
   4.9. Institutes and Symposia
   4.10. Joint Committees
5. Representatives
6. Index

Terms of members expire on January 31 following the year given unless otherwise specified.

1. Officers

President	James G. Glimm	2008
Immediate Past President		
	James G. Arthur	2007
Vice Presidents	Haïm Brezis	2007
	Robert L. Bryant	2009
	Ruth M. Charney	2008
Secretary	Robert J. Daverman	2008
Associate Secretaries	Susan J. Friedlander	2007
	Michel L. Lapidus	2007
	Matthew Miller	2008
	Lesley M. Sibner	2008
Treasurer	John M. Franks	2008
Associate Treasurer	Donald E. McClure	2008

1.1. Liaison Committee

All members of this committee serve *ex officio*.

	Robert J. Daverman
	John M. Franks
Chair	James G. Glimm
	Linda Keen

2. Council

2.0.1. Officers of the AMS

President	James G. Glimm	2008
Immediate Past President		
	James G. Arthur	2007
Vice Presidents	Haïm Brezis	2007
	Robert L. Bryant	2009
	Ruth M. Charney	2008
Secretary	Robert J. Daverman	2008
Associate Secretaries*	Susan J. Friedlander	2007
	Michel L. Lapidus	2007
	Matthew Miller	2008
	Lesley M. Sibner	2008
Treasurer	John M. Franks	2008
Associate Treasurer	Donald E. McClure	2008

2.0.2. Representatives of Committees

Bulletin	Susan J. Friedlander	2008
Colloquium	Paul J. Sally, Jr.	2007
Executive Committee	Sylvan E. Cappell	2009
Journal of the AMS	Robert K. Lazarsfeld	2009
Mathematical Reviews	Jonathan I. Hall	2008
Mathematical Surveys and Monographs	J. Tobias Stafford	2007
Mathematics of Computation	Chi-Wang Shu	2007
Proceedings	Ronald Fintushel	2009
Transactions and Memoirs	Robert Guralnick	2008

* Only one Associate Secretary at a time is a voting member of the Council, namely the cognizant Associate Secretary for the scientific sessions.

2.0.3. Members at Large

Sara C. Billey	2007	Frank S. Quinn	2009
Robert L. Devaney	2009	Katherine St. John	2009
William M. Goldman	2008	Marjorie Senechal	2009
Carolyn S. Gordon	2007	Michael F. Singer	2007
Craig L. Huneke	2008	Francis Edward Su	2009
Sheldon H. Katz	2007	Judy L. Walker	2008
Judy Anita Kennedy	2008	Catherine H. Yan	2007
Ken Ono	2008		

2.1. Executive Committee of the Council

	James G. Arthur	*ex officio*
	Sylvain Cappell	2009
	Ruth M. Charney	2010
	Robert J. Daverman	*ex officio*
	James G. Glimm	*ex officio*
	Robert Guralnick	2008
	Paul J. Sally, Jr.	2007

3. Board of Trustees

	John B. Conway	2010
	John M. Franks	*ex officio*
	Eric M. Friedlander	2009
	James G. Glimm	*ex officio*
Chair	Linda Keen	2008
Secretary	Donald E. McClure	*ex officio*
	Jean E. Taylor	2007
	Carol S. Wood	2011

4. Committees

4.1. Committees of the Council

Standing Committees

4.1.1. Editorial Boards

	Eric Bedford	2009
	Robert L. Bryant	2008
	Margaret Cheney	2007
	Robert J. Daverman	*ex officio*
	John H. Ewing	*ex officio*
	Stephen Lichtenbaum	2008
	Irena Swanson	2009
Chair	Abigail A. Thompson	2007

4.1.2. Nominating Committee

Terms begin on January 1 and expire on December 31 of the year listed.

Chair	Michael G. Crandall	2008
	Phillip Griffith	2007
	Thomas C. Hales	2009
	Roger Howe	2009
	David Jerison	2007
	Linda Keen	2007
	M. Susan Montgomery	2008
	Hema Srinivasan	2009
	Lisa M. Traynor	2008

Special Committees

4.1.3. First-Year College Mathematics Experience, Task Force on

David M. Bressoud	2008
Ruth M. Charney	2008
David H. Collingwood	2008
James G. Glimm	2008
Raymond L. Johnson	2008
Dan Kannan	2008
Judy Anita Kennedy	2008
William James Lewis	2008
William G. McCallum	2008
Robert E. Megginson	2008
Robert F. Olin	2008
Donald G. Saari	2008
Alan C. Tucker	2008

4.1.4. Working Group on Preparation for Technical Careers Advisory Board

Solomon Friedberg	2008
Peter E. Haskell	2008
Andy R. Magid	2008
Paul J. Sally, Jr	2008
W. Stephen Wilson	2008

4.2. Editorial Committees

4.2.1. Abstracts Editorial Committee

All members of this committee serve *ex officio*.

Chair	Robert J. Daverman
	Susan J. Friedlander
	Michel L. Lapidus
	Matthew Miller
	Lesley M. Sibner

4.2.2. Bulletin (New Series)

Consultant	Gerald L. Alexanderson	2007
Book Reviews Editor	Robert L. Devaney	2008
Chief Editor	Susan J. Friedlander	2008
Consultant	Jane Kister	2007

Associate Editors for Bulletin Articles

David J. Benson	2007	Bryna R. Kra	2008
Persi W. Diaconis	2008	Barry Mazur	2008
Lawrence Craig Evans	2008	Robert A. Oliver	2008
Edward Frenkel	2008	Paul H. Rabinowitz	2007
Mark Goresky	2007	Yuri Tschinkel	2008
Andrew J. Granville	2008	Michael Wolf	2007

Associate Editors for Book Reviews

Jonathan L. Alperin	2008	Ken Ono	2008
Steven Krantz	2008	Philip E. Protter	2008
Peter Kuchment	2007	Lisa Traynor	2008

4.2.3. Collected Works

Chair	Phillip A. Griffiths	2007
	Dusa McDuff	2008
	Elias M. Stein	2008

4.2.4. Colloquium

	Yuri Manin	2009
Chair	Paul J. Sally, Jr.	2007
	Peter Sarnak	2008

4.2.5. Contemporary Mathematics

	George Andrews	2007
	Andreas R. Blass	2007
Chair	Dennis DeTurck	2007
	Abel Klein	2007

4.2.6. Electronic Research Announcements

	Dimitri Burago	2007
Co-Managing Editor	Keith H. Burns	2009
	Luis A. Caffarelli	2007
	Tobias Colding	2007
	J. Brian Conrey	2009
	Marc E. Culler	2008
	Sergey Fomin	2009
	Mark Freidlin	2008
	Timothy Gowers	2009
	Robert Louis Greiss	2008
	Boris Hasselblatt	2009
Co-Managing Editor	Svetlana R. Katok	2007
	Carlos Kenig	2007
	János Kollár	2007
	Alex Lubotsky	2008
	Barry Mazur	2007
	Walter David Neumann	2007
	Leonid Polterovich	2007
	Klaus Schmidt	2007
	Paul Seidel	2008
	Mikhail Vishik	2008
	Guido L. Weiss	2007
	Sylvia Wiegand	2007
	W. Hugh Woodin	2008
	Efim I. Zelmanov	2007

4.2.7. Graduate Studies in Mathematics

Chair	David A. Cox	2008
	Walter Craig	2007
	Nikolai Ivanov	2007
	Steven G. Krantz	2009

4.2.8. Journal of the AMS

	Weinan E	2009
Chair	Robert K. Lazarsfeld	2009
	John W. Morgan	2009
	Andrei Okounkov	2009
	Karl Rubin	2011
	Terence Tao	2007

Associate Editors

Noga Alon	2011	Andrew M. Odlyzko	2009
Francis Bonahon	2008	Bjorn Poonen	2009
Robert L. Bryant	2007	Sorin T. Popa	2011
Pavel I. Etingof	2007	Victor S. Reiner	2009
Mark Goresky	2007	Oded Schramm	2008
Alexander Kechris	2008	Richard L. Taylor	2008
Robert Edward Kottwitz		S. R. S. Varadhan	2007
	2008	Avi Wigderson	2008
Peter Kronheimer	2008	Lia-Sang Young	2007
Haynes R. Miller	2008	Shou-Wu Zhang	2007

4.2.9. Mathematical Reviews

AMS staff contact: Kevin F. Clancey

	Lisa Fauci	2008
Chair	Jonathan I. Hall	2008
	Peter Maass	2008
	Tadao Oda	2009
	Ronald J. Stern	2007
	Trevor D. Wooley	2008

4.2.10. Mathematical Surveys and Monographs

	Jerry L. Bona	2009
	Ralph L. Cohen	2009
	Michael G. Eastwood	2009
	Michael P. Loss	2007
Chair	J. Tobias Stafford	2007

4.2.11. Mathematics of Computation

	Susanne C. Brenner	2008
	Ronald F. Cools	2007
	Harald Niederreiter	2007
Chair	Chi-Wang Shu	2007

Associate Editors

David W. Boyd	2009	Stanley Osher	2007
Zhiming Chen	2009	Joseph E. Pasciak	2007
Bernardo Cockburn	2007	Lothar Reichel	2007
Arjeh M. Cohen	2008	Renate Scheidler	2009
Ricardo G. Duran	2009	Jie Shen	2007
Ivan P. Gavrilyuk	2007	Igor Shparlinski	2007
Viviette Girault	2008	Chris J. Smyth	2009
Ernst Hairer	2007	Michael Stillman	2008
Daniel W. Lozier	2007	Daniel B. Szyld	2009
John McKay	2009	Denis Talay	2009
Jean-Francois Mestre	2007	Tao Tang	2008
Marian Neamtu	2007	Paul Tseng	2008
Ricardo Horacio Nochetto		Jinchao Xu	2009
	2007		

4.2.12. Notices Editorial Board

Terms begin on January 1 and expire on December 31 of the year listed.

Editor	Andy R. Magid	2009

Associate Editors

Daniel Kalman Biss	2009	Robion C. Kirby	2009
Susanne C. Brenner	2009	Steven G. Krantz	2009
William Casselman	2009	Peter C. Sarnak	2009
Robert J. Daverman		Mark E. Saul	2009
	ex officio	John R. Swallow	2009
Lisette de Pillis	2009	Lisa M. Traynor	2009
Susan J. Friedlander	2009		

4.2.13. Proceedings

	Mario Bonk	2011
	Richard Bradley	2010
	Carmen C. Chicone	2007
	Ted C. Chinburg	2009
Coordinating	Peter A. Clarkson	2010
	Walter Craig	2008
	Alexander N. Dranishnikov	2007
Chair	Ronald A. Fintushel	2009
	Paul Goerss	2008
	Matthew J. Gursky	2010
	James Haglund	2009
	Jonathan I. Hall	2010
	Jane Hawkins	2009
	Birge Huisgen-Zimmerman	2009
	Marius Junge	2010
	Julia Knight	2008
	Michael T. Lacey	2008
	Gail R. Letzter	2010
	Wen-Ching Winnie Li	2009
Coordinating	Martin Lorenz	2009
	Ken Ono	2008
	Daniel Ruberman	2009
Coordinating	Andreas Seeger	2008
	Mei-Chi Shaw	2008
	Mikhail Shubin	2008

	Hart F. Smith	2010
Coordinating	Chuu-Lian Terng	2009
	Nicole Tomczak-Jaegermann	2007
	Tatiana Toro	2010
	Bernd Ulrich	2009
	Edward C. Waymire	2007
	Michael Weinstein	2008
	Richard Wentworth	2009
Coordinating	Jon Wolfson	2009

4.2.14. Proceedings of Symposia in Applied Mathematics

	Mary C. Pugh	2009
	Leonid Ryzhik	2007
Chair	Eitan Tadmor	2007

4.2.15. Transactions and Memoirs

	Dan Abramovich	2010
	Alejandro Adem	2008
	Mladen Bestvina	2007
	Krzysztof Burdzy	2007
Chair	Robert Guralnick	2008
	Lisa Claire Jeffrey	2008
	Alexander Kleshchev	2008
	Steffan Lempp	2007
	William P. Minicozzi II	2010
	V. Kumar Murty	2010
	Alexander Nagel	2010
	Peter Polacik	2010
	Gustavo Alberto Ponce	2009
	Dimitri Shlyakhtenko	2010
	Robert J. Stanton	2009
	John R. Stembridge	2009
	Daniel I. Tartaru	2010
	Mina Teicher	2008
	Amie Wilkinson	2009

4.2.16. Translation from Chinese

	Sun-Yung Alice Chang	
	S.-Y. Cheng	
Chair	Tsit-Yuen Lam	
	Tai-Ping Liu	
	Chung-Chun Yang	

4.2.17. Translation from Japanese

Chair	Shoshichi Kobayashi	1999
	Masamichi Takesaki	1999

Standing Committees

4.2.18. Conformal Geometry and Dynamics

	Mario Bonk	2009
	Sun-Yung Alice Chang	2010
Chair	Gaven J. Martin	2007
	Yair N. Minsky	2008
	Mary Rees	2007
	Caroline Series	2008

4.2.19. History of Mathematics

	Joseph W. Dauben	2007
	Peter L. Duren	2007
Chair	Karen H. Parshall	2007
	Michael I. Rosen	2008

4.2.20. Representation Theory

	Jens Carsten Jantzen	2008
	George Lusztig	2007
Chair	Dragan Milicic	2007
	Hiraku Nakajima	2007
	Henrik Schlichtkrull	2009
	Freydoon Shahidi	2008
	David A. Vogan	2009

4.2.21. Student Mathematics Library

	Gerald B. Folland	2008
Chair	Robin Forman	2007
	Brad G. Osgood	2007
	Michael Starbird	2008

4.2.22. University Lecture Series

	Jerry L. Bona	2009
Chair	Eric M. Friedlander	2008
	Adriano M. Garsia	2007
	Nigel Higson	2009
	J. Tobias Stafford	2007

4.3. Committees of the Board of Trustees

4.3.1. Agenda and Budget

All members of this committee serve *ex officio*.
AMS staff contact: Ellen H. Heiser

	Robert J. Daverman
	John M. Franks
Chair	James G. Glimm
	Linda Keen
	Donald E. McClure

4.3.2. Audit

All members of this committee serve *ex officio*.
AMS staff contact: Connie Pass.

Chair	John M. Franks
	Eric M. Friedlander
	Linda Keen
	Donald E. McClure

4.3.3. Bulletin Editor Search

	Robert J. Daverman	2008
Chair	John H. Ewing	2008
	James G. Glimm	2008
	Sheldon H. Katz	2008
	Judy Anita Kennedy	2008

4.3.4. Eastern Section Associate Secretary, Search Committee for

	Robert J. Daverman	2008
	Eric M. Friedlander	2008
	Robert M. Guralnick	2008
	Carol S. Wood	2008

4.3.5. Investment

AMS staff contact: Connie Pass.

Chair	John M. Franks	*ex officio*
	Linda Keen	*ex officio*
	Henry B. Laufer	2009
	Donald E. McClure	*ex officio*

4.3.6. Salary

All members of this committee serve *ex officio*.
AMS staff contact: Gary G. Brownell.

Chair	John M. Franks
	Linda Keen
	Donald E. McClure

4.4. Committees of the Executive Committee and Board of Trustees

4.4.1. Long Range Planning

All members of this committee serve *ex officio*.
AMS staff contact: Ellen H. Heiser.

	Sylvan Cappell
	Robert J. Daverman
	John H. Ewing
	John M. Franks
Chair	James G. Glimm
	Robert Guralnick
	Linda Keen

4.4.2. Nominating

All members of this committee serve *ex officio*.

	Michael G. Crandall
Chair	Eric M. Friedlander
	Robert Guralnick

4.5. Internal Organization of the American Mathematical Society

Standing Committees

4.5.1. Archives

	Judith Grabiner	2007
Chair	Karen H. Parshall	2009
	Anthony V. Phillips	2008

4.5.2. Books and Journal Donations Steering Committee

	Augustin Banyaga	2009
Chair	Ricardo Cortez	2007
	Dialla Konate	2008

4.5.3. Committee on Committees

	Andrea Bertozzi	2008
	Robert J. Daverman	*ex officio*
	Robert W. Ghrist	2008
	James G. Glimm	*ex officio*
	Carolyn S. Gordon	2008
	Ruth Haas	2008
	Palle E. T. Jorgesen	2008
	Louis H. Kauffman	2008
	Tai-Ping Liu	2008
	Jonathan Christopher Mattingly	2008
Chair	Mark Rieffel	2008
	Stephen Smale	2008
	Tara Smith	2008
	Yuri Tschinkel	2008

4.5.4. Library Committee

Co-chair	Jonathan M. Borwein	2008
	Michael Bowman	2009
	Michael J. Falk	2009
	Kristine K. Fowler	2008
Co-chair	Ann Jensen	2007
	Robion C. Kirby	2007
	Silvio Levy	2009
	George B. Seligman	2007

4.5.5. Publications

AMS staff contact: Carolyn Beattie.

	Robert L. Bryant	2007
	David A. Cox	2009
	Robert J. Daverman	*ex officio*
	Robert L. Devaney	2009
Chair	Beverly E. J. Diamond	2007
	John H. Ewing	*ex officio*
	Eric Friedlander	2007
	James G. Glimm	*ex officio*
	Jacques Hurtubise	2008
	John Luecke	2008
	Ken Ono	2008
	Elias M. Stein	2008

4.6. Program and Meetings

Standing Committees

4.6.1. Meetings and Conferences

AMS staff contact: Diane Saxe

	Robert J. Daverman	*ex officio*
	John H. Ewing	*ex officio*
	James G. Glimm	*ex officio*
Chair	Joel Hass	2007
	Judy Anita Kennedy	2008
	Jonathan P. McCammond	2007
	John C. Meakin	2008
	David B. Meredith	2009
	Gail D. L. Ratcliff	2007
	Catherine A. Roberts	2008
	Katherine St. John	2009
	Carol S. Wood	2007
	Catherine H. Yan	2007

4.6.2. Program Committee for National Meetings

	Robert Calderbank	2009
	Gui-Qiang Chen	2009
	Gregory Cherlin	2008
	Robert J. Daverman	*ex officio*
Chair	Lisa C. Jeffrey	2008
	Robion C. Kirby	2009
	Michel L. Lapidus	*ex officio*
	Alice Silverberg	2007

4.6.3. Short Course Subcommittee

	Joe P. Buhler	2008
	Peter E. Castro	2009
	Natalia Komarova	2007
	Yuval Peres	2009
Chair	Francis Edward Su	2007
	Lisa G. Townsley	2009
	Joseph C. Watkins	2008

4.6.4. Central Section Program Committee

	Min Chen	2007
	F. Michael Christ	2008
	James Wesley Cogdell	2008
	Susan J. Friedlander	*ex officio*
Chair	Gopal Prasad	2007

4.6.5. Eastern Section Program Committee

	Colin C. Adams	2007
	Robert H. Gilman	2008
	Andrew Granville	2008
	Lesley M. Sibner	*ex officio*
Chair	Yum-Tong Siu	2007

4.6.6. Southeastern Section Program Committee

	Nicholas J. Kuhn	2008
	Loredana Lanzani	2007
	Matthew Miller	*ex officio*
Chair	Kailash C. Misra	2007
	John G. Ratcliffe	2008

4.6.7. Western Section Program Committee

	Bruce K. Driver	2008
	Michel L. Lapidus	*ex officio*
	Jonathan Rogawski	2007
	Brad Shelton	2008
Chair	Hal L. Smith	2007

4.6.8. Agenda for Business Meetings

Chair	Robert J. Daverman	*ex officio*

4.6.9. Arnold Ross Lecture Series Committee

	Brian Conrad	2008
Chair	Frank Morgan	2009
	Dan Rockmore	2009
	Ravi D. Vakil	2007

4.6.10. Colloquium Lecture

	Persi W. Diaconis	2008
Chair	Bernd Strumfels	2007
	Lai-Sang Young	2009

4.6.11. Gibbs Lecturer for 2007 and 2008, Committee to Select

	Lawrence Craig Evans	2007
	Peter Goddard	2007
Chair	Ronald L. Graham	2007

4.7. Status of the Profession

Standing Committees

4.7.1. Academic Freedom, Tenure, and Employment Security

	Zeljko Cuckovic	2007
Chair	William Hawkins	2007
	Stephen B. Robinson	2009
	Ratnasingham Shivaji	2008
	Lorenzo Traldi	2009
	Sylvia M. Wiegand	2007
	Robert L. Wilson	2008

4.7.2. Education

AMS staff contact: Samuel M. Rankin III.

	Robert J. Daverman	*ex officio*
	John H. Ewing	*ex officio*
	James G. Glimm	*ex officio*
	William Mark Goldman	2008
	Lawrence Firman Gray	2009
	Sheldon H. Katz	2007
	Linda Keen	2007
	William James Lewis	2009
Chair	William McCallum	2007
	James E. McClure	2009
	Frank S. Quinn	2008
	Wilfried Schmid	2008
	Brad Shelton	2007
	_____	2009
	_____	2009

4.7.3. Fan Fund

	Weinan E	2009
	Lizhen Ji	2008
Chair	Shou-Wu Zhang	2007

4.7.4. Human Rights of Mathematicians

	M. Salah Baouendi	2007
	Alexander Beilinson	2008
	Alfonso Castro	2008
	Eduardo Cattani	2009
Chair	William G. Faris	2007
	Mary W. Gray	2007
	Joel L. Lebowitz	2009
	Wen-Ching Winnie Li	2009
	Norbert H. Schlomiuk	2008

4.7.5. Profession

AMS staff contact: Ellen J. Maycock.

	James H. Curry	2008
	Robert J. Daverman	*ex officio*
	James A. Donaldson	2009
	John H. Ewing	*ex officio*
	James G. Glimm	*ex officio*
	Carolyn Gordon	2007
Chair	Jim E. Hoste	2007
	Craig L. Huneke	2008
	Chawne M. Kimber	2008
	Ronald L. Lipsman	2008
	Lior Pachter	2007
	Kimberly R. Pearson	2007
	Javier Rojo	2007
	Francis Edward Su	2009
	Jean E. Taylor	2007

4.7.6. Professional Ethics

	Sheldon Axler	2009
	Patricia E. Bauman	2007
	Michael Beals	2009
	Lance L. Littlejohn	2009
Chair	Catherine A. Roberts	2008
	Bernard Shiffman	2007

4.7.7. Science Policy

AMS staff contact: Samuel M. Rankin III.

	James G. Arthur	*ex officio*
	John B. Conway	2007
	Isabel Darcy	2007
	Robert J. Daverman	*ex officio*
	John H. Ewing	*ex officio*
	James G. Glimm	*ex officio*
	Leon M. Hall	2007
Chair	Sheldon H. Katz	2007
	Robert P. Lipton	2008
	William McCallum	2007
	Fred S. Roberts	2007
	Marjorie Senechal	2009
	Freydoon Shahidi	2009
	Michael Singer	2007
	Ronald J. Stern	2009
	Judy L. Walker	2008
	Nolan Wallach	2008

4.7.8. Young Scholars Awards

Terms expire on June 30.

	David L. Ferguson	2009
Chair	Jon T. Jacobsen	2008
	Sergei Tabachnikov	2010
	Jeremy T. Teitelbaum	2010

4.8. Prizes and Awards

Standing Committees

4.8.1. AMS Public Policy Award Selection Committee

	James G. Arthur	2007
	James G. Glimm	2008
	Sheldon H. Katz	2007

4.8.2. Award for Distinguished Public Service, Committee to Select the Winner of the

	William James Lewis	2007
	Carolyn R. Mahoney	2009
Chair	Paul J. Sally, Jr.	2009
	Richard A. Tapia	2011
	Margaret Wright	2007

4.8.3. The Stefan Bergman Trust Fund

	Ronald Coifman	2009
	Charles Fefferman	2007
	Richard B. Melrose	2008

4.8.4. Bôcher Prize, Committee to Select the Winner of

	Peter S. Constantin	2007
Chair	Tai-Ping Liu	2007
	Elias Stein	2007

4.8.5. Centennial Fellowships

Terms expire on June 30.

	Richard T. Durrett	2009
	Wee Teck Gan	2008
	John E. Meier	2008
Chair	Theodore A. Slaman	2008
	Michael Thaddeus	2008
	Susan Tolman	2009
	Kevin Zumbrun	2009

4.8.6. Conant Prize, Committee to Select the Winner of the

	Noam Elkies	2007
	Stephen J. Greenfield	2009
Chair	Carl R. Riehm	2008

4.8.7. Joseph L. Doob Prize

	Andrew J. Granville	2012
	Robin C. Hartshorne	2012
	Steven G. Krantz	2007
Chair	Dale P. O. Rolfsen	2007
	Bhama Srinivasan	2007

4.8.8. Leonard Eisenbud Prize for Mathematics and Physics

	Joel L. Lebowitz	2007
Chair	David R. Morrison	2007
	Edward Witten	2007

4.8.9. Math in Moscow Progam—Travel Support

Terms expire on June 30.

	Askold Khovanskii	2009
	_____	2010
	_____	2010

4.8.10. Menger Prize, Committee to Select the Winner of the

Terms expire on May 31.

	Edward A. Connors	2007
	Doron Levy	2010
Chair	David B. Scott	2009

4.8.11. E. H. Moore Research Article Prize, Committee to Select the Winner of the

	Carolyn S. Gordon	2009
	Efim I. Zelmanov	2009
	_____	2009
	_____	2009
	_____	2009

4.8.12. National Awards and Public Representation

	James G. Arthur	*ex officio*
	Robert J. Daverman	*ex officio*
	Avner Friedman	2007
Chair	James G. Glimm	*ex officio*
	Dusa McDuff	2008

4.8.13. David P. Robbins Prize

	Jonathan Borwein	2008
	Jeffrey C. Lagarias	2008
	David I. Lieberman	2008
	Richard P. Stanley	2008
	Robin Thomas	2008

4.8.14. Satter Prize, Committee to Select the Winner of the

	Benedict H. Gross	2009
	Karen E. Smith	2007
	Chuu-Lian Terng	2007

4.8.15. Steele Prizes

	Rodrigo Banuelos	2007
	Enrico Bombieri	2009
	Russell Caflisch	2009
	L. Craig Evans	2008
	Lisa Claire Jeffrey	2009
	Nicholas Katz	2008
	Julius L. Shaneson	2008
	Richard P. Stanley	2009
Chair	David A. Vogan, Jr.	2007

Special Committees

4.8.16. Cole Prize, Committee to Select the Winner of the

	Nicholas M. Katz	2007
Chair	Kenneth A. Ribet	2007
	Alice Silverberg	2007

4.8.17. Exemplary Program or Achievement by a Mathematics Department, Committee to Select the Winner of the Prize for

	Steven A. Bleiler	2009
	Joel V. Brawley, Jr.	2007
Chair	Karl W. Knight	2008
	Donal B. O'Shea	2007
	Roger Wiegand	2009

4.8.18. Veblen Prize

	Cameron Gordon	2007
	Michael J. Hopkins	2007
	Ronald J. Stern	2007

4.9. Institutes and Symposia

Standing Committees

4.9.1. Liaison Committee with AAAS

	Edward F. Aboufadel	*ex officio*
	Douglas Arnold	2008
	Jere Confrey	*ex officio*
	Jack D. Cowan	*ex officio*
	Thomas C. Hales	2007
	William H. Jaco	*ex officio*
Chair	Carl Pomerance	*ex officio*
	Donald G. Saari	*ex officio*
	Ruth J. Williams	2007

4.9.2. Von Neumann Symposium Selection Committee

	Andrea L. Bertozzi	2007
	Robert L. Bryant	2007
Chair	Robert Calderbank	2007

4.10. Joint Committees

4.10.1. AMS-ASA-AWM-IMS-MAA-NCTM-SIAM Committee on Women in the Mathematical Sciences

	Kathryn E. Brenan (SIAM)	2009
	Alicia Carriquiry (IMS)	2007
	Sandra Clarkson (ASA)	2007
	Christine Escher (AMS)	2009
	Judy Green (AWM)	2009
	Priscilla Greenwood (Cindy) (IMS)	2009
	Jennifer Hontz (MAA)	2008
Chair	Janine E. Janosky (ASA)	2009
	Nicole Lazar (ASA)	2008
	Lisa Mantini (MAA)	2007
	Maura Mast (AWM)	2007
	Judith Olson (NCTM)	2007
	C. Lanette Poteete-Young (MAA)	2008
	Mary C. Pugh (AMS)	2007
	Mary Silber (SIAM)	2008
	Margaret F. Symington (AMS)	2007

4.10.2. AMS-ASA-IMS-MAA-SIAM Data Committee

AMS staff contact: James W. Maxwell.

	Richard J. Cleary (MAA)	2008
	Amy Cohen-Corwin (MAA)	2007
	James Crowley (SIAM)	2007
	Richard M. Dudley (AMS)	2009
	John W. Hagood (AMS)	2009
	Abbe H. Herzig (AMS)	2008
	Donald R. King (AMS)	2007
	David J. Lutzer (MAA)	2008
	James W. Maxwell (AMS)	*ex officio*
Chair	Polly Phipps (ASA)	2009
	David E. Rohrlich (AMS)	2007
	Henry Schenck (AMS)	2007
	Jianguo Sun (IMS)	2009

4.10.3. AMS-ASA-MAA-SIAM Joint Policy Board for Mathematics

ASA and SIAM members' terms expire December 31 of the year listed.

	Mary E. Bock (ASA)	2007
	James Crowley (SIAM)	2007
	Robert J. Daverman (AMS)	2008
	John H. Ewing (AMS)	2009
	Joseph A. Gallian (MAA)	2008
	James G. Glimm (AMS)	2008
	Martin Golubitsky (SIAM)	2007
	Sallie Keller-McNulty (ASA)	2007
	Clive Moler (SIAM)	2008
	Martha Siegel (MAA)	2008
	William B. Smith (ASA)	2007
	Tina H. Straley (MAA)	2008

4.10.4. AMS-ASL-IMS-SIAM Committee on Translations from Russian and Other Slavic Languages

Chair	James D. Stasheff (AMS)

AMS Subcommittee Members

Consultant	V. I. Arnol′d
	Luchezar Avramov
	Igor Dolgachev
Consultant	S. G. Gindikin
Consultant	Askol′d Georgievič Khovanskiĭ
	Robert D. MacPherson
	Grigorii A. Margulis
Consultant	N. K. Nikol′skiĭ
Chair	James D. Stasheff

ASL Subcommittee Members

	Marat Arslanov
	Sergei N. Artemov
	Oleg Belegradek
	Elisabeth Bouscaren
	Wilfried Buchholz
Chair	Steffen Lempp
	Mariko Yasugi

IMS Subcommittee Members

Chair	M. I. Freidlin
	B. Pittel
	A. Rukhin
	W. J. Studden

4.10.5. AMS-MAA Committee on Cooperation

All members of this committee serve *ex officio*.

	James G. Arthur (AMS)
	Carl C. Cowen (MAA)
	Robert J. Daverman (AMS)
	John H. Ewing (AMS)
	Joseph A. Gallian (MAA)
	James G. Glimm (AMS)
	Martha J. Siegel (MAA)
	Tina H. Straley (MAA)

4.10.6. AMS-MAA Committee on Mathematicians with Disabilities

	Yousef Alavi (MAA)	2009
	Curtis Bennett (MAA)	2008
	Theresa C. Michnowicz (MAA)	2009
	Judith R. Miller (AMS)	2008
	Eileen L. Poiani (AMS)	2007
Chair	Jack R. Porter (AMS)	2007

4.10.7. AMS-MAA Committee on Teaching Assistants and Part-time Instructors (TA/PTI)

	Kevin Charlwood (MAA)	2006
Chair	Larry Chrystal (AMS)	2007
	John D. Eggers (AMS)	2009
	Diane L. Herrmann (AMS)	2009
	Lisa A. Mantini (MAA)	2006
	Janet M. McShane (AMS)	2008
	Dennis Pence (MAA)	2007
	_____(MAA)	2007

4.10.8. AMS-MAA Joint Archives Committee

	William W. Dunham (MAA)	2008
	Judith Grabiner (AMS)	2007
	Mary W. Gray (MAA)	2009
Chair	Karen H. Parshall (AMS)	2009
	Anthony V. Phillips (AMS)	2008
	James J. Tattersall (MAA)	2009

4.10.9. AMS-MAA Joint Meetings Committee

All members of this committee serve *ex officio*.

	Robert J. Daverman
	John H. Ewing
Consultant	Diane Saxe
	Tina H. Straley
Chair	James J. Tattersall

4.10.10. AMS-MAA Exhibits Advisory Subcommittee

	Cheryl Adams
	Roger Astley
	James Chin
	Robert J. Daverman
	John Grafton
	Elizabeth Huber
	Patricia Kearney
	Bob Mathews
	Elaine Pedreira-Sullivan
	Penny Pina
	Bob Pirtle
	Diane M. Saxe
	Sandi Lynn Scherer
	Amy Sell
	Jackie Smith
Chair	James J. Tattersall

4.10.11. AMS-MAA Joint Program Committee for the San Diego Meeting January 6–9, 2008

	Gui-Qiang Chen (AMS)
Chair	Annalisa Crannell (MAA)
	Ellen E. Krikman (MAA)
	Alice Silverberg (AMS)

4.10.12. AMS-MAA-SIAM Joint Committee on Employment Opportunities

AMS staff contact: Ellen Maycock.

	Edward F. Aboufadel (AMS)	2009
	Annalisa Crannell (MAA)	2007
	David A. Field (SIAM)	2007
	Ellen Maycock (AMS)	*ex officio*
	Michael Pearson (MAA)	*ex officio*
	Margaret Robinson (MAA)	2009
	Lee Seitelman (SIAM)	2007
	Randall J. Swift (MAA)	2007
	Linda Thiel (SIAM)	*ex officio*
Chair	Emil J. Volcheck (AMS)	2007
	Sarah J. Witherspoon (AMS)	2008

4.10.13. AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student

	Kelly J. Black (SIAM)	2007
	James H. Curry (SIAM)	2007
	Karen Smith (MAA)	2008
	Kannan Soundararajan (AMS)	2009
	Judy L. Walker (AMS)	2007
Chair	Paul Zorn (MAA)	2009

Special Committees

4.10.14. AMS-Brazilian Mathematical Society (BMS) Joint Program Committee, June 4–7, 2008

Harold Rosenberg	
Michael Shub	
Lesley M. Sibner	*ex officio*
Hector J. Sussman	

4.10.15. AMS-New Zealand Mathematical Society (NZMS) Joint Program Committee, December 12–15, 2008

Jeff Cheeger	
Peter W. Jones	
Vaughan F. R. Jones	
Matthew Miller	*ex officio*

4.10.16. AMS-Polish Mathematical Society (PMS) Joint Program Committee, Summer 2007

Mladen Bestiva	
Krzysztof Burdzy	
Susan J. Friedlander	*ex officio*
Peter Sarnak	

4.10.17. AMS-Shanghai Mathematical Society (SMS) Joint Program Committee, December 17–21, 2008

Robert L. Bryant	
Gui-Qiang Chen	
Susan J. Friedlander	*ex officio*
Shou-Wu Zhang	

5. Representatives

5.0.1. American Association for the Advancement of Science

Terms expire on February 21.

Section A	Donald G. Saari	2009
Section Q	Jere Confrey	2009

5.0.2. Canadian Mathematical Society

Catherine Huafei Yan	2007

5.0.3. Commission on Professionals in Science and Technology

Polly Phipps	2007

5.0.4. Committee on the American Mathematics Competition (MAA)

Term expires on June 30.

Kiran S. Kedlaya	2009

5.0.5. Conference Board of the Mathematical Sciences

James G. Glimm	2008

5.0.6. Delbert Ray Fulkerson Prize Selection Committee

Daniel J. Kleitman	2009

5.0.7. MAA Committee on Undergraduate Program in Mathematics (CUPM)

Alfonso Castro	2008
Mario Umberto Martelli	2008

5.0.8. U.S. National Committee on Theoretical and Applied Mechanics

Term expires on October 31.

David Kinderlehrer	2008

6. Index

Statistics on Women Mathematicians Compiled by the AMS

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

It was subsequently decided that this information would be gathered by determining the sex of the individuals in the above categories based on name identification if no other means was available and that additional information on the number of Ph.D.'s granted to women would also be collected using the AMS-ASA-IMS-MAA-SIAM Annual Survey. Since name identification was used, the information for some categories necessitated the use of three classifications:

Male: names that were obviously male

Female: names that were obviously female

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

The following is the twenty-second reporting of this information. Updated reports will appear annually in the *Notices*.

2006 Members of the AMS Residing in the U.S.

Male:	14,387	68%
Female:	3,741	18%
Unknown:	3,136	15%
Total:	21,264	

Invited Hour Address Speakers at AMS Meetings (1997–2006)

Male:	386	84%
Female:	72	16%
Unknown:	0	0%
Total:	458	

Speakers at Special Sessions at AMS Meetings (2002–2006)

Male:	9,862	79%
Female:	2,080	17%
Unknown:	486	4%
Total:	12,428	

Percentage of Women Speakers in AMS Special Sessions by Gender of Organizers (2006)

Special Sessions with at Least One Woman Organizer

Male:	580	76%
Female:	180	23%
Unknown:	6	1%
Total:	766	

Special Sessions with No Women Organizers

Male:	1,376	83%
Female:	260	16%
Unknown:	31	2%
Total:	1,667	

Trustees and Council Members

	2003		2004		2005		2006	
Male:	36	75%	29	71%	30	71%	27	66%
Female:	12	25%	12	29%	12	29%	14	34%
Total:	48		41		42		41	

Members of AMS Editorial Committees

	1997		1998		1999		2000		2001		2002		2003		2004		2005		2006	
Male:	189	89%	182	85%	198	86%	186	85%	190	85%	195	85%	189	84%	180	84%	184	83%	193	84%
Female:	24	11%	31	15%	32	14%	33	15%	34	15%	35	15%	35	16%	34	16%	38	17%	36	16%
Total:	213		213		230		219		224		230		224		214		222		229	

Ph.D.'s Granted to U.S. Citizens

	1997		1998		1999		2000		2001		2002		2003		2004		2005		2006	
Male:	368	71%	423	72%	367	66%	379	71%	343	69%	291	70%	341	68%	347	68%	355	72%	399	72%
Female:	148	29%	163	28%	187	34%	158	29%	151	31%	127	30%	158	32%	166	32%	141	28%	153	28%
Total:	516		586		554		537		494		418		499		513		496		552	

Mathematics Calendar

The most comprehensive and up-to-date Mathematics Calendar information is available on the AMS website at http://www.ams.org/mathcal/.

October 2007

* 22–26 **The practice and theory of stochastic simulation**, American Institute of Mathematics, Palo Alto, California.
Description: This workshop, sponsored by AIM and the NSF, concerns approaches for the numerical integration of stochastic systems which span many temporal-scales. Molecular dynamics and stochastic simulations in chemical kinetics, in particular, are two important examples among several other which require efficient and accurate integrators. The simulations of these systems generate many important questions which, so far, remain mostly open. Can stochastic differential equations (SDEs) represent a viable alternative to thermostats such as Nose-Hoover or Andersen for the simulation of systems in ensembles other than the microcanonical one? How to guarantee the ergodicity of integrators for such SDEs and assess their rate of convergence, accuracy and efficiency? How to efficiently compute expectation and free energies using such integrators, especially in systems displaying metastability? Activities at the workshop will focus on new developments and related issues in these areas.
Information: email: farmer@aimath.org event_day1; http://aimath.org/ARCC/workshops/stochasticsim.html.

November 2007

* 15–16 **Leonhard Euler (Mathematics and Music)**, Institut de Recherche Mathématique Avancée, Université Louis Pasteur, 7 rue Descartes, 67084, Strasbourg, France.
Description: To celebrate the three hundredth anniversary of the birth of Leonhard Euler, the conference will present some aspects of his work on mathematics, acoustics and theoretical music.
Speakers will include: Patrice Bailhache (Nantes), Dominique Foata (Strasbourg), Franck Jedrzejewski (CEA Paris), Pierre Jehel (ENS Cachan), Eberhard Knobloch (Berlin), François Nicolas (ENS Paris), Norbert Schappacher (IRMA) and Gérard Wanner (Genève).
Information:http://www-irma.u-strasbg.fr/article515.html; email: papadopoulos@math.u-strasbg.fr.

* 15–21 **Advanced School on Numerical Solutions of Partial Differential Equations: New Trends and Applications**, Centre de Recerca Matemàtica, Bellaterra, Italy.
Coordinators: José A. Carrillo, ICREA-UAB; Rosa Donat, Universitat de València; Carlos Parés, Universidad de Málaga; Yolanda Vidal, Universitat Politècnica de Catalunya.
Speakers: Blanca Ayuso, Universidad Autónoma de Madrid; Sonia Fernández-Méndez, Universitat Politècnica de Catalunya; Enrique Fernández-Nieto, Universidad de Sevilla; Francis Filbet, Université de Claude Bernard –Lyon I; Gabriella Puppo, Politecnico di Torino.
Further information: http://www.crm.cat/ASPDEs.

January 2008

* 1–March 31 **DocCourse in Combinatorics and Geometry: Additive Combinatorics**, Centre de Recerca Matemàtica, Bellaterra, Italy.
Coordinators: Javier Cilleruelo, Universidad Autónoma de Madrid; Marc Noy, Universitat Politècnica de Catalunya; Oriol Serra, Universitat Politècnica de Catalunya.
Speakers: Alfred Geroldinger, University of Graz, Institute for Mathematics and Scientific Computing, Algebraic Methods in Additive Combinatorics; Imre Z. Ruzsa, Alfréd Rényi Institute of Mathematics, Budapest, Sumsets and structure.
Information: http://www.crm.cat/AdditiveCombinatorics.

* 2–4 **Tenth International Symposium on Artificial Intelligence**

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 **eight 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/July, 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/.

and Mathematics (ISAIM 2008), Fort Lauderdale, Florida.
Description: We seek submissions of recent results with a particular emphasis on the foundations of AI and mathematical methods used in AI. Papers describing applications are also encouraged, but the focus should be on principled lessons learned from the development of the application.
Deadline: Paper Submission: October 1, 2007.
Invited Speakers: David McAllester, Toyota Technological Institute at Chicago, USA; Francesca Rossi, Padova University, Italy; Naftali Tishby, The Hebrew University, Israel.
Information: `http://isaim2008.unl.edu`.
Special Topic Invited Sessions: Logic in Artificial Intelligence Special Session in Honor of the 65th Birthday of Victor Marek. Organized by Michael Kaminski and Mirek Truszczynski; Computation and Social Choice. Organized by Toby Walsh, NICTA and University of New South Wales. Other special sessions may be announced soon.

