Notices

of the American Mathematical Society

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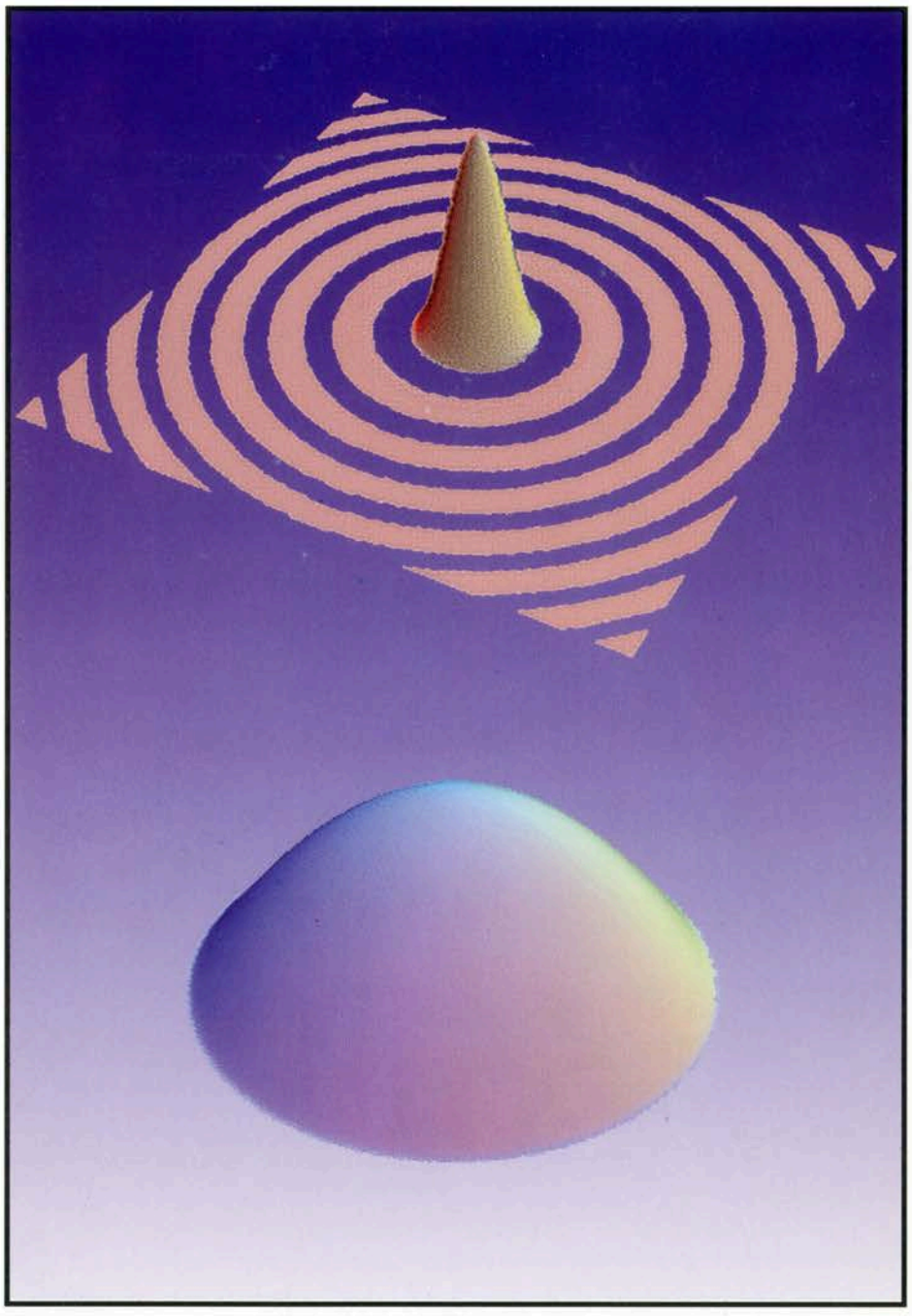

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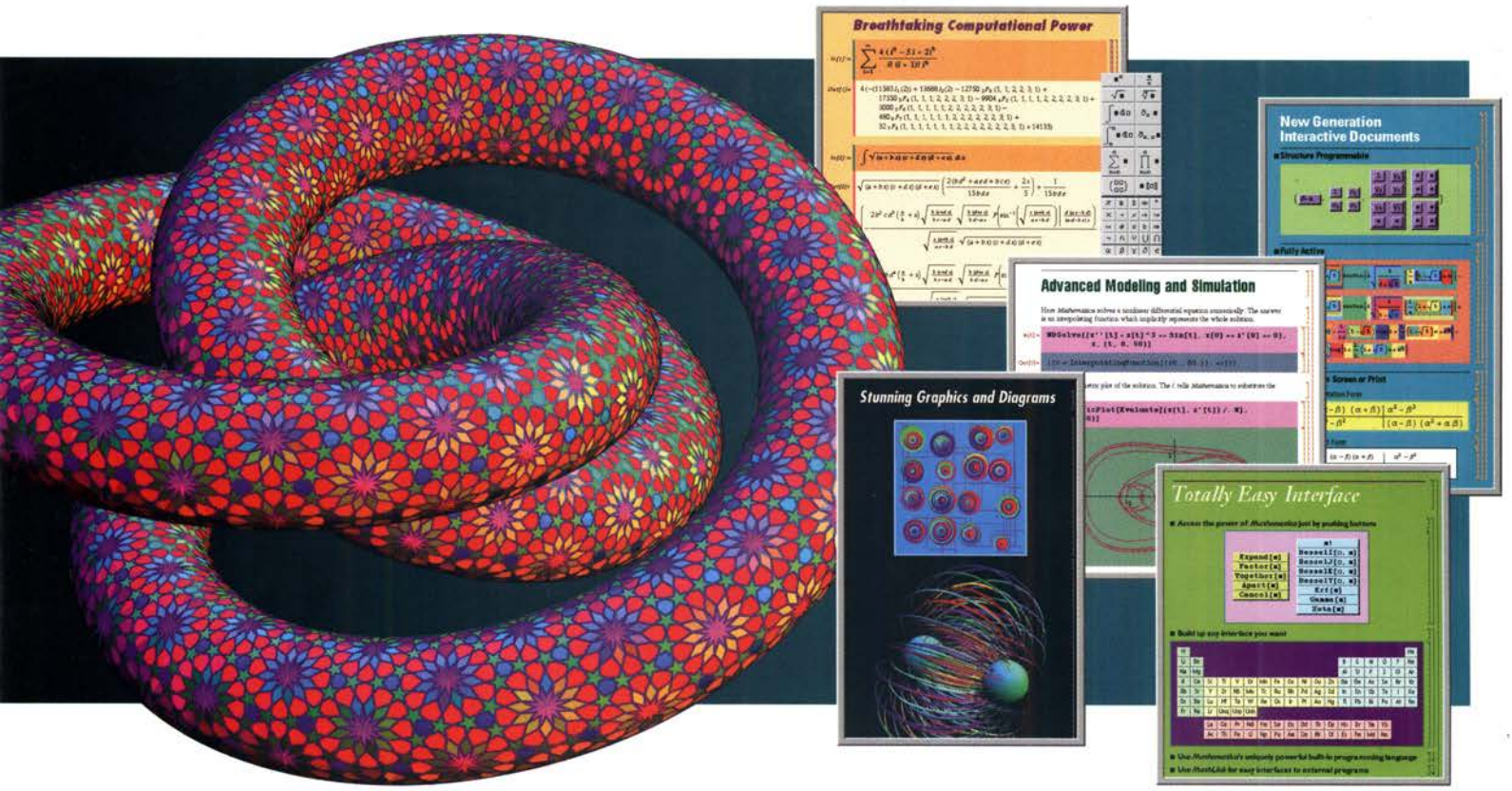

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In Memoriam

William Ashton Harris Jr. (1930–1998)

William Ashton Harris Jr., associate secretary of the American Mathematical Society and professor of mathematics at the University of Southern California, passed away suddenly on January 8, 1998, at the age of sixty-seven. Harris had been an associate secretary for the Western Section of the Society since February 1, 1996. He had been appointed to the position by the Council of the Society upon recommendation by the Executive Committee and the Society's Board of Trustees.

Bill was a welcome addition to the Secretariat, the committee of the secretary and associate secretaries of the Society that considers and sets most of the policy for the scientific meetings of the Society and that edits the *Abstracts of the American Mathematical Society*. In addition to his insightful contributions to the organization and programming of meetings, he brought a warm personality and wonderful sense of humor to the meetings and to his other interactions with officers, members, and staff. Often he was able to defuse a tense moment by inserting a concise, thoughtful comment spiced with a humorous delivery. During his term as associate secretary he arranged and supervised many meetings in the Western Section and laid the groundwork for several future meetings. It is ironic that he died during the Annual Meeting of the Society, a meeting he might have attended but could not because of the infirmity that was the eventual cause of his untimely death. The members and staff of the Society who were expecting to meet with him were truly saddened to learn of his passing.

Bill was born in New Orleans in 1930 but traveled north to receive his Ph.D. at the University of Minnesota. He received his doctorate in 1958 at Minnesota under the supervision of Hugh Turrittin. Harris remained at Minnesota as an instructor and rose through the ranks to become a professor in 1968. He moved to the University of Southern California in 1970. At USC he continued his active research program in ordinary differential equations and served actively in many administrative capacities, including a stint from 1977 to 1984 as chair of the Department of Mathematics.

Bill was also a world traveler, visiting institutes and departments in Japan, the United Kingdom, and Europe, in addition to many in North America.

Harris's area of research was the analytic theory of ordinary differential equations, with special emphasis on asymptotic integration and singular perturbations, topics about which he wrote more than seventy research papers. He supervised five Ph.D. candidates and ten applied mathematics master's degree candidates during his career.

Harris delivered Invited Addresses to the Mathematical Society of Japan in 1965 and to the AMS in 1979 and was the principal lecturer at a CBMS conference in 1975. In addition, he served as editor of the *SIAM Journal on Applied Mathematics* and of the journal *Nonlinear Analysis*. His research was supported throughout the years by both the National Science Foundation and the U.S. Army Research Office.