February 2008

* 4–14 **Advanced Course on Simplicial Methods in Higher Categories**, Centre de Recerca Matemàtica, Bellaterra, Italy.
Coordinators: Carles Casacuberta, Universitat de Barcelona; Joachim Kock, Universitat Autònoma de Barcelona.
Speakers: André Joyal, Université du Québec à Montréal, The theory of quasi-categories and its applications; Ieke Moerdijk, Universiteit Utrecht, Dendroidal sets; Bertrand Toën, Université Paul Sabatier, Simplicial presheaves and derived geometries.
Further information: `http://www.crm.cat/ACQuasiCategories`.

* 12–16 **Foundations of Lattice-Valued Mathematics with Applications to Algebra and Topology**, Linz, Austria.
Description: The last decade has witnessed a significant development of the categorical, logical, and order-theoretic foundations of lattice-valued mathematics and their impact on algebra and topology. These developments have created or significantly strengthened bridges between lattice-valued mathematics, logic, sheaves, algebraic theories, quantales and order-theoretic structures, various subdisciplines of topology, and theoretical computer science. The purpose of the 29th Linz Seminar is to discuss the synergy between these fields as well as identify important open questions. Accordingly, the topics of the Seminar will include but not be limited to: Categorical and logical approaches to lattice valued algebraic structures, powerset theories, topological structures, Lattice valued categories, equivalences, locales, orders, topologies Presheaf and sheaf theoretic approaches to lattice valued structures Programming semantics, semantic domains, topological systems.
Information: email: `fabrizio.durante@jku.at`; `http://www.flll.jku.at/research/linz2008/index.html`.

March 2008

* 12–19 **Advanced Course on Geometric Flows and Hyperbolic Geometry**, Centre de Recerca Matemàtica, Bellaterra, Italy.
Coordinators: Joan Porti, Universitat Autònoma de Barcelona; Vicente Miquel, Universitat de València.
Speakers: Ben Chow, University of California at San Diego, Some geometric and analytic aspects of geometric flows; Manuel Ritoré, Universidad de Granada, Geometric flows, isoperimetric inequalities, and hyperbolic geometry; Carlo Sinestrari, Università degli Studi di Roma Tor Vergata, Formation of singularities in mean curvature flow.
Further information: `http://www.crm.cat/ACGeometryFlows`.

April 2008

* 24–26 **SIAM International Conference on Data Mining**, Hyatt Regency Hotel, Atlanta, Georgia.
Information: Abstract due: October 5, 2007. Manuscripts due: October 12, 2007. For additional information, contact SIAM Conference Department at `meetings@siam.org`.

May 2008

* 10–13 **SIAM Conference on Optimization**, Boston Park Plaza Hotel and Towers, Boston, Massachusetts.
Invited Plenary Speakers: Etienne de Klerk, Tilburg University, Netherlands; Matthias Heinkenschloss, Rice University; Jan Modersitzki, University of Lubeck, Germany; Annick Sartenaer, Universite Notre Dame de la Paix, Belgium; Stefan Scholtes, Cambridge University, United Kingdom; Pascal Van Hentenryck, Brown University; Andreas Wächter, IBM Research; Robert Weismantel, University of Magdeburg, Germany.
Deadlines: Minisymposium proposals: October 9, 2007 EDT. Abstracts for all contributed and minisymposium presentations: November 8, 2007 EST.
Information: The Call for Presentations for this conference is available at: `http://www.siam.org/meetings/op08/`. For additional information, contact SIAM Conference Department at `meetings@siam.org`.

June 2008

* 23–27 **Homotopical Group Theory and Topological Algebraic Geometry**, Max Planck Institute for Mathematics, Bonn, Germany.
Conference Topics: The conference focuses on the new interactions of Algebraic Topology with Group Theory, Algebraic Geometry and Mathematical Physics which come from looking at these fields through the eye of a homotopy theorist. It celebrates one of the contributors to the subject by honoring the 60th birthday of Haynes Miller (MIT).
Registration: All participants are required to register.
Organizers: M. Ando (UIUC), J. Grodal (Copenhagen), G. Laures (Bochum), B. Shipley (UIC).
Financial support: The conference is partially supported by the DFG Graduiertenkolleg 1150 "Homotopy and Cohomology" and the Max Planck Institute Bonn. Support from the National Science Foundation for beginning researchers is under application.
Information: `http://www.ruhr-uni-bochum.de/topologie/conf08/`.

November 2009

* 1–30 **5th Asian Mathematical Conference (AMC 2009)**, Penang/Kulalumpur, Malaysia.
Description: Activities of the conference will include the following: Keynote addresses by internationally renowned mathematicians; Invited talks by prominent regional mathematicians; Contributed papers; Workshops Focus Areas of this conference are; Algebra; Algebraic Geometry; Analysis; Operator Algebra & Functional Analysis; Lie Groups and Lie Algebras; Number Theory; Combinatorics; Logic & Foundations of Mathematics; Ordinary Differential Equations and Dynamical Systems; Partial Differential Equations; Topology; Mathematical Aspects of Computer Science; Numerical Analysis and Scientific Computing; Control Theory, Optimization and Operations Research; Probability and Stochastic Process; Statistics; Application of Mathematics in Sciences.
Information: email: `vravi@maths.du.ac`; `http://math.usm.my/amc2009`.

Mark Your Calendar

Joint Mathematics Meetings

San Diego

January 6–9, 2008

See You There!

AMS SHORT COURSE

Applications of Knot Theory

January 4-5, 2008
San Diego, California

Organizers:

Dorothy Buck
Department of Mathematics
and Centre for Bioinformatics
Imperial College London

Erica Flapan
Department of Mathematics
Pomona College

Over the past twenty years, knot theory has rekindled its historic ties with biology, chemistry, and physics. While the original motivation for understanding and classifying knots came from chemistry, knot theory remained a primarily pure field of mathematics until the 1980s, when chemists, biologists, and physicists began searching for more sophisticated descriptions of entanglements of natural phenomena—from strings to small organic compounds to DNA.

Th is AMS Short Course will introduce knot theory, and some of its recent applications in molecular biology, chemistry, and physics. No prior knowledge of knot theory, biology, chemistry, or physics is assumed— there will be introductory talks on the first day. Speakers will survey their own work in these areas, as well as describing new avenues for interested researchers (and their students) to explore.

The Short Course will conclude with a panel discussion of the putative trajectories of these applications of knot theory, and summarize the major open problems and challenges. References will be available in advance and lecture notes published afterwards.

List of speakers:

Colin Adams (Williams College)
Dorothy Buck (Imperial College London)
Erica Flapan (Pomona College)
Lou Kauffman (University of Illinois at Chicago)
Ned Seeman (New York University)
Jon Simon (University of Iowa)

Advance registration fees:

member/nonmember	$90/120
Student/unemployed/emeritus	$40

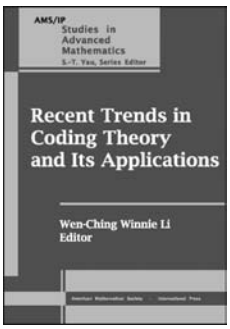
On-site registration fees:

member/nonmember	$120/151
student/unemployed/emeritus	$60

New Publications Offered by the AMS

To subscribe to email notification of new AMS publications, please go to http://www.ams.org/bookstore-email.

Applications



Recent Trends in Coding Theory and Its Applications

Wen-Ching Winnie Li, *Pennsylvania State University, University Park, PA*, Editor

Coding theory draws on a remarkable selection of mathematical topics, both pure and applied. The various contributions in this volume introduce coding theory and its most recent developments and applications, emphasizing both mathematical and engineering perspectives on the subject. This volume covers four important areas in coding theory: algebraic geometry codes, graph-based codes, space-time codes, and quantum codes. Both students and seasoned researchers will benefit from the extensive and self-contained discussions of the development and recent progress in these areas.

This item will also be of interest to those working in algebra and algebraic geometry.

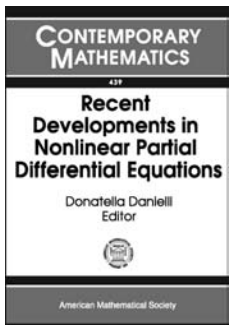
Titles in this series are co-published with International Press, Cambridge, MA.

Contents: *Algebraic geometry codes:* **M.-C. Kang**, Introduction to algebraic geometry codes; **W.-C. W. Li**, Upper and lower bounds for $A(q)$; **W.-C. W. Li**, Elkies' modularity conjecture; **H. Maharaj**, Explicit towers and codes; **W.-C. W. Li**, Improved algebraic geometry bounds; **A. Garcia** and **H. Stichtenoth**, On the Galois closure of towers; *Graph-based codes:* **N. Boston**, Graph-based codes; *New aspects of Reed Muller codes:* **A. R. Calderbank**, Reed Muller codes and symplectic geometry; *Quantum codes:* **A. Ashikhmin** and **S. Litsyn**, Foundations of quantum error correction; **K. Feng**, A new description of quantum error-correcting codes.

AMS/IP Studies in Advanced Mathematics, Volume 41

August 2007, 200 pages, Softcover, ISBN: 978-0-8218-4298-0, LC 2007060819, 2000 *Mathematics Subject Classification:* 94Bxx, **AMS members US$47**, List US$59, Order code AMSIP/41

Differential Equations



Recent Developments in Nonlinear Partial Differential Equations

Donatella Danielli, *Purdue University, West Lafayette, IN*, Editor

This volume contains research and expository articles based on talks presented at the 2nd Symposium on Analysis and PDEs, held at Purdue University. The symposium focused on topics related to the theory and applications of nonlinear partial differential equations that are at the forefront of current international research. Papers in this volume provide a comprehensive account of many of the recent developments in the field.

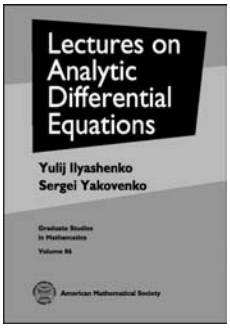
The topics featured in this volume include: kinetic formulations of nonlinear PDEs; recent unique continuation results and their applications; concentrations and constrained Hamilton–Jacobi equations; nonlinear Schrödinger equations; quasiminimal sets for Hausdorff measures; Schrödinger flows into Kähler manifolds; and parabolic obstacle problems with applications to finance.

The clear and concise presentation in many articles makes this volume suitable for both researchers and graduate students.

Contents: L. C. Evans, Lectures on kinetic formulations of nonlinear PDE; **C. E. Kenig**, Some recent applications of unique continuation; **G. Barles** and **B. Perthame**, Concentrations and constrained Hamilton-Jacobi equations arising in adaptive dynamics; **J. Colliander**, **M. Keel**, **G. Staffilani**, **H. Takaoka**, and **T. Tao**, The energy-critical nonlinear Schrödinger equation in $\mathbb{R}^3$; **G. David**, Quasiminimal sets for Hausdorff measures; **C. E. Kenig**, **G. Ponce**, and **L. Vega**, The initial value problem for the general quasi-linear Schrödinger equation; **A. Petrosyan** and **H. Shahgholian**, Parabolic obstacle problems applied to finance. A free-boundary-regularity approach.

Contemporary Mathematics, Volume 439

October 2007, 133 pages, Softcover, ISBN: 978-0-8218-3740-5, LC 2007060822, 2000 *Mathematics Subject Classification:* 49K99, 35Q55, 49L25, 35B25, 92D15, 35R35, 35K60, 58J35, **AMS members US$39**, List US$49, Order code CONM/439



Lectures on Analytic Differential Equations

Yulij Ilyashenko, *Cornell University, Ithaca, NY, and Independent University of Moscow, Russia*, and **Sergei Yakovenko**, *Weizmann Institute of Science, Rehovot, Israel*

The book combines the features of a graduate-level textbook with those of a research monograph and survey of the recent results on analysis and geometry of differential equations in the real and complex domain. As a graduate textbook, it includes self-contained, sometimes considerably simplified demonstrations of several fundamental results, which previously appeared only in journal publications (desingularization of planar analytic vector fields, existence of analytic separatrices, positive and negative results on the Riemann–Hilbert problem, Ecalle–Voronin and Martinet–Ramis moduli, solution of the Poincaré problem on the degree of an algebraic separatrix, etc.). As a research monograph, it explores in a systematic way the algebraic decidability of local classification problems, rigidity of holomorphic foliations, etc. Each section ends with a collection of problems, partly intended to help the reader to gain understanding and experience with the material, partly drafting demonstrations of the more recent results surveyed in the text.

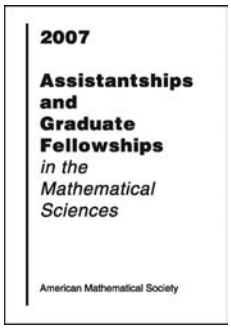
The exposition of the book is mostly geometric, though the algebraic side of the constructions is also prominently featured. On several occasions the reader is introduced to adjacent areas, such as intersection theory for divisors on the projective plane or geometric theory of holomorphic vector bundles with meromorphic connections. The book provides the reader with the principal tools of the modern theory of analytic differential equations and intends to serve as a standard source for references in this area.

Contents: Normal forms and desingularization; Singular points of planar analytic vector fields; Local and global theory of linear systems; Functional moduli of analytic classification of resonant germs and their applications; Global properties of complex polynomial foliations; Appendix. First aid; Bibliography; Index.

Graduate Studies in Mathematics, Volume 86

November 2007, approximately 636 pages, Hardcover, ISBN: 978-0-8218-3667-5, 2000 *Mathematics Subject Classification:* 34A26, 34C10; 14Q20, 32S65, 13E05, **AMS members US$63**, List US$79, Order code GSM/86

General and Interdisciplinary



Assistantships and Graduate Fellowships in the Mathematical Sciences 2007

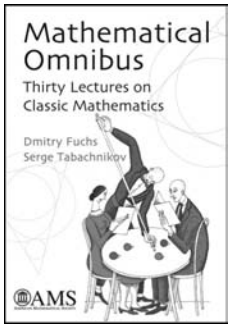
From a review of a previous edition:

This directory is a tool for undergraduate mathematics majors seeking information about graduate programs in mathematics. Although most of the information can be gleaned from the Internet, the usefulness of this directory for the prospective graduate student is the consistent format for comparing different mathematics graduate programs without the hype. Published annually, the information is up-to-date, which is more than can be said of some Websites. Support for graduate students in mathematics is a high priority of the American Mathematical Society, which also provides information for fellowships and grants they offer as well as support from other societies and foundations. The book is highly recommended for academic and public libraries.

— ***American Reference Books Annual***

This valuable reference source brings together a wealth of information about resources available for graduate study in mathematical sciences departments in the U.S. and Canada.

November 2007, approximately 112 pages, Softcover, ISBN: 978-0-8218-4322-2, **Individual member US$18**, List US$23, Order code ASST/2007



Mathematical Omnibus

Thirty Lectures on Classic Mathematics

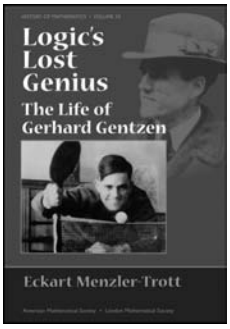
Dmitry Fuchs, *University of California, Davis, CA*, and **Serge Tabachnikov**, *Pennsylvania State University, University Park, PA*

The book consists of thirty lectures on diverse topics, covering much of the mathematical landscape rather than focusing on one area. The reader will learn numerous results that often belong to neither the standard undergraduate nor graduate curriculum and will discover connections between classical and contemporary ideas in algebra, combinatorics, geometry, and topology. The reader's effort will be rewarded in seeing the harmony of each subject. The common thread in the selected subjects is their illustration of the unity and beauty of mathematics. Most lectures contain exercises, and solutions or answers are given to selected exercises. A special feature of the book is an abundance of drawings (more than four hundred), artwork by an award-winning artist, and about a hundred portraits of mathematicians. Almost every lecture contains surprises for even the seasoned researcher.

Contents: Algebra and arithmetics: *Arithmetic and combinatorics:* Can a number be approximately rational?; Arithmetical properties of binomial coefficients; On collecting like terms, on Euler, Gauss,

and MacDonald, and on missed opportunities; *Equations:* Equations of degree three and four; Equations of degree five; How many roots does a polynomial have?; Chebyshev polynomials; Geometry of equations; **Geometry and topology:** *Envelopes and singularities:* Cusps; Around four vertices; Segments of equal areas; On plane curves; *Developable surfaces:* Paper sheet geometry; Paper Möbius band; More on paper folding; *Straight lines:* Straight lines on curved surfaces; Twenty-seven lines; Web geometry; The Crofton formula; *Polyhedra:* Curvature and polyhedra; Non-inscribable polyhedra; Can one make a tetrahedron out of a cube?; Impossible tilings; Rigidity of polyhedra; Flexible polyhedra; *Two surprising topological constructions:* Alexander's horned sphere; Cone eversion; *On ellipses and ellipsoids:* Billiards in ellipses and geodesics on ellipsoids; The Poncelet porism and other closure theorems; Gravitational attraction of ellipsoids; Solutions to selected exercises; Bibliography; Index.

October 2007, 463 pages, Hardcover, ISBN: 978-0-8218-4316-1, 2000 *Mathematics Subject Classification:* 00A05, **AMS members US$47**, List US$59, Order code MBK/46



Logic's Lost Genius

The Life of Gerhard Gentzen

Eckart Menzler-Trott, *Munich, Germany*

Gerhard Gentzen (1909–1945) is the founder of modern structural proof theory. His lasting methods, rules, and structures resulted not only in the technical mathematical discipline called "proof theory" but also in verification programs that are essential in computer science. The appearance, clarity, and elegance of Gentzen's work on natural deduction, the sequent calculus, and ordinal proof theory continue to be impressive even today.

The present book gives the first comprehensive, detailed, accurate scientific biography expounding the life and work of Gerhard Gentzen, one of our greatest logicians, until his arrest and death in Prague in 1945.

Particular emphasis in the book is put on the conditions of scientific research, in this case mathematical logic, in National Socialist Germany, the ideological fight for "German logic", and their mutual protagonists. Numerous hitherto unpublished sources, family documents, archival material, interviews, and letters, as well as Gentzen's lectures for the mathematical public, make this book an indispensable source of information on this important mathematician, his work, and his time. The volume is completed by two deep substantial essays by Jan von Plato and Craig Smoryński on Gentzen's proof theory; its relation to the ideas of Hilbert, Brouwer, Weyl, and Gödel; and its development up to the present day. Smoryński explains the Hilbert program in more than the usual slogan form and shows why consistency is important. Von Plato shows in detail the benefits of Gentzen's program.

This important book is a self-contained starting point for any work on Gentzen and his logic. The book is accessible to a wide audience with different backgrounds and is suitable for general readers, researchers, students, and teachers.

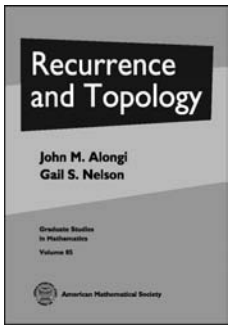
Co-published with the London Mathematical Society beginning with Volume 4. Members of the LMS may order directly from the AMS at the AMS member price. The LMS is registered with the Charity Commissioners.

Contents: Early youth and abitur; 1928-1938—Weimar Republic and National Socialism in peace. From the beginning of studies to the extension of the unscheduled assistantship for another year with effect from 1 October 1938; 1939-1942—From the beginning of the war to dismissal from the Wehrmacht and the wartime habilitation under Helmut Hasse; The fight over "German logic" from 1940 to 1945: A battle between amateurs; Recovery and docent position 1942 to 1944; Arrest, imprisonment, death and Nachlass; Conclusion; Tables of the life of Gerhard Gentzen; Appendix A: Gentzen and geometry, by C. Smoryński; Appendix B: Hilbert's programme, by C. Smoryński; Appendix C: Three lectures, by Gerhard Gentzen; Appendix D: From Hilbert's programme to Gentzen's programme, by Jan von Plato; Bibliography; Index.

History of Mathematics, Volume 33

November 2007, 442 pages, Hardcover, ISBN: 978-0-8218-3550-0, 2000 *Mathematics Subject Classification:* 01A60, **AMS members US$71**, List US$89, Order code HMATH/33

Geometry and Topology



Recurrence and Topology

John M. Alongi, *Northwestern University, Evanston, IL*, and **Gail S. Nelson**, *Carleton College, Northfield, MN*

Since at least the time of Poisson, mathematicians have pondered the notion of recurrence for differential equations. Solutions that exhibit recurrent behavior provide insight into the behavior of general solutions. In *Recurrence and Topology*, Alongi and Nelson provide a modern understanding of the subject, using the language and tools of dynamical systems and topology.

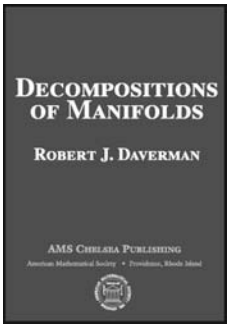
Recurrence and Topology develops increasingly more general topological modes of recurrence for dynamical systems beginning with fixed points and concluding with chain recurrent points. For each type of recurrence the text provides detailed examples arising from explicit systems of differential equations; it establishes the general topological properties of the set of recurrent points; and it investigates the possibility of partitioning the set of recurrent points into subsets which are dynamically irreducible. The text includes a discussion of real-valued functions that reflect the structure of the sets of recurrent points and concludes with a thorough treatment of the Fundamental Theorem of Dynamical Systems.

Recurrence and Topology is appropriate for mathematics graduate students, though a well-prepared undergraduate might read most of the text with great benefit.

Contents: Flows; Recurrent points; Irreducible sets; Test functions; Afterword; Appendix A. Discrete dynamical systems; Appendix B. Circle rotations; Appendix C. The Hausdorff metric; Bibliography; Index.

Graduate Studies in Mathematics, Volume 85

August 2007, 221 pages, Hardcover, ISBN: 978-0-8218-4234-8, LC 2007060754, 2000 *Mathematics Subject Classification:* 37-01, 37B20, 37B25, 37B35, 54H20; 37C10, 37C15, 37C25, 37C27, 37C50, 37C70, 34D45, **AMS members US$36**, List US$45, Order code GSM/85



Decompositions of Manifolds

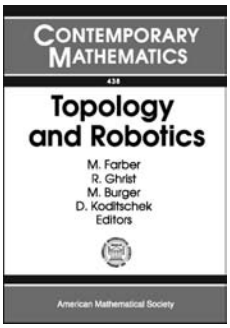
Robert J. Daverman, *University of Tennessee, Knoxville, TN*

Decomposition theory studies decompositions, or partitions, of manifolds into simple pieces, usually cell-like sets. Since its inception in 1929, the subject has become an important tool in geometric topology. The main goal of the book is to help students interested in geometric topology to bridge the gap between entry-level graduate courses and research at the frontier as well as to demonstrate interrelations of decomposition theory with other parts of geometric topology. With numerous exercises and problems, many of them quite challenging, the book continues to be strongly recommended to everyone who is interested in this subject. The book also contains an extensive bibliography and a useful index of key words, so it can also serve as a reference to a specialist.

Contents: Introduction; Preliminaries; The shrinkability criterion; Cell-like decompositions of absolute neighborhood retracts; The cell-like approximation theorem; Shrinkable decompositions; Nonshrinkable decompositions; Applications to manifolds; References; Index.

AMS Chelsea Publishing

September 2007, 317 pages, Hardcover, ISBN: 978-0-8218-4372-7, LC 2007020224, 2000 *Mathematics Subject Classification:* 57-01; 54B15, **AMS members US$44**, List US$49, Order code CHEL/362.H



Topology and Robotics

M. Farber, *University of Durham, United Kingdom*, **R. Ghrist**, *University of Illinois at Urbana-Champaign, IL*, **M. Burger**, *ETH, Zurich, Switzerland*, and **D. Koditschek**, *University of Pennsylvania, Philadelphia, PA*, Editors

Ever since the literary works of Čapek and Asimov, mankind has been fascinated by the idea of robots. Modern research in robotics reveals that along with many other branches of mathematics, topology has a fundamental role to play in making these grand ideas a reality. This volume summarizes recent progress in the field of topological robotics—a new discipline at the crossroads of topology, engineering and computer science.

Currently, topological robotics is developing in two main directions. On one hand, it studies pure topological problems inspired by robotics and engineering. On the other hand, it uses topological ideas, topological language, topological philosophy, and specially developed tools of algebraic topology to solve problems of engineering and computer science. Examples of research in both these directions are given by articles in this volume, which is designed to be a mixture of various interesting topics of pure mathematics and practical engineering.

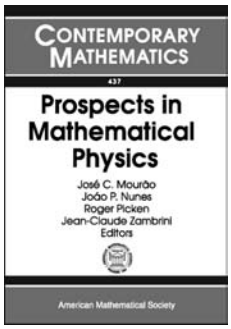
This item will also be of interest to those working in applications.

Contents: R. Ghrist, Winding numbers for networks with weak angular data; **E. Rodriguez**, The snake charmer's algorithm; **B. Tovar**, **L. Freda**, and **S. M. LaValle**, Using a robot to learn geometric information from permutations of landmarks; **J.-Cl. Hausmann**, Geometric descriptions of polygon and chain spaces; **Y. Gur** and **N. Sochen**, Diffusion over tensor fields via Lie group pde flows: Lagrangian action approach; **M. Farber**, **M. Grant**, and **S. Yuzvinsky**, Topological complexity of collision free motion planning algorithms in the presence of multiple moving obstacles; **M. Farber** and **M. Grant**, Symmetric motion planning; **L. Lechuga** and **A. Murillo**, Topological complexity of formal spaces; **S. Yuzvinsky**, Topological complexity of generic hyperplane complements; **A. D. Ames**, Homotopy meaningful hybrid model structures; **D. Farley**, Presentations for the cohomology rings of tree braid groups; **Y. Gabriely** and **E. Rimon**, Competitive disconnection detection in on-line mobile robot navigation.

Contemporary Mathematics, Volume 438

October 2007, 192 pages, Softcover, ISBN: 978-0-8218-4246-1, LC 2007060806, 2000 *Mathematics Subject Classification:* 55-06, 58-06, 68T40, **AMS members US$47**, List US$59, Order code CONM/438

Mathematical Physics



Prospects in Mathematical Physics

José C. Mourão and **João P. Nunes**, *Instituto Superior Tecnico, Lisbon, Portugal*, **Roger Picken**, *Institute Superior Tecnico, Lisbon, Portugal*, and **Jean-Claude Zambrini**, *University of Lisbon, Portugal*, Editors

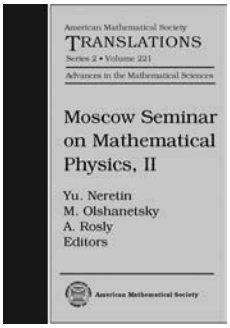
This book includes papers presented at the Young Researchers Symposium of the 14th International Congress on Mathematical Physics, held in July 2003, in Lisbon, Portugal. The goal of the book is to illustrate various promising areas of mathematical physics in a way accessible to researchers at the beginning of their careers. Two of the three laureates of the Henri Poincaré Prizes, Huzihiro Araki and Elliott Lieb, also contributed to this volume. The book provides a good survey of some active areas of research in modern mathematical physics.

Contents: M. Aizenman, **R. Sims**, and **S. L. Starr**, Mean-field spin glass models from the cavity–ROSt perspective; **C. D'Antoni**, **G. Morsella**, and **R. Verch**, Scaling algebras for charge carrying quantum fields and superselection structure at short distances; **H. Araki**, Equilibrium statistical mechanics of quantum lattice systems; **E. A. Carlen**, The rate of local equilibration in kinetic theory; **A. Hernández-Garduño**, Bifurcations of relative equilibria

in simple mechanical systems; **V. F. R. Jones**, In and around the origin of quantum groups; **E. H. Lieb** and **J. Yngvason**, A second look at the second law of thermodynamics; **F. Lledó** and **O. Post**, Generating spectral gaps by geometry; **M. Loss**, Stability of matter; **M. Mariño**, String theory and knot invariants; **N. M. Romão**, Slow dynamics of $\mathbb{CP}^1$ lumps on a cylinder; **Y. Sinai**, A new approach to the study of the $3\mathcal{D}$-Navier-Stokes system; **J. Teschner**, From Liouville theory to the quantum geometry of Riemann surfaces.

Contemporary Mathematics, Volume 437

September 2007, 246 pages, Softcover, ISBN: 978-0-8218-4270-6, LC 2007060805, 2000 *Mathematics Subject Classification:* 35-02, 37-02, 47-02, 60-02, 76-02, 81-02, 82-02, 83-02, **AMS members US$55**, List US$69, Order code CONM/437



Moscow Seminar on Mathematical Physics, II

Yu. Neretin, **M. Olshanetsky**, and **A. Rosly**, *Institute for Theoretical and Experimental Physics, Moscow, Russia*, Editors

The Institute for Theoretical and Experimental Physics (ITEP) is internationally recognized for achievements in various branches of theoretical physics. For many years, the seminars at ITEP have been among the main centers of scientific life in Moscow. This volume is a collection of articles by participants of the seminar on mathematical physics that has been held at ITEP since 1983. This is the second such collection; the first was published in the same series, AMS Translations, Series 2, vol. 191.

The papers in the volume are devoted to several mathematical topics that strongly influenced modern theoretical physics. Among these topics are cohomology and representations of infinite Lie algebras and superalgebras, Hitchin and Knizhnik-Zamolodchikov-Bernard systems, and the theory of D-modules.

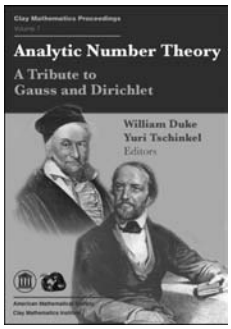
The book is intended for graduate students and research mathematicians working in algebraic geometry, representation theory, and mathematical physics.

Contents: **B. Enriquez** and **V. Rubtsov**, Hecke-Tyurin parametrization of the Hitchin and KZB systems; **B. Feigin**, **A. N. Kirillov**, and **S. Loktev**, Combinatorics and geometry of higher level Weyl modules; **V. V. Fock**, Cosh-Gordon equation and quasi-Fuchsian groups; **A. Gerasimov**, **S. Kharchev**, **D. Lebedev**, and **S. Oblezin**, On a class of representations of quantum groups and its applications; **A. L. Gorodentsev**, **A. S. Khoroshkin**, and **A. N. Rudakov**, On syzygies of highest weight orbits; **A. L. Gorodentsev** and **S. A. Kuleshov**, On finest and modular t-stabilities; **D. Kaledin**, Hochschild homology and Gabber's theorem; **S. Khoroshkin** and **S. Pakuliak**, Method of projections of Drinfeld currents; **A. Levin** and **A. Zotov**, On rational and elliptic forms and Painlevé VI equation; **Y. A. Neretin**, Determinantal point processes and fermionic Fock space; **Y. A. Neretin**, On adelic model of boson Fock space; **M. Verbitsky**, Hypercomplex manifolds with trivial canonical bundle and their holonomy.

American Mathematical Society Translations—Series 2 (*Advances in the Mathematical Sciences*), Volume 221

October 2007, approximately 213 pages, Hardcover, ISBN: 978-0-8218-4371-0, LC 91-640741, 2000 *Mathematics Subject Classification:* 00B25; 37-06, **AMS members US$87**, List US$109, Order code TRANS2/221

Number Theory



Analytic Number Theory

A Tribute to Gauss and Dirichlet

William Duke, *University of California, Los Angeles, CA*, and **Yuri Tschinkel**, *Courant Institute, New York University, NY*, Editors

Articles in this volume are based on talks given at the Gauss–Dirichlet Conference held in Göttingen on June 20–24, 2005. The conference commemorated the 150th anniversary of the death of C.-F. Gauss and the 200th anniversary of the birth of J.-L. Dirichlet.

The volume begins with a definitive summary of the life and work of Dirichlet and continues with thirteen papers by leading experts on research topics of current interest in number theory that were directly influenced by Gauss and Dirichlet. Among the topics are the distribution of primes (long arithmetic progressions of primes and small gaps between primes), class groups of binary quadratic forms, various aspects of the theory of L-functions, the theory of modular forms, and the study of rational and integral solutions to polynomial equations in several variables.

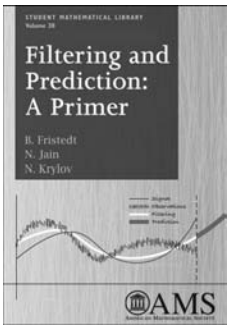
Titles in this series are co-published with the Clay Mathematics Institute (Cambridge, MA).

Contents: **J. Elstrodt**, The life and work of Gustav Lejeune Dirichlet (1805–1859); **T. D. Browning**, An overview of Manin's conjecture for del Pezzo surfaces; **J. Brüdern** and **T. D. Wooley**, The density of integral solutions for pairs of diagonal cubic equations; **A. Diaconu** and **D. Goldfeld**, Second moments of GL_2 automorphic L-functions; **J. Funke**, CM points and weight 3/2 modular forms; **D. A. Goldston**, **J. Pintz**, and **C. Y. Yıldırım**, The path to recent progress on small gaps between primes; **A. Granville** and **K. Soundararajan**, Negative values of truncations to $L(1,\chi)$; **B. Green**, Long arithmetic progressions of primes; **P. Michel** and **A. Venkatesh**, Heegner points and non-vanishing of Rankin/Selberg L-functions; **K. Ono**, Singular moduli generating functions for modular curves and surfaces; **P. Salberger**, Rational points of bounded height on threefolds; **P. Sarnak**, Reciprocal geodesics; **K. Soundararajan**, The fourth moment of Dirichlet L-functions; **H. M. Stark**, The Gauss class-number problems.

Clay Mathematics Proceedings, Volume 7

September 2007, 256 pages, Softcover, ISBN: 978-0-8218-4307-9, LC 2007060818, 2000 *Mathematics Subject Classification:* 01Axx, 11Dxx, 11Exx, 11Mxx, 11Nxx, 14Gxx, **AMS members US$39**, List US$49, Order code CMIP/7

Probability



Filtering and Prediction: A Primer

B. Fristedt, **N. Jain**, and **N. Krylov**, *University of Minnesota, Minneapolis, MN*

Filtering and prediction is about observing moving objects when the observations are corrupted by random errors. The main focus is then on filtering out the errors and extracting from the observations the most precise information about the object, which itself may or may not be moving in a somewhat random fashion. Next comes the prediction step where, using information about the past behavior of the object, one tries to predict its future path.

The first three chapters of the book deal with discrete probability spaces, random variables, conditioning, Markov chains, and filtering of discrete Markov chains. The next three chapters deal with the more sophisticated notions of conditioning in nondiscrete situations, filtering of continuous-space Markov chains, and of Wiener process. Filtering and prediction of stationary sequences is discussed in the last two chapters.

The authors believe that they have succeeded in presenting necessary ideas in an elementary manner without sacrificing the rigor too much. Such rigorous treatment is lacking at this level in the literature. In the past few years the material in the book was offered as a one-semester undergraduate/beginning graduate course at the University of Minnesota. Some of the many problems suggested in the text were used in homework assignments.

This item will also be of interest to those working in applications.

Contents: Preliminaries; Markov chains; Filtering of discrete Markov chains; Conditional expectations; Filtering of continuous-space Markov chains; Wiener process and continuous time filtering; Stationary sequences; Prediction of stationary sequences; Bibliography; Index.

Student Mathematical Library, Volume 38

October 2007, 252 pages, Softcover, ISBN: 978-0-8218-4333-8, LC 2007060783, 2000 *Mathematics Subject Classification:* 60-01; 60G99, **AMS members US$31**, List US$39, Order code STML/38

New AMS-Distributed Publications

Algebra and Algebraic Geometry

Algebraic Groups and Homogeneous Spaces

Vikram B. Mehta, *Tata Institute of Fundamental Research, Mumbai, India, Editor*

The area of algebraic groups and homogeneous spaces is one in which major advances have been made in recent decades. This was the theme of the (twelfth) International Colloquium organized by the Tata Institute of Fundamental Research in January 2004, and this volume constitutes the proceedings of that meeting.

This volume contains articles by several leading experts in central topics in the area, including representation theory, flag varieties, Schubert varieties, vector bundles, loop groups and Kac–Moody Lie algebras, Galois cohomology of algebraic groups, and Tannakian categories.

In addition to the original papers in these areas, the volume includes a survey on representation theory in characteristic p by H. Andersen and an article by T. A. Springer on Armand Borel's work in algebraic groups and Lie groups.

A publication of the Tata Institute of Fundamental Research. Distributed worldwide except in India, Bangladesh, Bhutan, Maldavis, Nepal, Pakistan, and Sri Lanka.

Contents: **T. A. Springer**, Armand Borel's work in the theory of linear algebraic Groups; **H. H. Andersen**, Cohomology of line bundles; **P. Belkale**, Extremal unitary local systems on $\mathbb{P}^1 - \{p_1, \ldots, p_s\}$; **I. Biswas** and **T. L. Gómez**, Higgs fields and flat connections on a principal bundle over a compact Kähler manifold; **M. Brion**, Construction of equivariant vector bundles; **J.-L. Colliot-Thélène** and **J.-J. Sansuc**, The rationality problem for fields of invariants under linear algebraic groups (with special regards to the Brauer group); **C. De Concini** and **C. Procesi**, On the geometry of graph arrangements; **P. Deligne**, La catégorie des représentations du groupe symétrique S_t, lorsque t n'est pas un entier naturel; **H. Garland**, Eisenstein series on loop groups: Maass-Selberg relations 1; **W. van der Kallen**, A reductive group with finitely generated cohomology algebras; **S. S. Kannan**, Cohomology of line bundles on Schubert varieties in the Kac-Moody setting; **F. Knop**, Composition Kostka functions; **V. Kreiman**, **V. Lakshmibai**, **P. Magyar**, and **J. Weyman**, On ideal generators for affine Schubert varieties; **H. Nakajima**, Crystal, canonical and PBW bases of quantum affine algebras; **R. Orellana** and **A. Ram**, Affine braids, Markov traces and the category $\mathcal{O}$; **R. Parthasarathy**, Quantum analogues of a coherent family of modules at roots of One: $\mathfrak{g}_2$; **V. L. Popov**, Generically multiple transitive algebraic group actions; **T. A. Springer**, Some subvarieties of a group compactification.

Tata Institute of Fundamental Research

June 2007, 535 pages, Hardcover, ISBN: 978-81-7319-802-1, 2000 *Mathematics Subject Classification:* 20-XX, 14-XX; 20Gxx, 14Lxx, **AMS members US$40**, List US$50, Order code TIFR/11

The Collected Papers of M. S. Narasimhan

M. S. Narasimhan, *Tata Institute of Fundamental Research, Mumbai, India*

M. S. Narasimhan (b. 1932) has made outstanding contributions to diverse areas of mathematics, including algebraic geometry, differential geometry, representation theory of Lie groups, partial differential equations, and mathematical aspects of physics. His famous joint work with Seshadri started a new period in the study of holomorphic vector bundles on projective varieties, and he, along with his collaborators, made pioneering progress in the study of their moduli. His work with Ramanan on universal connections and his work with Okamoto on geometric realization of discrete series are of fundamental importance. In a research career spanning five decades, he has authored about 50 research papers. He is the recipient of several honours and awards, including a Royal Society of London fellowship and the 2006 King Faisal Prize.

This single volume, with about 800 pages, will be of enduring value to mathematicians with diverse interests and backgrounds.

A publication of the Tata Institute of Fundamental Research. Distributed worldwide except in India, Bangladesh, Bhutan, Maldavis, Nepal, Pakistan, and Sri Lanka.

Contents: Papers of M. S. Narasimhan; Notes; Bibliography.

Tata Institute of Fundamental Research

June 2007, 850 pages, Hardcover, ISBN: 978-81-85931-77-7, 2000 *Mathematics Subject Classification:* 14-XX, 22E45, 35-XX, 32-XX, 53-XX, **AMS members US$80**, List US$100, Order code TIFR/10

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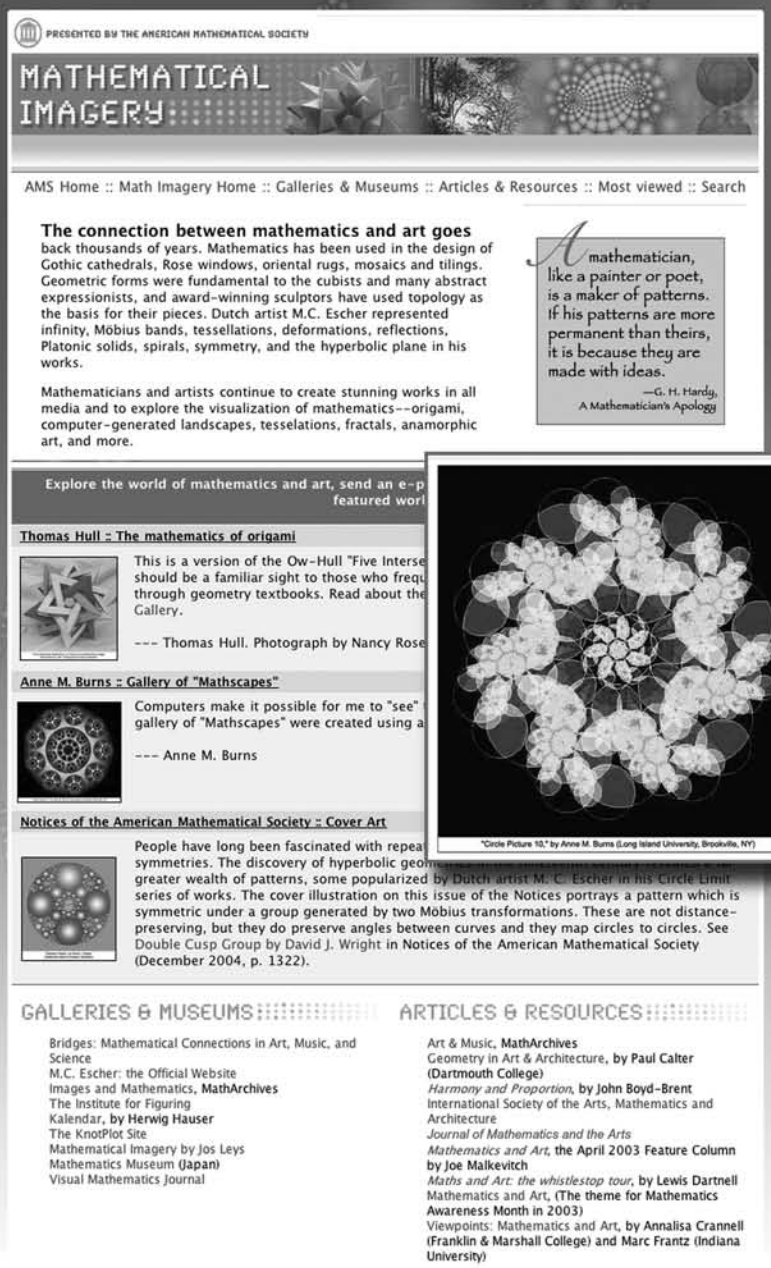

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MATHEMATICAL IMAGERY

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The connection between mathematics and art goes back thousands of years. Mathematics has been used in the design of Gothic cathedrals, Rose windows, oriental rugs, mosaics and tilings. Geometric forms were fundamental to the cubists and many abstract expressionists, and award-winning sculptors have used topology as the basis for their pieces. Dutch artist M.C. Escher represented infinity, Möbius bands, tessellations, deformations, reflections, Platonic solids, spirals, symmetry, and the hyperbolic plane in his works.

Mathematicians and artists continue to create stunning works in all media and to explore the visualization of mathematics--origami, computer-generated landscapes, tesselations, fractals, anamorphic art, and more.

A mathematician, like a painter or poet, is a maker of patterns. If his patterns are more permanent than theirs, it is because they are made with ideas.
—G. H. Hardy, A Mathematician's Apology

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featured worl

Thomas Hull :: The mathematics of origami

This is a version of the Ow-Hull "Five Interse
should be a familiar sight to those who frequ
through geometry textbooks. Read about the
Gallery.

--- Thomas Hull. Photograph by Nancy Rose

Anne M. Burns :: Gallery of "Mathscapes"

Computers make it possible for me to "see"
gallery of "Mathscapes" were created using a

--- Anne M. Burns

Notices of the American Mathematical Society :: Cover Art

People have long been fascinated with repeat
symmetries. The discovery of hyperbolic geom
greater wealth of patterns, some popularized by Dutch artist M. C. Escher in his Circle Limit series of works. The cover illustration on this issue of the Notices portrays a pattern which is symmetric under a group generated by two Möbius transformations. These are not distance-preserving, but they do preserve angles between curves and they map circles to circles. See Double Cusp Group by David J. Wright in Notices of the American Mathematical Society (December 2004, p. 1322).

GALLERIES & MUSEUMS

Bridges: Mathematical Connections in Art, Music, and Science
M.C. Escher: the Official Website
Images and Mathematics, MathArchives
The Institute for Figuring
Kalendar, by Herwig Hauser
The KnotPlot Site
Mathematical Imagery by Jos Leys
Mathematics Museum (Japan)
Visual Mathematics Journal

ARTICLES & RESOURCES

Art & Music, MathArchives
Geometry in Art & Architecture, by Paul Calter (Dartmouth College)
Harmony and Proportion, by John Boyd-Brent
International Society of the Arts, Mathematics and Architecture
Journal of Mathematics and the Arts
Mathematics and Art, the April 2003 Feature Column by Joe Malkevitch
Maths and Art: the whistlestop tour, by Lewis Dartnell
Mathematics and Art, (The theme for Mathematics Awareness Month in 2003)
Viewpoints: Mathematics and Art, by Annalisa Crannell (Franklin & Marshall College) and Marc Frantz (Indiana University)

"Circle Picture 10," by Anne M. Burns (Long Island University, Brookville, NY)

Dear Peter,
Here's one of the e-postcards from the site.

Nancy

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CALIFORNIA INSTITUTE OF TECHNOLOGY
Tenure-Track Position

The Division of Physics, Mathematics, and Astronomy at the California Institute of Technology invites applications for a tenure-track position at the assistant professor level in mathematics. We are especially interested in the following research areas: topology/geometry and analysis, but other fields may be considered. The term of the initial appointment is normally four years and appointment is contingent upon completion of the Ph.D. Exceptionally well-qualified applicants may also be considered at the associate or full professor level. We are seeking highly qualified applicants who are committed to a career in research and teaching. Applicants should write promptly to: Tenure-Track Search, Mathematics 253-37, California Institute of Technology, Pasadena, CA 91125. Please include a curriculum vitae, list of publications, description of research, and ensure that at least three letters of recommendation be sent to the above address. You may also apply online at `mathjobs.org`.

000078

CALIFORNIA INSTITUTE OF TECHNOLOGY
Harry Bateman Research Instructorships in Mathematics

Description: Appointments are for two years. The academic year runs from approximately October 1 to June 1. Instructors are expected to teach one course per quarter for the full academic year and to devote the rest of their time to research. During the summer months there are no duties except research.

Eligibility: Open to persons who have recently received their doctorates in mathematics.

Application information: Please apply online at `mathjobs.org`. 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.

000079

CALIFORNIA INSTITUTE OF TECHNOLOGY
Scott Russell Johnson Senior Postdoctoral Scholar in Mathematics

Description: There are three terms in the Caltech academic year. The fellow is expected to teach one course in two terms each year, and is expected to be in residence even during terms when not teaching. The initial appointment is for three years with an additional three-year terminal extension expected.

Eligibility: Offered to a candidate within six years of having received the Ph.D. who shows strong research promise in one of the areas in which Caltech's mathematics faculty is currently active.

Deadline: January 1, 2007.

Application information: Please apply online at `mathjobs.org`. To avoid duplication of paperwork, your application may also be considered for an Olga Taussky and John Todd Instructorship and a Harry Bateman Research Instructorship.

Caltech is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and disabled persons are encouraged to apply.

000080

CALIFORNIA INSTITUTE OF TECHNOLOGY
Olga Taussky and John Todd Instructorships in Mathematics

Description: Appointments are for three years. 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. These two terms will be devoted to research. During the summer months there are no duties except research.

Eligibility: Offered to persons within three years of having received the Ph.D. who show strong research promise in one

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 2007 rate is $110 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 ads.

Upcoming deadlines for classified advertising are as follows: November 2007 issue–August 28, 2007; December 2007 issue–October 1, 2007; January 2008 issue–October 26, 2007; February 2008 issue–November 28, 2007; March 2008–December 28, 2007; April 2008 issue–January 28, 2008.

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 email to `classads@ams.org`. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 20904. Advertisers will be billed upon publication.

of the areas in which Caltech's mathematics faculty is currently active.

Deadline: January 1, 2008.

Application information: Please apply online at mathjobs.org. 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.

000081

UNIVERSITY OF CALIFORNIA, BERKELEY
Department of Civil and Environmental Engineering

The Department of Civil and Environmental Engineering at the University of California, Berkeley, invites applications for a tenure-track assistant professor position in surface water hydrology. The appointment will be effective July 1, 2008. The successful candidate must hold a doctoral degree in an appropriate field and must demonstrate potential for high-quality research and teaching. Research interests should incorporate a fundamental approach to the hydrologic cycle that could encompass theoretical aspects of water transport, measurement technologies, integrative data analysis, and predictive modeling. Examples of research approaches include, but are not limited to, mechanistic studies in large-scale water circulation, ecosystem response to dynamic water stressors, human-altered systems, responses to climate change, terrestrial and atmospheric coupling, and the water-energy nexus. Expanding the disciplinary basis of hydrologic science is highly desirable. The faculty member will teach undergraduate and graduate courses as part of the Civil & Environmental Engineering curricula. The faculty member will be expected to interact with faculty in the Department of Civil and Environmental Engineering, the College of Engineering, research centers on campus, and relevant professional organizations.

Applicants must send by November 9, 2007, a detailed resume, a statement of teaching and research interests, copies of no more than two publications or manuscripts, and the names and contact information for five references. Submission of electronic applications is preferred. Please go to our department website at: http://www.ce.berkeley.edu. Alternately, hard copy applications can be sent to Lisa Alvarez-Cohen, Chair, Department of Civil and Environmental Engineering, MC 1710, ATTN: Hydrology Faculty Search Committee, University of California, Berkeley, Berkeley, CA 94720-1710. Applications postmarked after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

000064

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Tenured or Tenure-Track Positions

Pending budget approval, we invite applications for three positions effective July 1, 2008, at either the tenure-track (assistant professor) or tenured (associate or full professor) level, in 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 resume, and reprint or 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 at http://math.berkeley.edu/employment_academic.html.

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. It is available courtesy of the American Mathematical Society.

Applications for both tenure-track and tenure applications must be postmarked by December 1, 2007. Applications postmarked after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

000074

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Charles B. Morrey Jr. Assistant Professorships

We invite applications for these special (non-tenure-track) positions effective July 1, 2008. 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 resume, 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 at http://math.berkeley.edu/employment_academic.html. 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. It is available courtesy of the American Mathematical Society.

Applications must be postmarked by December 1, 2007. Applications postmarked after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

000075

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Temporary Postdoctoral Positions

Several temporary positions beginning in Fall 2008 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 resume 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 at http://math.berkeley.edu/employment_academic.html. 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. It is available courtesy of the American Mathematical Society.

Applications must be postmarked by December 1, 2007. Applications postmarked after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

000076

UNIVERSITY OF CALIFORNIA, LOS ANGELES
Department of Mathematics
2008-2009 Faculty Positions

The Mathematics Department is in a period of increased hiring of tenured and tenure-track faculty. Subject to administrative approval, we expect to make several regular appointments in a wide range of possible fields. We will also be making temporary and visiting appointments beginning in the academic year 2008-09 in the following categories:

(1) Tenure-Track/Tenured Faculty Position.

(2) E. R. Hedrick Assistant Professorships. Salary is $55,400. And appointments are for three years. The teaching load is four quarter courses per year.

(3) Research Assistant Professorships in Computational and Applied Mathematics (CAM). The salary is $55,400, and appointments are for three years. The teaching load is normally reduced to two or three quarter courses per year by research funding as available.

(4) Assistant Adjunct Professorships in the Program in Computing (PIC). Applicants for these positions must show very strong promise in teaching and research in an area related to computing. The teaching load is four one-quarter programming courses each year and one seminar every two years. Initial appointments are for one year and possibly longer, up to a maximum service of four years. The salary is $59,100.

(5) Assistant Adjunct Professorships and Research Postdocs. Normally appointments are for one year, with the possibility of renewal. Strong research and teaching background required. The salary range is $50,900-$55,400. Teaching load for Adjuncts is five quarter courses per year.

If you wish to be considered for any of these positions you must submit an application via `http://www.mathjobs.org`. Submit the AMS Cover Sheet and supporting documentation electronically.

For fullest consideration, an application must be submitted on or before December 12, 2007. Ph.D. is required for all positions.

The University of California asks that applicants complete the Equal Opportunity Employer survey for Letters and Science at the following URL: `http://cis.ucla.edu/facultysurvey/`.

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.

UCLA is an Equal Opportunity/Affirmative Action Employer.

000070

UNIVERSITY OF CALIFORNIA, SAN DIEGO
Department of Mathematics

The Department of Mathematics at the University of California, San Diego, is seeking outstanding candidates to fill approximately 6 tenure-track/tenured positions to start July 2008. The level for the large majority of these positions is at the Assistant Professor level, however, one or two positions are available for distinguished mathematicians with exceptional research records of the highest caliber.

Applicants for all positions must possess a Ph.D. and should have outstanding accomplishments in both research and teaching. We encourage applications from any area of pure mathematics, applied mathematics, or statistics. Level of appointment will be based on qualifications with appropriate salary per UC pay scales. To receive full consideration, applications should be submitted online through `http://www.mathjobs.org/` by November 1, 2007. For further instructions and information, see `http://www.math.ucsd.edu/about/employment/faculty`.

In compliance with the Immigration Reform and Control Act of 1986, individuals offered employment by the University of California will be required to show documentation to prove identity and authorization to work in the United States before hiring can occur. UCSD is an Equal Opportunity/Affirmative Action Employer with a strong institutional commitment to the achievement of diversity among its faculty and staff.

All applications should include the following items: 3 Reference Letters (Writers should upload their reference letters to: `mathjobs.org` or send them under separate cover; at least one letter should address teaching experience in some depth), Cover Letter, Curriculum Vitae, Publications List, Research Statement, Teaching Statement, and optionally a statement about contributions to diversity.

000061

UNIVERSITY OF CALIFORNIA, SANTA CRUZ
Mathematics Department

The Mathematics Department at the University of California, Santa Cruz, solicits applications for two tenure-track (assistant professor) positions in the areas of low dimensional topology or algebraic geometry, pending administrative approval. Duties include mathematical research, undergraduate and graduate teaching and departmental and university service. The standard teaching load is four one-quarter courses per year. The department invites applications from all qualified mathematicians. Colleagues who can contribute to the diversity and excellence of the academic community through their research, teaching, service and/or leadership are particularly encouraged to apply. Rank & Salary: assistant professor (9 month basis, step and salary commensurate with qualifications and experience). Minimum Qualifications: Ph.D. or equivalent in mathematics; demonstrated achievements or potential for excellence in research, teaching, professional service and leadership. Position Available: July 1, 2008. Closing Date: Positions are open until filled. Screening will begin with applications postmarked by November 15, 2007. To ensure full consideration, applications and letters of recommendation must arrive by the initial screening date. Applicants must submit hard copies of the AMS Cover Sheet, a curriculum vitae, a research statement, a teaching statement, and four letters of recommendation (at least one letter must address teaching experience and ability). (Letters of recommendation will be treated as confidential documents). Please direct your letter writers to the UCSC Confidentiality Statement at: `http://ahr.ucsc.edu/academic_policies_and_procedures/cappm/confstm.htm`.

All applications should be sent to: Faculty Recruitment Committee, Mathematics Department, University of California, 1156 High Street, Santa Cruz, CA 95064. Please refer to position #839-08 in your reply. Inquiries [not applications] can be sent to `mathrcr@ucsc.edu`. UCSC is an EEO/AA employer. See `http://www.math.ucsc.edu/about/jobs.html` for a complete job description.

000051

ILLINOIS

NORTHWESTERN UNIVERSITY
Department of Mathematics
2033 Sheridan Road
Evanston, Illinois 60208-2730
Boas Assistant Professor

Applications are solicited for up to three Ralph Boas assistant professorships of three years each starting September 2008. These are non-tenure-track positions with a teaching load of four quarter courses per year. We invite applications from qualified mathematicians in all fields.

Applications should be made electronically at `www.mathjobs.org` and should include (1) the American Mathematical Society Cover Sheet for Academic Employment, (2) a curriculum vitae, (3) a research statement, and (4) three letters of recommendation, one of which discusses the candidate's teaching qualifications. Inquiries may be sent to: `boas@math.northwestern.edu`.

Applications are welcomed at any time, but the review process starts December 1, 2007. Northwestern University is an Affirmative Action, Equal Opportunity Employer committed to fostering a diverse

faculty; women and minority candidates are especially encouraged to apply.

000065

NORTHWESTERN UNIVERSITY
Department of Mathematics
2033 Sheridan Road,
Evanston, Illinois 60208-2730

Applications are invited for anticipated tenured or tenure-track positions starting September 2008. Priority will be given to exceptionally promising research mathematicians. We invite applications from qualified mathematicians in all fields.

Applications should be made electronically at http://www.mathjobs.org and should include (1) the American Mathematical Society Cover Sheet for Academic Employment, (2) a curriculum vitae, (3) a research statement, and (4) three letters of recommendation, one of which discusses the candidate's teaching qualifications. Inquiries may be sent to: boas@math.northwestern.edu.

Applications are welcome at any time. Northwestern University is an Affirmative Action, Equal Opportunity Employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply.

000066

UNIVERSITY OF CHICAGO
Department of Mathematics

1. L.E. Dickson Instructor: This is open to mathematicians who have recently completed or will soon complete a doctorate in mathematics or a closely related field, and whose work shows remarkable promise in mathematical research and teaching. The appointment typically is for two years, with the possibility of renewal for a third year. The teaching obligation is up to four one-quarter courses per year. For applicants who are U.S. citizens or permanent residents, there is the possibility of reduced teaching and resources for summer support and travel from the department's VIGRE grant.

2. Assistant Professor: This is open to mathematicians who are further along in their careers, typically two or three years past the doctorate. These positions are intended for mathematicians whose work has been of outstandingly high caliber. Appointees are expected to have the potential to become leading figures in their fields. The appointment is generally for three years, with a teaching obligation of three one-quarter courses per year.

Applicants will be considered for any of the positions above which seem appropriate. Complete applications consist of (a) a cover letter, (b) a curriculum vitae, (c) three or more letters of reference, at least one of which addresses teaching ability, and (d) a description of previous research and plans for future mathematical research. Applicants are strongly encouraged to include information related to their teaching experience, such as a teaching statement or evaluations from courses previously taught, as well as an AMS cover sheet. If you have applied for an NSF Mathematical Sciences Postdoctoral Fellowship, please include that information in your application, and let us know how you plan to use it if awarded.

Applications must be submitted online through http://www.mathjobs.org. Questions may be directed to: apptsec@math.uchicago.edu. We will begin screening applications on December 3, 2007. Screening will continue until all available positions are filled. The University of Chicago is an Equal Opportunity/Affirmative Action Employer.

000055

INDIANA

UNIVERSITY OF NOTRE DAME
Department of Mathematics
Notre Dame NSF-SUMR
Instructorship in Mathematics

The Department of Mathematics of the University of Notre Dame invites applications from recent doctorates (since 2005) for the position of Notre Dame NSF-SUMR instructor in mathematics. Candidates in any specialty compatible with the research interests of the department will be considered. The position is for a term of three years beginning August 22, 2008; it is not renewable and is not tenure-track. The teaching load is one course per semester. Additional duties include mentoring of honors mathematics majors, and applicants should provide evidence of prior experience mentoring undergraduates. The salary will be competitive with those of distinguished instructorships at other AMS Group I universities, and the position includes $10,000 per year of summer research support for each of the first two summers. The position is associated with the department's recent successful five–year NSF grant in the program "Mentoring Through Critical Transition Points". Applications, including a curriculum vitae and a completed AMS standard cover sheet, should be filed through MathJobs (http://www.MathJobs.org). Applicants should also arrange for at least three letters of recommendation to be submitted through the MathJobs system. These letters should address the applicant's research accomplishments and supply evidence that the applicant has the ability to communicate articulately and teach effectively. Notre Dame is an Equal Opportunity Employer, and we particularly welcome applications from women and minority candidates. The evaluation of candidates will begin December 1, 2007. Information about the department is available at http://math.nd.edu.

000100

MARYLAND

JOHNS HOPKINS UNIVERSITY
Department of Mathematics

Subject to availability of resources and administrative approval, the Department of Mathematics solicits applications for two non-tenure-track J. J. Sylvester Assistant Professors for the 2008-2009 academic year. The J. J. Sylvester Assistant Professorship is a three-year position offered to recent Ph.D.'s with outstanding research potential. Candidates in all areas of pure mathematics, including analysis, mathematical physics, geometric analysis, complex and algebraic geometry, number theory, and topology are encouraged to apply. The teaching load is three courses per academic year. To submit your applications go to http://www.mathjobs.org/jobs/jhu. Applicants are strongly advised to submit their other materials electronically at this site. If you do not have computer access, you may mail your application to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218, and should include a vita, at least four letters of recommendation of which one concerns teaching, and a description of current and planned research. Write to: math@math.jhu.edu for questions concerning these positions. Applications received by November 16, 2007, will be given priority. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and women candidates are encouraged to apply.

000052

JOHNS HOPKINS UNIVERSITY
Department of Mathematics

Subject to availability of resources and administrative approval, the Department of Mathematics solicits applications for two tenure-track assistant professors for the 2008-2009 academic year. The assistant professorship is a three-year position. Candidates in all areas of pure mathematics, including analysis, mathematical physics, geometric analysis, complex and algebraic geometry, number theory, and topology are encouraged to apply. The teaching load is three courses per academic year. To submit your applications go to http://www.mathjobs.org/jobs/jhu. Applicants are strongly advised to submit their other materials electronically at this site. If you do not have computer access, you may mail your application to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218, and should include a vita, at least four letters of recommendation of which one concerns teaching, and a description of current and planned research. Write to: math@math.jhu.edu for questions concerning these positions. Applications re-

ceived by November 16, 2007, will be given priority. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and women candidates are encouraged to apply.

000053

MASSACHUSETTS

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Mathematics

The Mathematics Department at MIT is seeking to fill positions at the level of assistant professor or higher for September 2008. Appointments are based on exceptional research contributions in pure mathematics. Appointees will be expected to fulfill teaching duties and pursue their own research program. We request that applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendation, be submitted online at: `http://www.mathjobs.org`. Applications should be complete by **December 1, 2007,** to receive full consideration. We request that your letters of reference be submitted by the reviewers online via `mathjobs`. We will also accept recommendations either as PDF attachments sent to: `kimm@math.mit.edu`, or as paper copies mailed to: Pure Mathematics Committee, Room 2-263, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. Please do not mail or email duplicates of items already submitted via `mathjobs`.

MIT is an Equal Opportunity, Affirmative Action Employer.

000082

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Mathematics
C. L. E. Moore Instructorships in Mathematics

These positions for September 2008 are open to mathematicians who show definite promise in research. Appointees will be expected to fulfill teaching duties and pursue their own research program. We request that applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendation, be submitted online at: `http://www.mathjobs.org`. Applications should be complete by **December 1, 2007,** to receive full consideration. We request that your letters of reference be submitted by the reviewers online via mathjobs. We will also accept recommendations either as PDF attachments sent to: `kimm@math.mit.edu`, or as paper copies mailed to: Pure Mathematics Committee, Room 2-263, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. Please do not mail or email duplicates of items already submitted via mathjobs.

MIT is an Equal Opportunity, Affirmative Action Employer.

000083

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Mathematics
Applied Mathematics

The applied mathematics group at MIT is seeking to fill combined teaching and research positions at the level of instructor, assistant professor or higher, beginning September 2008. Appointments are mainly based on exceptional research qualifications. Candidates in all areas of applied mathematics, including physical applied mathematics, computational molecular biology, numerical analysis, scientific computation, and theoretical computer science will be considered. Current activities of the group include: combinatorics, operations research, theory of algorithms, numerical analysis, astrophysics, condensed matter physics, computational physics, fluid dynamics, geophysics, nonlinear waves, theoretical and computational molecular biology, material sciences, quantum computing and quantum field theory, but new hiring may involve other areas as well.

We request that applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendation, be submitted online at: `http://www.mathjobs.org`, and preferably well in advance of our deadline of **January 1, 2008,** since we will begin our deliberations in December. We request that your letters of reference be submitted by the reviewers online via `mathjobs`. We will also accept recommendations either as PDF attachments sent to: `applied@math.mit.edu`, or as paper copies mailed to: Applied Mathematics Committee, Room 2-345, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. Please do not mail or email duplicates of items already submitted via `mathjobs`.

MIT is an Equal Opportunity, Affirmative Action Employer.

000084

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Mathematics: Statistics

The Department of Mathematics at MIT is seeking to fill combined teaching and research positions at the level of instructor, assistant professor or higher in STATISTICS or APPLIED PROBABILITY beginning September 2008. Appointments are mainly based on exceptional research qualifications. We request that applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendations, be submitted online at: `http://www.mathjobs.org`. Applications should be complete by **January 1, 2008,** to receive full consideration. We request that your letters of reference be submitted by the reviewers online via `mathjobs`. We will also accept recommendations either as PDF attachments sent to: `kimm@math.mit.edu`, or as paper copies mailed to: Committee on Statistics, Room 2-263, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. Please do not mail or email duplicates of items already submitted via `mathjobs`.

MIT is an Equal Opportunity, Affirmative Action Employer.

000085

MICHIGAN

UNIVERSITY OF MICHIGAN, ANN ARBOR
Department of Mathematics

Pending authorization, the department invites applications for a Lecturer III in mathematics to begin September 2008. This is not a tenure-track position but may be renewed, annually for up to the first four years, and thereafter for intervals of three to five years. Criteria for renewal are excellence in classroom teaching and participation in administration of the department's introductory program and instructor development. Interest and activity in pedagogical research is encouraged but not essential for reappointment. The successful candidate is likely to have both a doctorate and substantial experience in teaching mathematics. Please submit a curriculum vitae, evidence of teaching excellence, and the names of at least three references. Application materials should preferably be submitted electronically through the AMS website `MathJobs.Org`. Alternatively, applications may be sent to: Personnel Committee, University of Michigan, Department of Mathematics, 2074 East Hall, 530 Church Street, Ann Arbor MI 48109-1043. Applications are considered on a continuing basis but candidates are urged to apply by November 1, 2007. Inquiries may be made by email to `math-fac-search@umich.edu`. More detailed information regarding the department may be found on our website: `http://www.math.lsa.umich.edu`. Women and minority candidates are encouraged to apply. The University of Michigan is an Equal Opportunity/Affirmative Action Employer .

000059

UNIVERSITY OF MICHIGAN
Department of Mathematics

Pending authorization, the Department of Mathematics anticipates having one or more openings at the tenure-track or tenured-level. Candidates should hold a Ph.D. in mathematics or a related field and should show outstanding promise

and/or accomplishments in both research and teaching. Applications are encouraged from any area of pure, applied, computational, or interdisciplinary mathematics. Salaries are competitive and are based on credentials. Junior candidates should furnish a placement dossier consisting of a letter of application, curriculum vitae and three letters of recommendation; senior candidates should send a letter of application, curriculum vitae, and names of three suggested references. In all cases please provide a statement of teaching philosophy and experience, evidence of teaching excellence, and a statement of current and future research plans. Application materials should preferably be submitted electronically through the AMS website `MathJobs.Org`. Alternatively, applications may be sent to: Personnel Committee, University of Michigan, Department of Mathematics, 2074 East Hall, 530 Church Street, Ann Arbor MI 48109-1043. Applications are considered on a continuing basis but candidates are urged to apply by November 1, 2007. Inquiries may be made by email to `math-fac-search@umich.edu`. More detailed information regarding the department may be found on our website: `http://www.math.lsa.umich.edu`. Women and minority candidates are encouraged to apply. The University of Michigan is supportive of the needs of dual career couples and is an Equal Opportunity/Affirmative Action Employer.

000060

MINNESOTA

UNIVERSITY OF MINNESOTA
Dunham Jackson Assistant Professor

This is a three-year appointment from fall semester 2008, through spring semester 2011, with a teaching load of 3 one-semester courses per academic year. Outstanding research and teaching abilities are required. Preference will be given to applicants whose research interests are compatible with those of the school. Applicants should have received or expect to receive a Ph.D. in mathematics no earlier than Jan. 1, 2007, and no later than August 27, 2008. Salary is competitive. For full consideration, applications and all supporting materials must be submitted electronically through: `http://www.mathjobs.org` by December 1, 2007. Applications received after the deadline will be considered as positions remain. No paper submission is needed unless the candidate is unable to submit electronically. In which case letters may be sent to the following address:

Lawrence F. Gray
Professor and Head
School of Mathematics
University of Minnesota
127 Vincent Hall,
206 Church Street S.E.
Minneapolis, MN 55455
email: `mathsrch@tc.umn.edu`

Applicants must include the following: Cover letter, curriculum vitae, at least 4 letters of recommendation, one of which should address teaching ability, description of research and a teaching statement. Reference letter writers should be asked to submit their letters online through `http://mathjobs.org`. If they are unable to do so, they may send their letters to the above mentioned address. In addition to your `MathJobs` application, the University of Minnesota requires all applicants to register at the website `http://employment.umn.edu`. At this site you should first click on the link "Search Positions". Enter Requisition Number 149251. When the job listing appears click the "'View" link in the Position Title field and then the button "Apply for this Posting". At this point you will be prompted to "Fill out a new Application". In your application, you should enter your name and optional demographic information. It is not necessary to fill out your complete contact information or to submit your other application material to this site.

The University of Minnesota is an Equal Opportunity Employer/Educator.

000071

UNIVERSITY OF MINNESOTA
School of Mathematics

The School of Mathematics of the University of Minnesota is seeking outstanding candidates for 2-3 tenured or tenure-track faculty positions starting fall semester 2008. Particular attention will be given to applicants at the assistant or associate professor level with strong interests in Geometry, Probability, and Scientific Computation. Candidates should have a Ph.D. or equivalent degree in mathematics or a closely related field and excellent records in both research and teaching.

For full consideration, applications and all supporting materials must be submitted electronically through: `http://www.mathjobs.org` by December 1, 2007. Applications received after the deadline will be considered as positions remain. No paper submission is needed unless the candidate is unable to submit electronically. In which case letters should be sent to the following address:

Lawrence F. Gray
Professor and Head
School of Mathematics
University of Minnesota
127 Vincent Hall
206 Church Street S. E.
Minneapolis, MN 55455
email: `mathsrch@tc.umn.edu`.

Applicants must include the following: Cover letter, Curriculum vitae, at least 4 letters of recommendation, one of which should address teaching ability, description of research and a teaching statement. Reference letter writers should be asked to submit their letters on line through `http://mathjobs.org`. If they are unable to do so, they may send their letters to the above mentioned address. In addition to your `MathJobs` application, the University of Minnesota requires all applicants to register at the website `http://employment.umn.edu`. At this site you should first click on the link "Search Positions". Enter Requisition Number 149255. When the job listing appears click the "View" link in the Position Title field and then the button "Apply for this Posting". At this point you will be prompted to "Fill out a new Application". In your application, you should enter your name and optional demographic information. It is not necessary to fill out your complete contact information or to submit your other application material to this site.

The University of Minnesota is an Equal Opportunity Employer/Educator.

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UNIVERSITY OF MINNESOTA
School of Mathematics

The School of Mathematics of the University of Minnesota in conjunction with the Institute for Mathematics and its Applications (IMA) seeks an outstanding mathematical scientist with a record of interdisciplinary research for a faculty position, anticipated to be at the tenure or tenure-track level depending on qualifications. The IMA is a partnership of the National Science Foundation, the University of Minnesota, and a consortium of affiliated institutions. Since its founding in 1982, the IMA has established itself as a leading research institute for mathematics and its applications, and the successful candidate will enjoy the benefits of its extraordinary scientific environment. In addition to faculty duties in the School of Mathematics, the successful candidate will support the activities of the IMA through mentorship, program participation and planning, and interaction with visitors, and have teaching load set accordingly.

Candidates should have a Ph.D. or equivalent terminal degree in mathematics or closely related field and excellent records in both research and teaching. For full consideration, applications and all supporting materials should be submitted electronically through the AMS mathjobs website at `http://www.mathjobs.org` by December 1, 2007. Applications will be reviewed from that date and continue until the position is filled. No paper submission is needed unless the candidate is unable to submit electronically. Reference letter writers should be asked to submit their letters online through `http://www.mathjobs.org`. If they are unable to do

so, they may send their letters to the following address:

Lawrence F. Gray
Professor and Head
School of Mathematics
127 Vincent Hall
206 Church Street S. E.
Minneapolis, MN 55455

Applicants must include the following: Cover letter, curriculum vitae, at least 4 letters of recommendation, one of which should address teaching ability, and description of research. In addition to your MathJobs application, the University of Minnesota requires all applicants to register at the website http://employment.umn.edu. At this site you should first click on the link "Search Postings". Enter the Requisition Number 149253. When the job listing appears click the "View" link in the Position Title field and then the button "Apply for this Posting". At this point you will be prompted to "Fill out a new Application". In your application you should enter your name and optional demographic information. It is not necessary to fill out your complete contact information or to submit your other application materials to this site.

The University of Minnesota is an Equal Opportunity Employer and Educator

000073

NEW JERSEY

INSTITUTE FOR ADVANCED STUDY, SCHOOL OF MATHEMATICS
Department of Mathematics

The School of Mathematics has a limited number of memberships, some with financial support for research in mathematics and computer science at the Institute during the 2008-09 academic year. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree.

During the 2008-09 year, Alice Chang of Princeton University will lead a special program on geometric partial differential equations. The emphasis will be on nonlinear partial differential equations with applications to problems in differential, conformal and convex geometry. Topics covered will include Yamabe type equations, Q-curvature equations, fully non-linear equations in conformal and convex geometry, construction of conformal invariants and operators, problems in conformally compact Einstein manifolds, measure and probability theory approaches to the Ricci Tensor. Partial differential equations continue to be one of the central tools for studying geometric and even topological questions, and one goal of this program will be to bring researchers in geometry and PDE together to study problems of common interest in areas such as those mentioned above.

Recently the school has established the von Neumann Early Career Fellowships. Six of these fellowships will be available for the 2008-09 academic year. To be eligible for the von Neumann Fellowships, applicants should be at least 5 years following the receipt of their Ph.D. but not yet eligible to receive their first paid sabbatical.

The Veblen Research Instructorship is a three-year position which the School of Mathematics and the Department of Mathematics at Princeton University established in 1998. Three-year instructorships will be offered each year to candidates in pure and applied mathematics who have received their Ph.D. within the last three years. The first and third year of the instructorship will be spent at Princeton University and will carry regular teaching responsibilities. The second year will be spent at the Institute and dedicated to independent research of the instructor's choice.

Application materials may be requested from Applications, School of Mathematics, Institute for Advanced Study, Einstein Drive, Princeton, NJ 08540; email: applications@math.ias.edu. Application forms may be downloaded via a Web connection to http://www.math.ias.edu. Application deadline is December 1.

The Institute for Advanced Study is committed to diversity and strongly encourages applications from women and minorities.

000068

NEW YORK

CORNELL UNIVERSITY
Department of Mathematics

The Department of Mathematics at Cornell University invites applications for two or more H. C. Wang Assistant Professors, non-renewable, 3-year term beginning July 1, 2008. Successful candidates are expected to pursue independent research at Cornell and teach three courses per year. The department actively encourages applications from women and minority candidates.

Applicants are strongly encouraged to apply electronically at: http://www.mathjobs.org.

For information about our positions and application instructions, see: http://www.math.cornell.edu/Positions/facpositions.html. Applicants will be automatically considered for all eligible positions. Deadline December 1, 2007. Early applications will be regarded favorably. Cornell University is an Affirmative Action/Equal Opportunity Employer and Educator.

000086

CORNELL UNIVERSITY
Department of Mathematics

The Department of Mathematics at Cornell University invites applications for two or more half-time visiting positions (rank based on experience) for mathematics professors on sabbatical/other leaves from colleges, universities, and engineering schools for our Teaching Program Visiting Faculty Positions beginning August 16, 2008. 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. The normal duties are to teach two identical courses each semester. The department actively encourages applications from women and minority candidates.

Applicants are strongly encouraged to apply electronically at: http://www.mathjobs.org.

For information about these positions and application instructions, see: http://www.math.cornell.edu/Positions/facpositions.html. Deadline December 1, 2007. Cornell University is an Affirmative Action/Equal Opportunity Employer and Educator.

000087

CORNELL UNIVERSITY
Department of Mathematics

The Department of Mathematics at Cornell University invites applications for possible visiting positions, academic year or one-semester teaching positions (rank based on experience) beginning August 16, 2008. We are seeking candidates who have excellent teaching skills. Teaching load varies from 1-4 courses per year, depending on the individual and the availability of courses. Candidates with teaching and research interests compatible with current faculty are sought. The department actively encourages applications from women and minority candidates.

Applicants are strongly encouraged to apply electronically at: http://www.mathjobs.org.

For information about our positions and application instructions, see: http://www.math.cornell.edu/Positions/facpositions.html. Applicants will be automatically considered for all eligible positions. Deadline December 1, 2007. Early applications will be regarded favorably. Cornell University is an Affirmative Action/Equal Opportunity Employer and Educator.

000088

CORNELL UNIVERSITY
Department of Mathematics

The Department of Mathematics at Cornell University invites applications for a tenure-track assistant professor position, or higher rank, pending administrative approval, starting July 1, 2008. Applications in all areas of mathematics will be considered with a priority given to probability. The department actively

encourages applications from women and minority candidates.

Applicants are strongly encouraged to apply electronically at http://www.mathjobs.org.

For information about our positions and application instructions, see: http://www.math.cornell.edu/Positions/facpositions.html. Applicants will be automatically considered for all eligible positions. Deadline November 1, 2007. Early applications will be regarded favorably. Cornell University is an Affirmative Action/Equal Opportunity Employer and Educator.

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RHODE ISLAND

BROWN UNIVERSITY
Department of Mathematics

The Mathematics Department at Brown University invites applications for one position at the level of tenured associate or full professor to begin July 1, 2008 in the area of analysis, broadly construed. [Exceptional candidates with less experience may also be considered for a tenure-track associate professor position.] Candidates should have a distinguished research record and a strong commitment to excellence in undergraduate and graduate teaching. Preference will be given to applicants with research interests consonant with those of the present members of the department. For more information see: http://www.math.brown.edu/faculty/faculty.html. Qualified individuals are invited to send a letter of application and a curriculum vitae to: Senior Search Committee, Department of Mathematics, Box 1917, Brown University, Providence, Rhode Island 02912. Applicants for full professor should include the names of five references who would be contacted at the appropriate time by the Search Committee. Applicants for associate professor should have three letters of reference sent at the time of application. Applications received by November 15, 2007, will receive full consideration, but the search will remain open until the position is closed or filled. For further information or inquiries, write to: srsearch@math.brown.edu. Brown University is an Equal Opportunity/Affirmative Action Employer and encourages applications from women and minorities.

000062

BROWN UNIVERSITY
Department of Mathematics

J. D. Tamarkin Assistant Professorship: One or two three-year non-tenured non-renewable appointments, beginning July 1, 2008. The teaching load is one course one semester, and two courses the other semester and consists of courses of more than routine interest. Candidates are required to have received a Ph.D. degree or equivalent by the start of their appointment, and they may have up to three years of prior academic and/or postdoctoral research experience.

Applicants should have strong research potential and a commitment to teaching. Field of research should be consonant with the current research interests of the department. For full consideration, a curriculum vitae, an AMS Standard Cover Sheet, and three letters of recommendation must be received by December 1, 2007. All inquiries and materials should be addressed to: Junior Search Committee, Department of Mathematics, Box 1917, Brown University, Providence, RI 02912. To access the AMS Standard Cover Sheet, visit our website: http://www.math.brown.edu/juniorsearch.html. Email inquiries should be addressed to: juniorsearch@math.brown.edu. Brown University is an Equal Opportunity/Affirmative Action Employer and encourages applications from women and minorities.

000063

TEXAS

BAYLOR UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for a tenure-track position at the assistant professor level, starting in August 2008. Salary and benefits are competitive. Excellence in teaching and research is essential. Strong potential for obtaining extramural funding is desirable. Special consideration will be given to strong applicants with research interests in the general areas of analysis, topology, algebra, and numerical linear algebra. Exceptional scholars in any area of specialization are strongly encouraged to apply. An application must include a current curriculum vitae and statements describing interests and goals in research and in teaching. In addition, at least three recent letters of reference must be made available on MathJobs.org or be sent directly to the search committee. An applicant who has received the doctoral degree within the last four years is encouraged to include a copy of the doctoral transcript. Applications will be reviewed beginning November 1, 2007. To ensure full consideration, an application should be received by November 15, 2007, but applications will be accepted until the position is filled or the search is terminated. Baylor University has approximately 14,000 students. The department has 30 faculty members and offers B.A., B.S., M.S., and Ph.D. degrees. The university provides generous benefits including tuition remission for qualified family members. Please visit the Baylor websites: http://www.baylor.edu and http://www.baylor.edu/math/ for further information about the university and the department. Baylor University is affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Employment Opportunity Employer, Baylor encourages minorities, women, veterans, and persons with disabilities to apply. Applicants are encouraged to submit all application materials online through MathJobs.org via the URL: http://www.mathjobs.org/jobs. Alternatively, send all materials to: Mathematics Search Committee, Baylor University, One Bear Place #97328, Waco, TX 76798-7328; email: Math_Search@baylor.edu.

000091

BAYLOR UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for a postdoctoral position, starting in August 2008. This position may be renewable annually to a maximum of three years and is not a tenure-track position. Customarily, the teaching load is two three-hour courses each semester. Salary and benefits are competitive. Excellence in teaching and research is essential. The department seeks candidates whose research interests are compatible with those of current faculty. Active research areas in the department are in the general areas of algebra, analysis, differential equations, mathematical physics, numerical analysis, representation theory, and topology. An application must include a current curriculum vitae and statements describing interests and goals in research and in teaching. In addition, at least three recent letters of reference must be made available on MathJobs.org or be sent directly to the search committee. An applicant who has received the doctoral degree within the last four years is encouraged to include a copy of the doctoral transcript. Applications will be reviewed beginning November 1, 2007. To ensure full consideration, an application should be received by November 15, 2007, but applications will be accepted until the position is filled or the search is terminated. Baylor University has approximately 14,000 students. The department has 30 faculty members and offers B.A., B.S., M.S., and Ph.D. degrees. Please visit the Baylor websites: http://www.baylor.edu and http://www.baylor.edu/math/ for further information about the university and the department. Baylor University is affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Employment Opportunity Employer, Baylor encourages minorities, women, veterans, and persons with disabilities to apply. Applicants are encouraged to submit all application materials online through MathJobs.org via the URL: http://www.mathjobs.org/jobs. Alternatively, send all materials to: Mathematics Search Committee, Baylor University, One Bear Place #97328, Waco,

TX 76798-7328; email: Math_Search@baylor.edu.

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RICE UNIVERSITY
Mathematics Department

The Department of Mathematics invites applications for an anticipated position at the rank of tenure-track assistant professor; candidates who could make an extraordinary contribution to the department may be considered at other levels. All applicants should have extremely strong research potential and demonstrated success in the classroom. Send a curriculum vitae to:

Appointments Committee,
Department of Mathematics,
Rice University, P. O. Box 1892,
Houston, TX 77251-1892.

In addition, please provide evidence of teaching skills and solicit at least 3 letters of reference, asking that they be sent directly to the address above. Submission of the AMS Application Cover Sheet would be greatly appreciated. Applications which are complete by November 1, 2007, will be assured consideration.

Rice University is an Equal Opportunity/Affirmative Action Employer and strongly encourages applications from women and members of underrepresented minority groups.

000047

TEXAS A&M UNIVERSITY
The Department of Mathematics

The Department of Mathematics anticipates several openings for tenured, tenure-eligible, and visiting faculty positions beginning fall 2008. The field is open, but we particularly seek applications from individuals whose mathematical interests would augment and build upon existing strengths both within the Mathematics Department as well as other departments in the university. Salary, teaching loads and start-up funds are competitive. For a tenured-position the applicant should have an outstanding research reputation and would be expected to fill a leadership role in the department. An established research program, including success in attracting external funding and supervision of graduate students, and a demonstrated ability and interest in teaching are required. Informal inquiries are welcome. For an assistant professorship, we seek strong research potential and evidence of excellence in teaching. Research productivity beyond the doctoral dissertation will normally be expected. We also have several visiting positions available. Our Visiting Assistant Professor positions are for a three year period and carry a three course per year teaching load. They are intended for those who have recently received their Ph.D. and preference will be given to mathematicians whose research interests are close to those of our regular faculty members. Senior Visiting Positions may be for a semester or one year period. The complete dossier should be received by December 15, 2007. Early applications are encouraged since the department will start the review process in October, 2007. Applicants should send the completed "AMS Application Cover Sheet", a vita, and arrange to have letters of recommendation sent to: Faculty Hiring, Department of Mathematics, Texas A&M University, College Station, Texas 77843-3368. Further information can be obtained from: http://www.math.tamu.edu/hiring.