Harris played a significant role in the founding and administration of the Summer School on High Performance Computing at the University of Minnesota in the early 1990s. Bill was the founding director of this program for a two-year period and made significant contributions in time and personal funds to ensure the success of the program. The program was later emulated by other Army centers, demonstrating the high regard it received.

Bill will be missed by his colleagues everywhere.

—Robert M. Fossum
Secretary of the AMS

Commentary

In Our Opinion

Collaboration and Respect

While the headlines scream that American math scores are shamefully low on a global scale, an important evolution is quietly taking place in the American mathematical community. Slowly, but with increasing momentum, American mathematicians and educators are joining in constructive dialogue to improve and strengthen mathematics education.

The growing dialogue between mathematicians and educators is not without its pains. Even within mathematics, people with different mathematical specializations have differing attitudes and viewpoints about mathematical knowledge and ways of using it. As Ronald D. Snee noted[1]:

"The presence of variation and uncertainty constitutes a fundamental difference between mathematics and statistics. Effective statisticians are comfortable with data that are variable and often suspect for many reasons. Many mathematicians are not comfortable with variation."

Similarly, mathematicians may not be comfortable with educational research or in teaching certain grade levels. The training and perspectives of mathematicians are quite different from the knowledge and experience of teachers and educational researchers. None of these types of expertise can replace the other, and the contributions of all are needed for meaningful gain. Thus our aim here is to stimulate discussion that will allow us to appreciate better each other's work and be more sensitized to our own mindsets and assumptions.

Those whose mathematical intuition is very reliable can sometimes overestimate the reliability of their pedagogical intuition. The logically most efficient presentation of a concept may not be the pedagogically most efficient. Working through a chain of deductive arguments to complete a proof may leave some with the impression that everything else is fairly straightforward. While the proof showcases the end result of mathematical thought, it does not convey the making of mathematics—the struggle that led to the result. Much of mathematics aims toward the greatest generality, whereas the teaching of mathematics often builds toward an abstract generality by a succession of concrete examples.

Mathematics research often centers on problems whose outcomes are well defined. This is quite different from research in mathematics education, where the results of thorny, open-ended issues are not always clear-cut. Both are different from classroom instruction, where the problem is to convey meaning, using such tools as timing and nuance.

Terminology in mathematics rests on precise, albeit arbitrary, definitions that retain their meanings in different mathematical contexts. In education, terminology often reflects the struggle to describe underlying notions ("understanding," "transferability") that are context-dependent and whose interpretations can change with time. Mathematicians used to working with clear terminology and precise definitions may become impatient with educational terminology. However, reflecting on what the terminology means and refers to can lead to significant insights about mathematics education.

Education research in this country grew out of statistical methodologies such as those used in agricultural research. Statistical studies can be useful for answering certain kinds of educational research questions that can be framed in quantitative terms, but they are not well suited to answering questions concerning the processes of learning mathematics. Other methodologies, such as ethnographic research or clinical, task-based interviews involving a small number of subjects are useful for probing these issues. For example, researchers have given us significant insights into how problem solvers use heuristics by carefully observing students in the process of doing mathematics.[2] Qualitative educational research that uses tight observational protocols and cross-supporting sources of evidence can provide a measure of objectivity. (Of course, poorly done qualitative research is just as useless as poorly done quantitative research.)

The most significant difference between mathematics and education research is that mathematics evolves and verifies largely by logical reasoning, whereas education research grows and confirms by observation. Thus we may use logical reasoning to rectify a mathematical misstatement, but only through careful, probing observations can we unearth a pervasive thought pattern of which this misstatement is an example.

There are many ways that mathematicians, teachers, and education researchers can work together. Mathematicians are our best source of information about what should be taught and with what emphases. Mathematicians can help students and teachers to appreciate better the nature of mathematics and how it is done. For example, they can provide opportunities such as mentorship programs for teachers to experience what mathematical research is like. And mathematicians can collaborate with education faculty to strengthen teacher programs.

To the mathematician's understanding of the subject the education researcher brings understanding of the learner. And the classroom teacher brings related practical experience to both. For example, the ability to do deductive reasoning may develop at different ages in different children. This does not mean that we must abandon mathematical maturity as a goal of education. Rather, it suggests that educational researchers, in collaboration with classroom teachers, help us assess what can be expected of students in different grade levels and at different stages of development. For meaningful gains in education, the results of these efforts and related research must be communicated throughout the mathematical community.

Surely mathematicians, educational researchers, and teachers can find other ways to work together. Working in isolation can lead to distortions and misperceptions. Working together, respectful of our diverse strengths and perspectives, we can obtain a richly textured picture of reality.

—Warren Page
New York City Technical College (CUNY)
—Mark Saul
Associate Editor

[1] *Snee, Ronald D.*, Mathematics is Only One Tool That Statisticians Use, *The College Math. J.* **19** *(1988), 30–32.*

[2] *See, for example, James J. Kaput and Ed Dubinsky (eds.),* Research Issues in Undergraduate Mathematics Learning, *MAA Notes* **33**, *Math. Assoc. America, 1993.*

Letters to the Editor

Stamps on Cover

I was delighted to see the postage stamps on the cover of the March 1998 AMS *Notices*. Members of the AMS might be interested in knowing that there is an organization devoted to mathematical philately, the Mathematical Study Unit, which is an affiliate of the American Philatelic Society and the American Topical Assocation. In addition to a quarterly newsletter, *Philamath*, the unit publishes a checklist of mathematical postage stamps. There are approximately 150 members worldwide, including Robin Wilson (mentioned in the article) and the president of a major mathematical organization in this country. A deceased member was a Nobel laureate. A number of years ago there was an article on our organization in a SIAM publication, but nothing has appeared in an AMS or MAA journal. As president of the Mathematical Study Unit, I encourage interested people to contact our secretary-treasurer, Estelle Buccino, 5615 Glenwood Rd., Bethesda, MD 20817, for further information on our activities.

—Monty J. Strauss
Texas Tech University

(Received February 16, 1998)

Author's Web Site Offers Precollege Math Lesson Suggestions

The 1989 NCTM document "Curriculum and Evaluation Standards for School Mathematics" at `http://www.enc.org/reform/journals/ENC2280/nf_280dtoc1.htm` does not provide methods to attain all the goals it sets. The 1995 British document "Tackling the Mathematics Problem" at `http://www.lms.ac.uk/policy/tackling/report.html` gives a UK perspective on causes, but still does not propose a full solution. A full solution to the mathematics education problem would have steps to explain each basic concept, since instruction like mathematical induction fails if one or more such steps are undefined or too high for most to climb.

Advice for instruction from primary school to college service courses is posted at my Web site at `http://www.cam.org/~aselby/`. Its main page now has 3,500 or so visits per week. The advice is written for precollege mathematics teachers trained in the discipline or seconded from another.

Collecting ideas easily described and repeated in the classroom advances the common knowledge as well as critical reading and writing skills in all disciplines. This eases one education problem. Others related to the contraction of schools and colleges still remain.

—Alan M. Selby
Montréal, Québec

(Received February 25, 1998)

E. J. McShane in 1938–42: A Personal Recollection

A fine retrospective on the career of E. J. (Jimmy) McShane (1904–1989) appeared in the year of his death: "A Tribute to E. J. McShane", by L. D. Berkowitz and Wendell H. Fleming, *SIAM Journal of Control and Optimization*, vol. 27, no. 5, pp. 909–915. Quoted there are some eloquent remarks by Victor Klee, a Ph.D. of McShane's from the year 1949, regarding his qualities of generosity, graciousness, and kindness. Coming across this recently in my files, it occurred to me that there might be some value in the kind of personal recollection recorded below.

McShane had come to the University of Virginia in 1935 to join G. T. Whyburn, from the University of Texas at Austin, as a full professor in the revitalization of what had become a moribund small department of mathematics. He had already attracted attention within the mathematical research community through a number of innovative postdoctoral papers and his superb English translation and enlargement of Richard Courant's monumental *Differential and Integral Calculus*, the result of the years 1932–33 spent with Courant in Göttingen.

When I arrived at the University of Virginia in the fall of 1938 with a fresh B.S. in mathematics and physics from then-tiny Stetson University in Florida, I was one of some twenty-odd mathematics graduate students. We students of those years quickly found that the department's two full professors had very different styles.

Whyburn, the department chairman, was stiff and formal. His topology seminar, conducted in his office-classroom in the manner of his famed Texas mentor, R. L. Moore, met three times a week. At the outset of each meeting he would state on the blackboard any new definitions required and the latest additions to his carefully ordered list of theorems to be proved. Then any student could volunteer to present *his own* proof of any previously stated theorem not yet proved in the seminar, accepting as known all the theorems that preceded that one on the list. Sometimes a difficult theorem would go unproved for weeks. Very occasionally Whyburn himself might have to present a correct proof. Apart from these seminar meetings and weekly department seminars, that was about all that we graduate students saw of Whyburn.

McShane was very different. By design he made his office-conference-room into an inviting center for graduate student study and activity, constantly buzzing with mathematical questions and challenges. In those days none of the instructors or teaching assistants had an office of his own, so everyone used McShane's.

Typically, about midmorning he would blow in, sit down, put his feet up on his desk, light his pipe, and ask about the mathematical question of the moment. Whatever it was and however vainly we might have been puzzling over it, he would puff on his pipe for a few moments and then go to the blackboard and make an incisive contribution, sometimes solving the problem outright. (Years later when his doctors warned him that smoking was beginning to seriously threaten his health, he simply stopped, humorously lamenting how much he missed it.)

In 1940, with entry of the U.S. into World War II imminent, McShane—unathletic and peaceable to a degree—was waggishly self-deprecatory about his volunteering his mathematical expertise to the Army, observing that

with no hair, bad eyes, false teeth, and flat feet he knew he would hardly be of use as a soldier. But having witnessed at first hand Hitler's coming to power in Germany, he was entirely serious about doing what he best could to contribute to the defeat of Hitler's Germany. He began spending his summers and half of most academic-year weeks at the Army's Aberdeen Proving Ground, doing immediately useful research in exterior ballistics.

To complete that part of the story: McShane took a leave of absence from the University of Virginia for the period 1943–45 to continue full-time his work at Aberdeen Proving Ground in a section headed at that time by astronomer Edwin Hubble, now memorialized by the Hubble Space Telescope. By 1944 he had succeeded in bringing to join him in that work J. L. Kelley, a brilliant 1940 University of Virginia Ph.D. in topology. In 1953, well after World War II was over, there appeared *Exterior Ballistics*, McShane's joint book with Kelley and Aberdeen's Frank Reno.