Texas A&M University is an Equal Opportunity Employer. The university is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment and strongly encourages applications from women, minorities, individuals with disabilities, and veterans. The university is responsive to the needs of dual career couples.

000050

UNIVERSITY OF TEXAS AT ARLINGTON
Department of Mathematics

The Department of Mathematics at The University of Texas at Arlington invites applications for two tenure-track assistant professor positions beginning September 1, 2008, subject to available funding. Tenured appointments at the rank of associate or full professor may be considered for exceptional candidates with a strong record of external funding. The minimum qualifications are an earned Ph.D. in mathematics, statistics, or mathematics education. At least two years of experience beyond the Ph.D. is preferable.

Demonstrated excellence in research and teaching and a strong potential for external funding are essential. While outstanding applicants from all mathematical research areas will be considered, preference will be given to those with significant research and scholarly accomplishments in statistics, operations research/combinatorics, algebra/algebraic geometry, or differential equations. For more details, visit the department's webpage at: http://www.uta.edu/math/pages/main/employment.htm.

Applicants should send a letter of application plus a complete curriculum vitae, statement on research interests, statement of teaching philosophy, one or two representative publications, and an AMS cover sheet to: Dr. Barbara Shipman, Chair, Faculty Recruiting Committee, Department of Mathematics, The University of Texas at Arlington, Arlington, TX 76019. Applicants should also arrange to have at least three letters of recommendation sent to the above address. Inquiries about the position may be directed to: mathsearch@uta.edu. Review of applications will begin on January 21, 2008, and will continue until the positions are filled. Underrepresented groups are encouraged to apply.

UT Arlington is an EO/AA Employer.

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UTAH

UNIVERSITY OF UTAH
Department of Mathematics

The Department of Mathematics at the University of Utah invites applications for the following positions:

Full-time tenure-track or tenured appointments at the level of assistant, associate, or full professor. Special consideration will be given to candidates in the area of statistics.

Three-year Scott, Wylie, Burgess, and VIGRE Assistant Professorships, depending on funding availability.

IGERT and RTG Postdoctoral Fellowships. IGERT fellowship applicants should have a background in mathematical biology; while RTG fellowship applicants should have a background in applied and computational mathematics and have interests in working in mathematical biology. These postdoctoral fellowships are 3-year positions. See http://www.math.utah.edu/research/mathbio/opportunities.html.

Please see our website at http://www.math.utah.edu/positions for information regarding available positions, application requirements and deadlines. Applications must be completed through the website http://www.mathjobs.org.

The University of Utah is an Equal Opportunity, Affirmative Action Employer and encourages applications from women and minorities, and provides reasonable accommodation to the known disabilities of applicants and employees.

The University of Utah values candidates who have experience working in settings with students from diverse backgrounds, and possess a strong commitment to improving access to higher education for historically underrepresented students.

000067

WISCONSIN

UNIVERSITY OF WISCONSIN - MADISON
Department of Mathematics

The Department of Mathematics invites applications for Van Vleck Visiting Assistant Professorships to begin August 25, 2008. Appointments are for a fixed term of two or three years. The usual teaching load is two courses per semester. Candidates with interests overlapping those of specific faculty members may be offered support from sponsored research grants together with a lower teaching load. Ordinarily only those applicants who have received their doctorate since 2006 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.

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 sent to the above address, three to four letters of recommendation, at least one of which must discuss the applicant's teaching experiences and capabilities. Other evidence of good teaching will be helpful.

The Department of Mathematics is committed to increasing the number of women and minority faculty. The University of Wisconsin is an Affirmative Action, Equal Opportunity Employer and encourages applications from women and minorities. Unless confidentiality is requested in writing, information regarding the applicants must be released upon request. Finalists cannot be guaranteed confidentiality.

For more information about the position please consult: `http://www.math.wisc.edu`.

Deadline for Applications: December 10, 2007, although applications will continue to be considered until all available positions are filled.

000093

CANADA

UNIVERSITY OF BRITISH COLUMBIA
Department of Mathematics

The Mathematics Department at the University of British Columbia is seeking outstanding candidates for at least three positions, subject to funding, at the tenure-track assistant professor level, with a starting date of July 1, 2008. Exceptional candidates at the associate professor or full professor level may be considered. Postdoctoral experience is normally expected. Priority research areas are analysis, combinatorics/discrete mathematics, mathematical finance, partial differential equations, probability, and scientific computation. More detail on hiring priorities will be posted by September 1, 2007, at `http://www.math.ubc.ca/priorities`. In any event, exceptional candidates in any area of mathematics may be considered. Joint positions with other departments may also be possible.

The successful applicant is expected to work in an area of interest to current faculty, to interact with related groups in the department and to have demonstrated interest and ability in teaching. The salary will be commensurate with experience and research record.

Applicants are strongly encouraged to apply online as described at: `http://www.math.ubc.ca/Dept/jobs.htm#Apply`.

Alternatively, applicants may send a current CV including a list of publications, statement of research and teaching interests, a teaching dossier or similar record of teaching experience, and should arrange for three letters of recommendation to be sent directly to:

Chair, Departmental Committee on Appointments
Department of Mathematics
#121-1984 Mathematics Road
University of British Columbia
Vancouver, B.C., Canada, V6T 1Z2

In order to ensure full consideration, applications should be received by November 20, 2007.

The department is one of the leading mathematics departments in Canada and has strong connections with other mathematical institutes, such as the Pacific Institute for the Mathematical Sciences (PIMS), Mathematics of Information Technology and Complex Systems (MITACS), Banff International Research Station (BIRS), and the UBC Institute of Applied Mathematics (IAM). For more information see `http://www.math.ubc.ca`.

The University of British Columbia hires on the basis of merit and is committed to employment equity. We encourage all qualified persons to apply; however Canadian citizens and permanent residents will be given priority.

000090

UNIVERSITY OF ALBERTA
Tenure-Track Position, Algebraic Geometry

The Department of Mathematical and Statistical Sciences at the University of Alberta invites applications for a tenure-track position in the area of algebraic geometry. We primarily seek candidates at the assistant professor level, but exceptional candidates at a more senior level will be considered.

The successful candidate will have established accomplishments and outstanding promise in research, as well as a strong commitment to graduate and undergraduate teaching. Candidates must hold a Ph.D. degree. We offer an excellent research environment with a normal teaching load of three courses per year. A close fit with some of the existing research being presently conducted in the department is an asset.

Alberta is one of the leading mathematics departments in Canada and has strong connections with other mathematical institutes, such as the Pacific Institute for the Mathematical Sciences (PIMS), Mathematics of Information Technology and Complex Systems (MITACS), and the Banff International Research Station (BIRS). For more information about the department, please visit our website at `http://www.math.ualberta.ca/`.

Applications should include a curriculum vitae, a research statement, a teaching profile outlining experience and/or interests, and at least three confidential letters of reference.

The closing date for applications is November 16, 2007, or until a suitable candidate is found. Early applications are encouraged.

Interested applicants may apply to:

Arturo Pianzola, Chair
Department of Mathematical and Statistical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1
email: `chairsec@math.ualberta.ca`

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority.

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.

000094

UNIVERSITY OF ALBERTA
Department of Mathematics
Tenure-Track Position, Geometrical Functional Analysis

The Department of Mathematical and Statistical Sciences at the University of Alberta invites applications for a tenure-track position in the area of geometrical functional analysis. We primarily seek candidates at the assistant professor level, but exceptional candidates at a more senior level will be considered.

The successful candidate will have established accomplishments and outstanding promise in research, as well as a strong commitment to graduate and undergraduate teaching. Candidates must hold a Ph.D. degree. We offer an excellent research environment with a normal teaching load of three courses per year. A fit with some of the existing research being presently conducted in the department is an asset. For more information about the department, please visit our website at `http://www.math.ualberta.ca/`.

We are looking for specialists in any of the areas of geometric functional analysis including asymptotic theory of normed spaces and high-dimensional convex geometry, related probabilistic methods, geometric inequalities and concentration inequalities, and related discrete mathematics aspects. Current research strengths in the analysis group of the department include asymptotic geometric analysis, abstract harmonic analysis, Banach spaces, Banach algebras and Banach

lattices, operator theory, approximation theory, Fourier and wavelet analysis.

Alberta is one of the leading mathematics departments in Canada and has strong connections with other mathematical institutes, such as the Pacific Institute for the Mathematical Sciences (PIMS), Mathematics of Information Technology and Complex Systems (MITACS), and the Banff International Research Station (BIRS).

Applications should include a curriculum vitae, a research statement, a teaching profile outlining experience and/or interests, and at least three confidential letters of reference.

The closing date for applications is November 16, 2007, or until a suitable candidate is found. Early applications are encouraged.

Interested applicants may apply to:

Arturo Pianzola, Chair
Department of Mathematical and Statistical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1
email: `chairsec@math.ualberta.ca`

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. If suitable Canadian citizens or permanent residents cannot be found, other individuals will be considered.

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.

000095

UNIVERSITY OF ALBERTA
Department of Mathematics
Tenure-Track Position,
Statistics and Probability

The Department of Mathematical and Statistical Sciences at the University of Alberta invites applications for a tenure-track position in the area of statistics and probability. We primarily seek candidates at the assistant professor level, but exceptional candidates at a more senior level will be considered.

The successful candidate will have established accomplishments and outstanding promise in research, as well as a strong commitment to graduate and undergraduate teaching. Candidates must hold a Ph.D. degree. We offer an excellent research environment with a normal teaching load of three courses per year. A close fit with some of the existing research being presently conducted in the department is an asset. Our statistics and probability group encompasses a broad spectrum of research interests, ranging from such interdisciplinary areas as biostatistics and environmetrics, through core research areas such as regression, design, sampling and notions of robustness and of statistical learning as applied to these and other areas, and on to theoretical investigations as embodied by mathematical statistics, probability, and stochastic processes.

Alberta is one of the leading mathematics departments in Canada and has strong connections with other mathematical institutes, such as the Pacific Institute for the Mathematical Sciences (PIMS), Mathematics of Information Technology and Complex Systems (MITACS), and the Banff International Research Station (BIRS). For more information about the department, please visit our websites at `http://www.mathstat.ualberta.ca/` and `http://www.stat.ualberta.ca/`.

Applications should include a curriculum vitae, a research statement, a teaching profile outlining experience and/or interests, and at least three confidential letters of reference.

The closing date for applications is November 16, 2007, or until a suitable candidate is found. Early applications are encouraged.

Interested applicants may apply to:

Arturo Pianzola, Chair
Department of Mathematical and Statistical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1
email: `chairsec@mathstat.ualberta.ca`

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. If suitable Canadian citizens or permanent residents cannot be found, other individuals will be considered.

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.

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UNIVERSITY OF ALBERTA
Department of Mathematics
Tenure-Track Position, Representation Theory

The Department of Mathematical and Statistical Sciences at the University of Alberta invites applications for a tenure-track position in the area of representation theory. We primarily seek candidates at the assistant professor level, but exceptional candidates at a more senior level will be considered.

The successful candidate will have established accomplishments and outstanding promise in research, as well as a strong commitment to graduate and undergraduate teaching. Candidates must hold a Ph.D. degree. We offer an excellent research environment with a normal teaching load of three courses per year. A close fit with some of the existing research being presently conducted in the department is an asset.

Alberta is one of the leading mathematics departments in Canada and has strong connections with other mathematical institutes, such as the Pacific Institute for the Mathematical Sciences (PIMS), Mathematics of Information Technology and Complex Systems (MITACS), and the Banff International Research Station (BIRS). For more information about the department, please visit our website at `http://www.math.ualberta.ca/`.

Applications should include a curriculum vitae, a research statement, a teaching profile outlining experience and/or interests, and at least three confidential letters of reference.

The closing date for applications is November 16, 2007, or until a suitable candidate is found. Early applications are encouraged.

Interested applicants may apply to:

Arturo Pianzola, Chair
Department of Mathematical and Statistical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1
`chairsec@math.ualberta.ca`

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. If suitable Canadian citizens or permanent residents cannot be found, other individuals will be considered.

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.

000097

UNIVERSITY OF ALBERTA
Department of Mathematics
Tenure-Track Position,
Partial Differential Equations

The Department of Mathematical and Statistical Sciences at the University of Alberta invites applications for a tenure-track position in the area of partial differential equations. We primarily seek candidates at the assistant professor level, but exceptional candidates at a more senior level will be considered.

The successful candidate will have established accomplishments and outstanding promise in research, as well as a strong commitment to graduate and undergraduate teaching. Candidates must hold a Ph.D. degree. We offer an excellent research environment with a normal teaching load of three courses per year. A close fit with some of the existing research being

presently conducted in the department is an asset.

Alberta is one of the leading mathematics departments in Canada and has strong connections with other mathematical institutes, such as the Pacific Institute for the Mathematical Sciences (PIMS), Mathematics of Information Technology and Complex Systems (MITACS), and the Banff International Research Station (BIRS). For more information about the department, please visit our website at `http://www.math.ualberta.ca/`.

Applications should include a curriculum vitae, a research statement, a teaching profile outlining experience and/or interests, and at least three confidential letters of reference.

The closing date for applications is November 16, 2007, or until a suitable candidate is found. Early applications are encouraged.

Interested applicants may apply to:

Arturo Pianzola, Chair
Department of Mathematical and Statistical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1
`chairsec@math.ualberta.ca`

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. If suitable Canadian citizens or permanent residents cannot be found, other individuals will be considered.

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.

000098

UNIVERSITY OF ALBERTA
Department of Mathematics
Max Wyman Assistant Professorship in Number Theory

The Department of Mathematical and Statistical Sciences at the University of Alberta invites applications for a Max Wyman Assistant Professorship in Number Theory. This is a three-year fixed-term position. The position offers an excellent research and teaching environment with a reduced teaching load (averaging two one-semester courses per year). A startup research grant is included with the position.

We are looking for a person with a Ph.D. (or near completion), excellent research potential, and strong communication and teaching skills. Candidates are expected to develop an independent research program, and will be eligible to apply for federal research funds.

Alberta is one of the leading mathematics departments in Canada and has strong connections with other mathematical institutes, such as the Pacific Institute for the Mathematical Sciences (PIMS), Mathematics of Information Technology and Complex Systems (MITACS), and the Banff International Research Station (BIRS).

Applications should include a curriculum vitae, research and teaching profiles outlining experience and/or interests, and at least three confidential letters of reference.

The closing date for applications is November 16, 2007, or until a suitable applicant is found. Early applications are encouraged.

For more information about the department and the University of Alberta, please visit our webpage (`http://www.math.ualberta.ca/`).

Interested applicants may apply to:

Arturo Pianzola, Chair
Department of Mathematical and Statistical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1
email: `chairsec@math.ualberta.ca`

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority.

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000099

HUNGARY

CENTRAL EUROPEAN UNIVERSITY (CEU)
Department of Mathematics
Study in the country of John von Neumann and Peter Erdos!

The Department of Mathematics and Its Applications of Central European University (CEU), Budapest, Hungary, offers innovative programs at both Ph.D. and MS levels. The language of instruction at CEU is English. The Ph.D. program in mathematics and its applications is registered by the board of regents of the University of the State of New York for, and on behalf of, the New York State Education Department. The program covers major branches in both mathematics and its applications. It is carried out jointly with the Renyi Institute of Mathematics of the Hungarian Academy. We further have partnership agreements with other prominent institutions from abroad. Outstanding foreign scholars are regularly invited to deliver lectures and teach our students, among whom were Haim Brezis (France), Carsten Carstensen (Germany), Constantin Corduneanu (USA), Eduard Feireisl (Czech Republic), Peter D. Lax (USA).

The department will launch an international, two-year Master of Science (MS) in applied mathematics program starting academic year 2008/2009. Our MS program will be focused on modern topics, including analytical, statistical, numerical and computational methods, which are essential in the employment market building strongly on cross-disciplinary practical skills.

For details see `http://www.ceu.hu/math` or write to: G. Morosanu; email: `morosanug@ceu.hu`.

000054

SINGAPORE

NATIONAL UNIVERSITY OF SINGAPORE (NUS)
Department of Mathematics

The Department of Mathematics at the National University of Singapore (NUS) invites applications for tenured, tenure-track and visiting (including postdoctoral) positions at all levels, beginning in August 2008.

NUS is a research intensive university that provides quality undergraduate and graduate education. The Department of Mathematics, which is one of the largest in the university, has about 70 faculty members and teaching staff whose expertise cover major areas of contemporary mathematical research.

We seek promising scholars and established mathematicians with outstanding track records in any field of pure and applied mathematics. The department offers internationally competitive salaries with start-up grants for research. The teaching load is particularly light for young scholars, in an environment conducive to research with ample opportunities for career development.

Research areas which the department plans to expand in the near future include (but are not limited to): All areas of pure mathematics (especially analysis) financial mathematics, mathematical imaging, probability & stochastic analysis, scientific computing.

Application materials should be sent to:

Search Committee
Department of Mathematics
National University of Singapore
2 Science Drive 2, Singapore 117543
Republic of Singapore

In addition, applicants should submit electronically a PDF-file to `search@math.nus.edu.sg`. Inquiries may also be sent to this link.

Please include the following supporting documentation in the application:

1) an American Mathematical Society Standard Cover Sheet; 2) a detailed CV including publications list; 3) a statement

of research accomplishments and plan; 4) a statement (max. of 2 pages) of teaching philosophy and methodology. Please attach evaluation on teaching from faculty members or students of your current institution, where applicable; 5) at least three letters of recommendation including one which indicates the candidate's effectiveness and commitment in teaching.

Review process will begin at the end of November and will continue until positions are filled. For further information about the department, please visit `http://www.math.nus.edu.sg`.

000077

ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Heinz Hopf Lectureships

The Department of Mathematics of the ETH Zurich invites applications for several **Heinz Hopf Lectureships** beginning September 1st, 2008 or earlier. These positions are intended for young scientists, after their Ph. D. up to five years. They are awarded for a period of 3 years, with the possibility of an extension by 1 year.

Duties of Heinz Hopf lecturers include research and teaching in mathematics. Together with the other members of the department, the new lecturers will be responsible for undergraduate and graduate courses for students of mathematics, natural sciences, and engineering. The moderate teaching load leaves ample room for further professional development. Courses at Master level may be taught in English.

Applicants should have proven excellence in research in any area of mathematics and possess potential for further outstanding achievements.

Applications with curriculum vitae and a list of publications should be submitted to Prof. H.-R. Kuensch, chair@math.ethz.ch, Department of Mathematics, ETH Zentrum, 8092 Zurich, Switzerland, **by November 30th, 2007**. Later applications can be considered for remaining positions. In addition, three letters of recommendation supporting the application should be sent directly to us. ETH Zurich specifically encourages female candidates to apply.

The Ohio State University at Lima

Assistant Professor of Math

The Ohio State University at Lima invites applications for a full-time, tenure-track Assistant Professor of Mathematics. The appointment will be made in the Department of Mathematics at The Ohio State University and begin in September 2008.

The search committee seeks mathematicians who can make a strong commitment to the teaching, research, and outreach missions of The Ohio State University. The successful candidate will have the ability to teach the courses that the Department of Mathematics offers at undergraduate level. The standard teaching load for the successful candidate will be six courses per academic year (Ohio State is on the quarter system), reduced to five courses for the first three years of service. An ability to teach courses in Computer Science and/or Statistics, as well as remedial math courses will be desirable. The position will require a strong record/potential of service and scholarly research, and a demonstrated commitment to teaching excellence is essential. Preference will be given to hiring a tenure line faculty with specialization in Numerical Analysis/Integral Equations. We will also consider applicants in all other areas compatible with the rest of present faculty's research interests (Ring Theory, Representation Theory and Model Theory). Candidates must have a PhD in hand at the time of appointment. Salary is competitive.

The Ohio State University at Lima is one of the five campuses of The Ohio State University. Current enrollment on the Lima campus is 1,200 students and there are approximately 100 full- and part-time faculty in all academic departments. Ohio State Lima offers the first two years of the Ohio State general education curriculum and nineprograms leading to baccalaureate degrees. Ohio State Lima also offers Master's degree programs in Education and Social Work.

THE OHIO STATE UNIVERSITY
LIMA

The review of applications will begin November 20, 2007 and will continue until the position is filled. Please send a cover letter, a current curriculum vita, and three letters of recommendation to:
Chair, Math Search Committee
c/o HR Officer Kathy Baker
Public Service Building
The Ohio State University at Lima
4240 Campus Drive, Lima OH 45804

To build a diverse workforce, Ohio State encourages applications from individuals with disabilities, minorities, veterans, and women. EEO/AA employer.

ETH

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To build a diverse workforce, Ohio State encourages applications from individuals with disabilities, minorities, veterans, and women. EEO/AA employer.

Mathematical Sciences Employment Center

San Diego Convention Center, San Diego, California
January 6, 7, 8, and 9, 2008

2008 Employment Center Schedule

October 24, 2007 Registration deadline for inclusion in *Winter List* books.

December 14, 2007 Advance registration deadline. After this date, all registration activities will happen on site in San Diego.

Sunday, January 6

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 a.m.–4:00 p.m. Submission of Scheduled Employment Register interview request forms for both Monday and Tuesday interviews. No request forms can be accepted after 4:00 p.m. Sunday.

9:30 a.m.–6:00 p.m. Interview Center open.
No Scheduled Employment Register interviews are held on Sunday.

Monday, January 7
7:00 a.m.–8:15 a.m. Distribution of interview schedules for both Monday and Tuesday for those participating in the Scheduled Employment Register. Employers who have elected the combination package will receive schedules for Monday only.
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.).

Tuesday, January 8
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.). Employers who have elected the combination package will now be moved into this section for interviews.

Wednesday, January 9
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 Sunday by 4:00 p.m. to turn in the Interview Request/Availability Form. Before traveling, please refer to the Employment Center Webpage for important phone numbers to contact in case of unexpected delays.

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 four-day program which takes place on the Sunday, Monday, Tuesday, and Wednesday (morning only) of the Joint Meetings. Most participants register in advance (by the October 24 deadline), and their brief résumé or job description is printed in a booklet that 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). Following two years of a job market favorable to employers, the Employment Center applicant/employer ratio seems to be remaining stable. At the 2007 Employment Center, 638 candidates and 142 employers participated, giving an overall applicant-to-employer ratio of 4.4:1 (compared with 554 applicants and 138 employers in 2006, a ratio of 3.9:1). 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. The total number of interviews arranged is dependent on the number of participating employers. Fewer employers will mean fewer interviews overall.

At the January 2008 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 24, 2007) 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 of these tables:

Computer-scheduled Employment Register table

Employer-scheduled Interview Center table

Combination Interview Table (split Computer-scheduled/Interview center)

The Employment Register Computer-Scheduling System

Employers register in advance by the October 24 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 Sunday, January 6, which of the eight sessions (of five interviews each) they will participate in and submit their Availability/Interview Request Forms between 9:30 a.m. and 4:00 p.m. Sunday. 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 Monday and Tuesday interviews on Monday morning. Employers who have elected the combination package will receive schedules for Monday only. 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 (however, **no more than two** may sit at the table at one time). For follow-up interviews, the scheduled tables will also be available for use until 7:30 p.m. on Monday and Tuesday, and on Wednesday 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. Monday or Tuesday, or on Wednesday 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 Sunday 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. Please note: Employers who have elected the combination package will be moved into this area on Tuesday.

The center will be open only during the following hours:

Sunday, January 6, 2008, 9:30 a.m.–6:00 p.m.
Monday, January 7, 2008, 8:00 a.m.–7:30 p.m.
Tuesday, January 8, 2008, 8:00 a.m.–7:30 p.m.
Wednesday, January 9, 2008, 9:00 a.m.–noon

The fee for use of this area is the same as the normal employer fee, $245. 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 San Diego, 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. Only banners that can be draped over the four-foot table can be accommodated.

Combination Interview Table

This year, employers may opt to pay one table fee and experience both settings. The combination table will be located in the computer-scheduled area for one full day of interviews, and then in the Interview Center for the last day and a half.

About the *Winter List of Applicants*

This booklet contains hundreds of résumés of applicants who registered by October 24 for the Employment Center. It will be mailed in December to all employers who register by October 24 and 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 is located on the Web at www.ams.org/emp-reg, 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 sent separately) by the October 24 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 electronically in early September 2007 at www.ams.org/amsmtgs/2109_intro.html 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. 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 24 deadline in order for your form to be included in the *Winter List of Employers*. However, registration will be accepted up to December 14 for the normal fees or on site in San Diego at the on-site rates. Call 800-321-4267, ext. 4113, with any questions or deadline problems.

Any representatives of the institution can sit at the table together or working in shifts (however, the limit is two at one time). If possible, 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 $245 for the first table and $95 for each additional table. On-site registration fees (any registrations after December 14, 2007) are $325 for the first table and $125 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 14 may register on site in San Diego 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 Sunday, January 6, to receive their materials. If registering for the employer-scheduled Interview Center only, registration on Monday is possible.

Applicants: Use of the computer-scheduled program is now optional.

In 2008 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 2008 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. Many applicants prefer the interviews they are invited for in this setting, since it is more relaxed and interviews tend to last longer.

Overall, many applicants report being disappointed that there are not more research-oriented jobs being interviewed for at the Employment Center. The best way to predict what type of employers will interview at the Employment Center is to peruse a list of institutions from the previous year, available at www.ams.org/emp-reg. Applicants should expect that many of the jobs are best suited to enthusiastic and well-qualified candidates who can contribute on many levels in an academic setting.

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 (Monday and Tuesday). 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 Sunday, 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 Monday morning.

Applicants are advised to place as many selections as possible on their scannable request sheets; however, be advised that this may result in interviews with less-preferred employers. Applicants should be aware that each year approximately 10 percent of applicants signing up for all services fail to submit a schedule request sheet. This is often due to having too many schedule conflicts.

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 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 bachelor's-granting 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. Approximately 32 percent of applicants responding to a recent survey report having between zero and two interviews in the Interview Center. The rest reported higher numbers. Most of the applicants reported that at least some of the Interview Center appointments had been arranged in advance of the meetings.

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 brief 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/hotel 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 24 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.

Results

In a recent survey, 63 percent of applicants responding reported being invited for at least one on-campus visit to an employer they had interviewed with during the Employment Center; 44 percent reported receiving at least one job offer in the months following the interview. Overall, 30 percent reported accepting a position with an employer they spoke with during the Employment Center. Another 56 percent reported (in May) having no new job offers. The rest accepted positions with employers they met through other means.

Applicants: Register Early

Applicants need to complete the following steps by the advance deadline of October 24, 2007.

1. Pay fees

Register for the Joint Mathematics Meetings (the electronic information available in early September 2007 at www.ams.org/amsmtgs/2109_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 $44; "Message Center and *Winter List* ONLY" registration is $22.

2. Send form

Submit the Applicant Form (a brief résumé form) electronically at www.ams.org/emp-reg/.

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. 4113) 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 24 applicants can still register for the Employment Center at the same prices until the final deadline of December 14. 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 14 must register on site at the Joint Meetings registration desk and pay higher fees ($82 Employment Center fee; however, the "Message Center and *Winter List* ONLY" fee is always just $22).

It is worthwhile to submit the applicant form even if you miss the October 24 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 Sunday, January 6, 2008, or they will not be included when the interview-scheduling program runs Sunday night. Before traveing, please refer to the Employment Center webpage for important phone numbers to contact in case of unexpected delays. 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 Sunday is allowed for a higher fee but is severely discouraged. Most employers will not notice an Applicant Form that arrives on Sunday. 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. Registering on site for a mailbox only is possible, at the $22 rate, on Sunday and Monday. Pay the fees at the Joint Meetings registration area and then bring your receipt to the Employment Center desk to register yourself.

AMS Short Course

Applications of Knot Theory

San Diego, California, January 4–5, 2008

Organized by
Dorothy Buck, Imperial College of London
Erica Flapan, Pomona College

Over the past twenty years, knot theory has rekindled its historic ties with biology, chemistry, and physics. While the original motiviation for understanding and classifying knots—Lord Kelvin's correlation of chemical elements with particular knotted configurations in the "ether"—proved erroneous, mathematicians continued to develop the theory of knots, and until the 1980s this remained a primarily pure field of mathematics.

At this time, chemists (most notably Ned Seeman and Kurt Mislow), biologists (most notably Nick Cozzarelli and Andrzej Stasiak), and physicists began searching for more sophisticated descriptions of the entanglements of natural phenomena—from strings to small organic compounds to, most famously, DNA.

Since their discovery in the late 1960s, DNA knots and links have been implicated in a number of cellular processes. In particular, they have been found during replication and recombination and as the products of protein actions, notably with topoisomerases, recombinases, and transposases. The variety of DNA knots and links observed made biologically separating and distinguishing these molecules a critical issue. While DNA knots and links can be visualized via electron microscopy, this process can be both difficult and time-consuming. So topological methods of characterizing and predicting their behavior can be helpful.

Topological techniques (notably the node number for knots, the Jones polynomial for catenanes/links, and the work of Schubert for 4-plats) played a significant role in characterizing knotted and linked DNA that arises from the biochemical process of site-specific recombination. Additionally, building on the experimental work of Wasserman and Cozzarelli as well as Conway's theory of tangles, Ernst and Sumners developed a tangle model of recombination to make predictions—later experimentally verified—about how a particular protein interacts with DNA. Modified versions of the tangle model have since been used to determine various features of protein-DNA interactions for a number of specific proteins.

Similarly, in chemistry, Pasteur began the study of molecular chirality. Since two enantiomers of the same drug can interact with a host's metabolism very differently, pharmaceutical companies are particularly interested in topological stereochemistry. Thus, knot theory techniques have been used to understand whether—and if so how intrinsically—a number of synthetic compounds are chiral.

In addition to the examples described above, there are many other deep interactions of knot theory with biology, chemistry and physics. While this Short Course can not cover all aspects of applied knot theory, the organizers' goal is to provide the participants with an appetizer—both as a small taste and to stimulate the (mathematical) appetite.

It is planned that lecture notes will be available to those who register for this course. Advance registration fees are: member of the AMS—US$94; nonmember—US$125; student, unemployed, emeritus—US$42. On-site fees are: member of the AMS—US$125; nonmember—US$155; student, unemployed, emeritus—US$63. Registration and housing information can be found in this issue of the *Notices*; see the section "Registering in Advance and Hotel Accommodations" in the announcement for the meetings in San Diego. The registration form is at the back of this issue.

Format of the Short Course:

This AMS Short Course will introduce knots, and some of their recent applications in molecular biology, chemistry, and physics.

No prior knowledge of knots, biology, or physics is assumed. In particular, the first day of the Short Course will include introductory lectures by Colin Adams on knot theory, Dorothy Buck on DNA and knots, and Erica

Flapan on topological stereochemistry. The second day will include lectures on particular aspects of these subjects: Lou Kauffman on applications of knot theory to physics; Ned Seeman, who uses topology for DNA nanotechnology; and Jon Simon on the statistical and energetic properties of knots and their relation to molecular biology.

Speakers will highlight both their own motivation and projects, as well as describing new avenues for interested researchers (and their students) to explore.

The Short Course will conclude with a panel discussion of the putative trajectories of these applications of knot theory, and summarize the major open problems and challenges.

In addition to the formal activities led by the speakers and organizers, the organizers will ensure that the participants themselves have adequate time to discuss topics of mutual interest—during the panel discussion, during smaller group discussions at the end of the first day, and at a dinner organized for the first evening.

Introduction to Knot Theory

Colin Adams, Williams College

Abstract: This talk will be an introduction to the mathematical theory of knots, including Reidemeister moves, surfaces, types of knots, and various invariants associated to knots. We will also touch on the stick number for knots and its implications for chemistry.

Colin Adams is the the Francis Christopher Oakley Third Century Professor of Mathematics at Williams College. He authored the now-standard undergraduate knot theory text, "The Knot Book", and is renowned for his witty and deceptively sophisticated introductory geometry and topology talks. His own research focuses on hyperbolic knots and 3-manifolds, and he has involved numerous undergraduates in annual summer research projects at Williams. He is a recipient of the Deborah and Franklin Tepper Haimo Distinguished Teaching Award from the MAA, a Polya Lecturer for the MAA, and a Sigma Xi Distinguished Lecturer.

Introduction to Topological Chirality

Erica Flapan, Pomona College

Abstract: Symmetry plays an important role in predicting the behavior of molecules. A particular type of symmetry that is chemically important is mirror image symmetry. A molecule is said to be chiral if it cannot change into its mirror image. In this talk we will explain why chirality is important; discuss the differences between chemical, geometric, topological, and intrinsic chirality; and introduce various techniques to show that a molecule is topologically chiral.

Erica Flapan is the Lingurn H. Burkhead Professor of Mathematics at Pomona College. Her research is in 3-dimensional topology and applications of topology to chemistry. Her book "When Topology Meets Chemistry", was jointly published by the Mathematical Association of America and Cambridge University Press. From 2000 to 2004, she was the principle investigator of an NSF-CCLI grant entitled "Enhancing the mathematical understanding of students in chemistry". As part of this grant, she developed a course entitled "Problem Solving in the Sciences", to help students with weak math skills succeed in general chemistry. Together with an organic chemist, she also developed an interdisciplinary upper division course on Symmetry and Chirality.

Introduction to Knots and DNA

Dorothy Buck, Imperial College London

Abstract: This talk will introduce DNA, and explain why knot theorists are interested in this molecule. We will explore the topological techniques used to understand both DNA itself and how it interacts with proteins in the cell. As an extended example, we will give an overview of the tangle model and its variations to understand the molecular process of site-specific recombination. We will also discuss mathematicians' contributions to several open questions involving DNA, including how a protein unknots DNA effectively and how complicated linked DNA is copied accurately.

Dorothy Buck is a mathematical biologist at Imperial College London in the Department of Mathematics and Centre for Bioinformatics. She specializes in 3-manifold topology and its applications to mathematical biology. Her training is in both mathematics and microbiology—she spent six years, both at University of Texas-Austin and Johns Hopkins Medical School, working in molecular biology labs. Before joining the faculty at Imperial, she was an NSF Postdoctoral Fellow with Craig Benham at the University of California Davis Genome Center, and an assistant professor in the Applied Mathematics Department at Brown University.

Knots and Physics

Lou Kauffman, University of Illinois–Chicago

Abstract: Knots are mathematical abstractions of the topological properties of rope in physical space. As such, there are immediate relationships of knots with the physics of ropes, weaves, long-chain molecules, and other knotting phenomena in Nature. There are also beautiful and surprising relationships of knot theory with the structures and methods of statistical mechanics and quantum theory. This talk will survey some of the speaker's favorite interactions between knots and physics.

Louis Kauffman is professor of mathematics at University of Illinois–Chicago. He authored the interdisciplinary text "Knots and Physics". He discovered the bracket polynomial state model for the Jones polnomial and the first direct relationship between statistical mechanics models and knot invariants. As a topologist, he is omnivorous, working in knot theory and its relationships with statistical mechanics, quantum theory, algebra, combinatorics, and more recently, biology. He is editor of the *Journal of Knot Theory and its Ramifications*.

Single-Stranded DNA Topology

Ned Seeman, New York University

Abstract: The double helical nature of the DNA molecule has a wide variety of topological implications. Most biologists are familiar with the notion that circular DNA molecules are catenanes/links, so that the strands are

linked about once every 10 nucleotides. Consequently, biological systems contain topoisomerases which change the linking topology of the molecule, thereby solving a variety of problems in the metabolism of the genetic material. Today, the realm of DNA extends beyond its biological role as a molecule with an unbranched helix axis. Branched DNA molecules exist as intermediates in genetic recombination, but for twenty-five years synthetic branched DNA molecules have been built for a variety of purposes that are important for nanotechnology and for molecular computation. The ability to assemble branched DNA backbones has enabled the deliberate construction of single-stranded knots, polyhedral catenanes and Borromean rings. New branched DNA motifs have been derived by using techniques from knot theory. Branched DNA molecules have enabled the deliberate construction of periodic and aperiodic DNA crystals. The applications of these systems include analysis of biological systems, nanoelectronics and nanorobotics.

Ned Seeman is professor of chemistry at New York University. He founded the field of single-stranded Nucleic Acid Topology. Among other work, his lab has characterized the interactions of synthetic DNA knots with topoisomerases, developed a general algorithm for the construction of any DNA knot, synthesized a DNA molecule that can be built to yield four different topological species, and discovered an RNA topoisomerase. For his innovation, he was awarded the Feynman Prize in Nanotechnology, the Emerging Technology Award from *Discover Magazine*, and elected Fellow of the Royal Society of Chemistry. He is the founding president of the International Society for Nanoscale Science, Computation and Engineering.

Long Tangled Filaments

Jon Simon, University of Iowa

Abstract: We are interested in filaments, from rope and string and hair to DNA and proteins, anything that might be understood as one-dimensional strands wiggling and tangling in three-dimensional space.

If the filaments are short, we can try to describe the exact geometric shape and understand how the shape relates to physical behavior. If the filaments are somewhat long and flexible, then topological knot type can be very useful, as evidenced by the success of topological methods for studying the actions of DNA enzymes. But if the filaments are very long (think of a complicated 3-dimensional scribble) or somehow random (think of a lot of complicated 3-dimensional scribbles) then it may be impractical to try describe the exact shapes or even knot types. We need to develop a vocabulary of ideas and models that describe physically important geometric/topological properties of long tangled things.

In this talk, we will consider ideas, experiments, and theorems dealing with packing, curvature, tangling, and knotting of individual complicated filaments as well as statistical ensembles. We will explore some of the work that has been done, some open research problems, and some topics that seem well-suited for undergraduate research activities.

Jon Simon is professor of mathematics at the University of Iowa. He, along with the chemist Kurt Mislow, pioneered the rigorous application of knot theory to chemistry, in particular by determining chirality of synthetic compounds. He codeveloped the idea of Möbius energy of thick knots. His current research also includes particular knotting and tangling of filaments; "energy" of knots; and applications to molecular biology, e.g., knotted DNA loops.

References

[1] *The Knot Book*, by Colin Adams, American Mathematical Society (2004).
[2] *Knots and Physics*, by L. Kauffman, World Scientific, Third Edition (2001).
[3] `http://www.math.uic/kauffman/Alex.pdf` (Alexander's original paper on the Alexander polynomial).
[4] `http://www.math.uic/kauffman/QuickTrip.pdf` (Fox's Quick Trip through Knot Theory).
[5] arXiv Math 0410329 (Kauffman's paper on Knot Diagrammatics).
[6] *DNA Topology*, by A. Maxwell and A. Bates, Cambridge University Press, Second Edition (2005).
[7] *When Topology Meets Chemistry: A Topological Look at Molecular Chirality*, by E. Flapan, Cambridge University Press and Mathematical Association of America (2000).
[8] Thickness of knots, by R. Litherland, J. Simon, E. Rawdon, and O. Durumeric, *Topology and its Applications* **91** (1999), 233–244.
[9] Physical models for exploring DNA topology, by N. C. Seeman, *Journal of Biomolecular Structure and Dynamics* **5** (1988), 997–1004.
[10] DNA nicks and nodes and nanotechnology, by N. C. Seeman, *NanoLetters* **1** (2001), 22–26.
[11] Models of entanglement, by G. Buck and J. Simon, Knot Theory for Scientific Objects, *OCAMI Studies* **1** (2007), 51–74.
[12] Total curvature and packing of knots, by G. Buck and J. Simon, *Topology and its applications* **154** (2007), 192–204.
[13] Thickness and crossing number of knots, by G. Buck and J. Simon, *Topology and its Applications* **91** (1999), 245–257.

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/`. Final programs for Sectional Meetings will be archived on the AMS website accessible from the stated URL and in an electronic issue of the *Notices* as noted below for each meeting.

Chicago, Illinois

DePaul University (Loop Campus)

October 5–6, 2007

Friday – Saturday

Meeting #1030

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: August 2007
Program first available on AMS website: August 16, 2007
Program issue of electronic *Notices*: October 2007
Issue of *Abstracts*: Volume 28, Issue 3

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Martin Golubitsky, University of Houston, *Symmetry breaking and synchrony breaking.*

Matthew J. Gursky, University of Notre Dame, *Origins and applications of some nonlinear equations in conformal geometry.*

Alex Iosevich, University of Missouri, *Incidence theory, Fourier analysis and applications to geometric combinatorics and additive number theory.*

David E. Radford, University of Illinois at Chicago, *Representations of pointed Hopf algebras.*

Special Sessions

Algebraic Coding Theory (in honor of Harold N. Ward's retirement), **Jay A. Wood**, Western Michigan University.

Algebraic Combinatorics: Association Schemes and Related Topics, **Sung Y. Song**, Iowa State University, and **Paul Terwilliger**, University of Wisconsin.

Algebraic Geometry, **Lawrence Man Hou Ein** and **Anatoly S. Libgober**, University of Illinois at Chicago.

Algorithmic Probability and Combinatorics, **Manuel Lladser**, University of Colorado, and **Robert S. Maier**, University of Arizona.

Analysis and CR Geometry, **Song-Ying Li**, University of California Irvine, and **Stephen S-T Yau**, University of Illinois at Chicago.

Applied Harmonic Analysis, **Jonathan Cohen** and **Ahmed I. Zayed**, DePaul University.

Automorphic Forms: Representation Theory of p-adic and Adelic Groups, **Mahdi Asgari** and **Anantharam Raghuram**, Oklahoma State University.

Differential Geometry and Its Applications, **Jianguo Cao**, University of Notre Dame.

Ergodic Theory and Symbolic Dynamical Systems, **Ayse A. Sahin** and **Ilie D. Ugarcovici**, DePaul University.

Extremal and Probabilistic Combinatorics, **Jozsef Balogh**, University of Illinois at Urbana-Champaign, and **Dhruv Mubayi**, University of Illinois at Chicago.

Free Resolutions, **Noam Horwitz** and **Irena Peeva**, Cornell University.

Geometric Combinatorics, **Caroline J. Klivans**, University of Chicago, and **Kathryn Nyman**, Loyola University Chicago.

Graph Theory, **Hemanshu Kaul** and **Michael J. Pelsmajer**, Illinois Institute of Technology.

Hopf Algebras and Related Areas, **Yevgenia Kashina** and **Leonid Krop**, DePaul University, **M. Susan Montgomery**, University of Southern California, and **David E. Radford**, University of Illinois at Chicago.