—Truman Botts
Arlington, VA

(Received February 28, 1998)

Teach Calculus with Big *O*

I am pleased to see so much serious attention being given to improvements in the way calculus has traditionally been taught, but I'm surprised that nobody has been discussing the kinds of changes that I personally believe would be most valuable. If I were responsible for teaching calculus to college undergraduates and advanced high school students today and if I had the opportunity to deviate from the existing textbooks, I would certainly make major changes by emphasizing several notational improvements that advanced mathematicians have been using for more than a hundred years.

The most important of these changes would be to introduce the O notation and related ideas at an early stage. This notation, first used by Bachmann in 1894 and later popularized by Landau, has the great virtue that it makes calculations simpler, so it simplifies many parts of the subject, yet it is highly intuitive and easily learned. The key idea is to be able to deal with quantities that are only partly specified and to use them in the midst of formulas.

I would begin my ideal calculus course by introducing a simpler "A notation", which means "absolutely at most". For example, $A(2)$ stands for a quantity whose absolute value is less than or equal to 2. This notation has a natural connection with decimal numbers: Saying that π is approximately 3.14 is equivalent to saying that $\pi = 3.14 + A(.005)$. Students will easily discover how to calculate with A:

$$\begin{aligned} 10^{A(2)} &= A(100); \\ (3.14 + A(.005))(1 + A(0.01)) &= 3.14 + A(.005) + A(0.0314) \\ &\quad + A(.00005) \\ &= 3.14 + A(0.03645) \\ &= 3.14 + A(.04). \end{aligned}$$

I would of course explain that the equality sign is not symmetric with respect to such notations; we have $3 = A(5)$ and $4 = A(5)$ but not $3 = 4$, nor can we say that $A(5) = 4$. We can, however, say that $A(0) = 0$.

The A notation applies to variable quantities as well as to constant ones. For example,

$$\begin{aligned} \sin x &= A(1); \\ x &= A(x); \\ A(x) &= xA(1); \\ A(x) \pm A(y) &= A(x + y) \\ &\qquad \text{if } x \geq 0 \text{ and } y \geq 0; \\ (1 + A(t))^2 &= 1 + 3A(t) \\ &\qquad \text{if } t = A(1). \end{aligned}$$

Once students have caught on to the idea of A notation, they are ready for O notation, which is even less specific. In its simplest form, $O(x)$ stands for something that is $CA(x)$ for some constant C, but we don't say what C is. We also define side conditions on the variables that appear in the formulas. For example, if n is a positive integer, we can say that any cubic polynomial in n is $O(n^3)$.

I would define the derivative by first defining what might be called a "strong derivative": The function f has a strong derivative $f'(x)$ at point x if

$$f(x + \epsilon) = f(x) + f'(x)\epsilon + O(\epsilon^2)$$

whenever ϵ is sufficiently small. The vast majority of all functions that arise in practical work have strong derivatives, so I believe this definition best captures the intuition I want students to have about derivatives.

I'm sure it would be a pleasure for both students and teacher if calculus were taught in this way. The extra time needed to introduce O notation is amply repaid by the simplifications that occur later. In fact, there probably will be time to introduce the "o notation", which is equivalent to the taking of limits, and to give the general definition of a not necessarily strong derivative:

$$f(x + \epsilon) = f(x) + f'(x)\epsilon + o(\epsilon).$$

But I would not mind leaving a full exploration of such things to a more advanced course, when it will easily be picked up by anyone who has learned the basics with O alone.

Students will be motivated to use O notation for two important reasons. First, it significantly simplifies calculations because it allows us to be sloppy—but in a satisfactorily controlled way. Second, it appears in the power series calculations of symbolic algebra systems like Maple and Mathematica, which today's students will surely be using.

For more than twenty years I have dreamed of writing a calculus text entitled *O Calculus*, in which the subject would be taught along the lines sketched above. Perhaps my ideas are preposterous, but I'm hoping that this letter will catch the attention of people who are much more capable than I of writing calculus texts for the new millenium. And I hope that some of these now-classical ideas will prove to be at least half as fruitful for students of the next generation as they have been for me.

Further details appear at http://www-cs-faculty.stanford.edu/~knuth/calc/.

—Donald E. Knuth
Stanford University

(Received March 18, 1998)

Conference to Honor Memory of Pontryagin

Readers may have noticed that a conference is scheduled in Moscow August 31–September 5, 1998, to honor the memory of the late Russian mathematician L. S. Pontryagin. What may be less well known are the reasons why this conference has been the subject of considerable controversy.

In late January I was invited to speak at the conference. Soon after, I noted the name of I. R. Shafarevich as a member of the Organizing Committee. I found that troubling, because he is the well-known author of the extreme right-wing and anti-Semitic polemic "Russophobia", a former editor of the anti-Semitic daily *Deyn*, and at the present time one of the most outspoken political activists in the extreme nationalistic and anti-Semitic Pamyat Party. On making inquiries, I learned that S. Novikov had resigned from the Organizing and Program Committees in November. In a letter to the organizers of the conference he explained his reasons. Professor Novikov has given me permission to quote from his letter:

> I respect Pontryagin and was ready to give his memory proper respect; however I already warned you that this occasion may be used for making an antisemitic shabash. I certainly refuse to participate jointly with Shafarevich, who has nothing in common with Pontryagin scientifically.

Upon further inquiry I received a letter from a member of the Program Committee in my area, who wrote that "good mathematicians who agreed to come take only about 1/3 of places, and many weak persons with suspicious past and strange science have applied."

I am writing to alert other would-be participants to the actual state of affairs. The decision as to whether to boycott this meeting or to participate in it is not a simple matter. One does not wish to lend one's support, even indirectly, to abhorrent ideas, but on the other hand one does not wish to turn one's back on those among our colleagues who are trying hard to keep the focus of this meeting on mathematics. After some consideration I have decided not to participate. I urge those who do participate to make every effort to disassociate themselves publicly from political events having nothing to do with the mathematics of Pontryagin. Those who decide not to participate because of the prominence of Shafarevich in the Organizing Committee are urged to send a letter to the organizers giving their reasons.

—Joan S. Birman
Barnard College and
Columbia University

(Received March 23, 1998)

Remarks about Birman's Letter

Professor J. Birman, in her "Letter to the Editor" concerning the Pontryagin memorial conference, gives the following quotation from my private letter: "...good mathematicians who agreed to come take only about 1/3 of places, and many weak persons with suspicious past and strange science have applied."

I find it necessary to make two contextual remarks, which I consider as extremely important for adequate reading of this sentence.

1. In this part of the letter I analyzed only the situation with applications to the topology section of the conference; in the other three sections it was much better. Indeed, a preceding part of the letter was as follows: "I am afraid that if nothing changes then our section can be the weakest among all four sections....Because good...etc."

2. This letter was written in February, about two months before the deadline for applications. Since then something has changed: many good topologists and geometers have agreed to come; thus my fears that many places would remain for weak mathematicians (who, as usual, also have applied) were not realized.

Independently of these remarks, I use this opportunity to confirm my deep respect for Professor J. Birman and also my very negative estimation of the national theories of Professor I. R. Shafarevich.

—V. A. Vassiliev
Independent Moscow University and
Steklov Mathematical Institute

(Received April 9, 1998)

The *Notices* invites letters from readers about mathematics and mathematics-related topics. Electronic submissions are best. Acceptable letters are usually limited to something under one printed page, and shorter letters are preferred. Accepted letters undergo light copyediting before publication. See the masthead for electronic and postal addresses for submissions.

The Mathematics of Moving Contact Lines in Thin Liquid Films

Andrea L. Bertozzi

Thin Films and Moving Contact Lines

The motion of a liquid under the influence of surface tension is a phenomenon we experience every day when we take a shower, drink a cup of coffee, or turn on the windshield wipers. All of these real-world situations involve not only the motion of the liquid and surrounding air but also their interaction with adjacent hard surfaces. As we know from waxing our cars and cooking with nonstick cookware, the dynamics of a fluid coating a solid surface depend heavily on the surface chemistry. Many industrial processes, ranging from spin coating of microchips to de-icing of airplane wings, rely on the ability to control these interactions.

An ongoing challenge is to explain the underlying physics of the motion of a *contact line*, a triple juncture of the solid/air, solid/liquid, and liquid/air interfaces. When the system is at rest, the three interfacial energies, determined by the energy per unit area γ_S ($S = sa$, sl, or la) on each surface, are in balance, and an equilibrium contact angle θ satisfying

$$\gamma_{sa} - \gamma_{sl} - \gamma_{la}\cos\theta = 0 \tag{1}$$

results. (See Figure 1. A derivation appears in [13].) However, the dynamically evolving contact line requires much more subtle modeling involving the interaction among multiple-length scales; the reason for this is born in the underlying fluid dynamics.

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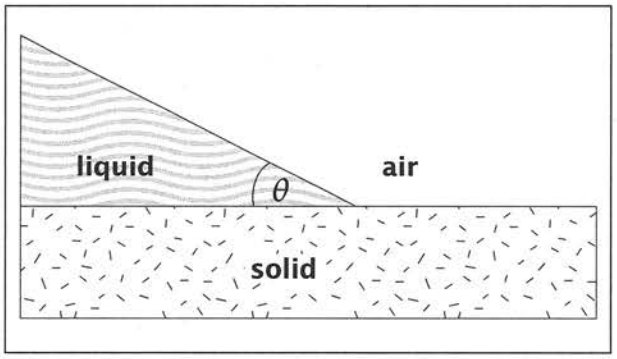

Figure 1: Simple trigonometry is all that is needed to derive Young's law (1), which is the equation for the equilibrium contact angle. However, in cases like complete wetting or driven contact lines a dynamic model is required. Physicists have been fascinated by this problem for decades.