Mathematical Modeling and Numerical Methods, **Atife Caglar**, University of Wisconsin-Green Bay.

Model Theory of Non-elementary Classes, **John T. Baldwin**, University of Illinois at Chicago, **David W. Kueker**, University of Maryland, and **Rami Grossberg**, Carnegie Mellon University.

Networks, **Martin Golubitsky**, University of Houston, and **Mary Silber**, Northwestern University.

Nonlinear Conservation Laws and Related Problems, **Cleopatra Christoforou** and **Gui-Qiang Chen**, Northwestern University.

Numerical and Symbolic Techniques in Algebraic Geometry and Its Applications, **Gian Mario Besana**, DePaul University, **Jan Verschelde**, University of Illinois at Chicago, and **Zhonggang Zeng**, Northeastern Illinois University.

Sequence Spaces and Transformations, **Constantine Georgakis**, DePaul University, and **Martin Buntinas**, Loyola University of Chicago.

Singular Integrals and Related Problems, **Laura De Carli**, Florida International University, and **A. M. Stokolos**, DePaul University.

Smooth Dynamical Systems, **Marian Gidea**, Northeastern Illinois University, and **Ilie D. Ugarcovici**, DePaul University.

The Euler and Navier-Stokes Equations, **Alexey Cheskidov**, University of Michigan, and **Susan J. Friedlander** and **Roman Shvydkoy**, University of Illinois at Chicago.

Wave Propagation from Mathematical and Numerical Viewpoints, **Gabriel Koch**, University of Chicago, **Catalin Constantin Turc**, Caltech and University of North Carolina at Charlotte, and **Nicolae Tarfulea**, Purdue University Calumet.

New Brunswick, New Jersey

Rutgers University-New Brunswick, College Avenue Campus

October 6–7, 2007

Saturday – Sunday

Meeting #1031

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: August 2007
Program first available on AMS website: August 16, 2007
Program issue of electronic *Notices*: October 2007
Issue of *Abstracts*: Volume 28, Issue 3

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Satyan L. Devadoss, Williams College, *The topology of particle collisions.*

Tara S. Holm, Cornell University, *Act globally, compute locally: Localization in symplectic geometry.*

Sir Roger Penrose, University of Oxford, *Spacetime conformal geometry, and a new extended cosmology* (Einstein Public Lecture in Mathematics).

Scott Sheffield, Courant Institute and Institute for Advanced Study, *Random metrics and geometries in two dimensions.*

Mu-Tao Wang, Columbia University, *Isometric embeddings and quasi-local mass.*

Special Sessions

Commutative Algebra, **Jooyoun Hong**, University of California Riverside, and **Wolmer V. Vasconcelos**, Rutgers University.

Geometric Analysis of Complex Laplacians, **Siqi Fu**, Rutgers University, Camden, **Xiaojun Huang**, Rutgers University, New Brunswick, and **Howard J. Jacobowitz**, Rutgers University, Camden.

Invariants of Lie Group Actions and Their Quotients, **Tara S. Holm**, Cornell University, and **Rebecca F. Goldin**, George Mason University.

Mathematical and Physical Problems in the Foundations of Quantum Mechanics (in honor of Shelly Goldstein's 60th birthday), **Roderich Tumulka** and **Detlef Dürr**, München University, and **Nino Zanghi**, University of Genova.

Noncommutative Geometry and Arithmetic Geometry, **Caterina Consani**, Johns Hopkins University, and **Li Guo**, Rutgers University.

Partial Differential Equations of Mathematical Physics, **Sagun Chanillo**, **Michael K.-H. Kiessling**, and **Avy Soffer**, Rutgers University.

Probability and Combinatorics, **Jeffry N. Kahn** and **Van Ha Vu**, Rutgers University.

Set Theory of the Continuum, **Simon R. Thomas**, Rutgers University.

Toric Varieties, **Milena S. Hering**, Institute for Mathematics and Its Applications, and **Diane Maclagan**, Rutgers University.

Albuquerque, New Mexico

University of New Mexico

October 13–14, 2007

Saturday – Sunday

Meeting #1032

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2007
Program first available on AMS website: August 30, 2007
Program issue of electronic *Notices*: October 2007
Issue of *Abstracts*: Volume 28, Issue 4

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Emmanuel J. Candes, California Institute of Technology, *The role of probability in compressed sensing*.

Alexander Polischuk, University of Oregon, *A-infinity structures and theta series*.

Eric Rains, California Institute of Technology, *Elliptic hypergeometric integrals*.

William E. Stein, University of California San Diego, *SAGE: Open source mathematics software*.

Special Sessions

Affine Algebraic Geometry, **David Robert Finston**, New Mexico State University.

Arithmetic and Algebraic Geometry, **Alexandru Buium** and **Michael J. Nakamaye**, University of New Mexico.

Computational Applications of Algebraic Topology, **Ross Staffeldt**, New Mexico State University.

Computational Methods in Harmonic Analysis and Signal Processing, **Emmanuel Candes**, California Institute of Technology, and **Joseph D. Lakey**, New Mexico State University.

Financial Mathematics: The Mathematics of Financial Markets and Structures, **Cristina Mariani** and **Kenneth Martin**, New Mexico State University.

Geometric Structures on Manifolds, **Charles Boyer** and **Krzysztof Galicki**, University of New Mexico.

Harmonic Analysis Applied to Partial Differential Equations, **Justin Holmer**, University of California Berkeley, **Changxing Miao**, Institute of Applied Physics and Computational Mathematics, and **Jiaong Wu**, Oklahoma State University.

Harmonic Analysis and Operator Theory, **Maria C. Pereyra** and **Wilfredo O. Urbina**, University of New Mexico.

Mathematical and Computational Aspects of Compressible Flow Problems, **Jens Lorenz** and **Thomas M. Hagstrom**, University of New Mexico.

Methods of Heterogeneous Data Analysis, **Hanna Ewa Makaruk**, Los Alamos National Laboratory, and **Nikita A. Sakhanenko**, University of New Mexico.

Nonlinear Waves in Optics, Hydrodynamics and Plasmas, **Alejandro Aceves** and **Pavel Lushnikov**, University of New Mexico.

Recent Developments in 2-D Turbulence, **Michael S. Jolly**, Indiana University, and **Greg Eyink**, Johns Hopkins University.

Topics in Mathematical Physics, **Rafal Komendarczyk**, University of Pennsylvania, and **Robert Michal Owczarek**, Los Alamos National Laboratory.

Variational Problems in Condensed Matter, **Lia Bronsard**, McMaster University, and **Tiziana Giorgi**, New Mexico State University.

Murfreesboro, Tennessee

Middle Tennessee State University

November 3–4, 2007

Saturday – Sunday

Meeting #1033

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: September 2007
Program first available on AMS website: September 20, 2007
Program issue of electronic *Notices*: November 2007
Issue of *Abstracts*: Volume 28, Issue 4

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: September 11, 2007

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Sergey Gavrilets, University of Tennessee, *Mathematical models of speciation*.

Daniel K. Nakano, University of Georgia, *Bridging algebra and geometry via cohomology*.

Carla D. Savage, North Carolina State University, *The mathematics of lecture hall partitions*.

Sergei Tabachnikov, Pennsylvania State University, *Ubiquitous billiards.*

Special Sessions

Advances in Algorithmic Methods for Algebraic Structures (Code: SS 3A), **James B. Hart**, Middle Tennessee State University.

Applied Partial Differential Equations (Code: SS 4A), **Yuri A. Melnikov**, Middle Tennessee State University, and **Alain J. Kassab**, University of Central Florida.

Billiards and Related Topics (Code: SS 6A), **Sergei Tabachnikov**, Pennsylvania State University, and **Richard Schwartz**, Brown University.

Combinatorial Enumeration, Optimization, Geometry, and Statistics (Code: SS 13A), **Nicholas A. Loehr**, College of William and Mary, **Gabor Pataki**, University of North Carolina, Chapel Hill, **Margaret A. Readdy**, University of Kentucky and M.I.T., **Carla D. Savage**, North Carolina State University, and **Ruriko Yoshida**, University of Kentucky.

Combinatorial Methods in Continuum Theory (dedicated to Jo Heath, Auburn University, on the occasion of her retirement) (Code: SS 8A), **Judy A. Kennedy**, University of Delaware and Lamar University, **Krystyna M. Kuperberg**, Auburn University, and **Van C. Nall**, University of Richmond.

Differential Equations and Dynamical Systems (Code: SS 1A), **Wenzhang Huang** and **Jia Li**, University of Alabama, Huntsville, and **Zachariah Sinkala**, Middle Tennessee State University.

Financial Mathematics (Code: SS 16A), **Abdul Khaliq**, Middle Tennessee State University.

Graph Theory (Code: SS 2A), **Rong Luo**, **Don Nelson**, **Chris Stephens**, and **Xiaoya Zha**, Middle Tennessee State University.

Lie and Representation Theory (Code: SS 11A), **Terrell L. Hodge**, Western Michigan University, **Daniel K. Nakano**, University of Georgia, and **Brian J. Parshall**, University of Virginia.

Mathematical Modeling in Biological Systems (Code: SS 9A), **Terrence J. Quinn**, Middle Tennessee State University.

Mathematical Tools for Survival Analysis and Medical Data Analysis (Code: SS 7A), **Curtis Church**, Middle Tennessee State University, **Chang Yu**, Vanderbilt University, and **Ping Zhang**, Middle Tennessee State University.

Nonlinear Partial Differential Equations and Applications (Code: SS 14A), **Emmanuele DiBenedetto**, **Mikhail Perepelitsa**, and **Gieri Simonett**, Vanderbilt University.

Physical Knots and Links (Code: SS 10A), **Yuanan Diao**, University of North Carolina at Charlotte, and **Claus Ernst**, Western Kentucky University.

Recent Advances in Algebraic Topology (Code: SS 12A), **Mark W. Johnson**, Pennsylvania State University, Altoona, and **Donald Yau**, The Ohio State University at Newark.

Splines and Wavelets with Applications (Code: SS 5A), **Don Hong**, Middle Tennessee State University, and **Qingtang Jiang**, University of Missouri-St. Louis.

Using National Assessment of Educational Progress (NAEP) Data to Enhance Assessment and Inform Instruction (Code: SS 15A), **Michaele F. Chappell**, Middle Tennessee State University, and **Judith H. Hector**, Walters State Community College.

Wellington, New Zealand

Victoria University of Wellington

December 12–15, 2007

Wednesday – Saturday

Meeting #1034

First Joint International Meeting between the AMS and the New Zealand Mathematical Society (NZMS).
Associate secretary: Matthew Miller
Announcement issue of *Notices*: June 2007
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: October 31, 2007

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/internmtgs.html`.

AMS Invited Addresses

Marston Conder, University of Auckland, *Chirality.*

Rodney G. Downey, Victoria University of Wellington, *Practical FPT and foundations of kernelization.*

Michael H. Freedman, Microsoft Research, *Physically motivated questions in topology: Manifold pairings.*

Bruce J. Kleiner, Yale University, *Title to be announced.*

Gaven J. Martin, Massey University, *Curvature and dynamics.*

Assaf Naor, Microsoft Research/Courant Institute, *Title to be announced.*

Theodore A. Slaman, University of California Berkeley, *Title to be announced.*

Matthew J. Visser, Victoria University of Wellington, *Emergent spacetimes, rainbow geometries, and pseudo-Finsler geometries.*

AMS Special Sessions

Computability Theory, **Rodney G. Downey** and **Noam Greenberg**, Victoria University of Wellington, and **Theodore A. Slaman**, University of California Berkeley.

Dynamical Systems and Ergodic Theory, **Arno Berger**, University of Canterbury, **Rua Murray**, University of Waikato, and **Matthew J. Nicol**, University of Houston.

Geometric Numerical Integration, **Laurent O. Jay**, The University of Iowa, and **Robert McLachlan**, Massey University.

Group Theory, Actions, and Computation, **Marston Conder**, University of Auckland, and **Russell Blyth**, Saint Louis University.

History and Philosophy of Mathematics, **James J. Tattersall**, Providence College, **Ken Pledger**, Victoria University of Wellington, and **Clemency Williams**, University of Canterbury.

Hopf Algebras and Quantum Groups, **M. Susan Montgomery**, University of Southern California, and **Yinhuo Zhang**, Victoria University of Wellington.

Infinite-Dimensional Groups and Their Actions, **Christopher Atkin**, Victoria University of Wellington, **Greg Hjorth**, University of California Los Angeles/University of Melbourne, **Alica Miller**, University of Louisville, and **Vladimir Pestov**, University of Ottawa.

Integrability of Continuous and Discrete Evolution Systems, **Mark Hickman**, University of Canterbury, and **Willy A. Hereman**, Colorado School of Mines.

Mathematical Models in Biomedicine, **Ami Radunskaya**, Pomona College, **James Sneyd**, University of Auckland, **Urszula Ledzewicz**, University of Southern Illinois at Edwardsville, and **Heinz Schaettler**, Washington University.

Matroids, Graphs, and Complexity, **Dillon Mayhew**, Victoria University of Wellington, and **James G. Oxley**, Louisiana State University.

New Trends in Spectral Analysis and Partial Differential Equations, **Boris P. Belinskiy**, University of Tennessee, Chattanooga, **Anjan Biswas**, Delaware State University, and **Boris Pavlov**, University of Auckland.

Quantum Topology, **David B. Gauld**, University of Auckland, and **Scott E. Morrison**, University of California Berkeley.

Special Functions and Orthogonal Polynomials, **Shaun Cooper**, Massey University, **Diego Dominici**, SUNY New Paltz, and **Sven Ole Warnaar**, University of Melbourne.

Water-Wave Scattering Focusing on Wave-Ice Interactions, **Michael H. Meylan**, Massey University, and **Malte Peter**, University of Bremen.

San Diego, California

San Diego Convention Center

January 6–9, 2008

Sunday – Wednesday

Meeting #1035

Joint Mathematics Meetings, including the 114th Annual Meeting of the AMS, 91st 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2007
Program first available on AMS website: November 1, 2007
Program issue of electronic *Notices*: January 2008
Issue of *Abstracts*: Volume 29, Issue 1

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: September 20, 2007

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/national.html`.

AMS-MAA Joint Invited Addresses

Fan Chung, University of California San Diego, *The mathematics of PageRank*, 11:10 a.m. on Tuesday.

Terence Tao, University of California Los Angeles, *Structure and randomness in the prime numbers*, 11:10 a.m. on Sunday.

AMS Committee on Science Policy-MAA Science Policy Committee Government Speaker, speaker and title to be announced, 4:20 p.m. on Tuesday.

Joint Prize Session

Prize Session and Reception: In order to showcase the achievements of the recipients of various prizes, the AMS and MAA are cosponsoring this event at 4:25 p.m. on Monday. A cash bar reception will immediately follow. All participants are invited to attend. The AMS, MAA, and SIAM will award the Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. The AMS will announce the winners of the Award for Distinguished Public Service, Bôcher Memorial Prize, Frank Nelson Cole Prize in Number Theory, Levi L. Conant Prize, Joseph L. Doob Prize, Leonard Eisenbud Prize for Mathematics and Physics, JPBM Communications Award, and the Leroy P. Steele Prizes. The MAA will award the Beckenbach Book Prize, Chauvenet Prize, Euler Book Prize, Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics, Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics, Certificates of Meritorious Service, and the David P. Robbins Prize. The AWM will present the Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman and the Louise Hay Award for Contributions to Mathematics Education.

114th Meeting of the AMS

AMS Invited Addresses

James G. Arthur, University of Toronto, *Semisimple groups as universal examples*, 3:20 p.m. on Monday. (AMS Retiring Presidential Address)

Constantine M. Dafermos, Brown University, *Progress in hyperbolic conservation laws*, 9:00 a.m. on Wednesday.

Wen-Ching Winnie Li, National Tsing Hua University and Pennsylvania State University, *Combinatorics and number theory*, 10:05 a.m. on Sunday.

Donald G. Saari, University of California Irvine, *A new mathematical frontier: The social and behavioral sciences*, 10:05 on Tuesday.

Peter Teichner, University of California Berkeley, *Quantum field theory and generalized cohomology,* 2:15 p.m. on Wednesday.

Wendelin Werner, University of Paris-Sud, *Random conformally invariant pictures*, 1:00 p.m. on Sunday, Monday, and Tuesday. (AMS Colloquium Lectures)

Avi Wigderson, Institute for Advanced Study, *Randomness—A computational complexity view*, 8:30 p.m. on Sunday. (AMS Josiah Willard Gibbs Lecture)

AMS Special Sessions

Some sessions are cosponsored with other organizations. These are noted within the parentheses at the end of each listing, where applicable.

Abstracts for all Special Sessions must be submitted through the meeting website at `www.ams.org/cgi-bin/abstracts/abstract.pl`. No speaker will be scheduled unless an abstract is submitted by the deadline for perusal by the Program Committee.

Algebraic Dynamics, **Diana M. Thomas**, Montclair State University, **Lennard F. Bakker**, Brigham Young University, and **Donald Mills**, Rose-Hulman Institute of Technology; Tuesday morning and afternoon.

Algebraic Topology, **Nitu Kitchloo**, University of California San Diego; **Ralph L. Cohen**, Stanford University; **James P. Lin** and **Justin Robert**, University of California San Diego; and **Peter Teichner**, University of California Berkeley; Sunday and Monday mornings and Sunday afternoon.

Algebraic and Geometric Aspects of Integrable Systems, **Baofeng Feng**, University of Texas-Pan American; **Wenxiu Ma**, University of South Florida; **Kenichi Maruno** and **Zhijun Qiao**, University of Texas-Pan American; and **Taixi Xu**, Southern Polytechnic State University; Wednesday morning and afternoon.

Applications of Computer Algebra in Enumerative and Algebraic Combinatorics, **Akalu Tefera**, Massachusetts Institute of Technology and Grand Valley State University, and **Moa Apagodu**, Virginia Commonwealth University; Tuesday afternoon.

Asymptotic Methods in Analysis with Applications, **Diego Dominici**, SUNY New Platz, and **Peter A. McCoy**, U.S. Naval Academy; Sunday morning and afternoon. (AMS-SIAM)

Automorphic Forms and Related Topics, **Olav K. Richter**, University of North Texas; **Kathrin Bringmann**, University of Minnesota; and **Harold M. Stark,** University of California San Diego; Sunday morning and afternoon.

Biomathematical Modeling, **Olcay Akman**, Illinois State University, and **Timothy D. Comar**, Benedictine University; Tuesday afternoon.

Conformally Flat Lorentzian Manifolds, **Virginie Charette**, Université de Sherbrooke, **William M. Goldman**, University of Maryland, **Karin H. Melnick**, Yale University, and **Kevin Scannel**, Saint Louis University; Monday morning and afternoon.

Dynamics and Stability of Coherent Structures, **Ricardo Carretero** and **Jennifer M. Gorsky**, University of San Diego; Tuesday morning and afternoon.

E-Theory, Extensions, and Elliptic Operators, **Constantin D. Dumitrascu**, University of Arizona, and **John D. Trout**, Dartmouth College; Wednesday morning and afternoon.

Environmental Mathematics: Some Mathematical Problems on Climate Change and Geophysical Fluid Dynamics, **Samuel S. Shen**, San Diego State University, and **Gerald R. North**, Texas A&M University (AMS-SIAM); Wednesday morning.

Expanders and Ramanujan Graphs: Construction and Applications, **Michael T. Krebs** and **Anthony M. Shaheen**, California State University, Los Angeles, and **Audrey A. Terras**, University of California San Diego; Tuesday and Wednesday afternoons and Wednesday morning.

Feynman Integral in Mathematics and Physics, **Lance W. Nielsen**, Creighton University; Wednesday morning and afternoon.

Financial Mathematics, **Jean-Pierre Fouque**, University of California Santa Barbara; **Kay Giesecke**, Stanford University; **Ronnie Sircar**, Princeton University; and **Knut Solna**, University of California Irvine; Tuesday and Wednesday, mornings and afternoons.

Global Optimization and Operations Research Applications, **Ram U. Verma**, University of Central Florida; Wednesday morning and afternoon.

Graph Theory, **Andre Kundgen** and **K. Brooks Reid**, California State University, San Marcos; Monday and Tuesday mornings and Monday afternoon.

Groups, Representations, and Character Theory, **Manouchehr Misaghian**, Johnson C. Smith University, and **Mohammad Reza Darafsheh**, University of Tehran; Sunday morning and afternoon.

Heegaard Splittings, Bridge Positions, and Low Dimensional Topology, **Jesse Johnson**, Yale University; **Abigail A. Thompson**, University of California Davis; and **Robin Wilson**, University of California Santa Barbara; Wednesday morning and afternoon.

History of Mathematics, **Joseph W. Dauben,** Lehman College, CUNY; **Patti Hunter**, Westmont College; **Victor J. Katz**, University of District of Columbia; and **Karen H. Parshall**, University of Virginia; Tuesday and Wednesday, mornings and afternoons. (AMS-MAA)

Hyperbolic Dynamical Systems, **Todd L. Fisher**, University of Maryland, and **Boris Hasselblatt**, Tufts University; Sunday morning and afternoon.

Interactions Between Noncommutative Algebra and Algebraic Geometry, **Daniel S. Rogalski** and **Lance W. Small**, University of California San Diego, and **James J. Zhang**, University of Washington; Sunday morning and afternoon.

Inverse Problems in Geometry, **Peter A. Perry**, University of Kentucky, and **Carolyn S. Gordon**, Dartmouth College; Tuesday morning and afternoon.

Learning and Math Graduate Students in K–12 Classroom, **Richard S. Millman**, University of Kentucky, **Loyce M. Adams**, University of Washington; **Overtoun M. Jenda**, Auburn University; and **M. Helena Noronha**, California State University, Northridge; Tuesday afternoon.

Linear Diophantine Problem of Frobenius, **Matthias Beck**, San Francisco State University; **Stanley Wagon**, Macalester College; and **Kevin M. Woods**, Oberlin College; Wednesday afternoon.

Low Genus Curves and Applications, **Kristin E. Lauter**, Microsoft Research, and **Peter Stevenhagen**, Leiden University; Monday and Tuesday afternoons and Tuesday morning.

Mathematical Problems in Biological Formations, **Yuanwei Qi**, University of Central Florida; Wednesday afternoon.

Mathematics and Education Reform, **Bonnie S. Saunders**, University of Illinois, Chicago; **William H. Barker**, Bowdoin College; **Dale R. Oliver**, Humboldt State University; and **Michael Starbird**, University of Texas, Austin; Wednesday morning and afternoon. (AMS-MAA-MER)

Mathematics for Teaching: Educating Elementary and Middle School Teachers for Success, **Babette M. Benken**, California State University, Long Beach, and **Lynn C. McGrath** and **Perla L. Myers**, University of San Diego; Monday morning and afternoon.

Mathematics of Information and Knowledge, **Peter W. Jones**, Yale University; **James G. Glimm**, SUNY at Stony Brook; **Steve Smale**, Toyota Institute of Technology at Chicago; Sunday and Monday, mornings and afternoons.

Modular Forms and Modularity, **Ling Long**, Iowa State University; **Wen-Ching Winnie Li**, Pennsylvania State University; and **Tong Liu**, University of Pennsylvania; Monday and Tuesday mornings and Monday afternoon.

Monotone Discrete Dynamical Systems with Applications, **M. R. S. Kulenovic** and **Orlando Merino**, University of Rhode Island, and **Hal L. Smith**, Arizona State University; Monday morning and afternoon.

Probability Theory and Statistical Mechanics, **Itai Benjamini**, Weizmann Institute and Microsoft Research, and **Wendelin Werner**, University of Paris-Sud; Wednesday morning and afternoon.

Progress in Commutative Algebra, **Janet Striuli**, University of Nebraska, Lincoln; **Sean M. Sather-Wagstaff**, North Dakota State University; and **Lars Winther Christensen**, Texas Tech University; Sunday and Monday mornings and Monday afternoon.

Recent Advances in Mathematical Biology, Ecology, and Epidemiology, **Linda J. S. Allen**, Texas Tech University; **Sophia R. Jang**, University of Louisiana at Lafayette; and **Lih-Ing W. Roeger**, Texas Tech University; Sunday and Monday mornings and Sunday afternoon.

Representation Theory and Nonassociative Algebras, **Murray R. Bremner**, University of Saskatchewan; **Irvin R. Hentzel**, Iowa State University; and **Luiz A. Peresi**, University of Sao Paulo; Tuesday afternoon.

Research in Mathematics by Undergraduates, **Darren A. Narayan** and **Bernard Brooks,** Rochester Institute of Technology; **Jacqueline A. Jensen**, Sam Houston State University; **Vadim Ponomarenko**, San Diego State University; and **Tamas Wiandt**, Rochester Institute of Technology; Tuesday and Wednesday mornings and Monday and Wednesday afternoons. (AMS-MAA-SIAM)

Scholarship of Teaching and Learning in Mathematics, **Curtis D. Bennett** and **Jacqueline M. Dewar**, Loyola Marymount University; Sunday morning and afternoon (AMS-MAA)

Secant Varieties and Related Topics, **Christopher S. Peterson**, Colorado State University; **Hirotachi Abo**, University of Idaho; and **Anthony V. Geramita**, Queen's University and University of Genoa; Tuesday morning and afternoon.

Set Theory and Banach Spaces, **Christian Rosendal**, University of Illinois at Urbana-Champaign, and **Stevo B. Todorcevic**, University of Toronto and CNRS, Université Paris 7; Sunday and Monday mornings and Sunday afternoon. (AMS-ASL)

Stochastic, Large-Scale, and Hybrid Systems with Applications, **Aghalaya S. Vatsala**, University of Louisiana at Lafayette, and **G. S. Ladde**, University of Texas at Arlington; Monday morning and afternoon.

Structure, Geometry, and Symbolic Computation of Algebraic Groups and Symmetric Spaces, **Jennifer R. Daniel**, Lamar University, and **Aloysius G. Helminck**, North Carolina State University; Monday and Tuesday mornings and Monday afternoon.

Time-Frequency Analysis: Hilbert Huang Transform and Wavelet Analysis, **Yuesheng Xu**, Syracuse University; **Sherman D. Riemenschneider**, West Virginia University; and **Samuel S. Shen**, San Diego State University; Monday morning and afternoon.

Voting Theory, **Michael A. Jones**, Montclair State University; **Eric I. Gottlieb**, Rhodes College; and **Brian P. Hopkins**, Saint Peter's College; Monday morning and afternoon.

Wavelet Sets and Tilings of R^n, **Kathy D. Merrill**, Colorado College, and **Lawrence W. Baggett** and **Judith A. Packer**, University of Colorado, Boulder; Tuesday morning and afternoon.

Zeta Functions of Graphs, Ramanujan Graphs, and Related Topics, **Audrey A. Terras**, University of California San Diego, and **Matthew Horton**, Wellesley College; Sunday morning and afternoon. (AMS-AWM)

Contributed Paper Sessions

There will be sessions for contributed papers of ten minutes' duration. Contributed papers will be grouped by related Mathematics Subject Classification into sessions insofar as possible. The author(s) and their affiliation(s) and the title of each paper accepted will be listed in the program along with the date and time of presentation. Although an individual may present only one contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. Abstracts will be published in *Abstracts Presented to the American Mathematical Society* and should be submitted electronically. See `www.ams.org/cgi-bin/abstracts/abstract.pl` for the form. Select AMS CP 1 as the event code. See the beginning of this announcement for pertinent deadlines, which are strictly enforced.

Other AMS Sessions

Grant Writing in the Mathematical Sciences, Sunday, 8:00 a.m. to 10:55 a.m. and 2:15 p.m. to 5:30 p.m., organized by **Michelle Wagner**, National Security Agency, and **Deborah F. Lockhart**, National Science Foundation. The goals of this workshop are to inform the community about ongoing and new funding opportunities in the mathematical sciences, provide grant writing guidance from program managers and successful proposal writers, and provide a hands-on opportunity for participants to write mock proposals and have their work critiqued by their peers and other experts. The first part of the program will feature presentations by program managers of several agencies that provide funding in the mathematical sciences. Program managers will provide an overview of the kinds of funding opportunities that exist within their organizations, and will also describe proposal submission processes, evaluation criteria, and funding rates and statistics. In the next segment of the session, a panel of program managers and successful proposal writers will talk about the "dos and don'ts" of proposal writing. Successful proposal writers will share their experiences of navigating the proposal submission and review process; program managers will talk more in depth about review processes, and will present specific strategies for writing sound proposals of different types (research, conference, REU, etc). The workshop will culminate with a hands-on opportunity for participants to write short sections of mock proposals and have them critiqued by other session participants and the session leader. Please be sure to check the appropriate box on the registration form.

Congressional Fellowship Session, Sunday, 4:30 p.m. to 5:50 p.m., organized by **Samuel M. Rankin, III**, AMS. This program is administered by the American Association for the Advancement of Science (AAAS). The fellowship is designed to provide a unique public policy learning experience, to demonstrate the value of science/government interaction, and to bring a technical background and external perspective to the decision-making process in Congress. We intend to have the three AMS-sponsored Congressional Fellows give their perspective on the fellowship to interested meeting participants to encourage applications for future fellowships.

Who Wants to Be a Mathematician, Tuesday, 10:00 a.m. to 10:55 a.m., organized by **Michael A. Breen**, AMS, and **William T. Butterworth**, DePaul University. Come watch eight of the area's top high school students compete for cash and prizes by answering questions about mathematics. You are invited to come and take part in this educational and fun presentation.

Current Events Bulletin, Tuesday, 1:00 p.m. to 6:00 p.m., organized by **David Eisenbud**, Mathematical Sciences Research Institute. This session follows the model of the Bourbaki Seminars in that mathematicians with strong expository skills speak on work not their own. Written versions of the talks will be distributed at the session.

Wiki Math, Tuesday, 1:00 p.m. to 2:15 p.m., organized by **William Casselman**, University of British Columbia. Nominally, mathematics should be an ideal subject for Wikipedia, since mathematical facts are ... well ... facts, and there ought to be little room for disagreement. How does this work out in practice? The session will offer an anecdotal survey, exhibiting some of the best as well as some of the worst. We hope also to discuss how perhaps it *should* deal with mathematics.

Committee on Science Policy Panel Discussion: Tuesday, 2:30 p.m. to 4:00 p.m.

Committee on Education Panel Discussion: Wednesday, 8:30 a.m. to 10:00 a.m.

Other AMS Events

Council: Saturday, 1:30 p.m.

Business Meeting: Wednesday, 11:45 a.m.

The secretary notes the following resolution of the Council: Each person who attends a business meeting of the Society shall be willing and able to identify himself as a member of the Society. In further explanation, it is noted that each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society. The Society has a Committee on the Agenda for Business Meetings. The purpose is to make business meetings orderly and effective. The committee does not have legal or administrative power. It is intended that the committee consider what may be called "quasipolitical" motions. The committee has several possible courses of action on a proposed motion, including but not restricted to:

(a) doing nothing,

(b) conferring with supporters and opponents to arrive at a mutually accepted amended version to be circulated in advance of the meeting,

(c) recommending and planning a format for debate to suggest to a business meeting,

(d) recommending referral to a committee, and

(e) recommending debate followed by referral to a committee.

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

In order that a motion for this business meeting receive the service offered by the committee in the most effective manner, it should be in the hands of the AMS Secretary by December 7, 2007.

AMS Short Course

This two-day course on *Applications of Knot Theory* is organized by **Dorothy Buck**, Imperial College London, and **Erica L. Flapan**, Pomona College, and takes place on Friday and Saturday, January 4 and 5. Over the past twenty years knot theory has rekindled its historic ties with biology, chemistry, and physics. While the original motivation for understanding and classifying knots came from chemistry, knot theory remained a primarily pure field of mathematics until the 1980s, when chemists, biologists, and physicists began searching for more sophisticated descriptions

of entanglements of natural phenomena—from strings to small organic compounds to DNA.

This course will introduce knot theory and some of its recent applications in molecular biology, chemistry, and physics. No prior knowledge of knot theory, biology, chemistry, or physics is assumed—there will be introductory talks on the first day. Speakers will survey their own work in these areas, as well as describing new avenues for interested researchers (and their students) to explore. The course will conclude with a panel discussion of the putative trajectories of these applications of knot theory, and summarize the major open problems and challenges. References will be available in advance and lecture notes published afterwards.

Speakers are **Colin C. Adams**, Williams College; **Dorothy Buck; Erica L. Flapan**; **Louis H. Kauffman**, University of Illinois at Chicago; **Nadrian C. Seeman**, Department of Chemistry, New York University; and **Jonathan Simon**, University of Iowa. Please see the complete article on page 1218 or at `www.ams.org/meetings/shcourse.html`. There are separate registration fees to participate. See the fee schedule on the registration form at the back of this issue or visit `www.ams.org/amsmtgs/2109_registration.html`.

Department Chairs Workshop

This annual one-day workshop for chairs and leaders of departments of mathematical sciences will be held a day before the start of the Joint Meetings on Saturday, 8:00 a.m. to 6:30 p.m. The workshop format is intended to stimulate discussion among attending chairs and workshop leaders. Sharing ideas and experiences with peers provides a form of department chair therapy, creating an environment that enables attending chairs to address departmental matters from new perspectives.

Past workshop sessions have focused on a range of issues facing departments today, including personnel issues (staff and faculty), long-range planning, hiring, promotion and tenure, budget management, assessments, outreach, stewardship, junior faculty development, communication, and departmental leadership.

There is a registration fee for the workshop, which is in addition to and separate from the Joint Meetings registration. An invitation to attend the workshop will be sent to department chairs this fall. Information will also be posted on the AMS website. For further information, please contact the AMS Washington Office at 202-588-1100 or `amsdc@ams.org`.

91st Meeting of the MAA

MAA Invited Addresses

John H. Conway, Princeton University, *Title to be announced*, 2:15 p.m. on Sunday.

Carl C. Cowen, Indiana University-Purdue University Indianapolis, *The teaching-technology linkage in mathematics*, 10:05 a.m. on Wednesday. (MAA Retiring Presidential Address)

Paul H. Edelman, Vanderbilt University, *Mathematics and the law: The apportionment of the House of Representatives*, 3:20 p.m. on Sunday.

Karen H. Parshall, University of Virginia, *4000 years of algebra: An historical tour from BM 13901 to* Moderne Algebra, 9:00 a.m. on Monday.

Carl Pomerance, Dartmouth College, *The covering congruences of Paul Erdős,* 9:00 a.m. on Tuesday.

Presentations by Teaching Award Recipients

Tuesday, 2:30 p.m.–4:00 p.m., organized by MAA secretary, **Martha Siegel**, Towson University, and moderated by MAA president, **Joseph A. Gallian**, University of Minnesota-Duluth. Winners of the Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching will give presentations on the secrets of their success.

MAA Minicourses

Minicourses are open only to persons who register for the Joint Meetings and pay the Joint Meetings registration fee in addition to the appropriate minicourse registration fee of US$60. The MAA reserves the right to cancel any minicourse that is undersubscribed. Participants in Minicourses #1–#6 are required to come with a laptop computer equipped with appropriate software. Instructions to download any data files needed for those courses will be provided by the organizers.

Minicourse #1: *Teaching a Galois theory course for undergraduates*, organized by **John R. Swallow**, Davidson College; Part 1: Sunday, 9:00 a.m.–11:00 a.m., and Part 2: Tuesday, 9:00 a.m.–11:00 a.m. Participants explore Galois theory from an undergraduate perspective, gaining materials and technological tools for use teaching an undergraduate course. The course outlines the theory from a concrete, computational point of view, assuming only one semester of abstract algebra. The course also introduces *AlgFields*, a package for use with *Maple* or *Mathematica*, to facilitate computation in number fields. Participants study examples, solve exercises, and pose new problems, all built around the concept of an algebraic number with complex approximation. Handouts and web links to the freely available package will be distributed. Laptops should be equipped with either *Maple* (version 9 or later) or *Mathematica* (version 4.2 or later), but no prior experience with *Mathematica* or *Maple* is required. Enrollment limit is 30.

Minicourse #2: *Some deterministic models in mathematical biology and their simulations*, organized by **Cammey Cole Manning**, Meredith College; **Huseyin Kocak**, University of Miami; and **James F. Selgrade**, North Carolina State University; Part 1: Sunday, 2:15 p.m.–4:15 p.m., and Part 2: Tuesday, 1:00 p.m.–3:00 p.m. This minicourse will present and analyze discrete and continuous models from physiology (e.g., the Hodgkin-Huxley model), pharmacokinetics, and population biology (e.g., the chemostat model). The class will be conducted in a computer lab where participants will use the software *Phaser* to simulate model behavior. Each of the four topics will be discussed for 30 minutes followed by 30 minutes of computer experimentation. The

participants will be provided electronic copies of the web-based notes, simulations, and the software. Familiarity with the material in undergraduate courses in ordinary differential equations and linear algebra will be helpful. Participants for this minicourse will be required to bring a laptop equipped with at least 100MB of available disk space, 512MB RAM, with a CDROM drive and with one of the three operating systems: Windows 2000/XP/Vista, Mac OS X (10.4.5 or later, with Java 5 or greater installed) or Linux. A free and fully functional evaluation copy of *Phaser 3.0* may be downloaded at `http:www.phaser.com/`. Each prospective registrant should download and install a copy of *Phaser* on his/her laptop to prepare for the minicourse. Technical support for any installation related issues should be addressed to Jason Glick at `jason@phaser.com`. Each registrant of the minicourse will be provided a license activation key for the copy of *Phaser* downloaded at no additional charge. Enrollment limit is 30.

Minicourse #3: *Introduction to the mathematics of modern cryptography*, organized by **Jeffrey Ehme** and **Colm K. Mulcah**y, Spelman College; Part 1: Sunday, 4:45 p.m.–6:45 p.m., and Part 2: Tuesday, 3:30 p.m.–5:30 p.m. The mathematics of modern cryptography is for anyone with an interest in mathematics today, especially if that person also registers for classes (or submits grades) on line, or pays bills or shops on the Internet. Since that includes most of our students and most of us, it is a perfect subject for adding to the standard undergraduate curriculum, either in a regular or special topics course, or as a subject for directed research. There can be no better way of illustrating the application to everyday life of abstract mathematics and clever modern ideas. This minicourse will focus on the basics, assuming only a rudimentary knowledge of number theory and abstract algebra (e.g., Fermat's Little Theorem and the concept of an abelian group), and cover topics ranging from 1970s breakthroughs such as Diffie Hellman key exchange and the RSA cryptography, to the more recent methods of ElGamal, elliptic curves and Groebner bases. Participants are expected to bring laptops equipped with *Maple*, Adobe Acrobat Reader, and a CD drive. Enrollment limit is 30.

Minicourse #4: *Wavelets and applications: A multidisciplinary undergraduate course with an emphasis on scientific computing*, organized by **Patrick J. Van Fleet**, University of St. Thomas, and **David K. Ruch**, Metropolitan State College of Denver; Part 1: Monday, 8:00 a.m.–10:00 a.m., and Part 2: Wednesday, 9:00 a.m.–11:00 a.m. This minicourse provides a basic introduction to wavelets and applications. The wavelet transform is developed in an ad hoc manner. It is then used in applications such as data compression. Participants develop the necessary software and are encouraged to bring their own digital images or audio files to use. Our construction is easy to understand but is limited in applications. Thus we have the motivation for developing wavelets in a general context. The minicourse content provides an excellent template for an undergraduate class in wavelets and applications. We discuss how the course can be offered to undergraduates. Participants receive software and lecture materials that can be used to offer the course at their home institution. Participants are expected to have one of *Mathematica*, *Matlab*, or *Maple* installed on their laptop as well as Adobe Acrobat Reader. For those interested in attending the workshop but who do not have a CAS on their laptop, please contact the organizers. For more information, please visit `http://cam.mathlab.stthomas.edu/wavelets`. Enrollment limit is 30.

Minicourse #5: *Visualizing abstract mathematics with cellular automata*, organized by **Michael J. Bardzell** and **Donald E. Spickler**, Salisbury University; Part 1: Monday, 10:30 a.m.–12:30 p.m., and Part 2: Wednesday, 1:00 p.m.–3:00 p.m. Many undergraduate students are familiar with Pascal's triangle and, in some cases, Pascal's triangle mod n. This later construction is a type of infinite one-dimensional cellular automata generated over a finite group. Cellular automata, both finite and infinite, can be generated over other groups as well. Studying these dynamical systems necessitates simple techniques from abstract algebra, discrete mathematics, number theory, fractal geometry, and computer graphics. We present innovative classroom activities and undergraduate research projects that have evolved from this project. The supporting computer software *PascGaloisJE* will be introduced. A basic knowledge of group theory is sufficient for the course. We will provide copies of the software at the workshop but it can take some time to install the package, although Windows users can run the software right from a provided CD. So we ask that the other participants download and install the software before the beginning of the workshop. You can get the software from `http://pascgalois.org/`and follow the "A download site for PascGaloisJE, ..." link at the bottom of the page or go directly to the download site at `http://faculty.salisbury.edu/~despickler/PascGaloisJE.htm`. Enrollment limit is 30.

Minicourse #6: *Sonification for mathematics instruction*, organized by **Steven M. Hetzler** and **Robert M. Tardiff**, Salisbury University; Part 1: Monday, 1:00 p.m.–3:00 p.m., and Part 2: Wednesday, 3:30 p.m.–5:30 p.m. Some students struggle to interpret standard graphic and symbolic representations of mathematics, and many of these students are primarily auditory learners. At `http://faculty.salisbury.edu/~smhetzler/Minicourse2008/`, there are illustrations of how auditory graphs can be used with spreadsheets to enhance calculus instruction. This minicourse is designed to teach participants how to use nonspeech audio to improve student learning. Participants work together to create an activity that uses sound to teach interpretation of horizontal asymptotes. Then, working individually or in pairs, participants will develop another activity in their own area of interest. The minicourse will conclude with a discussion of the potential of sound for representing other mathematical concepts, and participants will receive a copy of all materials created in the sessions. Participants' laptops will need to be running Windows XP and Microsoft Excel 2003 or higher, with a headphone jack for the soundcard and either a CD-RW drive or USB port. Partial support for this work was provided by the National Science Foundation–Course,

Curriculum, and Laboratory Improvement program under grant 0442450. Enrollment limit is 30.

Minicourse #7: *Directing undergraduate research*, organized by **Aparna W. Higgins**, University of Dayton; Part 1; Sunday, 9:00 a.m.–11:00 a.m., and Part 2: Tuesday, January 8, 1:00 p.m.–3:00 p.m. This course will cover many aspects of facilitating research by undergraduates, such as getting students involved in research, finding appropriate problems, deciding how much help to provide, and presenting and publishing the results. Similarities and differences between research conducted during summer programs and research that can be conducted during the academic year will be discussed. Although the examples used will be primarily in the area of discrete mathematics, the strategies discussed can be applied to any area of mathematics. Enrollment limit is 50.

Minicourse #8: *Mathematics and geometry of voting*, organized by **Donald G. Saari**, University of California Irvine; Part 1: Sunday, 4:45 p.m.–6:45 p.m, and Part 2: Tuesday, 3:30 p.m.–5:30 p.m. By now, most of us know that voting rules can cause unexpected outcomes and delicious paradoxes. It is possible for the standard plurality ranking, for instance, to be Alice > Barb > Connie while the "vote for two" outcome is precisely the opposite. The mathematical issues—which constitute the theme of this course—are to identify everything that can possibly happen and why, how to construct any number of illustrating examples, to identify which voting rule is the "best", and to learn how to convert portions of this recent research into rich course offerings for our undergraduates. Enrollment limit is 50.

Minicourse #9: *Classroom response systems: Teaching with clickers*, organized by **Derek Bruff**, Vanderbilt University; **Matthew Leingang**, Harvard University; and **Kelly Cline**, **Mark R. Parker**, and **Holly S. Zullo**, Carroll College; Part 1: Sunday, 2:15 p.m.–4:15 p.m., and Part 2: Tuesday, 1:00 p.m.–3:00 p.m. Classroom response systems, or "clickers", are instructional technologies that enable teachers to rapidly collect and analyze students' responses to multiple-choice questions. In this minicourse, participants will learn how to use clickers to transform the way they use class time—promoting active participation, engagement, and discussion among students; assessing student learning in real-time during class; and adapting lessons to respond to the particular learning needs of one's students. This minicourse will also feature a question-writing "workshop" and a mock clicker class as ways to explore the kinds of questions and activities that make the most of teaching with clickers. Enrollment limit is 50.

Minicourse #10: *The Fibonacci and Catalan numbers*, organized by **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology; Part 1: Monday, 9:00 a.m.–11:00 a.m., and Part 2: Wednesday, 9:00 a.m.–11:00 a.m. In many introductory courses in discrete mathematics or combinatorics, one often encounters the sequences of numbers called the Fibonacci numbers and the Catalan numbers. This minicourse is designed to demonstrate how certain properties of these sequences come about and to examine where ideas related to these sequences arise in applications dealing with geometry, trigonometry, set theory, number theory, tilings, permutations, chemistry, optics, electrostatics, probability, and graph theory. Enrollment limit is 50.

Minicourse #11: *More music and mathematics*, organized by **Leon Harkleroad**, Wilton, Maine; Part 1: Monday, 1:00 p.m.–3:00 p.m., and Part 2: Wednesday, 1:00 p.m.–3:00 p.m. This session will focus on an all new set of topics from the interface of math and music. We will explore subjects such as historical geometric methods to approximate equal tempering in instrument design, group theory in contradancing, and music from space-filling curves and fractals. This minicourse will not repeat material from the original minicourse (given in Atlanta, GA, in January 2005), and it will not assume that participants attended that earlier installment. Enrollment limit is 50.

Minicourse #12: *Developing department self-studies*, organized by **Donna L. Beers**, Simmons College, and **Richard Alan Gillman**, Valparaiso University; Part 1: Sunday, 9:00 a.m.–11:00 a.m., and Part 2: Tuesday, 9:00 a.m.–11:00 a.m. The self-study process and report are critical components of a departmental program review. They are retrospective, engaging department members and other interested parties (e.g., other departments and the administration) in examining the current status of all aspects of departmental programs. They are also forward-looking, anticipating new areas for growth and contribution to the institutional mission. Since the self-study entails honest discussion of issues confronting a department, it is both a process of reflection and a report. This minicourse enables participants to determine how a self-study, which is usually conducted in response to an administrative mandate, can be a positive opportunity for departmental renewal. Enrollment limit is 50.

Minicourse #13: *Teaching and the philosophy of mathematics*, organized by **Martin E. Flashman**, Humboldt State University; Part 1: Sunday, 2:15 p.m.–4:15 p.m., and Part 2: Tuesday, 1:00 p.m.–3:00 p.m. The goal of this minicourse is to introduce participants to issues in the philosophy of mathematics that can be used to illuminate classroom topics in undergraduate courses at a variety of levels and provide a foundation for organizing an undergraduate course in the philosophy of mathematics for mathematics and philosophy students. The course will focus primarily on issues related to i) the nature of the objects studied in mathematics (ontology) and ii) the knowledge of the truth of assertions about these objects (epistemology). Responses ascribed to many views such as platonism, formalism, intuitionism, constructivism, logicism, structuralism, and empiricism will be outlined. Enrollment limit is 50.

Minicourse #14: *Beyond formulas and algorithms: Teaching a conceptual/thematics single variable calculus course*, organized by **Shahriar Shahriari**, Pomona College; Part 1: Sunday, 4:45 p.m.–6:45 p.m., and Part 2: Tuesday, 3:30 p.m.–5:30 p.m. Many students enter college having seen the main ideas of calculus and knowing how to do routine calculus problems but without a firm grasp of the concepts underlying calculus. In this hands-on course, the participants will be introduced and will have a chance to explore an honors calculus class where the theme is

approximations and one of the test cases is approximating the number of primes up to x. In this alternative calculus class, the students take an active role in formulating questions, and in developing the material. A thematic/conceptual approach using open-ended problems that incorporates some unusual mathematics (in this case, analytic number theory) allows us to take advantage of the students' prior experience with calculus to get a deeper understanding of the subject. Enrollment limit is 50.

Minicourse #15: *Evaluating student presentations in mathematics*, organized by **Suzanne Dorée**, Augsburg College; **Richard Jardine**, Keene State College; and **Thomas Linton**, Central College; Part 1: Monday, 9:00 a.m.–11:00 a.m., and Part 2: Wednesday, 9:00 a.m.–11:00 a.m. Do your students give in-class presentations? Present their undergraduate research project at a conference or senior seminar? While most mathematics professors can tell a great mathematics talk from a truly horrible one, when it comes to grading student presentations we are often at a loss. In this mini-course we'll examine what makes a good student mathematics talk, offer concrete advice on helping students prepare to speak, discuss the use of rubrics for evaluating presentations, and explore the role of presentations in departmental curriculum and assessment. Participants will practice using rubrics to evaluate presentations on video and at the meetings themselves. Enrollment limit is 50.

Minicourse #16: *A beginner's guide to the scholarship of teaching and learning in mathematics*, organized by **Curtis D. Bennett** and **Jacqueline M. Dewar**, Loyola Marymount University; Part 1: Monday, 1:00 p.m.–3:00 p.m. and Part 2: Wednesday, 1:00 p.m.–3:00 p.m. This course will introduce participants to the scholarship of teaching and learning in mathematics (SoTL). We will present a framework that illustrates the similarities between disciplinary research and SoTL work, offer examples of SoTL projects in mathematics at varying stages of development, discuss methods for investigation, and help participants begin projects of their own. Participants will be guided in transforming a teaching problem of their own into a problem for scholarly investigation. Suggestions for how to make this work public will also be given. Enrollment limit is 50.

MAA Contributed Paper Sessions

The MAA Committee on Contributed Paper Sessions solicits contributed papers pertinent to the sessions listed below. Contributed paper session organizers generally limit presentations to ten or fifteen minutes. Each session room contains a computer projector, an overhead projector, and one screen. Please note that the dates and times scheduled for these sessions remain tentative. Full descriptions of these sessions may be found in the August issue of the *Notices*, p. 939, or see `www.ams.org/amsmtgs/2109_maacontrib.html`.

Assessment of Student Learning in Undergraduate Mathematics, Monday afternoon, organized by **William O. Martin**, North Dakota State University; **Bernard L. Madison**, University of Arkansas; **Kimberly M. Vincent**, Washington State University; and **Maura B. Mast**, University of Massachusetts-Boston. The SIGMAA-QL and Project SAUM are sponsors of this event.

Biomathematics in the Undergraduate Curriculum, Wednesday morning and afternoon, organized by **Timothy D. Comar** and **Lisa G. Townsley**, Benedictine University; **Glenn W. Ledder**, University of Nebraska; and **Olcay Akman**, Illinois State University. This session is sponsored by the SIGMAA on Mathematical and Computational Biology (BIO).

Building Diversity in Advanced Mathematics: Models that Work, Wednesday morning, organized by **Abbe H. Herzig**, University at Albany, State University of New York, and **Patricia L. Hale**, California State Polytechnic University, Pomona. The session is cosponsored by the MAA Committee on the Participation of Women, the MAA Committee on the Participation of Minorities, and the AMS-ASA-AWM-IMS-MAA-NCTM-SIAM Joint Committee on Women.

College Algebra: Concepts, Data, and Models, Monday morning, organized by **Florence S. Gordon**, New York Institute of Technology, **Laurette Foster**, Prairie View A&M University, **Mary R. Robinson**, University of New Mexico Valencia Campus, and **Yajun Yang**, Farmingdale State College of New York. This session is cosponsored by CRAFTY and the Committee on Two Year Colleges (CTYC).

Countering "I Can't Do Math": Strategies for Teaching Under-Prepared Math-Anxious Students Interested in Business and the Sciences, Tuesday morning, organized by **Kimberly J. Presser** and **J. Winston Crawley**, Shippensburg University.

Crossing the "Bridge to Higher Mathematics": What Works and Why, Sunday morning, organized by **George J. Davis**, Georgia State University.

Cryptology for Undergraduates, Wednesday morning, organized by **Chris Christensen**, Northern Kentucky University, and **Robert E. Lewand**, Goucher College.

Curriculum Materials for Preservice Middle School Mathematics Teachers, Monday afternoon, organized by **Laurie J. Burton**, **Maria G. Fung**, and **Klay T. Kruczek**, Western Oregon University. This session is sponsored by the Committee on the Mathematical Education of Teachers (COMET).

Demos and Strategies with Technology that Enhance Teaching and Learning Mathematics, Monday morning and afternoon, organized by **David R. Hill**, Temple University; **Scott Greenleaf**, University of New England; **Mary L. Platt**, Salem State College; and **Lila F. Roberts**, Georgia College & State University.

Ethnomathematics and Its Uses in Teaching, Sunday morning, organized by **Dorothee J. Blum** and **Ximena P. Catepillan**, Millersville University; **Robert E. Jamison**, Clemson University; **Shemsi I. Alhaddad**, University of South Carolina; and **Amy Shell-Gellasch**, Pacific Lutheran University. This contributed paper session is sponsored by the SIGMAA on the History of Mathematics.

Great Activities for an Introductory Statistics Class, Sunday morning, organized by **Patricia B. Humphrey**, Georgia Southern University; **Christopher J. Lacke**, Rowan University; and **Ginger Holmes-Rowell**, Middle Tennessee State University. The session is sponsored by the SIGMAA on Statistics Education. In order to be considered for this

session applicants should submit a one-page summary of the presentation to Pat Humphrey at `phumphre@georgiasouthern.edu` along with the abstract to the meeting website. Presenters in the session will be considered for the SIGMAA on Statistics Education's Best Contributed Presentation Award.

Guided Discovery in Mathematics Education, Tuesday afternoon, organized by **Jerome S. Epstein**, Polytechnic University, and **Chris Rasmussen**, San Diego State University. This session is sponsored by the SIGMAA on Research in Undergraduate Mathematics Education.

Innovative and Effective Ways to Teach Linear Algebra, Tuesday morning, organized by **David M. Strong**, Pepperdine University, and **Gilbert Strang**, Massachusetts Institute of Technology.

Mathematics and the Arts, Monday afternoon, organized by **Douglas E. Norton**, Villanova University. This session is sponsored by the SIGMAA-ARTS.

Mathematics Experiences in Business, Industry, and Government, Tuesday morning, organized by **Philip Gustafson**, Mesa State College, and **Michael G. Monticino**, University of North Texas. This session is sponsored by the MAA Business, Industry and Government Special Interest Group (BIG SIGMAA).

Mathlets and Web Resources for Mathematics and Statistics Education, Wednesday morning, organized by **Thomas E. Leathrum**, Jacksonville State University; **Patricia B. Humphrey**, Georgia Southern University; **Christopher J. Lacke**, Rowan University; **David M. Strong**, Pepperdine University; and **Joe Yanik**, Emporia State University. The session is jointly sponsored by the SIGMAA on Statistics Education and MAA CTiME (Committee on Technology in Math Education). Presentations related to statistics will be considered for the SIGMAA on Statistics Education's Best Contributed Presentation Award. Presenters who wish to be considered for the award should also send a one-page summary of their presentation to Patricia Humphrey, `phumphre@georgiasouthern.edu`, by the abstracts deadline.

Philosophy of Mathematics, Monday morning, organized by **Kevin M. Iga**, Pepperdine University, and **Bonnie Gold**, Monmouth University. This session is sponsored by the SIGMAA for the Philosophy of Mathematics.

The Power of Inductive and Recursive Thinking, Sunday afternoon, organized by **William A. Marion**, Valparaiso University.

Preparing Faculty for Success in a Problem-Solving and Technology-Rich Curriculum, Sunday morning, organized by **Alex J. Heidenberg**, **Gerald C. Kobylski**, **Barbra Melendez**, and **Rodney Sturdivant**, U.S. Military Academy.

Research and Professional Development Activities for Math Majors, Monday afternoon, organized by **Suzanne M. Lenhart**, University of Tennessee; **Mike O'Leary**, Towson University; and **Margaret M. Robinson**, Mount Holyoke College. The session is sponsored by MAA CUPM Subcommittee on Research by Undergraduates.

Research on the Teaching and Learning of Undergraduate Mathematics, Wednesday afternoon, organized by **David E. Meel**, Bowling Green State University; **Michelle J. Zandieh**, Arizona State University; and **Chris Rasmussen**, San Diego State University.

Serving Students Who Have Taken Calculus in High School, Sunday afternoon, organized by **Ann E. Watkins**, California State University, Northridge, and **Daniel J. Teague**, North Carolina School of Science and Mathematics. This session is sponsored by the MAA-NCTM Committee on Mutual Concerns.

Topics and Techniques for Real Analysis, Monday morning, organized by **Erik O. Talvila**, University College of the Fraser Valley; **Robert W. Vallin**, Slippery Rock University; and **James E. Peterson**, Benedictine College.

Using Ideas from Asian Mathematics in the Classroom, Sunday afternoon, organized by **Victor J. Katz**, University of the District of Columbia, **Kim L. Plofker**, Brown University, and **Frank Swetz**, Pennsylvania State University, Harrisburg. This session is sponsored by the SIGMAA on the History of Mathematics.

Using Innovative Technologies to Implement Active Learning in Mathematics (and in other STEM disciplines), Wednesday morning, organized by **Marilyn A. Reba**, Clemson University, and **Beth Simon**, University of California San Diego.

General Session, Sunday, Monday, Tuesday, and Wednesday mornings and afternoons; organized by **Sarah L. Mabrouk**, Framingham State University. Papers may be presented on any mathematical topic. Papers that fit into one of the other sessions should be sent to that organizer, not to this session.

Submission Procedures for MAA Contributed Papers

Send your abstract directly to the meeting website (abstracts should not be sent to the organizer(s) who will automatically receive a copy). Please read the session descriptions thoroughly as some organizers require an additional summary of your proposal be sent to them directly. Participants may speak in at most two MAA contributed paper sessions. If your paper cannot be accommodated in the session for which it was submitted, it will be automatically considered for the general session. Speakers in the general session will be limited to one talk because of time constraints. Abstracts must be submitted by Thursday, **September 20, 2007**.

All accepted abstracts will be published in a book available at the meeting to all registered participants. Abstracts must be submitted electronically. While no knowledge of LaTeX is necessary for submission, LaTeX and $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX are the only typesetting systems that can be used if mathematics or any text markup (e.g., accent marks) is included. The abstracts submissions page is at `http://www.ams.org/cgi-bin/abstracts/abstract.pl`. Simply select the San Diego meeting, fill in the number of authors, and proceed with the step-by-step instructions. Submitters will be able to view their abstracts before final submission. Upon completion of your submission, your unique abstract number will immediately be sent to you. All questions concerning the submission of abstracts should be addressed to `abs-coord@ams.org`.

MAA Panels, Posters, and Other Sessions

National Science Foundation Programs Supporting Learning and Teaching in the Mathematical Sciences, Sunday, 9:00 a.m.–10:20 a.m., **Lloyd E. Douglas,** Division of Mathematical Sciences, National Science Foundation; and **Daniel P. Maki, Elizabeth J. Teles,** and **Lee L. Zia**, Division of Undergraduate Education, National Science Foundation. A number of NSF divisions offer a variety of grant programs that support innovations in learning and teaching in the mathematical sciences. These programs will be discussed along with examples of successful projects. Anticipated budget highlights and other new initiatives for the next fiscal year will also be presented.

Making the Connection Between Research and Teaching in Undergraduate Mathematics Education, Sunday, 9:00 p.m.–10:20 p.m., **Chris Rasmussen**, San Diego State University; **Marilyn P. Carlson**, Arizona State University; and **David E. Meel**, Bowling Green State University. This session of invited speakers will discuss several chapters from a forthcoming *MAA Notes* volume on research in undergraduate mathematics education, edited by Carlson and Rasmussen. Chapters from the forthcoming book include papers written by mathematics education researchers and by mathematicians discussing topics in the undergraduate curriculum as well as overarching issues in undergraduate mathematics education, with emphasis on the implications of that research in the teaching of undergraduate mathematics courses. The panel session will feature the following three presentations, followed by discussion and questions from the audience: **Guershon Harel**, University of California San Diego, and **Stacy Brown**, University of Illinois at Chicago, *Mathematical induction: Cognitive and instructional considerations*; **Annie** and **John Selden**, New Mexico State University, *Overcoming students' difficulties in learning to understand and construct proofs*; and **Keith H. Weber**, Rutgers University and **Sean P. Larsen**, Portland State University, *Teaching and learning group theory*. The session is sponsored by SIGMAA on Research in Undergraduate Mathematics Education.

Tenure (and Promotion)—You Know You Want It, Sunday, 9:00 a.m.–10:20 a.m., **James E. Hamblin**, Shippensburg University, and **Kimberly A. Roth**, Juniata College. Once you get your tenure-track job, the next step is to get tenure and promotion. Tenure and promotion policies, of course, vary from institution to institution, but there are some general things you can do to help the process go smoothly. Panelists will discuss their advice for people on the tenure-track and their experiences on it. The session is co-sponsored by the Young Mathematician's Network and Project NExT.

Project NExT/Young Mathematicians' Network Poster Session, Sunday, 2:15 p.m.–4:15 p.m., organized by **Kevin E. Charlwood**, Washburn University, and **Michael C. Axtell**, Wabash College. Junior mathematicians who are no more than five years beyond their Ph.D. are invited by Project NExT and the Young Mathematicians' Network to submit abstracts for the session. The poster size will be 48" (length) by 36" (height). Posters and materials for posting pages on the posters will be provided onsite. Applications should be submitted to Kevin Charlwood, `kevin.charlwood@washburn.edu`, or Mike Axtell `axtellm@wabash.edu`, by Friday, December 7, 2007.

Mathematics and Hollywood: A Conversation with Mathematical Hollywood Writers and Mathematics Faculty, Sunday, 2:15 p.m.–3:35 p.m., **Christopher Goff**, University of the Pacific, and **Sarah J. Greenwald**, Appalachian State University. Recently, Hollywood has expanded its use of mathematical themes. A parallel trend involves linking these "mathematical moments" to educational initiatives. Our panel will furnish insiders' perspectives on the effect of mathematical training on the creative process and the challenges of representing mathematics and mathematicians in Hollywood. We will also begin a critical discussion about how Hollywood affects mathematics education and public perceptions. As schedules allow, planned panel members include mathematical writers as well as mathematical consultants: **David M. Bressoud**, Macalester College, is a *NUMB3RS* worksheet author; **Ken Keeler** has a doctorate in applied mathematics and has won Writer's Guild and Emmy Awards for his work on *The Simpsons* and *Futurama,* Twentieth Century Fox; **Alice Silverberg**, University of California Irvine, has consulted for film and television; **Eric Weisstein**, Wolfram Research, consults for *NUMB3RS*; and **Jeff Westbrook** has a doctorate in computer science and is currently a writer for *The Simpsons*, Twentieth Century Fox. The panel is sponsored by SIGMAA on Mathematics and the Arts.

What Every Chair Should Know About NSF Funding, Sunday, 2:15 p.m.–3:35 p.m., **Catherine M. Murphy**, Purdue University Calumet, and **Daniel P. Maki**, Indiana University. **Dan Maki** will speak about curriculum funding through DUE and a yet-to-be-named representative from DMS will speak about research funding in this session for chairs. There will time available for questions and conversation with the presenters.

How to Interview for a Job in the Mathematical Sciences, Sunday, 2:15 p.m.–3:35 p.m., organized by **David C. Manderscheid**, University of Iowa. This session is aimed at Ph.D. students and at recent graduates. An overview of the employment process will be given with ample opportunity for participants to ask questions. The emphasis will be on the portion of the employment process from interviewing through accepting an offer. Questions that will be addressed include: How do employers conduct interviews? How can you best prepare for these interviews? How do employers choose to whom they will make offers? How do you negotiate once you have an offer? How do you choose among competing offers? The panelists are **Allen Butler**, Daniel H. Wagner Associates, Inc.; **Sharon M. Clarke**, Pepperdine University; **James H. Freeman**, Cornell College; **Sarah Ann Stewart**, Belmont University; and **David C. Manderscheid**. The session is cosponsored by the MAA Committee on Graduate Students and The Young Mathematicians Network.

Engaging Students in College Mathematics Courses, Sunday, 3:50 p.m.–5:10 p.m., **Juli D'Ann Ratheal**, West Texas A&M University. Most colleges and universities encounter problems associated with retention and passing rates in mathematics courses, especially core courses.

The emphasis of this panel discussion will be how to engage students and enhance their learning experience in mathematics courses. Instructional strategies designed to increase the level of student engagement and conceptual understanding by establishing learning communities through collaborative activities and projects will be explored. Data which measured students' attitudes toward specific pedagogical methods used in college algebra classes were collected over a three-year period. These data will be reviewed and discussed by the panelists, who have worked collaboratively for a number of years to reform mathematics courses by implementing instructional strategies which increase student engagement and make course content more meaningful. Panelists will include **James A. M. Epperson**, Unversity of Texas-Arlington; **Winifred A. Mallam**, Texas Woman's University; **Kimberly M. Childs,** Stephen F. Austin State University; **Bowen Brawner**, Tarleton State University; **Rebecca Walls**, West Texas A&M University; and **Juli D'Ann Ratheal**.

Tracking Our Students from College Algebra to Calculus: Where They Come From, Where They Go, and Where They Don't, Sunday, 3:50 p.m.–5:50 p.m., organized by **Sheldon P. Gordon**, Farmingdale State College. A growing body of evidence shows that only a very small percentage of the approximately 1,000,000 students who take college algebra and related courses each year ever go on to start calculus, which is the focus of most of these courses. In this session, the panelists will discuss the results of student tracking studies and their implications, including comparisons of students who have taken prerequisite courses in high school or in college, what courses students take after taking college algebra or precalculus courses, and where the students who take calculus have come from. Panelists include **Barbara E. Edwards**, Oregon State University; **Steven R. Dunbar**, University of Nebraska; **Aimee Ellington**, Virginia Commonwealth University; **Scott Herriott**, Maharishi International University; **Mercedes McGowen**, William Rainey Harper College; and **William A. Waller**, University of Houston–Downtown. The panel is sponsored by the MAA committee on Curriculum Renewal Across the First Two Years (CRAFTY).

Proposal Writing Workshop for Grant Applications to the NSF Division of Undergraduate Education, Monday, 9:00 a.m.–10:30 a.m., **Daniel P. Maki, Elizabeth J. Teles,** and **Lee L. Zia,** Division of Undergraduate Education, National Science Foundation. Presenters will describe the general NSF grant proposal process and consider particular details relevant to programs in the Division of Undergraduate Education. This interactive session will feature a series of "read/think/share/report" exercises built around a series of short excerpts from sample proposals.

Outreach Programs For Underrepresented Populations in Mathematics, Monday, 9:00 a.m.–11:00 a.m., **Elizabeth Yanik,** Emporia State University; **Jennifer Hontz**, Meredith College; and **Kathleen Sullivan**, Seattle University. This poster session is designed to showcase successful outreach mathematics programs that encourage students from underrepresented populations to continue their study of mathematics. The participants in such programs range in grade level from elementary students to undergraduates. It is expected that posters representing a wide variety of programs will be displayed. Possible programming formats include after school clubs, special conferences, mentoring programs, and summer camps. Those who are in the process of constructing an outreach program are especially encouraged to attend this session to acquire valuable insights and tips for designing and implementing a mathematics outreach project. We solicit abstracts from all those involved with such outreach work. For example, successful grant awardees from both the Tensor Foundation and Summa Programs might be particularly interested in participating. The session is sponsored by the Women and Mathematics Network. The deadline for submissions is Friday, December 7, 2007. Applications should be submitted to Betsy Yanik, `eyanik@emporia.edu`.

Exciting, Surprising, and Satisfying: Why and How to Teach Proof, Monday, 9:00 a.m.–10:20 a.m., **Carol S. Schumacher,** Kenyon College, and **Diane Herrmann**, University of Chicago. CUPM has been considering the tricky point in the early to middle of the undergraduate mathematics curriculum where students first encounter proof in a serious way. There are issues of both "salesmanship" (This is hard. Is really necessary? Is it worthwhile?) and tactics (how do we help our students to learn to engage the mathematics on their own?) Panelists will discuss various successful strategies for helping students through this difficult phase. Panelists include **T. Christine Stevens**, Saint Louis University, and **Susanna S. Epps**, DePaul University.

Research and Outreach Focusing on the Mathematics Education of K–8 Latino/a Students, Monday, 9:00 a.m.–10:20 a.m., **Taliesin Sutton**, University of Arizona and **Laura Kondek McLeman**, University of Arizona. Interest in the mathematics education for underrepresented groups has grown in recent years, due in part to the discouraging results in national tests at the K–12 level (e.g., NAEP) as well as the lack of minority groups choosing to major in mathematics at the college level. Researchers from the Center for the Mathematics Education of Latino/as provide some insight into these issues as they investigate the teaching and learning of mathematics to Latino/as at the elementary and middle school level. This work focuses not only on student understanding, but also on what roles parents and teachers play in furthering Latino/a students' mathematics education. The panelists will discuss their work with preservice and inservice teachers, parents, and students, focusing specifically on how language and culture impacts the mathematics education of Latino/a students. The panel includes **Richard Kitchen**, University of New Mexico; and **Virginia Horak**, **Laura Kondek McLeman**, **José María Menéndez**, and **Taliesin Sutton** from the University of Arizona.

Using the New Technologies in Teaching Mathematics Invited Paper Session, Monday, 9:00 a.m.–noon, **Lawrence C. Moore**, Duke University, and **Bruce W. Yoshiwara**, Los Angeles Pierce College.

Classroom Voting Comes to the Mathematics Classroom, Monday, 10:45 a.m.–12:05 p.m., **Mark R. Parker**, Carroll College, and **Cheryl L. Olsen**, Nebraska Wesleyan

University. This session is dedicated to examining the pedagogy behind the popular new technology, to sharing lessons learned from practitioners, and to spotlighting another tool for engaging students in all levels of mathematics classrooms. We will start with a series of classroom voting questions to demonstrate different techniques: (1) vote with no discussion, (2) vote, peer discussion, revote and (3) peer discussion, vote. Voting will be accomplished via both colored paper as well as electronic personal response systems. Panelists will discuss their use of, and student responses to, classroom voting. The session will conclude with a question and answer period from the audience. The panelists have a depth of experience with the pedagogy of classroom voting. **Kelly Cline,** Carrroll College, is co-PI on the NSF-funded MathQUEST project to develop classroom voting questions for linear algebra and differential equations. **David O. Lomen**, University of Arizona, was part of the ConceptTests development team for the Harvard Calculus Consortium. **Maria S. Terrell**, Cornell University, was the PI of the NSF-funded GoodQuestions project to develop classroom voting questions for calculus. This session is sponsored by the Committee on the Teaching of Undergraduate Mathematics.

Creating and Implementing a Capstone Course in Mathematics for Preservice Secondary Teachers, Monday, 1:00 p.m.–2:20 p.m., **David W. Dempsey**, Jacksonville State University, and **Matthew Winsor**, University of Texas at El Paso. Reports from the MAA and NCTM indicate that as a result of changes in the way mathematics is being taught in secondary schools, teachers need a more thorough preparation in mathematics (Conference Board of Mathematical Sciences (CBMS), 2001; Leitzel, 1991; NCTM, 1991, 2000). In response to the need for improving preservice teachers' content knowledge, *The Mathematical Education of Teachers* (MET) publication charges mathematics departments with supporting the development of "a capstone course sequence for teachers in which conceptual difficulties, fundamental ideas, and techniques of high school mathematics are examined from an advanced standpoint" (CBMS, 2001, p. 39). This panel session will present several examples of capstone courses that have been implemented at different universities around the nation. Panel members will discuss how they created and implemented a capstone course, give examples of mathematics from capstone courses, and present research based on their capstone course. Time will be allowed for discussion. Panelists include **Edward E. Aboufadel** and **Rebecca Walker**, Grand Valley State University; **Gail Burrill**, Michigan State; **Henry S. Kepner**, University of Wisconsin-Milwaukee, **David W. Dempsey**, and **Matthew Winsor**.

The Political Dimension of Ethnomathematics, Monday, 1:00 p.m.–3:00 p.m., **Amy Shell-Gellasch**, Pacific Lutheran University, and **Janet L. Beery**, University of Redlands. Ethnomathematics is a growing area of both research and educational ideas. With its emphasis on cultural contexts for mathematical ideas, the study of ethnomathematics draws on diverse disciplines and has the potential to influence education and society in meaningful and even radical ways. Panelists will address the political and social realities and ramifications of conducting and communicating research in ethnomathematics. Panelists and their topics include **Ubiratan D'Ambrosio**, Universidade Estadual de Campinas, Brazil, *Social justice and ethnomathematics*; **Ana Lúcia Braz Dias**, Central Michigan University, *The role of ethnomathematics in refuting deficit explanations for the achievement gap*; and **Arthur B. Powell**, Rutgers University, *Ethnomathematics: Traversing the 'digital divide'*. The panel is sponsored by the SIGMAA on History of Mathematics.

Projects Supported by the NSF Division of Undergraduate Education, Monday, 2:00 p.m.–4:00 p.m., **Jon W. Scott**, Montgomery Community College. This poster session will feature principal investigators (PIs) presenting progress and outcomes from various NSF funded projects in the Division of Undergraduate Education and other NSF divisions supporting opportunities to improve undergraduate education. The poster session format will permit ample opportunity for attendees to engage in small group discussions with the PIs and to network with each other. Information about presenters and their projects will appear in the program.

Dueling Platforms: *Java* vs. *Flash*, Monday, 2:30 p.m.–3:50 p.m., **Mary L. Platt,** Salem State College, and **Lawrence C. Moore,** Duke University. Trying to decide between learning *Java* and learning *Flash*? In this panel presentation a team of two representing *Java* and a corresponding team representing *Flash* will present work on a common assigned task. Each team will demonstrate their completed mathlet(s) and will describe the process of creating the mathlet(s) from scratch using their tool. Their accounts will include the time spent on the task, advantages of their approach, and problems encountered. Teams will also describe collections of programs that could be used as building blocks in larger collections. Each team will have a chance to comment on the other team's work. Time will be reserved for questions and comments from the audience. The session will be moderated by **Mary L. Platt**. Panelists include **Thomas E. Leathrum,** Jacksonville State University**; Kyle T. Siegrist,** University of Alabama, Huntsville**; Doug Ensley,** Shippensburg University; and **Barbara Kaskosz,** University of Rhode Island**.**

The Proof is in the Pudding: Humorous Theater of the Mathematical Variety*,* Monday, 6:00 p.m.–7:30 p.m., **Colin C. Adams** et al, Williams College. With several short theatrical pieces, *A Difficult Delivery*, *Trial and Error*, and *A Killer Theorem*, we will attempt a proof of the following proposition: Theorem. Math can be funny.

A Quick Introduction to WeBWorK, a Web-Based Interactive Homework System*,* Tuesday, 1:00 p.m.–2:20 p.m., **Michael E. Gage**, **Arnold K. Pizer**, and **Vicki Roth**, University of Rochester. *WeBWorK* is a program which allows students to do their mathematical homework interactively over the Web. It is currently being used by over 100 colleges, universities, and high schools in courses such as college algebra, pre-calculus to vector calculus, differential equations, linear algebra, complex variables, and statistics. WeBWorK can handle most homework problems typically used in such courses and is distributed with an extensive library of problems. With *WeBWorK* students get immediate

feedback on the validity of their answers and have the opportunity to correct mistakes while they are still thinking about the problem. Students receive individualized versions of problems so instructors can encourage students to work together yet each student must develop an answer to their own version of the problem. Further *WeBWorK* provides automatic scoring of assignments. The session will provide an interactive introduction to *WeBWorK*. We will demonstrate how students use *WeBWorK*, how professors administer *WeBWorK* and will also discuss various assessment issues. Further information on *WeBWorK* and this session can be found at `www.maa.org/webwork/`.

Summer Research Programs, Tuesday, 2:30 p.m.–3:50 p.m., **William A. Hawkins Jr**, MAA, and **Robert E. Megginson**, University of Michigan. The MAA has sponsored Summer Research Programs since 2003 with funding from NSF, NSA, and the Moody's Foundation. Each program consists of a small research group of four minority undergraduates mentored by a faculty member. Thirty-three sites had been funded as of summer 2006 and 12–13 were funded in summer 2007. Panelists include **Tuncay Aktosun** and **Minerva Cordero**, University of Texas at Arlington, and **Monica Stephens**, Spelman College. These site directors will discuss their programs. There will be ample time for questions and discussion. Funding will be available for summer 2008. Additional information can be found on the NREUP website at `www.maa.org/nreup`. The session is sponsored by CMPM, SUMMA (Strengthening Underrepresented Minority Mathematics Achievement), and the Office of Minority Participation.

Current Issues in Actuarial Science Education, Tuesday, 5:00 p.m.–7:00 p.m. **Robert E. Buck,** Slippery Rock University; **Bettye Anne Case,** Florida State University; **Matthew J. Hassett,** Arizona State University; and **Steve Paris**, Florida State University. A diverse group of working actuaries, publishers, and actuarial educators bring new information from professional society committees, specialized publications initiatives, and academic department experience. The pace of change is faster than in most academic areas, and the session helps faculty adjust as quickly as possible not only to educate their students generally, but give the students good professional information and to determine upcoming curriculum change that may be necessary.

Hard Problems, Tuesday, 6:00 p.m.–7:30 p.m., **George P. Csicsery**, Zala Films. The world premiere of a 90-minute documentary about the USA team's participation in the 2006 International Mathematical Olympiad in Slovenia will be shown. A question and answer session with Csicsery and a reception will follow the film presentation. Other films by Csicsery are *N is a Number: A Portrait of Paul Erdős, porridge pulleys and Pi,* and *Invitation to Discover.*

Dancing Mathematics and the Mathematics of Dance, Tuesday 6:45 p.m.–7:45 p.m., presented by **Sarah-Marie Belcastro**, Smith College, **Karl Schaffer**, DeAnza College. This session will be a lecture/demonstration/performance that will consist of brief introductions of our mathematical and dance backgrounds, descriptions of the connections we see between mathematics and dance, and video clips of our separate choreography giving explanations of how these exhibit mathematics in dance, along with the performance of three very short mathematical dances we have created together (including at least one proof!).

So You Want to Teach Environmental Math, Do You? A skit portraying the efforts to implement an environmental mathematics course at a mathematics department meeting, Tuesday, 7:00 p.m.–8:00 p.m. Texts are appearing which attempt to teach mathematics in an environmental context, using mathematics to understand some of the most important problems facing us today—and hopefully contributing to solutions. In this one-act skit, the pros and cons of introducing an "Environmental Math" class are presented in a humorous fashion at a meeting of the mathematics faculty at Bogus U, revealing personalities that most of us will recognize. The skit is authored by **Martin E. Walter**, University of Colorado at Boulder, directed by **Patricia Clark Kenschaft**, Bloomfield College, and sponsored by the Environmental Mathematics SIGMAA.

Special Interest Groups of the MAA (SIGMAAs)

SIGMAAs will be hosting a number of interesting activities, sessions, and guest lecturers. There are currently nine such focus groups offering members opportunities to interact not only at meetings but throughout the year via newsletters and email-based communications. For more information visit `www.maa.org/SIGMAA/SIGMAA.html`.

SIGMAA on Mathematical and Computational Biology

Biomathematics in the Undergraduate Curriculum, Wednesday morning and afternoon (See the "MAA Contributed Paper Sessions" section).

SIGMAA on Business, Industry, and Government

Guest Lecturer, Monday, 3:00 p.m.–3:45 p.m. **Robert J. Lang**, Alamo, California, will speak on *From flapping birds to space telescopes: The art, math, and science of origami.*

SIGMAA on Environmental Mathematics

Guest Lecture and Business Meeting, Sunday, 4:00 p.m.–5:30 p.m.

So You Want to Teach Environmental Math, Do You? A skit portraying the efforts to implement an environmental mathematics course at a mathematics department meeting, Tuesday, 7:00 p.m.–8:00 p.m. (See the "MAA Panels, Posters, and Other Sessions" section).

SIGMAA on the History of Mathematics

Business Meeting, Reception, and Guest Lecturer, Sunday, 5:30 p.m.–7:30 p.m.

The Political Dimension of Ethnomathematics, Monday, 1:00 p.m.–3:00 p.m. (See the MAA Panels, Posters and Other Sessions" section).

SIGMAA on Mathematics and the Arts

Mathematics and Hollywood: A Conversation with Mathematical Hollywood Writers and Mathematics Faculty, Sunday, 2:15 p.m.–3:35 p.m. (See the "MAA Panel and Poster Sessions" section).

SIGMAA on the Philosophy of Mathematics

Business Meeting, Reception, and Guest Lecturer, Monday, 5:45 p.m.–7:15 pm. The featured speaker is **Penelope Maddy**, University of California Irvine, *How applied mathematics became pure*. A reception will follow the lecture.

SIGMAA on Quantitative Literacy

Business Meeting and Reception, Monday, 5:45 p.m.–6:45 p.m.

Assessment of Student Learning in Undergraduate Mathematics, Monday afternoon (See the "MAA Contributed Paper Sessions" section).

SIGMAA on Research in Undergraduate Mathematics

Making the Connection Between Research and Teaching in Undergraduate Mathematics Education, Sunday, 9:00 p.m.–10:20 p.m. (See the "MAA Panels, Posters and Other Sessions" section).

Business Meeting, Tuesday, 6:00 p.m. - 7:00 p.m.

SIGMAA on Statistics Education

Business Meeting, Monday, 5:45 p.m.–7:15 p.m.

Project NExT Sessions

Project NExT (New Experiences in Teaching) is the MAA's professional development program for new and recent Ph.D.'s in the mathematical sciences. Each year, about sixty new faculty are selected as Project NExT Fellows; application materials for 2008–09 are available at the Project NExT booth in the exhibit area. Project NExT has organized several sessions to which it invites all meeting participants.

The following sessions were organized by Project NExT Fellows to address the concerns of faculty who have four to ten years of teaching experience.

Making the Math Major Work for the Under-Prepared Student, Monday, 2:30 p.m.–4:00 p.m., organized by **Linda Braddy**, East Central University, and **Pamela B. Pierce**, The College of Wooster. Wouldn't it be great if all students considering a major in mathematics were adequately prepared to succeed in the major? Of course, the reality is that many of our students need additional motivation, guidance, and assistance with the material in order to make it through the major. Our panelists will give brief presentations on some strategies that have proven successful at helping such students to succeed without compromising learning in the major. We plan to conclude this session by soliciting ideas, concerns, and success stories from members of the audience. Panelist include **Bonnie Gold**, Monmouth University; **John Ramsay**, The College of Wooster; **Laura Taalman**, James Madison University.

Capstone and One-Semester Research Projects for a Variety of Students, Tuesday, 1:00 p.m.–2:30 p.m., organized by **Steven W. Morics**, University of Redlands, and **Mary D. Shepherd**, Northwest Missouri State University. Creating a true mathematical research experience for all students can be a challenge. Students have varying abilities and interests. Mathematics majors, even those not destined for mathematical stardom, can benefit from a real mathematical research experience. This session is designed to help faculty recognize and find appropriate problems that can be tackled in a single semester, match problems to students, and mentor these young researchers throughout the research experience from initial approach to final product, a paper and/or presentation. Panelists include **William E. Fenton**, Bellarmine University; **Steven W. Morics**; and **Barbara Reynolds**, Cardinal Stritch University.

New Technologies for Faculty: Wikis, Discussion Boards, and Clickers, Wednesday, 9:30 a.m.–11 a.m., organized by **Mason A. Porter**, University of Oxford, and **Holly S. Zullo**, Carroll College. Technology changes rapidly, leading to an inevitable influx of new innovations in teaching and research. This can feel overwhelming, but many of your colleagues have found exciting ways to improve their pedagogy with cutting-edge technology. Come learn how you too can enhance your teaching with these easy-to-learn technologies. Among other topics the panelists will discuss how to use wikis and clickers to increase student communication both in and out of class. Panelists will give short presentations describing the way they use technology, and there will be an open discussion at the end. Panelists include **Joy L. Becker**, University of Wisconsin, Stout; **Kris Green**, St. John Fisher College; **Jean McGivney-Burelle**, University of Hartford; **Steven W. Morics**, University of the Redlands; and **Reva Narasimhan**, Kean University.

MAA Sessions for Students

Help for Undergraduates: Negotiating the Joint Meetings, Sunday, 5:00 p.m.–6:30 p.m., **Elizabeth Mayfield**, Hood College, How do you make sense of a 200-page program book? What is the difference between a contributed talk and an invited talk—and how can you tell which of those might be accessible to undergraduates? Which social events are you allowed to attend? What's up with the exhibits? What special events are planned for students at the Joint Meetings? This informal panel will help undergraduate students find their way through the Joint Mathematics Meetings and make this a successful experience for them. Panelists include **Dan Kalman**, American University, **Jacqueline A. Jensen**, Sam Houston State University, and an undergraduate student. The session is sponsored by the MAA Committee on Undergraduate Student Activities and Chapters.