The classical theory of fluids [1] tells us that when a viscous fluid meets a solid boundary, the correct model for the boundary is a "no-slip" condition on the solid/liquid interface.[1] Mathematically this requires setting the fluid velocity to be zero on the solid boundary. While this makes sense for the *Navier-Stokes equations* (describing the motion of an incompressible fluid) in bounded domains, its relevance to the moving contact line problem is dubious. The problem is that a moving contact line coupled with a no-slip condition on the liquid/solid interface results in a multivalued velocity field. This means that the velocity field is not

[1] *See [15], pp. 676–680, for a comprehensive discussion of the history of the "no-slip" boundary condition.*

well defined at the contact line because the limit along the surface is zero, while the limit along the liquid/air interface (which is moving) is nonzero. Regardless of the liquid/air interface model, the tangential component of force exerted by the fluid on the solid diverges whenever the velocity is multivalued at the contact line [14, 18].

The fact that such a paradox exists is hardly surprising. We should not expect to find a self-consistent *universal* hydrodynamic model that does not incorporate the surface chemistry. Several models have been proposed to study the motion of moving contact lines. All of them involve adding an additional effect on a microscopic length-scale. The two that we discuss in the next paragraphs are (1) weakening the no-slip boundary condition via a slip condition effective at small scales and (2) incorporating the effect of long-range "Van der Waals forces" between the liquid and solid.

Perhaps the simplest context in which to test these theories is that of thin viscous coating flows. For such problems a lubrication approximation simplifies bulk flow fluid dynamics to a single equation, relating the depth-averaged horizontal fluid velocity to the shape and thickness of the liquid/air interface. The *Navier slip* condition[2] near the liquid/solid interface demands that the velocity at the interface be proportional to its normal derivative:

$$u = \frac{\partial u}{\partial z} k(h) \quad \text{at} \quad z = 0. \tag{2}$$

Here u is the vector-valued horizontal fluid velocity and z is the variable in the direction normal to the solid surface. The parameter $k(h)$ is a slip parameter and can depend on the thickness h of the film. We can think of condition (2) as a generalization of the standard no-slip condition, which corresponds to $k \equiv 0$ in (2).

Another choice for removing the singularity due to no slip is to include microscopic scale forces, in the form of long-range *Van der Waals* (VW) interactions between the liquid and solid substances, near the contact line. The most systematic way to do this is via an additional body force in the fluid of the form[3]

$$\Pi(h) = A_D h^{D-5}, \tag{3}$$

where D is the dimension of the substrate.[4] Here A_D is the Hamaker constant, depending on the dimension of space and also on the strength of the interaction between the liquid and solid particles. The sign of A_D depends on whether the VW forces are attractive or repulsive. The particular power in (3) comes from assuming the particles in the fluid interact with particles in the solid substrate via a "nonretarded" potential. The references [13] and [20] and the references therein provide more discussion of this and other potentials.

The lubrication approximation can be derived from a systematic rescaling and asymptotic expansion of the Navier-Stokes equations in the limit of vanishing *capillary number* C_a and *Reynolds number* R_e, two dimensionless parameters given by

$$Ca = \frac{3\nu V}{\gamma}, \quad R_e = \frac{\rho V h_0}{\nu}, \tag{4}$$

where ν is viscosity, γ is surface tension, and V is the characteristic velocity of the film. The result is the dimensionless lubrication equation

$$\begin{aligned} &h_t + \nabla \cdot (f(h)(\nabla \Delta h - \nabla g(h))) = 0, \\ &f(h) = h^3 + b^{3-p} h^p, \\ &g(h) = (Ca)^{1/2} h + C\Pi(h). \end{aligned} \tag{5}$$

Here b represents a dimensionless slip length, and C is a dimensionless parameter that depends on the Hamaker constant and the characteristic height h_0 of the film.

Typically only a subset of the terms in the equation appear in any one given paper. For example, Greenspan [16] derives (5) with $b > 0$, "singular slip" $p = 1 > 0$, and $\Pi(h) = 0$. Haley and Miksis [17] consider this same model with different integer values of $p = 0, 1, 2$. Williams and Davis [24] study film rupture due to Van der Waals interactions via an equation of the type (5) with $b = 0$ (no slip) and the incorporation of Van der Waals forces (with $\Pi < 0$). In all cases the highest-order term in the model describes fourth-order degenerate diffusion, a phenomenon we discuss in more detail in the next section.

The engineering and applied mathematics literature has had much discussion of the most appropriate boundary conditions for an equation of the form (5) near the vicinity of a contact line, especially in the context of a slip model.[5] During the past eight years mathematicians working in the field of nonlinear PDEs have become interested in this problem from a more analytical point of view.

In this article we explain some of the fundamental mathematics problems associated with such equations as well as some of the rigorous machinery and numerical methods that have been developed recently to attack these problems.

Fourth-Order Degenerate Diffusion

Diffusion equations arise in models of any physical problem in which some quantity spreads or smears out. The classical example is the heat equation $h_t = \nabla \cdot k \nabla h$ where the diffusion coefficient k controls the rate at which heat "diffuses" through

[2] *A generalization of the no-slip condition in which the fluid is allowed to slip tangentially along the solid boundary.*

[3] *As in §II.D of [13] and in §II.E of [20].*

[4] *That is, $D = 2$ for a film on a two-dimensional surface and $D = 1$ for a flow in the plane, bounded by a line.*

[5] *See §§II.B and V of [20] and the references therein. See also Hocking, J. Fluid Mech.* **239** *(1992).*

the medium. In order to understand the models proposed in equation (5) we need to understand something about *degenerate diffusion equations*, where the constant k depends on the solution u in a degenerate way, so that $k \to 0$ as $u \to 0$. A family of second-order degenerate diffusion equations is known as the *porous media equations* [21]:

$$h_t - \Delta(\Phi(h)) = 0, \tag{6}$$

where $\Phi'(h) > 0$ for $h > 0$ and $\Phi(h) \sim h^m$ as $h \to 0$. Here $m > 1$ makes the equation degenerate.

The Laplacian operator Δ endows the evolution equation (6) with some well-known special properties:

1. *Instantaneous smoothing* of the solution in regions of positive h, since the equation is uniformly parabolic (i.e., the "diffusion coefficient" is bounded away from zero) where the solution is bounded away from zero.
2. *Maximum principle.* The solution is bounded from above and below by its initial data. This is true regardless of whether or not $m = 1$ (heat equation) or $m > 1$.
3. *Well-posed weak solutions* for smooth nonnegative initial data.
4. *Finite speed of propagation* of the support of the solution.

The last property is special to *degenerate* diffusion ($m > 1$). The heat equation ($m = 1$) has infinite speed of propagation of the support.

Consider now the fourth-order analogue of (6),

$$h_t + \nabla \cdot (f(h)\nabla\Delta h) = 0. \tag{7}$$

In the context of thin film dynamics we are interested in questions of existence, uniqueness, and finite speed of propagation of the support of weak solutions of equations of the form (7). The important difference from the case (6) is that (7) is fourth order as opposed to second order. It is diffusive, so we have property (1), instantaneous smoothing where the solution is positive; but property (2), the maximum principle, is far from guaranteed. Indeed, if we take the nondegenerate case $f(h) = 1$, then solutions can change sign. This can be seen by simply examining the heat kernel for fourth-order diffusion in $\mathbf{R}^D$ and noting that unlike the well-known second-order heat kernel, the fourth-order heat kernel has an oscillatory exponentially decaying tail that changes sign. This behavior is illustrated in the color image shown on the cover of this issue. It is not immediately apparent why the nonlinear problem (7) should have solutions that preserve their sign.

What is remarkable is that the nonlinear structure of (7) can endow it with a positivity-preserving property. In particular, one can show for one space dimension for $f(h) = h^n$ with $n \geq 3.5$ on a periodic spatial domain that if the initial condition h_0 is positive, then the solution $h(x, t)$ is guaranteed to stay positive. In fact, one can derive an a priori pointwise lower bound depending only on the H^1 norm and minimum value of the initial data. This form of a weak maximum principle is due to the nonlinear structure of (7), not the structure of the fourth-order diffusion operator. It is noteworthy that other fourth-order degenerate diffusion equations with different nonlinear structure have weak solutions that change sign (F. Bernis, *Nonlinear analysis and applications*, 1987). Despite the positivity-preserving property for large n, solutions of (7) with smaller values of n computationally exhibit finite-time singularities of the form $h \to 0$. We discuss this phenomenon in more detail in the next section. The fact that such singularities may occur makes the development of a weak solution theory, analogous to that of the porous media equation, all the more difficult. Over the past few years, mathematical machinery, largely involving energy estimates and nonlinear entropies, have been developed to address these problems. Such methods have been used to prove weak maximum principles, to derive existence results for weak (nonnegative) solutions, and to prove results concerning the finite speed of propagation of the support of nonnegative solutions (F. Bernis, 1996 articles in *Adv. Differential Equations* and *C. R. Acad. Sci. Paris*).

Finite-Time Singularities and Similarity Solutions of Lubrication Equations

The study of finite-time singularities and similarity solutions of (7) began in the early 1990s by a group at the University of Chicago. The original project addressed the breakup of a thin neck in the "Hele-Shaw cell" when forced by external pressures. The experiment, performed by Goldstein at Princeton [11], can be modeled, via lubrication theory, by a fourth-order degenerate diffusion equation in one space dimension:

$$h_t + (h^n h_{xxx})_x = 0 \tag{8}$$

with "pressure" boundary conditions $h(\pm 1) = 1$, $h_{xx}(\pm 1) = -p$, and $n = 1$. Carefully resolved numerical computations revealed that this problem yields both finite and infinite time singularities for various initial data.

What is unusual about the structure of these singularities is that, while they locally have self-similar structure of the form

$$h(x, t) \sim \tau(t) H\left(\frac{x - a(t)}{l(t)}\right), \tag{9}$$

the time dependences τ, $l(t)$, and $a(t)$ are not determined by dimensional analysis of the PDE. Such anomalous "second type" scaling [3] arises in problems like the focusing solution of the porous media equation (Aronson and Graveleau, European J. Appl. Math. (1993)), where one solves a nonlinear eigenvalue problem to determine the profile H and the relationship between scales τ and $l(t)$.

However, in the case of the lubrication singularities above, the scaling relations are typically found by asymptotic matching involving the boundary conditions or matching to an intermediate length-scale.

The original work on the Hele-Shaw problem was subsequently generalized to the case of variable nonlinearity (other values of n) with other boundary conditions [10, 2] and to different fourth-order degenerate PDEs (SIAM J. Appl. Math (1996), by the author). The similarity solutions observed were found using careful numerical computations involving adaptive mesh refinement near the singularity. Scaling was observed for many decades in h_{min}. All of these papers make the following observations:

- All observed finite-time singularities of the form $h \to 0$ as $t \to t_c$ involve second type scaling behavior in which the similarity solution described in (9) satisfies the quasi-static equation $(f(h)h_{xxx})_x = 0$.
- Sometimes several kinds of similarity solutions can occur for different initial conditions within the same equation. The far field dynamics of the structure may cause the similarity solution to destabilize, at arbitrarily small length-scales, from one type of similarity solution to another [2].

As an example, consider equation (8) with $n = 1/2$, periodic boundary conditions on $[-1, 1]$, and initial condition

$$h_0(x) = 0.8 - \cos(\pi x) + 0.25\cos(2\pi x). \tag{10}$$

The solution develops a finite-time "pinching" singularity with a simultaneous blowup in the fourth derivative. The third derivative forms a step function (see Figure 2). Near the pinch point the solution has a leading order asymptotic form

$$h(x,t) \approx c(t_c - t) + \frac{p(x - x_c)^2}{2},$$

where t_c is the time of pinch-off and x_c is the pinch point and the constant p is the curvature of the interface at the time of pinch. The blowup in higher derivatives can be seen only in higher-order terms:

$$h_{xxx} \approx \frac{cx}{\sqrt{c(t_c - t) + p(x - x_c)^2/2}},$$

so that the local curvature h_{xx} has the form

$$p + \frac{c}{p}\sqrt{c(t_c - t) + p(x - x_c)^2/2}.$$

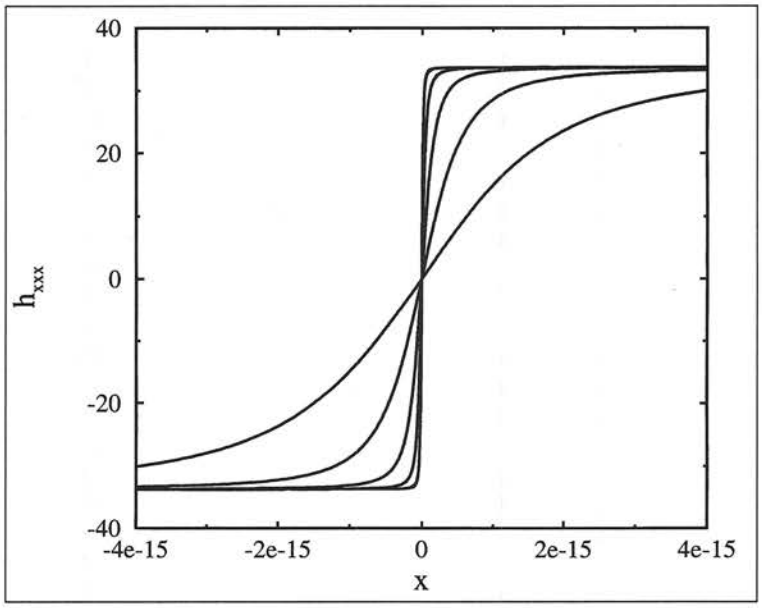

Figure 2: Onset of initial singularity in solution of (8) with $n = 1/2$ and initial data (10). Formation of a jump discontinuity in the third derivative. The solution can be continued after the initial pinch-off singularity. We discuss the continuation of this particular example later in this paper (see Figures 3–5).

This scaling structure of the singularity was confirmed via numerical simulations using a self-similar adaptive mesh refinement code that resolved the singularity over thirty orders of magnitude in $h(x_c, t)$. The solution can be continued after the initial pinch-off singularity. We discuss the continuation of this particular example later in this paper (see Figures 3–5).

The fact that we can rigorously prove that finite-time singularities cannot occur for $n \geq 3.5$ yet they are observed for certain $n < 2$ suggests the existence of a *critical exponent*. This is a value of $n_* > 0$ for which solutions to (8) stay positive whenever $n > n_*$ and where finite-time singularities are possible for $n \leq n_*$. To date no such n_* has been established, but numerical simulations suggest that $1 < n_* < 3.5$. It is also not clear whether n_* depends on boundary conditions. Since singularities appear to be localized, it is reasonable to expect that n_* might be independent of boundary conditions. It is an interesting open question whether this behavior persists in higher space dimensions ($D > 1$).

Entropies, the Weak Maximum Principle, and Weak Solutions

In the previous section we discussed the open problem of finding a "critical exponent" associated with strictly positive initial data: equations with exponent larger than n_* have solutions that remain strictly positive, while ones with exponents less

than n_* allow for the possibility of finite-time singularities. Critical exponents are also relevant for the weak solutions that continue the evolution after a "touch down" singularity or that evolve nonnegative initial data. Here the critical exponent n_{crit} separates equations for which the solution has increasing support from equations for which the support of the solution cannot increase. For the porous media equation (6), the support of the solution is always monotonically increasing, regardless of the size of $m > 1$. For the lubrication equation (8) with $D = 1$, the support of the solution cannot increase whenever $n \geq 4$, as is shown in [6]. On the other hand, there are solutions with support that eventually increase to fill the entire domain for all $n < 3$. It has been conjectured that the critical exponent for increasing support is $n_{crit} = 3$, but this remains to be proved.

The exact value of the critical exponent has important ramifications for the moving contact line problem. If indeed $n_{crit} = 3$, it tells us that there are no solutions of (5) with $b = 0$ (no slip) that describe a moving contact line. Such a result would not be surprising. It is consistent with the fact that such a scenario introduces a multivalued velocity field that is known to produce infinities in the physics (hence the introduction of the slip terms that give $n < 3$).

Examples of known exact solutions support the conjecture that $n_{crit} = 3$ in both one and two space dimensions. One class of examples is known as the "source type solutions", solutions that start as a delta function at the origin and spread out in a self-similar way while conserving their mass. Starov [22] looked for such solutions to (7) with $f(h) = h^3$ in two space dimensions. He was trying to find a similarity solution to describe spreading drops under the influence of surface tension. What he discovered was that the resulting ODE for the similarity solution did not have any solutions of compact support. That is, there are no similarity solutions describing spreading drops with no-slip on the solid/liquid interface. Bernis and collaborators[6] showed that in all space dimensions source type solutions ($f(h) = h^n$) exist for $n < 3$ and they cease to exist for $n \geq 3$. What is interesting is that this critical exponent cannot be predicted from dimensional analysis of the equation; it is determined by properties of the ODE for the shape of the similarity solution. Traveling wave (i.e., advancing front) solutions also change behavior at the critical exponent[7] of 3.

We now discuss some of the key ideas used to prove results about the PDE (7). A seminal paper in the mathematical development of the theory of weak solutions for lubrication-type equations is the work [7] by Bernis and Friedman. There they showed that, in addition to conservation of mass,

$$\frac{\partial}{\partial t}\int h(x)dx = 0, \tag{11}$$

and surface tension energy dissipation,

$$\frac{\partial}{\partial t}\int |\nabla h|^2 = -\int f(h)|\nabla \Delta h|^2 dx, \tag{12}$$

equations of the type (7) possess a nonlinear *entropy* dissipation of the form

$$\frac{\partial}{\partial t}\int G(h) = -\int |\Delta h|^2 dx. \tag{13}$$

Here $G(h)$ is a convex function satisfying $G''(h) = 1/f(h)$. For the case $f(h) = h$ (e.g., Hele-Shaw) the entropy $\int G(h)$ is of the form $\int h \log h$; hence the name "entropy" was born [9] to describe this object. Using the entropy (13), Bernis and Friedman proved that in one space dimension the critical exponent n_*, above which singularity formation is forbidden, satisfies $n_* < 4$. The proof uses the fact that (12) and conservation of mass imply an a priori bound on the $C^{1/2}$ norm of the solution while (13) insures a bound on $\int h^{2-n}$. This gives an a priori pointwise lower bound for the solution.

It turns out that the integral $\int G(h)dx$ above is not the only dissipative entropy. In one dimension we also have a family of entropies satisfying

$$\frac{\partial}{\partial t}\int G^s(h) \leq 0, \quad (G^s)'' = \frac{h^s}{f(h)}, \tag{14}$$

where $\frac{1}{2} \leq s \leq 1$. Taking $s \to \frac{1}{2}$ gave the upper bound $n_* \leq 3.5$ proved in [10].

The generalized entropy plays an important role in the development of a weak existence theory for nonnegative solutions from nonnegative initial data and for proving results on finite speed of propagation of the support. Uniqueness of weak solutions still remains an open problem. Later in this paper we see how entropies have also been used recently to design numerical methods for solving these equations.

Weak Solutions versus Constitutive Laws for Moving Contact Lines

The recent results on weak solutions of (7) have interesting ramifications for the moving contact line problem. Consider, for example, equation (5) with $f(h)$ as given in (2) with $b > 0$, $0 < p < 3$, and $g(h) = 0$. This particular model has been used many times to describe motion of a moving contact line in either a partial wetting (where there exists an equilibrium configuration that locally solves Young's law (1)) or complete wetting context (where the liquid energetically prefers to wet the solid). Greenspan and McKay considered this model with "singular slip" ($p = 1$) and made an argument that an additional boundary condition at the contact

[6] *In Nonlinear Anal., TMA (1992), and European J. Appl. Math. (1997).*

[7] *Boatto et al., Phys. Rev. E.* **48** *(6) (1993).*

line, in the form of a constitutive law, was required to obtain a well-posed model. Such conditions make sense for nondegenerate fourth-order equations, but these arguments do not directly carry over to the general case where $f(h) \to 0$ as $h \to 0$.

On a more physical level, we see that the constitutive law and fixed contact angle models may make sense locally at a contact line, but they do not address things such as topological transition, i.e., what happens when two contact lines collide, or when a film ruptures and a new contact line forms.

Recent progress has been made at constructing more robust models for certain specific cases. For example, in the case of complete wetting we would like to construct a solution that has a zero contact angle and will eventually spread to cover the entire surface. It was proved in [6, 9] that such a solution does exist (for $D = 1$) for all slip conditions (2) with $0 < p < 3$. The solution is for general H^1 initial data and includes such phenomena as film rupture and droplet merger (see the computational example in the next section). The method of construction is to use the weak maximum principle for such problems and to construct a positive solution of a regularized problem (see, e.g., equation (18) below) and then pass to the limit in the regularization parameter. These results have recently been extended to higher space dimensions.[8] The higher-dimensional proof does not directly use the regularization (18), since it does not guarantee positive approximations in more than one dimension. However, the recent existence results are derived using higher-dimensional forms of the generalized entropies (14).