Undergraduate Career Paths in Math: What Can You Do with a Math Degree?, Monday, 10:45 a.m.–12:05 p.m., **Vanessa Garcia**, Texas State University–San Marcos, and **Dov N. Chelst**, DeVry University. A myriad of choices are available for students who major in mathematics. This panel showcases a selection of career choices from industry, government, and education. Come to learn more about your options with an undergraduate degree in mathematics.

J. Brian Conrey, The American Institute of Mathematics, *The Riemann Hypothesis,* Tuesday, 1:00 p.m. (Student Lecture)

Undergraduate Student Poster Session, Tuesday, 3:00 p.m.–5:30 p.m., organized by **Diana M. Thomas**, Montclair State University. The session is reserved for undergraduates and first-year graduate students submitting posters on work done while undergraduates. Abstracts are accepted on a first come basis. Space is limited and students are encouraged to apply early. Beginning August 1, 2007 students can submit abstracts online at `http://www.maa.org/students/undergrad/poster08.htm`. Students are encouraged to apply early. Examples of poster topics include a new result, a different proof of a known theorem, an innovative solution of a Putnam problem, a new mathematical model or method of solution an applied problem. Purely expository posters cannot be accepted. Prizes will be awarded to the top rated posters with money provided by the AMS, MAA, AWM, CUR, PME and by the Moore Foundation. Trifold, self-standing 48" by 36" tabletop posters will be provided. Additional material or equipment is the responsibility of the presenters. Questions regarding the session may be directed to Diana Thomas at `thomasdia@mail.montclair.edu`. The deadline for proposals is Friday, November 2, 2007. The session is sponsored by the MAA-CUPM Subcommittee on Undergraduate Research and the MAA Committee on Undergraduate Student Activities and Chapters (CUSAC).

Also see the "Social Events" section for the open hours of the **Student Hospitality Center** and the **Reception for Undergraduates**.

MAA Short Course

This two-day Short Course on *Combinatorics: Past, Present, and Future* is organized by **Robin Wilson**, The Open University, and will take place on Friday and Saturday, January 4 and 5.

The object of this short course is to learn about the development of a wide range of combinatorial topics, from earliest times up to the present day and beyond. The topics presented will include early combinatorics from China and the Islamic and Hebrew traditions, European combinatorics during the Renaissance, the legacy of Leonhard Euler, and combinatorial topics in the modern era. Speakers and their topics include:

Early Combinatorics (up to the 17th century): **Andrea Breard**, Université des Sciences et Technologies de Lille, France, *China*; **Victor Katz**, University of the District of Columbia, *Combinatorics in the Islamic and Hebrew traditions*;

Europe: **Eberhard Knobloch**, Technical University of Berlin, *European combinatorics, 1200–1700*;

Euler's Legacy: **Robin Wilson**, *Early graph theory and Cayley's work on trees, to the early attempts to solve map-coloring problems*; **George Andrews**, Pennsylvania State University, *Euler's* "De Partitio Numerorum"; **Lars Andersen**, University of Aalborg, *Latin squares*; **Robin Wilson**, *Triple systems, schoolgirls, and designs*;

Combinatorics Comes of Age: **Lowell Beineke**, Indiana University–Purdue University at Fort Wayne, *20th-century graph theory*; **Herb Wilf,** University of Pennsylvania, Philadelphia, and **Lily Yen**, Capilano College, *Sister Celine as I knew her*; **Bjarne Toft**, Southern Denmark University, *The game of Hex: History, results and problems*;

Toward the Future: **Ronald L. Graham**, University of California, San Diego, *Combinatorics: The future and beyond.*

There are separate registration fees to participate. See the fee schedule on the registration form at the back of this issue or visit `www.ams.org/amsmtgs/2109_registration.html`.

Other MAA Events

Board of Governors, Saturday, 8:30 a.m.–4:00 p.m.

Section Officers, Sunday, 2:30 p.m.–5:00 p.m.

Joint PME and MAA Student Chapter Advisors' Meeting, Sunday, 3:00 p.m. to 3:50 p.m.

SIGMAA Officers Meeting, Monday 8:00 a.m.–10:00 a.m., chaired by **Amy Shell-Gellasch**, Pacific Lutheran University.

Business Meeting, Wednesday, 11:10 a.m.–11:40 p.m., organized by MAA secretary, **Martha J. Siegel**, Towson University, and moderated by MAA president, **Joseph A. Gallian,** University of Minnesota-Duluth.

Department Liaisons Meeting, day and time to be determined.

Minority Chairs Breakfast Meeting, day and time to be determined.

See the listings for various receptions in the "Social Events" section.

Activities of Other Organizations

Several organizations or special groups are having receptions or other social events. Please see the "Social Events" section of this announcement for details.

Association for Symbolic Logic (ASL)

This **two-day program on Tuesday and Wednesday** will include sessions of contributed papers and Invited Addresses.

See also the Special Session cosponsored by the ASL on *Set Theory and Banach Spaces* on Sunday and Monday in the "AMS Special Sessions" listings.

Association for Women in Mathematics (AWM)

Twenty-Ninth Annual Emmy Noether Lecture, Monday, 10:05 a.m., will be given by **Audrey Terras**, University of California San Diego, *title to be announced.* A luncheon will be given in her honor; see the "Social Events" section for details. Also see the related Special Session on *Zeta Functions of Graphs, Ramanujan Graphs, and Related Topics* jointly sponsored by the AWM listed under the "AMS Special Sessions" heading.

Panel Discussion, Sunday, 2:15 p.m.–3:40 p.m. Topic and panelists to be announced. Just before the panel discussion, AWM will recognize the Alice T. Schafer award honorees. Note that formal prizewinner announcements are made at the Joint Prize Session on Monday afternoon.

Business Meeting, Sunday, 3:45 p.m.–4:15 p.m.

Workshop, Wednesday, 8:20 a.m.–4:20 p.m. With funding from the Office of Naval Research and the National

Security Agency, AWM will conduct its workshop for women graduate students and women who have received the Ph.D. within the last five years. Twenty women mathematicians are selected in advance of this workshop to present their research; graduate students will present posters, and the recent Ph.D.'s will give 20-minute talks. The workshop opens with a dinner on a previous evening to introduce workshoppers and mentors, and includes a panel discussion on career issues. All mathematicians (female and male) are invited to attend the entire program. Departments are urged to help graduate students and recent Ph.D.'s who do not receive funding to obtain some institutional support to attend the workshop and other meeting sessions. The deadline for applications for presenting and funding has expired. Updated information about the Workshop is available at `www.awm-math.org/workshops.html`. AWM seeks volunteers to lead discussion groups and to act as mentors for workshop participants. If you are interested, please contact the AWM office; inquiries regarding future workshops may be made to the office at `awm@awm-math.edu`.

Reception, Sunday, 9:30 p.m.–11:00 p.m. See the listing in the "Social Events" section of this announcement.

National Association of Mathematicians (NAM)

Granville-Brown-Haynes Session of Presentations by Recent Doctoral Recipients in the Mathematical Sciences, Tuesday, 2:15 p.m.–4:00 p.m.

Cox-Talbot Address, to be given Tuesday after the banquet; speaker and title to be announced.

Panel Discussion, Wednesday, 9:00 a.m.–9:50 a.m.

Business Meeting, Wednesday, 10:00 a.m.–10:50 a.m.

Claytor-Woodard Lecture: Wednesday, 1:00 p.m., speaker and title to be announced.

See details about the banquet on Tuesday in the "Social Events" section.

National Science Foundation (NSF)

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

Pi Mu Epsilon (PME)

Council Meeting, Tuesday, 8:00 a.m.–11:00 a.m.

Rocky Mountain Mathematics Consortium (RMMC)

Board of Directors Meeting, Tuesday, 2:15 p.m.–4:10 p.m.

Society for Industrial and Applied Mathematics (SIAM)

The Invited Address will be given by **Inez Fung**, Berkeley Institute of the Environment, University of California Berkeley, *From global predictions to local action: Mathematical challenges in global warming* at 11:10 a.m. on Monday.

Minisymposia and their organizers include

Education and Applied Mathematics, **William L. Briggs**, University of Colorado at Denver (Sunday morning);

Analysis and Computation of Stochastic Equations, **Jack Xin**, University of California Irvine (Sunday afternoon);

From Global Predictions to Local Action, **Inez Fung, Christopher K. Jones**, University of North Carolina, and **Mary Lou Zeeman**, Bowdoin College (Monday morning and afternoon);

Environmental Mathematics: Some Mathematical Problems on Climate Change and Geophysical Fluid Dynamics, **Samuel S. Shen**, San Diego State University, and **Gerald R. North**, Department of Meteorology, Texas A&M University (Tuesday morning and afternoon);

Graph Coloring and Partitioning, **Andre Kundgen** and **Radhika Ramamurthi**, California State University-San Marcos, (Wednesday morning and afternoon).

Young Mathematicians Network (YMN)

Concerns of Young Mathematicians: A Town Meeting, Tuesday, 7:30 p.m.–8:30 p.m., organized by **David T. Kung**, St. Mary's College of Maryland. This panel discussion will focus on the current primary concerns of young mathematicians, from undergraduates to newly-tenured professors, with emphasis on audience participation.

Also see details about the events cosponsored by the YMN under the "MAA Panels, Posters, and Other Sessions" section.

Others

Math on the Web, Sunday–Wednesday, various times. The problem of communicating math on the Web is really no different than communicating math via other media. Namely, authoring and displaying mathematical notation is difficult. On top of that, the Web is a dynamic medium, where users can interact with rich media documents in sophisticated ways. This introduces a whole new layer of challenges and possibilities for engaging, interactive communication between authors and readers. There will be several presentations on the exhibit hall floor throughout the meeting.

Mathematical Art Exhibit, organized by **Robert Fathauer**, Tesselations Company, **Nathaniel A. Friedman**, ISAMA and SUNY Albany, and **Reza Sarhangi**, Bridges Conference, Towson University. A popular feature at the last Joint Mathematics Meetings in New Orleans, this exhibit provides a break in your day. On display are works in various media by artists who are inspired by mathematics and by mathematicians who use visual art to express their findings. Fractals, symmetry, and tiling are some of the ideas at play here. Don't miss this unique opportunity for a different perspective on mathematics. The exhibit will be open during the regular exhibit hours.

Summer Program for Women in Mathematics (SPWM) Reunion, Monday, 1:00 p.m.–4:00 p.m. organized by **Murli M. Gupta**, George Washington University. SPWM participants will describe their experiences from past programs.

Social Events

All events listed are open to all registered participants. It is strongly recommended that for any event requiring a ticket, tickets should be purchased through advance registration. Only a very limited number of tickets, if any, will be available for sale on site. If you must cancel your participation in a ticketed event, you may request a 50% refund by returning your ticket(s) to the Mathematics Meetings Service Bureau (MMSB) **by December 21**. After that date no refunds can be made. Special meals are available at banquets upon advance request, but this must be indicated on the Advance Registration/Housing Form.

AMS Banquet: As a fitting culmination to the meetings, the AMS banquet provides an excellent opportunity to socialize with fellow participants in a relaxed atmosphere. The participant who has been a member of the Society for the greatest number of years will be recognized and will receive a special award. The banquet will be held on Wednesday, with a cash bar reception at 6:30 p.m. and dinner at 7:30 p.m. Tickets are US$52, including tax and gratuity.

Association of Christians in the Mathematical Sciences (ACMS) Reception and Banquet, Tuesday, 6:00 p.m.–10:00 p.m. This annual dinner at 6:30 p.m. is preceded by a reception and will be followed by an after-dinner talk by Fernando Gouvêa, Colby College. Tickets must be ordered by November 30; see `www.acmsonline.org` for details.

ACMS Worship Service, Sunday, 7:00 a.m.–7:50 a.m. Begin the joint meetings by attending a nondenominational service provided by members of the Association of Christians in the Mathematical Sciences.

Association of Lesbian, Gay, Bisexual, and Transgendered Mathematicians Reception, Monday, 5:45 p.m.–7:00 p.m. Everyone is welcome to attend this open reception. Meet some new friends or get together with some old friends. Please join us!

AWM Reception: There is an open reception on Sunday at 9:30 p.m. after the AMS Gibbs Lecture. This has been a popular, well-attended event in the past.

AWM Luncheon to honor Noether Lecturer, Audrey Terras, Monday. Those interested may email `awm@awm-math.org`; a sign-up sheet for those interested will also be located at the AWM table in the exhibit area and also at the AWM panel discussion and Business Meeting.

Budapest Semesters in Mathematics Reunion, Tuesday, 6:00 p.m.–8:00 p.m. All alumni, family, and spouses are invited.

University of Chicago Mathematics Alumni Reception, Monday, 6:00 p.m.–7:00 p.m.

Reception for Graduate Students and First-Time Participants, Sunday, 5:30 p.m.–6:30 p.m. The AMS and the MAA cosponsor this social hour. Graduate students and first-timers are especially encouraged to come and meet some old-timers to pick up a few tips on how to survive the environment of a large meeting. Refreshments will be served.

Hawkes Learning Systems Courseware Presentation, Tuesday, 6:00 p.m.–7:00 p.m. Alll participants are invited.

University of Illinois at Urbana-Champaign Department of Mathematics Alumni Reception, Tuesday, 5:30 p.m.–7:30 p.m. Everyone ever connected with the department is encouraged to get together for conversation and to hear about mathematics at the University of Illinois. Please see `www.math.uiuc.edu/jmm-reception.html`.

University of Iowa Mathematics Department Reception, Monday, 5:45 p.m.–7:00 p.m.

Knitting Circle, Monday, 8:15 p.m.–9:45 p.m. Bring a project (knitting/crochet/tatting/beading/etc.) and chat with other mathematical crafters!

Lehigh University Reception, Monday, 5:45 p.m.–7:00 p.m. All friends and graduates of the Lehigh Math Program are invited to attend.

MAA–Project NExT Reception, Tuesday, 8:30 p.m.–10:30 p.m., organized by **T. Christine Stevens**, St. Louis University, **Joseph A. Gallian**, University of Minnesota, Duluth, and **Aparna W. Higgins**, University of Dayton. All Project NExT Fellows, consultants, and other friends of Project NExT are invited.

MAA Two-Year College Reception, Monday, 5:45 p.m.–7:00 p.m., is open to all meeting participants, particularly two-year faculty members. This is a great opportunity to meet old friends and make some new ones. There will be hot and cold refreshments and a cash bar. Sponsored by Addison Wesley.

***Mathematical Reviews* Reception**, Tuesday, 6:00 p.m.–7:00 p.m. All friends of *Mathematical Reviews* (*MR*) are invited to join reviewers and MR editors and staff (past and present) for a reception in honor of all the efforts that go into the creation and publication of the *Mathematical Reviews* database. Refreshments will be served.

Mathematical Institutes Open House, Sunday, 5:30 p.m.–8:00 p.m. Participants are warmly invited to attend this open house cosponsored by several North American mathematical institutes. Come find out about the latest activities and programs at each of the Institutes that may be suited to your own research interests.

MER Banquet: The Mathematicians and Education Reform (MER) Forum welcomes all mathematicians who are interested in precollege, undergraduate, and/or graduate educational reform to attend the MER banquet on Monday evening. This is an opportunity to make or renew contacts with other mathematicians who are involved in education projects and to engage in lively conversation about educational issues. The after-dinner discussion is an open forum for participants to voice their impressions, observations, and analyses of the current education scene. There will be a cash bar beginning at 6:30 p.m. Dinner will be served at 7:30 p.m. Tickets are US$50 each, including tax and gratuity.

NAM Banquet, Tuesday, 6:00 p.m.–9:30 p.m. The National Association of Mathematicians will host a banquet on Tuesday evening. A cash bar reception will be held at 6:00 p.m., and dinner will be served at 6:30 p.m. Tickets are US$49 each, including tax and gratuity.

NSA Women in Mathematics Society Networking Session, Monday, 6:30 p.m.–8:30 p.m. Everyone is invited to this annual session.

New Mexico State University Department of Mathematical Sciences Reception, Monday, 5:45 p.m.–7:15 p.m. All members and friends are invited.

Student Hospitality Center, Sunday–Tuesday, 9:00 a.m.–5:00 p.m., and Wednesday, 9:00 a.m.–3:00 p.m., organized by **Richard** and **Araceli Neal**, American Society for the Communication of Mathematics.

Reception for Undergraduates, Sunday, 4:00 p.m.–5:00 p.m.

Wine and Jazz Evening, Tuesday, 7:00 p.m.–10:00 p.m. Join your colleagues for an informal evening enjoying fine wines and cool jazz at the San Diego Wine & Culinary Center Cafe, 200 Harbor Drive (across from the Convention Center). Relax in the casual atmosphere and enjoy a delicious menu of reasonably priced appetizers and entrees, with wines, both locally produced and international, priced by the glass or bottle.

Other Events of Interest

AMS Information Booth: All meetings participants are invited to visit the AMS Information Booth during the meetings. A special gift will be available for participants, compliments of the AMS. AMS staff will be at the booth to answer questions about AMS programs and membership.

Book Sales and Exhibits: All participants are encouraged to visit the book, education media, and software exhibits from 12:15 p.m.–5:30 p.m. on Sunday, 9:30 a.m.–5:30 p.m. on Monday and Tuesday, and 9:00 a.m.–1:00 p.m. on Wednesday. Books published by the AMS and MAA will be sold at discounted prices somewhat below the cost for the same books purchased by mail. These discounts will be available only to registered participants wearing the official meetings badge. Most major credit cards will be accepted for book sale purchases at the meetings. Also, AMS electronic products and the AMS website will be demonstrated. Participants visiting the exhibits are required to display their meetings badge in order to enter the exhibit area.

The AMS and the MAA cordially invite all registered participants to enjoy complimentary tea and coffee (available at noon and 2:00 p.m. on Sunday; 9:00 a.m., noon, and 2:00 p.m. on Monday and Tuesday; and 9:00 a.m. on Wednesday) while perusing the associations' booths.

Mathematical Sciences Employment Center: Those wishing to participate in the Mathematical Sciences Employment Center should read carefully the important article about the center beginning on page 1213 in this issue of *Notices* or at `www.ams.org/emp-reg/`.

Networking Opportunities: There are many opportunities to meet new friends and greet old acquaintances in addition to the vast array of scientific sessions offered at these meetings. These opportunities are listed on the newcomers page at `www.ams.org/amsmtgs/2109_newcomers.html`. Newcomers may want to investigate the many receptions listed in the "Social Events" section, the Student Hospitality Center, and the Employment Center. On site a Networking Center featuring casual seating and lists of registered participants sorted by school and math subject classification will be available for your perusal. This is a great place to relax between sessions and forge new friendships.

Registering in Advance and Obtaining Hotel Accommodations

The AMS and MAA make every effort to keep participant expenses at meetings and registration fees for meetings as low as possible. We work hard to negotiate the best hotel rates and to make the best use of your registration dollars to keep the meetings affordable for you. The AMS and the MAA encourage all participants to register for the meeting. When you pay the registration fee, you are helping to support a wide range of activities associated with planning, organizing, and running a major meeting of this size.

How to Register in Advance: The importance of advance registration cannot be overemphasized. Advance registration fees are considerably lower than the fees that will be charged for registration at the meetings. Participants registering by November 15 may receive their badges, programs, and tickets (where applicable) in advance by mail approximately three weeks before the meetings. Participants who wish to have their registration materials mailed must check the appropriate box on the Advance Registration/Housing Form, and provide a home address for mailing. Registration materials will be mailed only to those who checked the box on the form and who provided a home address. Because of delays that occur in U.S. mail to Canada, advance registrants from Canada must pick up their materials at the meetings. Because of delays that occur in U.S. mail to overseas, materials are never mailed overseas. There will be a special Registration Assistance Desk at the Joint Meetings to assist individuals who either do not receive this mailing or who have a problem with their registration. Please note that a US$5 replacement fee will be charged for programs and badges that are mailed but not taken to San Diego. Acknowledgments of registrations will be sent by email to the email addresses given on the Advance Registration/Housing Form. If you do not wish your registration acknowledged by email, please mark the appropriate box on the form.

Email Advance Registration: This service is available for advance registration and housing arrangements by requesting the forms via email from `meetreg-request@ams.org` or by visiting `http://www.ams.org/amsmtgs/2109_reg.html`. VISA, MasterCard, Discover, and American Express are the only methods of payment which can be accepted for email advance registration, and charges to credit cards will be made in U.S. funds. Completed email forms should be sent to `meetreg-submit@ams.org`. All advance registrants will receive acknowledgment of payment prior to the meetings.

Internet Advance Registration: This service is available for advance registration and housing arrangements at `http://www.ams.org/amsmtgs/2109_reg.html`. VISA, MasterCard, Discover, and American Express are the only methods of payment which are accepted for Internet advance registration, and charges to credit cards will be

Joint Mathematics Meetings

Jan 6, 2008 to Jan 9, 2008

SAN DIEGO Convention Center

Hotel	Distance from SDCC
Downtown San Diego	
1 500 West Hotel	0.75
2 Rodeway Inn and Suites	1.05
3 Courtyard San Diego Downtown by Marriott	0.70
4 Embassy Suites Hotel San Diego Bay - Downtown	0.45
5 Hilton San Diego Gaslamp Quarter	0.06
6 Holiday Inn Express San Diego Downtown	1.06
7 Holiday Inn San Diego on the Bay	1.10
8 Horton Grand Hotel	0.33
9 Omni San Diego Hotel	0.12
10 San Diego Marriott Hotel & Marina Headquarters Hotel	0.05

How to Obtain Hotel Accommodations

Room Raffle/Lottery: For this meeting, we are offering a special raffle for anyone who reserves a room at the Marriott Hotel & Marina by October 31. We are also offering the Room Lottery again for anyone who reserves a room at any of the following hotels by October 31. See *How To Register in Advance* for details.	**General Instructions:** Participants must register in advance in order to obtain hotel accommodations through the Mathematics Meetings Service Bureau (MMSB). Special rates have been negotiated exclusively for this meeting at the following hotels. With the exception of the Student Hostel and Hotel Occidental, reservations must be made through the Mathematics Meetings Service Bureau (MMSB) to receive these rates. **Please call the Student Hostel and Hotel Occidental directly for reservations.** All other hotels will ONLY start accepting reservations directly after **December 17**, at which time rooms and rates will be based on availability**. A higher rate will be applied to any rooms reserved directly with any of these hotels before December 18.** **To make a reservation,** please submit a completed housing section of the Advance Registration/Housing (ARH) Form (paper or electronic) with a guarantee by **November 15. Sorry, reservations cannot be taken by phone.** Participants interested in reserving suites should contact the MMSB for further information.	**Deadlines:** • Raffle and Room Lottery qualification: **October 31, 2007** • Reservations through MMSB: **November 15, 2007** • Changes/cancellations through MMSB: **December 7, 2007**
Rates: • Subject to 10.6 % state and local tax • Only certified students or unemployed mathematicians qualify for student rates. • See ARH Form for detailed breakdown of rates for each hotel.	**General Information:** • Check-in 3:00 p.m./checkout 12:00 p.m. – all hotels except for the Hilton, Embassy Suites, San Diego Marriott (check-in 4:00 p.m./checkout 12:00 p.m.) and Holiday Inn Express (check-in 3:00 p.m./checkout 11:00 a.m.) • Windows open in some rooms - see descriptions below • Children are free in existing beds only. See age limits in each hotel. • Limited availability of cribs, free of charge • All hotels have a limited environmental policy regarding linens where all requests for a limited change of linens will be honored. • Distance from hotels to the San Diego Convention Center (CC) is indicated in each listing. • Cloud 9 Shuttle is offering a special discount for this meeting. Go to https://www.hudsonltd2.com/cgi-bin/cld1/res?LOGON=GO&USERIDENTRY=JMM08 to make a reservation and receive this discount. Note also that some hotels are offering free airport shuttles. • Wireless is free in some hotels - see descriptions below. • Some hotels will only send confirmations by email and some are not sending any confirmations - see descriptions below. • All hotels are in acceptable compliance with ADA. All hotels have TTYs/TDDs text telephones on the premises or can rent them by request.	**Guarantee Requirements/Cancellation Policy:** • One night deposit by check, or • Credit cards accepted: VISA, MC, AMEX, Diners, and Discover (except for Horton Grand which does not accept Discover) • **72-hour cancellation policy** for all hotels except 500 West (24-hour cancellation policy) and Omni (7-day cancellation policy) • **Please note that early departure penalties will apply at some of the hotels** – see descriptions below

Continued ➔

San Diego Marriott Hotel & Marina
(Headquarters)
(Location of Council, Board of Governors, Child Care, EC, Miscellaneous Sessions, and Short Courses; all other events at CC)
(Next door to CC)

333 W. Harbor Drive
San Diego, CA 92101
619-230-8316
City Single/Double US $172
Bay Single/Double US $192
Student Single/Double US $138

All Non-Smoking Hotel; Restaurants; Lounges; Fitness center; Heated outdoor pools; Starbucks; Shops; Tennis court; Marina; Parking per day – US $20 self or US $26 valet; All rooms have full amenities; Windows open in South Tower, Balconies in North Tower; Children under 18 years free; High speed internet in rooms at a cost of US $9.95 per day plus tax and includes phone usage for local and long distance; Wireless in DW's Lounge and lobby lounge - cost based on usage; Business Center runs wireless connection in Starbucks foyer at a cost of US $10 per day; Hard lines available at Business Center at a cost of US $5 per 10 minutes; **Confirmations provided by email only**

Horton Grand Hotel
(.33 mile to CC - 3 blocks)

311 Island Avenue
San Diego, CA 92101
619-544-1886
Single/Double US $155
Student Single/Double US $145

Historic Hotel – All One-Bedded Rooms (Very limited number of rooms with two queen beds); Restaurant (serving breakfast only); Bar; Parking per day – US $14 day or US $24 over night valet; All rooms have full amenities including gas fireplace; High speed internet OR wireless in room at a cost of US $9.95 per day plus tax; Windows open in some rooms; Balconies in some rooms; Majority of rooms have one king bed; Children under 10 years free; **No roll-in showers available; Confirmations provided by email only**

Hilton San Diego Gaslamp Quarter
(Across the street to CC - .06 mile)

401 K. Street
San Diego, CA 92101
619-231-4040
Single/Double US $150
Student Single/Double US $140

All Non-Smoking Hotel; Restaurant; Lounge; Fitness center; Outdoor heated pool; Parking per day – US $30 valet; All rooms have full amenities; Complimentary high speed internet access in room and complimentary WiFi in lobby; Windows open in rooms; Children under 18 years free; **Confirmations provided by email only**; **All changes to departure dates must be made at check-in to avoid a US $75 penalty charge**

Embassy Suites San Diego Bay-Downtown
(.45 mile to CC / across the street from Seaport Village)

601 Pacific Highway
San Diego, CA 92101
619-239-2400
Single/Double US $149
Student Single/Double US $135
Additional US $20 for bay view

All Suites Hotel; Complimentary fully cooked breakfast and daily evening cocktail reception included in rates; Restaurant; Lounge; Fitness center; Starbucks; Indoor pool; Glass elevators; Parking per day – US $26 valet; Complimentary airport shuttle; All rooms are suites with private bedroom and living room area with sleeper sofa; Full amenities in all rooms including refrigerator and microwave oven; Windows open in all rooms; Wireless high speed internet throughout hotel at a cost of US $9.95 per 24 hours plus tax; Children under 18 years free; **Confirmations provided by email only**; **All changes to departure dates must be made at check-in to avoid a US $75 penalty charge**

Omni San Diego
(Across the street to CC - .10 mile)

675 L. Street
San Diego, CA 92101
619-231-6664
Single/Double US $140
Student Single/Double US $125

Restaurant; Lounge; Fitness center; Outdoor heated pool; Bar; Parking per day - US $26 valet or US $14 self; All rooms have full amenities including mini bar, refreshment center, and bathrobes; Complimentary wired and wireless internet in all rooms, hotel lobby, bar, and pool deck; Windows open in all rooms; Children under 12 years free; **Confirmations provided by email only**;

Holiday Inn on the Bay
(1.10 miles to CC)
(2 blocks from trolley)

1355 North Harbor Drive
San Diego, CA 92101
619-232-3861
Single/Double US $135
Student Single/Double US $125
Additional US $30 for bay view

Restaurants; Lounge; Fitness center; Outdoor heated pool; Parking per day - US $24 valet or US $20 self; Complimentary airport shuttle; All rooms have full amenities including refrigerators; Most rooms have patios; Windows open in all rooms; Complimentary wireless internet in all rooms and lobby; Children under 18 years free; **Confirmations provided by email only**

Holiday Inn Express
(1.8 miles to CC)
(2 blocks from trolley)

1430 7th Avenue
San Diego, CA 92101
619-696-0911
Single/Double US $129
Student Single/Double US $119

All Non-Smoking Hotel; Restaurant; Complimentary continental breakfast; Outdoor pool; Parking per day - US $12 self; Complimentary airport shuttle; All rooms have full amenities including safes and refrigerators; Windows open in all rooms; Most rooms have balconies; Complimentary high speed internet and wireless in all rooms and lobby; Children under 18 years free; **Confirmations provided by email only**

Courtyard by Marriott - Downtown
(.9 miles to CC)
(1 block from trolley)

530 Broadway Street
San Diego, CA 92101
619-446-3000
Single/Double US $109

All Non-Smoking Historic Hotel; Restaurant; Bar; Business center; Fitness center; Courtyard market; Parking per day - US $24 valet w/ in and out privileges; All rooms have full amenities; Some rooms have microwave ovens; Windows do not open in rooms; Complimentary high speed internet access in rooms and complimentary wireless in the bar and lobby; Children under 18 years free; **Confirmations will not be sent**.

Continued ➔

Rodeway Inn & Suites *(1.8 miles to CC)* *(3 blocks from trolley)*	500 West *(.75 mile from CC)* *(1 block from train station and trolley)*	**Attention Students**
719 Ash Street San Diego, CA 92101 619-232-2525 Single/Double US $91 **No Restaurant**; Complimentary continental breakfast; Limited smoking rooms; Free access to outdoor pool at Holiday Inn Express across the street; Complimentary parking; Complimentary airport shuttle; Rooms open from the outside; All rooms have full amenities including safes and refrigerators; Windows open in all rooms; Complimentary high speed internet and wireless in all rooms and lobby; Children under 18 years free; **Confirmations provided by email only**	500 W. Broadway San Diego, CA 92101 800-276-7415 Single occupancy only – US $49, twin beds only **All Non-Smoking Hotel; No air conditioning**; Cafe; YMCA on lower floor; Common room with full kitchen; Laundry; Parking per day – US $15 overnight w/ no in and out (located next door); Daily maid service; Shared bathrooms; Windows open in all rooms; Complimentary wireless internet throughout hotel; **Confirmations provided**	As alternative housing choices, we list the following: 1. **Hostelling International-San Diego Downtown** is located on the corner of 5th and Market Street in the soul of the city's Gaslamp Quarter. It is located four blocks from the Convention Center and three blocks from the trolley. They offer comfortable dorm rooms and up to date private rooms, free pancake breakfast, free Wi-Fi in rooms, full kitchen, and onsite laundry. 521 Market Street San Diego, CA 92101 (619) 525-1531 (619) 338-0129 (fax) www.sandiegohostels.org **Please call directly for further information and reservations.** 2. **Hotel Occidental** is a Budget Hotel located 11 blocks from the Convention Center, 7 blocks from the trolley, and 1 block from the bus station. The bus runs every 20 minutes on a weekday and every hour on the weekend. The guest rooms range from singles and doubles with shared baths to private baths in single, doubles and queen suites. Each features private kitchenettes, large windows, high ceilings with ceiling fans, TV's with DVD players, central air and heat, complimentary high speed wireless internet access, safes, digital phones with free local calls, and free continental breakfast. 410 Elm Street San Diego, CA 92101 619-232-1336 Hoteloccidental-sandiego.com **Please call directly for further information and reservations.**

made in U.S. funds. All Internet advance registrants will receive acknowledgment of payment upon submission of this form.

Cancellation Policy: Those who cancel their advance registration for the meetings, MAA Minicourses, or Short Courses by December 28 (the deadline for refunds for banquet tickets is December 21) will receive a 50% refund of fees paid. No refunds will be issued after this date.

Joint Mathematics Meetings Registration Fees

	by Dec. 14	at meeting
Member of AMS, ASL, Canadian Mathematical Society, MAA, SIAM	US$214	US$279
Emeritus Member of AMS, MAA; Unemployed; Librarian; High School Teacher; Developing Countries Special Rate	43	53
Graduate Student	44	54
Undergraduate Student	23	29
Temporarily Employed	172	200
Nonmember	332	431
High School Student	5	10
One-Day Member of AMS, ASL, CMS, MAA, SIAM	n/a	153
One-Day Nonmember	n/a	238
Nonmathematician Guest	15	15
MAA Minicourses	60	60*
*if space is available		

Employment Center (please note that earlier deadlines apply for inclusion in the *Winter Lists*)

1st Table (computer, self-scheduled, or combination interview)	US$245	US$325
2nd Table (computer, self-scheduled, or combination interview)	95	125
Employer Posting Fee	50	N/A
Applicants (all services)	44	82
Applicants (*Winter List* & message center only)	22	22
AMS Short Course		
Member of AMS or MAA	US$94	US$125
Nonmember	125	155
Student/Unemployed/Emeritus	42	63
MAA Short Course		
MAA or AMS Member	$125	$140
Nonmember	175	190
Student/Unemployed/Emeritus	50	60

Full-Time Students: Those currently working toward a degree or diploma. Students are asked to determine whether their status can be described as graduate (working toward a degree beyond the bachelor's), undergraduate (working toward a bachelor's degree), or high school (working toward a high school diploma) and to mark the Advance Registration/Housing Form accordingly.

Emeritus: Any person who has been a member of the AMS or MAA for twenty years or more and who retired because of age or long-term disability from his or her latest position.

Librarian: Any librarian who is not a professional mathematician.

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

Developing Country Participant: Any person employed in developing countries where salary levels are radically noncommensurate with those in the U.S.

Temporarily Employed: Any person currently employed but who will become unemployed by June 1, 2008, and who is actively seeking employment.

Nonmathematician Guest: Any family member or friend who is not a mathematician and who is accompanied by a participant in the meetings. These official guests will receive a badge and may attend all sessions and the exhibits.

Participants Who Are Not Members of the AMS and register for the meetings as a nonmember will receive mailings after the meetings are over with a special membership offer.

Advance registration and on-site registration fees only partially cover the expenses of holding meetings. All mathematicians who wish to attend sessions are expected to register and should be prepared to show their badges if so requested. Badges are required to enter the exhibit area, to obtain discounts at the AMS and MAA Book Sales, and to cash a check with the Joint Meetings cashier.

Advance registration forms accompanied by insufficient payment will be returned, thereby delaying the processing of any housing request, or a US$5 charge will be assessed if an invoice must be prepared to collect the delinquent amount. Overpayments of less than US$5 will not be refunded.

For each invalid check or credit card transaction that results in an insufficient payment for registration or housing, a US$5 charge will be assessed. Participants should check with their tax preparers for applicable deductions for education expenses as they pertain to these meetings.

If you wish to be included in a **list of individuals sorted by mathematical interest**, please provide the one mathematics subject classification number of your major area of interest on the Advance Registration/Housing Form. (A list of these numbers is available by sending an empty email message to `abs-submit@ams.org`; include the number 1035 as the subject of the message.) Copies of this list will be available for your perusal in the Networking Center.

If you do not wish to be included in any mailing list used for promotional purposes, please indicate this in the appropriate box on the Advance Registration/Housing Form.

Advance Registration Deadlines

There are four separate advance registration deadlines, each with its own advantages and benefits.

EMPLOYMENT CENTER advance registration (inclusion in the *Winter Lists*)	**October 24**
EARLY meetings advance registration (room lottery and raffle)	**October 31**

ORDINARY meetings advance registration (hotel reservations, materials mailed) **November 15**

FINAL meetings advance registration (advance registration, Short Courses, Employment Center, MAA Minicourses, banquets) **December 14**

Employment Center Advance Registration: Applicant and employer forms must be received by October 24 in order to appear in the publications distributed to all participants. For detailed information on the Employment Center, see the separate article on page 1213.

Early Advance Registration: Those who register by the **early** deadline of October 31 will be included in a random drawing to select winners of complimentary hotel rooms in San Diego. Multiple occupancy is permissible. The location of rooms to be used in this lottery will be based on the number of complimentary rooms available in the various hotels. Therefore, the free room may not necessarily be in the winner's first-choice hotel. The winners will be notified by mail prior to December 20. So register early!

Applicant and employer forms must be received by October 24 in order to be reproduced in the *Winter Lists* for the Employment Center.

Ordinary Advance Registration: Those who register after October 31 and by the **ordinary** deadline of November 15 may use the housing services offered by the MMSB but are not eligible for the room lottery and raffle. You may also elect to receive your badge and program by mail in advance of the meetings.

Final Advance Registration: Those who register after November 15 and by the **final** deadline of December 14 must pick up their badges, programs, and any tickets for social events at the meetings. Unfortunately, it is sometimes not possible to provide **final** advance registrants with housing, so registrants are strongly urged to make their hotel reservations by November 15. Please note that the **December 14 deadline is firm**; any forms received after that date will be returned and full refunds issued. Please come to the Meetings Registration Desk in Hall B1 at the San Diego Convention Center.

Hotel Reservations

Participants should be aware that the AMS and MAA contract only with facilities who are working toward being in compliance with the public accommodations requirements of the ADA.

Participants requiring hotel reservations should read the instructions on the following hotel pages. Participants who did not reserve a room during advance registration and would like to obtain a room at one of the hotels listed on the following pages should call the hotels directly after December 17. However, after that date the MMSB can no longer guarantee availability of rooms or special convention rates. Participants should be aware that most hotels are starting to charge a penalty fee to guests for departure changes made before or after guests have checked into their rooms. These hotels are indicated on the hotel page at `http://www.ams.org/amsmtgs/2109_hotelpage.html`. Participants should also inquire about this at check-in and make their final plans accordingly.

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

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

Importance of Staying in the Official Meetings Hotels: Your patronage of the official headquarters hotels enables the JMM to secure the meeting space at a greatly reduced cost which helps to keep the cost of the meeting and your registration fees down. Also, networking events will be held at the Marriott for the convenience of our participants.

Headquarters Raffle: Win an Olympus FE-230 digital camera and Fujifilm 1 GB xD picture card valued at over US$200! Participants who register and reserve a room at the Marriott by October 31, 2007, will be eligible to enter this drawing. All participants who are eligible will receive a raffle ticket on their badge sheet. Those who wish to enter the drawing must turn in their tickets at the Meetings Registration Desk in the San Diego Convention Center. You must turn in your ticket to be entered into the drawing! The winning ticket will be drawn before the end of the meeting on Wednesday, specific day and time to be announced.

Room Lottery: Win FREE room nights at our official hotels as listed on the hotel pages. Multiple winners! Participants who register and reserve a room at any of the meetings hotels listed by October 31, 2007, will automatically be included in a random drawing to select a winner of free room nights in that hotel. The number of drawings to be made will be based on the number of complimentary room nights available in the various hotels. Multiple occupancy is permissible. The winners will be drawn at random from the hotel reservation lists and notified by email or phone prior to December 20, 2007.

Miscellaneous Information

Audio-Visual Equipment: Standard equipment in all session rooms is one overhead projector and screen. (Invited 50-minute speakers are automatically provided with two overhead projectors and a laptop projector; AMS Special Sessions and MAA Contributed Paper Sessions on a specific topic are provided with the standard equipment and a laptop projector.) Blackboards are not available. Organizers of sessions that by their nature demand additional equipment (e.g., VCR and monitor or laptop projection device) and where the majority of speakers in the session require this equipment should contact the audio-visual coordinator for the meetings at the AMS office in Providence at 401-455-4140 or by email at `wsd@ams.org` to obtain the necessary approvals. Individual speakers must consult with the session organizer(s) if additional equipment or services are needed. If your session has no organizer, please contact the audio-visual coordinator directly. All requests should be received by November 1.

Equipment requests made at the meetings most likely will not be granted because of budgetary restrictions. Unfortunately no audio-visual equipment can be provided for committee meetings or other meetings or gatherings not on the scientific program.

Childcare: The American Mathematical Society and the Mathematical Association of America will again offer childcare services for the Joint Mathematics Meetings to registered participants.

The child care will be offered through KiddieCorp Children's Program. KiddieCorp is an organization that has been providing high quality programs for children of all ages at meetings throughout the United States and Canada since 1986. Read all about them at `http://www.kiddiecorp.com/`.

The childcare services provided at the JMM are for children ages 6 months through 12 years old. Space per day will be limited and is on a space available basis. The dates and times for the program are January 6–9, 2008, 8:00 a.m.–5:00 p.m. each day. It will be located at the San Diego Marriott Hotel and Marina, 333 W. Harbor Dr., San Diego, CA 92101. Parents are encouraged to bring snacks and beverages for their children but items such as juice boxes, cheerios, and crackers will be provided. KiddieCorp can arrange meals for children at cost plus 15% or parents can be responsible for meals for their children.

Registration starts in September. The registration fee is US$30 per family (nonrefundable). Additional cost will be US$9 per hour per child or US$7 per hour per child for graduate students. These reduced child care rates are made possible to the meetings participant by the American Mathematical Society and the Mathematical Association of America, who subsidize this service thus keeping this program affordable for families. Parents must be registered for the JMM to participate. Full payment is due at the time of registration with KiddieCorp. Deadline for registering is December 9, 2007.

If parents do not pick up their children at the time scheduled or by the end of the day (no later than 5:00 pm), they will be charged a late fee of US$5 per child for every 15 minutes thereafter.

Cancellations must be made to KiddieCorp prior to December 9, 2007, for a full refund. Cancellations made after that date will be subject to a 50% cancellation fee. Once the program has begun, no refunds will be issued.

To register, go to `https://www.kiddiecorp.com/jmmkids.htm` or call KiddieCorp at (858) 455-1718 to request a form.

Email Services: Limited email access for all Joint Meetings participants will be available. The hours of operation will be published in the program.

Information Distribution: Tables are set up in the exhibit area for dissemination of general information of possible interest to the members and for the dissemination of information of a mathematical nature not promoting a product or program for sale.

If a person or group wishes to display information of a mathematical nature promoting a product or program for sale, they may do so in the exhibit area at the Joint Books, Journals, and Promotional Materials exhibit for a fee of US$58 (posters are slightly higher) per item. Please contact the exhibits manager, MMSB, P.O. Box 6887, Providence, RI 02940, for further details.

The administration of these tables is in the hands of the AMS-MAA Joint Meetings Committee, as are all arrangements for Joint Mathematics Meetings.