Another recent manuscript by F. Otto proves the existence of a fixed contact angle solution in one space dimension of (7) with $f(h) = h$. An interesting open problem is to try to extend this result to prove existence of fixed contact angle solutions for other slip models.

Van der Waals Forces and Superdiffusion

The Van der Waals model with $b = 0$ and $g(h) = C\Pi(h)$ also yields an interesting set of mathematical problems. Here we consider models of the type

$$\frac{\partial h}{\partial t} = -\operatorname{div}(h^3(\nabla(\Delta h - \Pi(h)))). \tag{15}$$

The singularity in $\Pi(h)$ (from (3)) yields an evolution equation (15) that has fourth-order *degenerate* diffusion and second-order superdiffusion. The latter refers to cases where the diffusion coefficient blows up as $h \to 0$. Superdiffusive problems are known from [12] and the references therein to have some strange behavior, including infinite speed of propagation of the support (as in the case of regular, nondegenerate diffusion) as well as the possibility of extinguishing of the solution in finite time.

In the case where $\Pi(h)$ is positive (attractive forces) this could lead to a model where the superdiffusive term leads to some unphysical behavior for the solution. However, it turns out that the model (3) for long-range Van der Waals interactions is valid only on a mesoscopic length-scale, that of 100–1000 Ångstroms. The model breaks down when the film reaches a molecular-scale thickness. There are two ways of dealing with this breakdown of continuum theory: one is to use a modified continuum model with a cutoff of the singularity in (3) on a molecular scale. The other is to use a molecular model on this scale. In a 1994 article in *Nonlinearity*, the author and Mary Pugh considered the former approach for the case of solutions of (3) that depend on only one space coordinate. We showed that if one uses a "porous media" type cutoff of (3), where the effective second-order diffusion coefficient behaves like the nonlinear term in (6) with $1 < m < 2$, then there exists a solution to (15) with support that eventually increases to fill the domain and has, almost every time, a zero contact angle at the edge of the support. Numerical simulations of the model show that the "porous media" cutoff dominates the behavior of the solution at the edge of its support.

A number of authors have performed simulations of molecular dynamics models of moving contact lines (see, e.g., [25, 23, 19]). However, the problem with a purely molecular model is that it is impossible to put enough particles in the system in order to see the interaction of the molecular scale with macroscopic structures several orders of magnitude larger than the molecular scale. An interesting and difficult problem is the understanding of the interactions between these microscopic effects and the large-scale dynamics such as surface tension.

Numerical Methods for Solving Lubrication Equations

The complex structure of the fourth-order PDE poses a challenging problem for the design of numerical methods for solving these problems. For the computation of nonnegative weak solutions, a nonnegativity-preserving "finite element method" was proposed in [5]. This method allows for solutions with positive initial data to lose positivity; a variational problem involving a Lagrange multiplier must then be solved to advance the nonnegative solution.

Even when the analytical solution is strictly positive, the solution of a generic scheme may become negative, especially when the grid is underresolved. And once the numerical solution becomes negative it cannot always be continued in time in

[8] *In Dal Passo et al., SIAM J. Math. Anal.* **29** *(2) (1998), and references therein.*

a unique or stable way. When a positive approximation of the solution is desired, it has been necessary to do computationally expensive local mesh refinement near the minimum of the solution in order to avoid such premature or "false" singularities [10]. Other examples include flow down an inclined plane,[9] where resolution was required at the apparent contact line, and the approximation of nonnegative weak solutions via strong solutions [8].

Recent work of L. Zhornitskaya and the author [26] shows that it is possible to use the entropy ideas above for smooth solutions of the PDE to construct numerical schemes that preserve positivity of the solution and hence have global solutions.

For example, consider a one-dimensional periodic domain divided up into N equally spaced intervals of size Δx, with nodes $x_0, \dots, x_N$. Let y_i approximate $h(x_i)$, and denote by

$$y_{x,i} = \frac{y_{i+1} - y_i}{\Delta x}, \qquad y_{\bar{x},i} = \frac{y_i - y_{i-1}}{\Delta x},$$
$$y_{\bar{x}x,i} = \frac{y_{\bar{x},i+1} - y_{\bar{x},i}}{\Delta x}, \quad y_{\bar{x}x\bar{x},i} = \frac{y_{\bar{x}x,i} - y_{\bar{x}x,i-1}}{\Delta x}$$

the finite differences in space.

The coupled system of ODEs

$$\begin{aligned} &\partial_t y_i + (a(y_{i-1}, y_i) y_{\bar{x}x\bar{x},i})_x = 0, \\ &i = 0, 1, \dots, N-1, \\ &y_i(0) = h_0(x_i), \end{aligned} \tag{16}$$

is a continuous-time discrete-space approximation of the PDE

$$\partial_t h + \partial_x (f(h) \partial_x^3 h) = 0$$

provided $a(y_{i-1}, y_i)$ approximates $f(h(x))$ (again, let $f(h) \sim h^n$ as $h \to 0$) on the interval $[x_{i-1}, x_i]$. One example of a choice of a is $a(s_1, s_2) = 0.5(f(s_1) + f(s_2))$.

While any choice of $a(s_1, s_2)$ yields a scheme that satisfies the discrete form of conservation of mass (11) and surface tension energy dissipation (12), only the special choice of

$$a(s_1, s_2) = \begin{cases} \frac{s_1 - s_2}{G'(s_1) - G'(s_2)} & \text{if } s_1 \neq s_2, \\ f(s_1) & \text{if } s_1 = s_2, \end{cases} \tag{17}$$

yields a scheme that dissipates a discrete form of the entropy (13) and preserves positivity of the numerical solutions for all $n \geq 2$. The lower bound on the solution depends on the grid size for $2 \leq n < 3.5$ and is independent of the grid size for $n \geq 3.5$. This special choice of discretization yields a scheme that, for all $n \geq 2$, has global solutions for arbitrary grid size and converges to a positive solution of the PDE as $O((\Delta x)^2)$.

[9] *As in Bertozzi and Brenner, Phys. Fluids* 9 *(3) (1997).*

This idea can be generalized to an abstract finite-element setting. For positive solutions the "entropy-dissipating" (EDS) finite-element method discussed in [26] differs from the one proposed in [5] only in that for the EDS scheme a nonlinear function of the solution $G'(z)$ is assumed to be in the element space instead of the solution z itself and an additional numerical integration rule is imposed. For solutions that lose positivity the scheme in [5] requires solving a variational problem, while EDS schemes are guaranteed not to lose positivity. We expect that the best choice of scheme will depend on the specific problem of interest.

We now present a computational example from [26] that illustrates the effectiveness of using a positivity-preserving (EDS) scheme over a generic one. Consider the example discussed earlier with initial condition (10) and $n = 1/2$. We discussed the formation of a finite-time singularity that exhibited a discontinuiuty in third derivative as $h \to 0$. From [7, 6, 9] we know that the solution can be continued in time as the limit of a sequence of positive approximations. That is, consider the regularization

$$\begin{aligned} &h_{\epsilon t} + (f_\epsilon(h_\epsilon) h_{\epsilon xxx})_x = 0, \\ &f_\epsilon(h_\epsilon) = \frac{h_\epsilon^4 f(h_\epsilon)}{\epsilon f(h_\epsilon) + h_\epsilon^4}. \end{aligned} \tag{18}$$

Coarse Grid Computation. Generic Scheme.

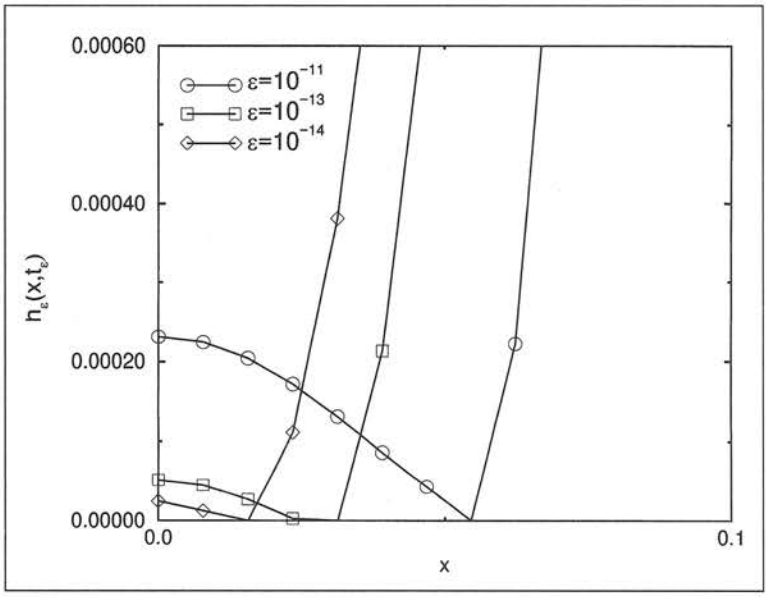

Figure 3: Failed attempt to compute, using a generic difference scheme on a coarse grid, the positive approximations of the weak continuation after the initial singularity described in Figure 2. Final times $t \approx$ 0.00086, 0.00076 and 0.00074 correspond to $\epsilon = 10^{-11}, 10^{-13}$, and 10^{-14}; 128 grid points on [0,1]; $\log_{10}(\min \Delta t) = -14$. We could not continue computing beyond these times, since the numerical solution becomes negative.

Coarse Grid Computation. Entropy Dissipating Scheme.

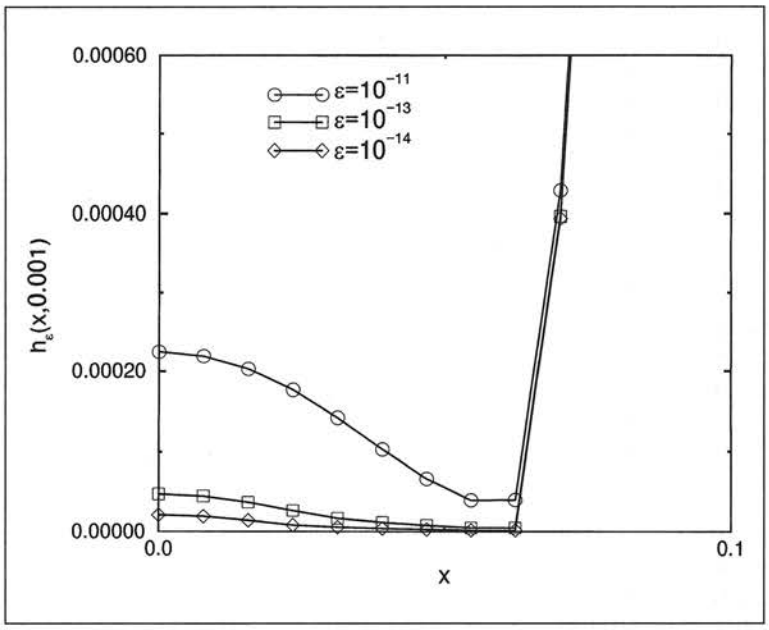

Figure 4: Successful attempt to compute, using an entropy dissipating scheme on a coarse grid, the numerical solution at fixed time $t = 0.001$, $\epsilon = 10^{-11}$, $\epsilon = 10^{-13}$, and $\epsilon = 10^{-14}$; 128 grid points on [0,1]; $\log_{10}(\min \Delta t) = -6.6$ for $\epsilon = 10^{-11}$, -7.2 for $\epsilon = 10^{-13}$, and -7.4 for $\epsilon = 10^{-14}$.

Fine Grid Computation. Entropy Dissipating Scheme.

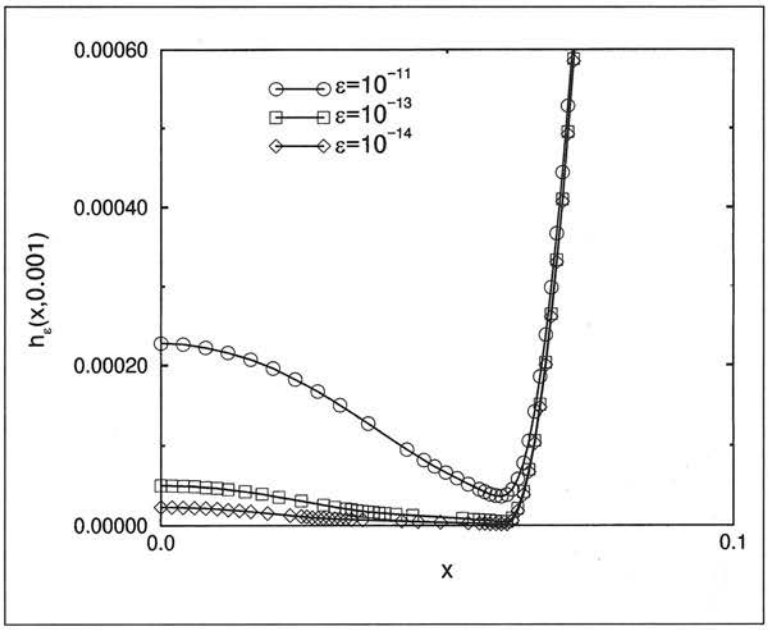

Figure 5: Comparison of computation in Figure 4 with numerical solution on a fine grid. Same fixed time $t = 0.001$, $\epsilon = 10^{-11}$, $\epsilon = 10^{-13}$, and $\epsilon = 10^{-14}$; 1,024 grid points on [0,1]; $\log_{10}(\min \Delta t) = -6.7$ for $\epsilon = 10^{-11}$, -7.0 for $\epsilon = 10^{-13}$, and -7.3 for $\epsilon = 10^{-14}$.

Since

$$f_\epsilon(h_\epsilon) \sim \frac{h_\epsilon^4}{\epsilon} \quad \text{as } h_\epsilon \to 0$$

we know that for all $\epsilon > 0$ the analytical solution of the regularized problem is positive. In [8] a nonnegative weak solution was computed numerically by taking successively smaller values of ϵ in the above. That paper used a scheme of the type (16) with $a(s_1, s_2) = f(0.5(s_1 + s_2))$. A fine grid was required to resolve the spatial structure and keep the numerical solution positive in order to continue the computation. Here we show that an entropy-dissipating scheme does a much better job at computing this problem without requiring excessive spatial resolution.

Figure 3 shows the computational results obtained by the generic scheme for three values of the regularization parameter $\epsilon = 10^{-11}, 10^{-13}$, and 10^{-14} on the grid that had 128 points on $[0, 1]$. In all of those cases we prescribed the final time to be 10^{-3}. However, the generic scheme developed a singularity earlier, which made us unable to compute the solution at the time prescribed.

Figure 4 shows the results that the entropy-dissipating scheme gave for the same input. In this case we did successfully compute the numerical solution at $t = 10^{-3}$. Note that in both cases we used the same purely implicit method for time integration, choosing the time step Δt small enough to ensure that the discrete-time system shows the same behavior as a continuous-time one.

Figure 5 shows the results obtained by the entropy-dissipating scheme on a much finer grid, namely, on the one that had 1,024 points on [0,1]. Note that even though the graphs look much smoother now, they show very good agreement with those shown in Figure 2.

Remarks

The contact line problem has generated some very interesting and difficult mathematical problems associated with the model equations discussed in this paper. In particular, questions of uniqueness of weak solutions and the precise value of critical exponents remain rigorously unresolved. In the case of critical exponents for finite-time pinch-off, it is difficult even to conjecture what the correct value might be. Much of the work on this particular aspect of the thin film equations is numerical, and this work has shown what is probably just a small subset of the kind of behavior that is possible for solutions of higher-order degenerate diffusion equations.

We find that the dynamics of the moving contact line models can lead to complicated structure of the solution in a neighborhood of the contact line. Indeed, the complications associated with the models described here have led applied math-

ematicians to look at new formulations for removing the singularity at the contact line [4].

It is the hope of the author that this article will spark more interest in these problems within the mathematical community which could lead to fruitful interactions with physicists and engineers working in this field.

Acknowledgments

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References

[1] D. J. Acheson, *Elementary fluid dynamics*, Oxford Univ. Press, Oxford, 1990.

[2] Robert Almgren, Andrea L. Bertozzi, and Michael P. Brenner, *Stable and unstable singularities in the unforced Hele-Shaw cell*, Phys. Fluids **8** (6) (June 1996), 1356–1370.

[3] G. I. Barenblatt, *Scaling, self-similarity, and intermediate asymptotics*, Cambridge Univ. Press, New York, 1996.

[4] G. I. Barenblatt, E. Beretta, and M. Bertsch, *The problem of the spreading of a liquid film along a solid surface: A new mathematical formulation*, Proc. Nat. Acad. Sci. U.S.A. **94** (1997), 10024–10030.

[5] John W. Barrett, James F. Blowey, and Harald Garcke, *Finite element approximation of a fourth order degenerate parabolic equation*, 1997, to appear.

[6] Elena Beretta, Michiel Berstch, and Roberta Dal Passo, *Nonnegative solutions of a fourth order nonlinear degenerate parabolic equation*, Arch. Rational Mech. Anal. **129** (1995), 175–200 .

[7] F. Bernis and A. Friedman, *Higher order nonlinear degenerate parabolic equations*, J. Differential Equations **83** (1990), 179–206.

[8] A. L. Bertozzi, *Loss and gain of regularity in a lubrication equation for thin viscous films*, Free Boundary Problems: Theory and Applications (Proc. Internat. Colloq. Free Boundary Problems, Toledo, Spain, June 1993) (J. I. Díaz, M. A. Herrero, A. Liñán, and J. L. Vázquez, eds.), Pitman Res. Notes Math. Ser., vol. 323, Longman, 1995, pp. 72–85.

[9] A. L. Bertozzi and M. Pugh, *The lubrication approximation for thin viscous films: Regularity and long time behavior of weak solutions*, Comm. Pure Appl. Math. **49** (2) (1996), 85–123.

[10] Andrea L. Bertozzi, Michael P. Brenner, Todd F. Dupont, and Leo P. Kadanoff, *Singularities and similarities in interface flow*, Trends and Perspectives in Applied Mathematics (L. Sirovich, ed.), Appl. Math. Sci., vol. 100, Springer-Verlag, New York, 1994, pp. 155–208.

[11] Peter Constantin, Todd F. Dupont, Raymond E. Goldstein, Leo P. Kadanoff, Michael J. Shelley, and Su-Min Zhou, *Droplet breakup in a model of the Hele-Shaw cell*, Phys. Rev. E **47** (6) (1993), 4169–4181.

[12] Panagiota Daskalopoulos and Manuel del Pino, *Recent progress on superdiffusive nonlinear parabolic problems*, Reaction Diffusion Systems (Trieste, 1995), Lecture Notes Pure Appl. Math., vol. 194, Dekker, New York, 1998, pp. 107–119.

[13] P. G. de Gennes, *Wetting: Statics and dynamics*, Rev. Modern Phys. **57** (1985), 827.

[14] E. B. Dussan V and S. Davis, *On the motion of a fluid-fluid interface along a solid surface*, J. Fluid Mech. **65** (1974), 71–95.

[15] Sydney Goldstein, ed., *Modern developments in fluid dynamics*, vol. 2, Dover, Inc., 1965.

[16] H. P. Greenspan, *On the motion of a small viscous droplet that wets a surface*, J. Fluid Mech. **84** (1978), 125–143.

[17] Patrick J. Haley and Michael J. Miksis, *The effect of the contact line on droplet spreading*, J. Fluid Mech. **223** (1991), 57–81.

[18] Chun Huh and L. E. Scriven, *Hydrodynamic model of steady movement of a solid/liquid/fluid contact line*, J. Colloid Interface Sci. **35** (1971), 85–101.

[19] Joel Koplik, Jayanth Banavar, and Jorge Willemsen, *Molecular dynamics of Poiseuille flow and moving contact lines*, Phys. Rev. Lett. **60** (13) (1988), 1282–1285.

[20] Alexander Oron, Stephen H. Davis, and S. George Bankoff, *Long-scale evolution of thin liquid films*, Rev. Mod. Phys. **69** (3) (1997), 931–980.