Local Information: For information about the city see `www.meetmeinsandiego.com/AMS/` and for complete restaurant information, including maps and menus, see `www.sandiego.org/nav/Visitors/DiningAndNightlife.`

Petition Table: At the request of the AMS Committee on Human Rights of Mathematicians, a table will be made available in the exhibit area at which petitions on behalf of named individual mathematicians suffering from human rights violations may be displayed and signed by meetings participants acting in their individual capacities. For details contact the director of meetings in the Providence office at 401-455-4137 or by email at `dms@ams.org`.

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

Any material that is not a petition (e.g., advertisements, résumés) will be removed by the staff. At the end of the exhibits on Monday, any material on the table will be discarded, so individuals placing petitions on the table should be sure to remove them prior to the close of exhibits.

Telephone Messages: The most convenient method for leaving a message is to do so with the participant's hotel. Another method would be to leave a message at the meetings registration desk from January 5 through 8 during the

hours that the desk is open. These messages will be posted on the Math Meetings Message Board; however, staff at the desk will try to locate a participant in the event of a bona fide emergency. The telephone number will be published in the program and daily newsletter.

Discounted Air Travel

San Diego is on Pacific Standard Time. San Diego International Airport (SAN) www.san.org/airport/splash.asp is served by all major airlines and is slightly over three miles from the downtown area and the Convention Center. For reference, the floor plan of the San Diego International Airport can be seen at www.san.org/airport/terminals/terminal_maps.asp#t1. Airlines arriving and departing at each of the three terminals are listed, and the locations of the baggage claim areas and ground transportation areas are marked. While you are at the airport, you might need to travel between terminal buildings. The airport provides free transportation between the terminals on the Red Bus.

The official airline for the meetings is **Delta**. The AMS and MAA have made an agreement with Delta that will enable meetings' participants to enjoy exclusive discounts! Discounts vary depending on the cabin and available airfare level. We cannot guarantee that these will be the lowest fares when you make your arrangements. However, we strongly urge participants to make use of this special deal if at all possible, since the AMS and MAA can earn complimentary tickets. These tickets are used to send meetings' staff (not officers or other staff) to the Joint Mathematics Meetings, thereby keeping the costs of the meetings (and registration fees) down.

To make reservations, visit www.ams.org/amsmtgs/2109_travel.html#delta and click on the Delta Air Lines logo. This will bring you to the Delta Air Lines website where you can make your reservations and have your tickets issued. The applicable discount will automatically apply and the total airfare noted including all taxes and fees—convenient, fast, and no special meeting code is needed. Reservations must be made through this link to be recognized as a Joint Mathematics Meetings participant. If you go to the www.delta.com website directly you will **not** get a discount. Your benefits include no airline or agency booking fees; Delta SkyMile frequent flyer bonus miles, 500 round trip, 250 one way; and skip the airport lines! Check in online and print your boarding pass within 24 hours of your flight time.

Traveling from the airport: To depart the San Diego airport, head for the baggage claim area at any of the terminals. The shuttles, taxis, car rental companies, and the bus can be accessed from this location.

Airport Shuttle: Please note that Embassy Suites, Comfort Inn, Holiday Inn Express, and the Holiday Inn on the Bay provide complimentary airport shuttles. In the Baggage Claim area, either locate the nearest courtesy phone and call the hotel, or call the hotel directly from your cell phone. Identify yourself as a person who has a reservation and you will be given a pickup location and an estimated time of arrival. Guests are advised to call the hotel only after they have claimed their luggage and are actually ready for pickup, as vehicles are not allowed to wait in the pickup area. The last airport pickup for the Embassy Suites is at 10:30 p.m. Please check with the other hotels to see when the last pickup is available.

Shuttle service is available from the airport to the downtown hotels for approximately US$8–11 per person one way and US$16–22 per person round trip. See www.san.org/airport/ground_transportation/shuttle_services.asp for shuttle information. Shuttles can be picked up from the Transportation Plazas across from Terminals 1 and 2, and curbside at the Commuter Terminal. From Terminal 1 you must cross the skybridge, and take the escalators or the elevators to street level. From Terminal 2, cross the Terminal 2 skybridge and take the escalators or the elevators to street level, or use the pedestrian crosswalk conveniently located outside the Terminal 2 Baggage Claim Area to access the Transportation Plaza. A Transportation Coordinator will assist you with getting a shuttle.

Special Deal! Sign up for the Cloud 9 shuttle online in advance and save at https://www.hudsonltd2.com/cgi-bin/cld1/res?LOGON=GO&USERIDENTRY=JMM08. Shuttle service from the airport to the hotels if you reserve in advance using this link is US$6 (per person, one-way), or US$12 (round trip). Regular Cloud 9 price is US$8 one way, and US$16 round trip. The telephone number for Cloud 9 is 800-9-SHUTTLE (1-800-974-8885).

Public Transportation from/to the airport: General information on San Diego public transportation is at http://www.sdmts.com/.

The Metropolitan Transit System Bus, Flyer Route No. 992, runs every 10 minutes between 5:00 a.m. and 12:50 a.m. to and from the airport and downtown San Diego, stopping between Terminals 1 and 2 and the Commuter Terminal of the San Diego International Airport. Flyer Route No. 992 connects with Trolley, Coaster and Amtrak stations and is wheelchair accessible. Information on Flyer Route No. 992 is available at www.sdmts.com/RouteFiles/routes/pdf/992.pdf. The price is currently US$2.25, exact fare is appreciated. Flyer Route No. 992's final stop is at 5th Avenue and J Street in the Gaslamp District not far from the Convention Center. However depending on your destination, it may be more convenient to transfer to the downtown trolley route when the Flyer stops at Broadway and Kettner Blvd, (where the Amtrak station is located). Trolley information is located at: http://www.sdmts.com/Trolley/Trolley.asp.The trolley has a regular stop at the San Diego Convention Center.

Taxicabs: Taxi fare to the downtown area is approximately US$10–12 dollars one way. In the airport follow the signs leading to the Ground Transportation Plazas, and a Transportation Coordinator will place you with the first available taxi.

Driving Directions from the airport to the Convention Center: The San Diego Convention Center is located at 111 W. Harbor Drive, San Diego, CA 92101. Upon leaving the airport, drive out of parking lot, and follow signs to Interstate 5/Downtown. The ramp will put you on Harbor Drive going south. Follow signage to the parking entrance for the San Diego Convention Center. For driving directions from other points, see www.visitsandiego.com/

maps/. The hotels being used by the Joint Mathematics Meetings are downtown and locations can be ascertained by checking the map.

Train: The Union Station (Santa Fe Depot) train station is conveniently located in downtown San Diego at 1050 Kettner Boulevard. There is a trolley stop at the train station. For additional information on Amtrak service to or from San Diego, telephone 1-800-USA-RAIL, or visit Amtrak www.amtrak.com/servlet/ContentServer?pagename=Amtrak/HomePage or Amtrak California at www.amtrakcalifornia.com/rail/go/amtrak/index.cfm.

Discounted Car Rental

Avis Rent A Car is the official car rental company for the meetings. All car rentals include unlimited free mileage. Renters must meet Avis's age, driver, and credit requirements. Avis offers special convention rental rates effective December 30–January 16, 2008.

Car Type	Daily	Weekly	Weekend Daily
Subcompact	US$38	US$151	US$22
Compact	43	162	24
Intermediate	48	184	26
Full-Size 2-Door	50	194	29
Full-Size 4-Door	54	206	33
Premium	60	270	41
Luxury,	87	368	66
Minivan	60	302	60
Convertible	60	305	60
Sport Utility	60	302	60

These rates are guaranteed. Return to the same rental location or additional surcharges may apply. Weekend daily rates are available from noon Saturday until 11:59 p.m. Thursday (vehicle must be checked out by 3:00 p.m. Sunday). Should a lower qualifying rate become available, Avis is pleased to present a 5% discount off the lower qualifying rate or the meetings rate, whichever is lowest. Rates do not include any state or local surcharges, tax, optional coverages, or gas refueling charges. Reservations can be made by calling 800-331-1600 or online at www.avis.com; cite **group ID number J098887**.

All car rental agencies are off-site and do not have counters inside the terminal facilities. The car rental reservation boards are located near the baggage claim areas of Terminals 1 and 2. Use the courtesy phones provided to request shuttle transport to the car rental company of your choice. Please note that using a reservation board is not always necessary. Car rental shuttles regularly operate at the Terminal 1 center traffic aisle and at the traffic island at the far west end of Terminal 2. If you follow the signage to any of these areas, it is likely that a shuttle will be waiting.

Travel Information for International Participants

International participants should view the important information about traveling to the United States at www7.nationalacademies.org/visas/Traveling_to_US.html.

Because of increased scrutiny of visa applicants, many potential attendees of scientific meetings in the United States have experienced unusual delays in obtaining travel visas. If you need a letter of invitation from the AMS and have not yet requested it, please send email to meet@ams.org and an invitation will be forwarded as soon as possible. In order to compose and send your letter, we will need your document number, email address, and your complete mailing address. Also see this very informative document from the U.S. Department of State which lists answers to frequently asked questions about the processing of visas (www.ams.org/amsmtgs/FAQ-Bus-1-Visa.pdf). You should also be aware that this meeting has been registered with the U.S. Department of State.

Machine Readable Passports Required by June 26, 2005: The Department of Homeland Security reminds travelers from the 27 Visa Waiver Program (VWP) countries (see the website cited above for a list) that as of June 26, 2005, they must have a machine-readable passport to enter the United States without a visa. Beginning June 26, 2005, transportation carriers will be fined US$3,300, per violation, for transporting any VWP traveler to the United States without a machine-readable passport. Similarly, VWP travelers arriving in the United States on that date without a machine-readable passport should not anticipate being granted one-time entry into the country. As an alternative for persons with immediate travel plans who are unable to obtain a machine-readable passport in time, the individual may apply for a U.S. visa at a U.S. Consulate or Embassy abroad.

Weather

The temperature in January ranges from about 50 °F. to 66 °F. The sun shines during 72% of the daylight hours. Average precipitation in January is 2.28 inches. For more current information use your favorite search engine or try the sites: http://asp.usatoday.com/weather/basemaps/usa/ca/nw722900.htm or www.weather.com/weather/local/92101.

New York, New York

Courant Institute of New York University

March 15–16, 2008

Saturday – Sunday

Meeting #1036

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: January 2008
Program first available on AMS website: January 31, 2008
Program issue of electronic *Notices*: March 2008
Issue of *Abstracts*: Volume 29, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: November 27, 2007
For abstracts: January 22, 2008

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Weinan E, Princeton University, *Title to be announced.*

Ilya Kapovich, University of Illinois at Urbana-Champaign, *Title to be announced.*

Ovidiu Savin, Columbia Univeristy, *Title to be announced.*

Ravi Vakil, Stanford University, *Title to be announced.*

Special Sessions

Algebraic Combinatorial Geometry (Code: SS 3A), **Julianna Tymoczko**, University of Iowa, and **Linda Chen**, Ohio State University.

Buckminster Fuller's Synergetics and Mathematics (Code: SS 5A), **Christopher J. Fearnley** and **Joe Clinton**, Synergetics Collaborative.

Isoperimeric Problems and Partial Differential Equations (Code: SS 6A), **Bernd Kawohl**, University of Cologne, and **Marcello Lucia**, City University of New York.

L-Functions and Automorphic Forms (Code: SS 1A), **Alina Bucur**, Institute for Advanced Study, **Ashay Venkatesh**, Courant Institute of Mathematical Sciences, **Stephen D. Miller**, Rutgers University, and **Steven J. Miller**, Brown University.

Mathematics of Multiscale Phenomena (Code: SS 4A), **Peter McCoy** and **Reza Malek-Madani**.

Nonlinear Elliptic Equations and Geometric Inequalities (Code: SS 2A), **Fengbo Hang**, Princeton University, and **Xiaodong Wang**, Michigan State University.

Baton Rouge, Louisiana

Louisiana State University, Baton Rouge

March 28–30, 2008

Friday – Sunday

Meeting #1037

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: February 2008
Program first available on AMS website: February 14, 2008
Program issue of electronic *Notices*: March 2008
Issue of *Abstracts*: Volume 29, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 11, 2007
For abstracts: February 5, 2008

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Maria Chudnovsky, Columbia University, *Title to be announced.*

Soren Galatius, Stanford University, *Title to be announced.*

Zhongwei Shen, University of Kentucky, *Title to be announced.*

Mark Shimozono, Virginia Polytechnic Institute & State University, *Title to be announced.*

Special Sessions

Geometric and Combinatorial Representation Theory (Code: SS 7A), **Promad N. Achar** and **Daniel S. Sage**, Louisiana State University.

Harmonic Analysis and Partial Differential Equations in Real and Complex Domains (Code: SS 3A), **Loredana Lanzani**, University of Arkansas, and **Zhongwei Shen**, University of Kentucky.

Knot and 3-Manifold Invariants (Code: SS 6A), **Oliver T. Dasbach** and **Patrick M. Gilmer**, Louisiana State University.

Nonlinear Evolution Equations of Mathematical Physics (Code: SS 5A), **Jerry L. Bona,** University of Illinois at Chicago, and **Michael M. Tom**, Louisiana State University.

Recent Advances in Knot Theory: Quandle Theory and Categorified Knot Invariants (Code: SS 4A), **Sam Nelson**, Pomona College, and **Alissa S. Crans**, Loyola Marymount University.

Structural Graph Theory (Code: SS 2A), **Maria Chudnovsky**, Columbia University.

White Noise Distribution Theory and Orthogonal Polynomials (Code: SS 1A), **Jeremy J. Becnel**, Stephen F. Austin State University, and **Aurel I. Stan**, The Ohio State University at Marion.

Bloomington, Indiana

Indiana University

April 5–6, 2008

Saturday – Sunday

Meeting #1038

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: February 2008
Program first available on AMS website: February 21, 2008
Program issue of electronic *Notices*: April 2008
Issue of *Abstracts*: Volume 29, Issue 3

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 18, 2007

For abstracts: February 12, 2008

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Shi Jin, University of Wisconsin, *Title to be announced.*

Michael J. Larsen, Indiana University, *Title to be announced.*

Mircea Mustata, University of Michigan, *Title to be announced.*

Margaret H. Wright, New York University-Courant Institute, *Title to be announced.*

Special Sessions

Algebraic Aspects of Coding Theory (Code: SS 5A), **Heide Gluesing-Luerssen**, University of Kentucky, and **Roxana Smarandache**, San Diego State University.

Birational Algebraic Geometry (Code: SS 3A), **Mircea I. Mustata**, University of Michigan, and **Mihnea Popa**, University of Illinois at Chicago.

Combinatorial and Geometric Aspects of Commutative Algebra (Code: SS 1A), **Juan Migliore**, University of Notre Dame, and **Uwe Nagel**, University of Kentucky.

Hyperbolic and Kinetic Equations (Code: SS 2A), **Shi Jin**, University of Wisconsin, and **Marshall Slemrod**, Univesity of Wisconsin.

Some Mathematical Problems in Biology, from Macromolecules to Ecosystems (Code: SS 6A), **Santiago David Schnell**, Indiana University, and **Roger Temam**, Indiana University.

Weak Dependence in Probability and Statistics (Code: SS 4A), **Richard C. Bradley** and **Lahn T. Tran**, Indiana University.

Claremont, California

Claremont McKenna College

May 3–4, 2008

Saturday – Sunday

Meeting #1039

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: March 2008
Program first available on AMS website: March 20, 2008
Program issue of electronic *Notices*: May 2008
Issue of *Abstracts*: Volume 29, Issue 3

Deadlines

For organizers: October 4, 2007
For consideration of contributed papers in Special Sessions: January 15, 2008
For abstracts: March 11, 2008

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Michael Bennett, University of British Columbia, *Title to be announced.*

Chandrashekhar Khare, University of Utah, *Title to be announced.*

Huaxin Lin, University of Oregon, *Title to be announced.*

Anne Schilling, University of California Davis, *Title to be announced.*

Special Sessions

Diophantine Problems and Discrete Geometry (Code: SS 3A), **Matthias Beck**, San Francisco State University, and **Lenny Fukshansky**, Texas A&M University.

Dynamical Systems and Differential Equations (Code: SS 1A), **Adolfo Rumbos**, Pomona College, **Mario Martelli**, Claremont McKenna College, and **Alfonso Castro**, Harvey Mudd College.

Operators, Functions and Linear Spaces (Code: SS 2A), **Asuman G. Aksoy**, Claremont McKenna College, **Stephan R. Garcia**, Pomona College, **Michael Davlin O'Neill**, Claremont McKenna College, and **Winston C. Ou**, Scripps College.

Recent Developments in Riemannian and Kaehlerian Geometry (Code: SS 4A), **Hao Fang,** University of Iowa, **Zhiqin Lu**, University of California, Irvine; **Dragos-Bogdan Suceava**, California State University Fullerton; and **Mihaela B. Vajiac**, Chapman University.

Rio de Janeiro, Brazil

Instituto Nacional de Matemática Pura e Aplicada (IMPA)

June 4–7, 2008

Wednesday – Saturday

Meeting #1040

First Joint International Meeting between the AMS and the Sociedade Brasileira de Matemática.
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: February 2008
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: November 1, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/internmtgs.html`.

AMS Invited Addresses

Ruy Exel, University Federal de Santa Catarina, *Title to be announced.*

Velimir Jurdjevic, University of Toronto, *Title to be announced.*

Andre Nachbin, Institute for Pure-Applied Mathematics, *Title to be announced.*

Richard M. Schoen, Stanford University, *Title to be announced.*

Ivan P. Shestakov, University of Sao Paulo, *Title to be announced.*

Amie Wilkinson, Northwestern University, *Title to be announced.*

Vancouver, Canada

University of British Columbia and the Pacific Institute of Mathematical Sciences (PIMS)

October 4–5, 2008

Saturday – Sunday

Meeting #1041

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2008
Program first available on AMS website: August 21, 2008
Program issue of electronic *Notices*: October 2008
Issue of *Abstracts*: Volume 29, Issue 4

Deadlines

For organizers: March 9, 2008
For consideration of contributed papers in Special Sessions: June 17, 2008
For abstracts: August 12, 2008

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Richard Kenyon, University of British Columbia, *Title to be announced.*

Alexander S. Kleshchev, University of Oregon, *Title to be announced.*

Mark Lewis, University of Alberta, *Title to be announced.*

Audrey A. Terras, University of California San Diego, *Title to be announced.*

Middletown, Connecticut

Wesleyan University

October 11–12, 2008

Saturday – Sunday

Meeting #1042

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: August 2008
Program first available on AMS website: August 28, 2008
Program issue of electronic *Notices*: October 2008
Issue of *Abstracts*: Volume 29, Issue 4

Deadlines

For organizers: March 11, 2008
For consideration of contributed papers in Special Sessions: June 24, 2008
For abstracts: August 19, 2008

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Special Sessions

Algebraic Geometry (Code: SS 1A), **Eyal Markman** and **Jenia Tevelev**, University of Massachusetts, Amherst.

Kalamazoo, Michigan

Western Michigan University

October 17–19, 2008

Friday – Sunday

Meeting #1043

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: August 2008
Program first available on AMS website: September 4, 2008
Program issue of electronic *Notices*: October 2008
Issue of *Abstracts*: Volume 29, Issue 4

Deadlines

For organizers: March 17, 2008
For consideration of contributed papers in Special Sessions: July 1, 2008
For abstracts: July 26, 2008

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

M. Carme Calderer, University of Minnesota, *Title to be announced.*

Alexandru Ionescu, University of Wisconsin, *Title to be announced.*

Boris S. Mordukhovich, Wayne State University, *Title to be announced.*

David Nadler, Northwestern University, *Title to be announced.*

Huntsville, Alabama

University of Alabama, Huntsville

October 24–26, 2008

Friday – Sunday

Meeting #1044

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: August 2008
Program first available on AMS website: September 11, 2008
Program issue of electronic *Notices*: October 2008
Issue of *Abstracts*: Volume 29, Issue 4

Deadlines

For organizers: March 24, 2008
For consideration of contributed papers in Special Sessions: July 8, 2008
For abstracts: September 2, 2008

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Mark Behrens, Massachusetts Institute of Technology, *Title to be announced.*

Anthony Michael Bloch, University of Michigan, Ann Arbor, *Title to be announced.*

Roberto Camassa, University of North Carolina, Chapel Hill, *Title to be announced.*

Mark V. Sapir, Vanderbilt University, *Title to be announced.*

Shanghai, People's Republic of China

Fudan University

December 17–21, 2008

Wednesday – Sunday

Meeting #1045

First Joint Interntional Meeting Between the AMS and the Shanghai Mathematical Society
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: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/internmtgs.html`.

Invited Addresses

L. Craig Evans, University of California Berkeley, *Title to be announced.*

Zhi-Ming Ma, Chinese Academy of Sciences, *Title to be announced.*

Richard Schoen, Stanford University, *Title to be announced.*

Richard Taylor, Harvard University, *Title to be announced.*

Xiaoping Yuan, Fudan University, *Title to be announced.*

Weiping Zhang, Chern Institute, *Title to be announced.*

Washington, District of Columbia

Marriott Wardman Park Hotel and Omni Shoreham Hotel

January 7–10, 2009

Wednesday – Saturday
Joint Mathematics Meetings, including the 115th Annual Meeting of the AMS, 92nd 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: October 2008
Program first available on AMS website: November 1, 2008
Program issue of electronic *Notices*: January 2009
Issue of *Abstracts*: Volume 30, Issue 1

Deadlines

For organizers: April 1, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Urbana, Illinois

University of Illinois at Urbana-Champaign

March 27–29, 2009

Friday – Sunday
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 29, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.
Special Sessions
Geometric Group Theory (Code: SS 2A), **Sergei V. Ivanov**, **Ilya Kapovich**, **Igor Mineyev**, and **Paul E. Schupp**, University of Illinois at Urbana-Champaign.
q-Series and Partitions (Code: SS 1A), **Bruce Berndt**, University of Illinois at Urbana-Champaign.

Raleigh, North Carolina

North Carolina State University

April 4–5, 2009

Saturday – Sunday
Southeastern Section
Associate secretary: Matthew Miller
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 4, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Francisco, California

San Francisco State University

April 25–26, 2009

Saturday – Sunday
Western Section
Associate secretary: Michel L. Lapidus
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 25, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Waco, Texas

Baylor University

October 16–18, 2009

Friday – Sunday
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: March 17, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Boca Raton, Florida

Florida Atlantic University

October 30 – November 1, 2009

Friday – Sunday
Southeastern Section
Associate secretary: Matthew Miller
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: March 30, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Riverside, California

University of California

November 7–8, 2009

Saturday – Sunday
Western Section
Associate secretary: Michel L. Lapidus
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: Expired
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Francisco, California

Moscone Center West and the San Francisco Marriott

January 6–9, 2010

Wednesday – Saturday
Joint Mathematics Meetings, including the 116th Annual Meeting of the AMS, 93rd 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), with sessions contributed by the Society of Industrial and Applied Mathematics (SIAM).
Associate secretary: Matthew Miller
Announcement issue of *Notices*: October 2009
Program first available on AMS website: November 1, 2009
Program issue of electronic *Notices*: January 2010
Issue of *Abstracts*: Volume 31, Issue 1

Deadlines

For organizers: April 1, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Lexington, Kentucky

University of Kentucky

March 27–28, 2010

Saturday – Sunday
Southeastern Section
Associate secretary: Matthew Miller
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 28, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

New Orleans, Louisiana

New Orleans Marriott and Sheraton New Orleans Hotel

January 5–8, 2011

Wednesday – Saturday
Joint Mathematics Meetings, including the 117th Annual Meeting of the AMS, 94th Annual Meeting of the Mathematical Association of America, 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: October 2010
Program first available on AMS website: November 1, 2010
Program issue of electronic *Notices*: January 2011

Issue of *Abstracts*: Volume 32, Issue 1

Deadlines

For organizers: April 1, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Boston, Massachusetts

John B. Hynes Veterans Memorial Convention Center, Boston Marriott Hotel, and Boston Sheraton Hotel

January 4–7, 2012

Wednesday – Saturday
Joint Mathematics Meetings, including the 118th Annual Meeting of the AMS, 95th Annual Meeting of the Mathematical Association of America, 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2011
Program first available on AMS website: November 1, 2011
Program issue of electronic *Notices*: January 2012
Issue of *Abstracts*: Volume 33, Issue 1

Deadlines

For organizers: April 1, 2011
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Diego, California

San Diego Convention Center and San Diego Marriott Hotel and Marina

January 9–12, 2013

Wednesday – Saturday
Joint Mathematics Meetings, including the 119th Annual Meeting of the AMS, 96th Annual Meeting of the Mathematical Association of America, 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
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 1, 2012
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Baltimore, Maryland

Baltimore Convention Center

January 15–18, 2014, *Wednesday – Saturday*

Joint Mathematics Meetings, including the 120th Anual Meeting of the AMS, 97th Annual Meeting of the Mathematical Association of America, 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, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Matthew Miller
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 1, 2013
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Program at a Glance

This document provides a thumbnail sketch of all scientific and social events so you can easily see which events may overlap and better plan your time.

Friday, January 4

8:00 a.m.–5:00 p.m.	**AMS SHORT COURSE ON APPLICATIONS OF KNOT THEORY (PART I)**
8:00 a.m.–5:00 p.m.	**MAA SHORT COURSE ON COMBINATORICS: PAST, PRESENT, AND FUTURE (PART I)**

Saturday, January 5

8:00 a.m.–6:00 p.m.	**MAA BOARD OF GOVERNORS**
9:00 a.m.–5:00 p.m.	**AMS SHORT COURSE ON APPLICATIONS OF KNOT THEORY (PART II)**
9:00 a.m.–5:00 p.m.	**MAA SHORT COURSE ON COMBINATORICS: PAST, PRESENT, AND FUTURE (PART II)**
1:30 p.m.–10:00 p.m.	**AMS COUNCIL**
3:00 p.m.–7:00 p.m.	**JOINT MEETINGS REGISTRATION**, Exhibit Hall B, San Diego Convention Center

Sunday, January 6

7:30 a.m.–4:00 p.m.	**JOINT MEETINGS REGISTRATION**, Exhibit Hall B, San Diego Convention Center
7:00 a.m.–7:50 a.m.	**ASSOCIATION FOR CHRISTIANS IN THE MATHEMATICAL SCIENCES NONDENOMINATIONAL WORSHIP SERVICE**
8:00 a.m.–10:50 a.m.	**AMS-MAA SPECIAL SESSION ON THE SCHOLARSHIP OF TEACHING AND LEARNING IN MATHEMATICS, I**
	AMS-SIAM SPECIAL SESSIONS
8:00 a.m.–10:50 a.m.	*Asymptotic Methods in Analysis with Applications, I*
8:00 a.m.–10:50 a.m.	*Environmental Mathematics: Some Mathematical Problems on Climate Change and Geophysical Fluid Dynamics, I*
8:00 a.m.–10:50 a.m.	**AMS-ASL SPECIAL SESSION ON SET THEORY AND BANACH SPACES, I**
8:00 a.m.–10:50 a.m.	**AMS-AWM SPECIAL SESSION ON ZETA FUNCTIONS OF GRAPHS, RAMANUJAN GRAPHS, AND RELATED TOPICS, I**
	AMS SPECIAL SESSIONS
8:00 a.m.–10:50 a.m.	*Automorphic Forms and Related Topics, I*
8:00 a.m.–10:50 a.m.	*Recent Advances in Mathematical Biology, Ecology, and Epidemiology, I*
8:00 a.m.–10:50 a.m.	*Progress in Commutative Algebra, I*
8:00 a.m.–10:50 a.m.	*The Mathematics of Information and Knowledge, I*
8:00 a.m.–10:50 a.m.	*Hyperbolic Dynamical Systems, I*
8:00 a.m.–10:50 a.m.	*Interactions Between Noncommutative Algebra and Algebraic Geometry, I*
8:00 a.m.–10:50 a.m.	*Algebraic Topology, I*
8:00 a.m.–10:50 a.m.	*Groups, Representations, and Character Theory, I*

Joint Meetings Advance Registration/Housing Form

Note: Write your name as you would like it to appear on your badge (no titles, please). Badges and programs can only be mailed to home addresses. If you would like your registration materials mailed to you on December 13, please register by November 15, provide your home address, and check this box: ☐ **I want my materials mailed to the following address on 12/13/07.**
☐ **I do not want my materials mailed. I will pick them up onsite.**

Joint Mathematics Meetings
San Diego
January 6–9, 2008

Name _____

Mailing Address _____

_____

Telephone: _____ Fax: _____

In case of emergency (for you) at the meeting, call: Day #: _____ Evening #: _____

Email Address _____

Affiliation for name badge _____

Nonmathematician guest badge name _____ (please note charge below)

Acknowledgment of this registration will be sent to the email address listed, unless you check this box: Send by U.S. Mail ☐

Membership
✓ all that apply. First column is eligible for member registration fee

❑ AMS ❑ ASA
❑ MAA ❑ AWM
❑ ASL ❑ NAM
❑ CMS ❑ YMN
❑ SIAM

Registration Fees

Joint Meetings	**by Dec 14**	**at mtg**	**Subtotal**
❑ Member AMS, ASL, CMS, MAA, SIAM	US $214	US $279	
❑ Nonmember	US $332	US $431	
❑ Graduate Student	US $ 44	US $ 54	
❑ Undergraduate Student	US $ 23	US $ 29	
❑ High School Student	US $ 5	US $ 10	
❑ Unemployed	US $ 43	US $ 53	
❑ Temporarily Employed	US $172	US $200	
❑ Developing Countries Special Rate	US $ 43	US $ 53	
❑ Emeritus Member of AMS or MAA	US $ 43	US $ 53	
❑ High School Teacher	US $ 43	US $ 53	
❑ Librarian	US $ 43	US $ 53	
❑ Nonmathematician Guest	US $ 15	US $ 15	
			$ _____

AMS Short Course: *Applications of Knot Theory (1/4–1/5)*

❑ Member of AMS or MAA	US $ 94	US $125	
❑ Nonmember	US $125	US $155	
❑ Student, Unemployed, Emeritus	US $ 42	US $ 63	
			$ _____

MAA Short Course: *Combinatorics: Past, Present, Future. (1/4–1/5)*

❑ Member of MAA or AMS	US $125	US $140	
❑ Nonmember	US $175	US $190	
❑ Student, Unemployed, Emeritus	US $ 50	US $ 60	
			$ _____

MAA Minicourses (see listing in text)

I would like to attend: ❑ One Minicourse ❑ Two Minicourses
Please enroll me in MAA Minicourse(s) #_____ and/or #_____
In order of preference, my alternatives are: #_____ and/or #_____
Price: US $60 for each minicourse.
(For more than 2 minicourses, call or email the MMSB.) $ _____

Employment Center

Applicant résumé forms and employer job listing forms will be on the AMS website at www.ams.org/emp-reg/.

Employer—First Table	US $245	US $325	
❑ Computer-scheduled ❑ Self-scheduled ❑ Combination Interview			
Employer— Each Additional Table	US $ 95	US $125	
❑ Computer-scheduled ❑ Self-scheduled ❑ Combination Interview			
❑ Employer—Posting Job Description Only	US $ 50	N/A	
❑ Applicant (all services)	US $ 44	US $ 82	
❑ Applicant (Winter List & Message Ctr only)	US $ 22	US $ 22	
			$ _____

Events with Tickets

MER Banquet (1/7)	US $50.00	#____Regular	#____Veg	#____Kosher
NAM Banquet (1/8)	US $49.00	#____Regular	#____Veg	#____Kosher
AMS Banquet (1/9)	US $52.00	#____Regular	#____Veg	#____Kosher

$ _____

Other Events

❑ AMS Workshop on Grant Writing (1/6) (no charge)
❑ Graduate Student/First Time Attendee Reception (1/6) (no charge)

Total for Registrations and Events $ _____

Registration for the Joint Meetings is not required for the Short Courses, but it is required for the Minicourses and the Employment Center

Payment

Registration & Event Total (total from column on left) $ _____

Hotel Deposit (only if paying by check) $ _____

Total Amount To Be Paid **$** _____

(Note: A US $5 processing fee will be charged for each returned check or invalid credit card. Debit cards are not accepted.)

Method of Payment

❑ Check. Make checks payable to the AMS. Checks drawn on foreign banks must be in equivalent foreign currency at current exchange rates.
❑ Credit Card. VISA, MasterCard, AMEX, Discover (no others accepted)

Card number: _____

Exp. date: _____ Zipcode of credit card billing address: _____

Signature: _____

Name on card: _____

❑ Purchase order # _____ (please enclose copy)

Other Information

Mathematical Reviews field of interest # _____

How did you hear about this meeting? Check one: ❑ Colleague(s) ❑ *Notices* ❑ *Focus* ❑ Internet

❑ This is my first Joint Mathematics Meeting.
❑ I am a mathematics department chair.
❑ For planning purposes for the MAA Two-year College Reception, please check if you are a faculty member at a two-year college.
❑ I would like to receive promotions for future JMM meetings.
❑ Please ✓ this box if you have a disability requiring special services.
❑ **Please do not include my name on any promotional mailing list.**

Mail to:

Mathematics Meetings Service Bureau (MMSB)
P. O. Box 6887
Providence, RI 02940-6887 Fax: 401-455-4004
Questions/changes call: 401-455-4143 or 1-800-321-4267 x4143; mmsb@ams.org

Deadlines *Please register by the following dates for:*

Résumés/job descriptions printed in the *Winter Lists*	**Oct. 24, 2007**
To be eligible for the room lottery and the raffle:	**Oct. 31, 2007**
For housing reservations, badges/programs mailed:	**Nov. 15, 2007**
For housing changes/cancellations through MMSB:	**Dec. 7, 2007**
For advance registration for the Joint Meetings, Employment Center, Short Courses, MAA Minicourses, & Tickets:	**Dec. 14, 2007**
For 50% refund on banquets, cancel by:	**Dec. 21, 2007***
For 50% refund on advance registration, Minicourses & Short Courses, cancel by:	**Dec. 28, 2007***

***no refunds after this date**

San Diego Joint Meetings Hotel Reservations

To ensure accurate assignments, please rank hotels in order of preference by writing 1, 2, 3, etc., in the column on the left and by circling the requested room type and rate. If the rate or the hotel requested is no longer available, you will be assigned a room at a ranked or unranked hotel at a comparable rate. Participants are urged to call the hotels directly for details on suite configurations, sizes, and availability; however, suite reservations can be made only through the MMSB to receive the convention rates listed. Reservations at the following hotels must be made through the MMSB to receive the convention rates listed. Reservations made directly with the hotels may be changed to a higher rate. All rates are subject to a 10.6% sales tax. **Guarantee requirements: First night deposit by check (add to payment on reverse of form) or a credit card guarantee.**

❑ Deposit enclosed (see front of form) ❑ Hold with my credit card Card Number _____ Exp. Date _____ Signature _____

Date and Time of Arrival _____ **Date and Time of Departure** _____

Name of Other Room Occupant _____ **Arrival Date** _____ **Departure Date** _____ **Child (give age(s)** _____

Order of choice	Hotel	Single	Double 1 bed	Double 2 beds	Triple 2 beds	Triple 2 beds w/cot	Triple - king or queen w/cot	Quad 2 beds	Quad 2 beds w/cot	Suites Starting rates
	San Diego Marriott Hotel & Marina (hqtrs)									
	Cityview	US $172	US $172	US $172	US $192	US $192	US $192	US $212	US $212	N/A
	Bayview	US $192	US $192	US $192	US $212	US $212	US $212	US $232	US $232	US $685
	Student	US $138	US $138	US $138	US $158	US $158	US $158	US $178	US $178	N/A
	Horton Grand Hotel	US $155	US $155	US $155 (very limited)	US $175 (very limited)	N/A	N/A	US $195 (very limited)	N/A	US $215
	Student	US $145	US $145	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Hilton San Diego Gaslamp Quarter	US $150	US $150	US $150	US $170	N/A	US $190	US $190	N/A	US $489
	Student	US $140	US $140	US $140	US $160	N/A	US $180	US $180	N/A	N/A
	Embassy Suites-Cityview Suites	US $149	US $149	US $149	US $169	No rollaways; have sleeper sofa	No rollaways; have sleeper sofa	US $189	N/A	all suites
	Bayview Suites	US $169	US $169	US $169	US $189	No rollaways; have sleeper sofa	No rollaways; have sleeper sofa	US $209	N/A	all suites
	Student Suites	US $135	US $135	US $135	US $145	No rollaways; have sleeper sofa	No rollaways; have sleeper sofa	US $155	N/A	all suites
	Omni San Diego	US $140	US $140	US $140	US $160	N/A	US $185	US $180	N/A	Jr. Suite: US $399; 1BR US $499
	Student	US $125	US $125	US $125	US $145	N/A	US $170	US $165	N/A	N/A
	Holiday Inn on the Bay-Cityview	US $135	US $135	US $135	US $150	N/A	US $160	US $165	N/A	N/A
	Bayview	US $165	US $165	US $165	US $180	N/A	US $190	US $195	N/A	US $338
	Student	US $125	US $125	US $125	US $140	N/A	US $150	US $155	N/A	N/A
	Holiday Inn Express	US $129	US $129	US $129	US $144	N/A	N/A	US $159	N/A	US $239
	Student	US $119	US $119	US $119	US $134	N/A	N/A	US $149	N/A	N/A
	Courtyard Marriott Downtown	US $109	US $109	US $109	US $119	N/A	King only-US $119	US $129	N/A	US $169
	Rodeway Inn and Suites	US $91	US $91	US $91	US $101	$121	US $121	US $111	US $131	N/A
	500 West Hotel	US $49	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Special Housing Requests:.

❑ I have disabilities as defined by the ADA that require a sleeping room that is accessible to the physically challenged. My needs are: _____

❑ Other requests: _____

_____

❑ I am a member of a hotel frequent-travel club and would like to receive appropriate credit.

The hotel chain and card number are: _____

Email confirmations (no paper) will be sent by the Hilton, Embassy Suites, Holiday Inns, Horton, Marriott (hqtrs), Omni & Rodeway Inn. **Please provide your email address:** _____

If you are not making a reservation, please check off one of the following:

❑ I plan to make a reservation at a later date.

❑ I will be making my own reservations at a hotel not listed. Name of hotel: _____

❑ I live in the area or will be staying privately with family or friends.

❑ I plan to share a room with _____, who is making the reservations.

Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: Michel L. Lapidus, Department of Mathematics, University of California, Surge Bldg., Riverside, CA 92521-0135; e-mail: lapidus@math.ucr.edu; telephone: 951-827-5910.

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Southeastern Section: Matthew Miller, Department of Mathematics, University of South Carolina, Columbia, SC 29208-0001, e-mail: miller@math.sc.edu; telephone: 803-777-3690.

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 can be found at** www.ams.org/meetings/**.**

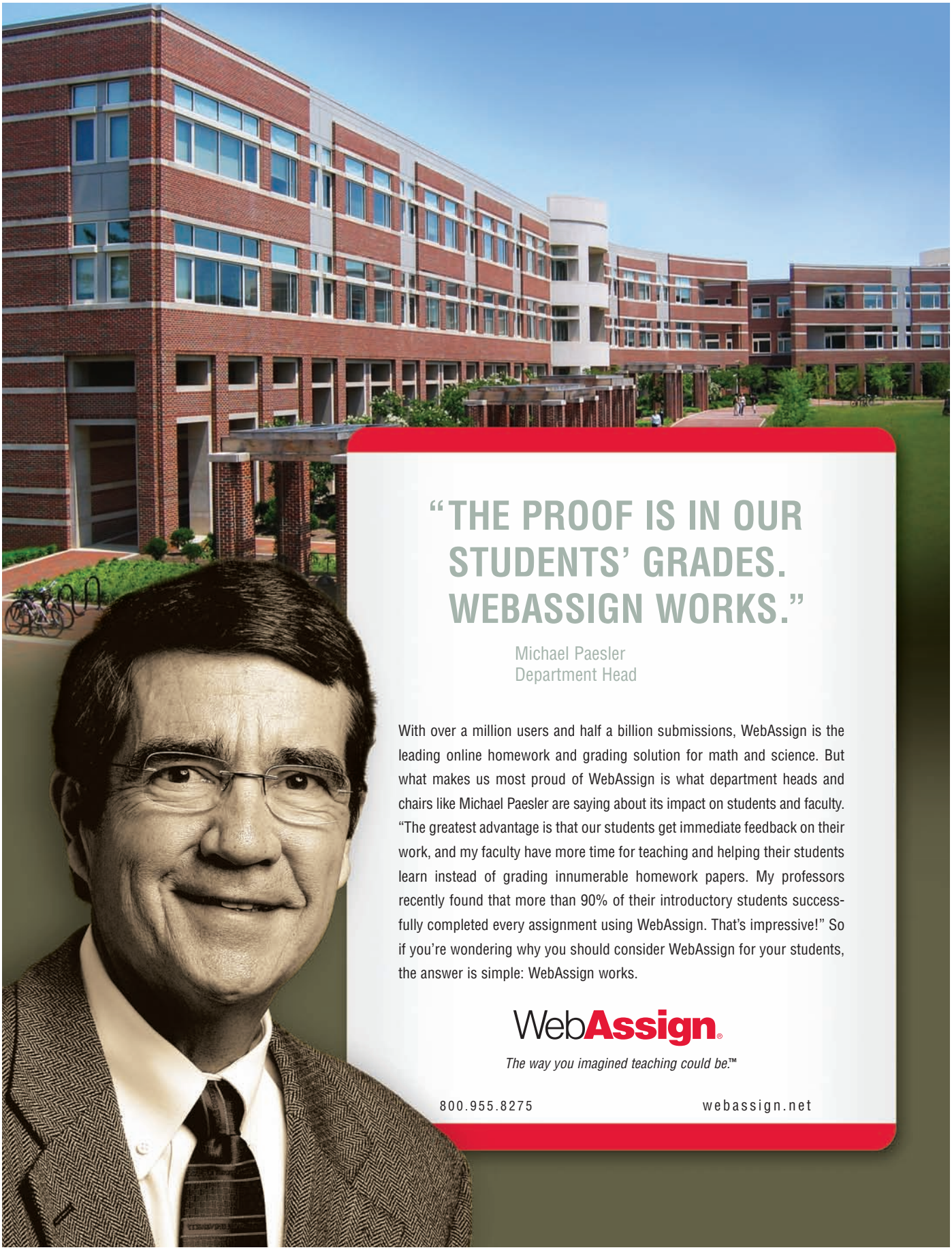
Meetings:

Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 78 in the the January 2007 issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

Abstracts

Speakers should submit abstracts on the 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 and similarily coded material (such as accent marks in text) must be typeset in LaTeX. Visit http://www.ams.org/cgi-bin/abstracts/abstract.pl. Questions about abstracts may be sent to abs-info@ams.org. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.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