[21] L. A. Peletier, *The porous media equation*, Applications of Nonlinear Analysis in the Physical Sciences (H. Amman et al., eds.), Pitman, New York, 1981, pp. 229–241.

[22] V. M. Starov, *Spreading of droplets of nonvolatile liquids over a flat solid*, J. Colloid Interface Sci. USSR **45** (1983).

[23] Peter A. Thompson and Mark O. Robbins, *Simulations of contact-line motion: Slip and the dynamic contact angle*, Phys. Rev. Lett. **63** (7) (1989), 766–769.

[24] Malcolm B. Williams and Stephen H. Davis, *Nonlinear theory of film rupture*, J. Colloid Interface Sci. **90** (1) (1982).

[25] Ju-zing Yang, Joel Koplik, and Jayanth Banavar, *Terraced spreading of simple liquids on solid surfaces*, Phys. Rev. A **46** (12) (1992), 7738–7749.

[26] L. Zhornitskaya and A. L. Bertozzi, *Positivity preserving numerical schemes for lubrication-type equations*, 1998, preprint.

About the Cover

Fourth-order diffusion (in R^2)of an initially nonnegative function with compact support. The top figure shows a surface plot of the positive part of the solution for the case of linear diffusion, $h_t = -\Delta^2 h$. The pattern of rings is due to the oscillatory behavior in the tail of the fourth-order heat kernel (behavior not present in second-order diffusion, like the heat equation). Fourth-order degenerate diffusion can remove the change in sign, as shown in the bottom surface. Here we start with the same initial data but evolve according to $h_t = -\nabla \cdot (h^2 \nabla \Delta h)$. Such degenerate diffusion equations arise in models for moving contact lines, as discussed in this article, starting on page 689.

Theory into Profit: Microsoft Invests in Mathematicians

Allyn Jackson

At a time when many companies have scaled back or eliminated their research efforts, Microsoft Corporation is betting millions on the notion that funding its own research will pay off. And it can afford the gamble: the company's revenues reached $11.35 billion in 1997. Although Microsoft will not disclose the budget for its think tank, Microsoft Research, it says it plans to spend $2.6 billion per year in research and development overall. The overwhelming dominance Microsoft enjoys in the world of personal computing software has brought a variety of reactions, ranging from the wisecracking—a CD-ROM satire of Windows features Bill Gates as a cyberpet who must be fed money to stay alive—to the dead serious—the Justice Department has brought an antitrust suit against Microsoft over the company's tactics for pushing its Internet browser. As a result, some have seen the growth of Microsoft Research as a publicity stunt designed to show that Microsoft is a good guy when it comes to funding research. Others have watched with envy as Microsoft snapped up some of the brightest stars in software research and development. Still others have applauded the company for providing a new haven for research when academia and the government are cutting back.

All of this might have passed unnoticed among mathematicians, who tend to be more accustomed to TeX and Unix than Word and Windows. But last July the mathematical community was startled to learn that Michael Freedman had become the first Fields Medalist ever to take a job in industry: he joined the Theory Group at Microsoft Research. The group is headed by statistical physicists Christian Borgs and Jennifer Chayes and also includes graph theorist Jeong Han Kim. According to Phillip Griffiths, director of the Institute for Advanced Study in Princeton, the formation of the Theory Group "is one of the potentially most interesting developments related to the mathematical community in a long time."

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A Research Lab is Born

Microsoft Research is the brainchild of the firm's chief technology officer, Nathan Myhrvold. He is someone who appreciates curiosity-driven research: he has a Ph.D. in physics (with a specialty in theoretical and mathematical physics) from Princeton University and as a postdoc studied cosmology with Stephen Hawking in Cambridge. Even after he came to Microsoft in 1986, Myhrvold remained interested in questions lying well outside the interests of the company. Last year he wrote a paper with a paleontologist in which they presented computer simulations showing that the tail of a large dinosaur might have been capable of cracking like an enormous bullwhip. When Myhrvold started Microsoft Research in 1991, he wasn't worried by the fact that no other software company did its own research. "We decided that we were of a size and our industry was in a state where it really made sense for us to put our own effort into inventing our future," he says.

Since then Microsoft Research has assembled a powerhouse staff. It now employs about two hundred fifty researchers, up from one hundred fifty

a year ago, and is slated to grow to six hundred by the year 2000. The top positions are filled by people with high quality credentials as well as hands-on experience in software development. The management bureaucracy is thin, comprising just three people: Richard Rashid, a computer scientist from Carnegie Mellon University who is Microsoft's vice president for research; Daniel Ling, an engineer from IBM who holds seven patents and is director of Microsoft Research; and James Kajiya, a graphics pioneer from Caltech who is assistant director. Microsoft Research comprises twelve groups whose areas range from speech and vision technology to cryptography to databases. Graphics is a special strength: In addition to Kajiya, one finds at Microsoft such stars as James Blinn, who rose to fame in the 1970s for his NASA animations of the moons of Jupiter and rings of Saturn, and Alvy Ray Smith, one of the founders of Pixar, which created *Toy Story*, the first entirely computer-generated film. Other luminaries include the creator of the VAX operating system, C. Gordon Bell; intentional programming guru Charles Simonyi; and laser printer inventor Charles Starkweather.

Microsoft Research has been the subject of a good deal of media attention, including a cover story in *Fortune* magazine late last year. The media often compare Microsoft Research to such legendary think tanks as Bell Laboratories and IBM Research. However, the comparison is premature. In their heydays Bell Labs and IBM Research spanned a much wider range of fundamental research than one finds at Microsoft. Bell Labs is famous not only for the invention of the transistor but also for developing the Unix programming language; IBM's innovations range from the hard disk drive to the programs that allowed Deep Blue to beat chess champion Gary Kasparov. The division of Bell Labs into AT&T Research and Lucent Technologies and the cutbacks at IBM Research have brought a more applied orientation to what they do today. Nevertheless, Andrew Odlyzko, head of the Mathematics and Cryptography Research Department at AT&T Labs, says, "if you look at how much unfettered research [Microsoft has], I would say it has still quite a bit less than" at AT&T, Lucent, or IBM.

One of the key differences is that those three labs cover a broad range of research in hardware, systems, and software, while Microsoft Research addresses only software. One would not find researchers at Microsoft producing a new surgical method for hip replacement, as IBM researchers recently did. The emphasis at Microsoft Research has been in areas such as computer graphics, databases, programming languages, operating systems, and networking, which have clear and immediate relevance to the company's main business. Odlyzko drily opines that Microsoft needs to do research in these areas "because they need to be able to build even more bloated software, loaded with novel features, to be able to persuade people to upgrade. This is their business plan.... It's just a no-brainer." However, with the formation of the Theory Group the goals of Microsoft Research seem to be expanding. "They are hiring people with much more freedom than was customary at Microsoft," Odlyzko remarks, "which is certainly very good."

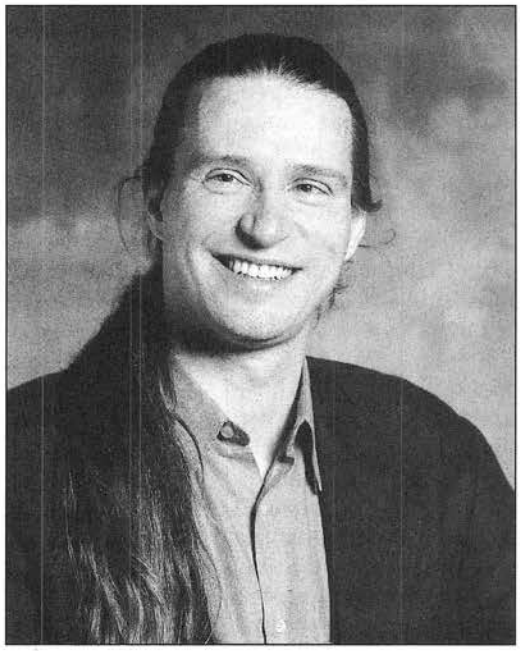
Spanning the Spectrum from Research to Products

The kind of person who fits perfectly into the culture at Microsoft Research is someone like Eric Horvitz, who works in the Decision Theory and Adaptive Systems Group. An expert in the use of Bayesian models for decision making, he writes theoretical papers in the subject and serves as the editor in this area for the *Journal of the Association for Computing Machinery*. But Horvitz is also very interested in Microsoft products: In a blaze of graphics that spill over two of the three workstations in his office, Horvitz explains how his work in decision theory formed the basis for the "Office Assistant" feature of the Office 97 software package, which uses Bayesian principles to decide when to offer help to the user and to guess at what kind of help might be needed. "I like getting my stuff into real-world products," Horvitz says. "But I also happen to like doing clean, easy-to-read papers with good results in them that can apply to anything." And he does mean anything: In addition to having a Ph.D., Horvitz earned an M.D. degree and has developed related methods to help trauma surgeons make good decisions under time and resource constraints.

Not everyone at Microsoft Research has to span the spectrum from research to product development, as Horvitz manages to do. What is more important is that the organization as a whole span that spectrum; the mathematicians in the Theory Group are at the far theoretical end. They were hired to do mathematics, which means that, like mathematicians everywhere, they write research papers, talk to colleagues, read journals, and attend conferences. They were not hired to solve somebody else's ugly integrals. As Kajiya puts it, "No research group is a service organization for the other groups." Chayes says her mathematical colleagues sometimes ask if Microsoft plans to bring in a lot of good mathematicians only to make them stop thinking about mathematics and start thinking about Microsoft products. "But why would we want to do that?" she asks. Microsoft hires plenty of good product developers, Kajiya points out. "We don't have to turn brilliant mathematicians into mediocre product developers."

While its distant connection to Microsoft products gives the Theory Group a lot of freedom, there are some risks. According to Griffiths one challenge facing the Theory Group is to be sure it cultivates that connection. "It's important for a number of

Jennifer Chayes



Christian Borgs

Photographs this page by Michael Moore. © 1998 Microsoft Corp.

reasons, not the least of which is to have support in the rest of the company," he says. "Not just in principle, but when push comes to shove and resource allocations are made, research should be seen as important." The Theory Group has to stay plugged into academic research while also staying plugged into the business of Microsoft. Says Griffiths, "This is what they have to balance."

The Microsoft Milieu

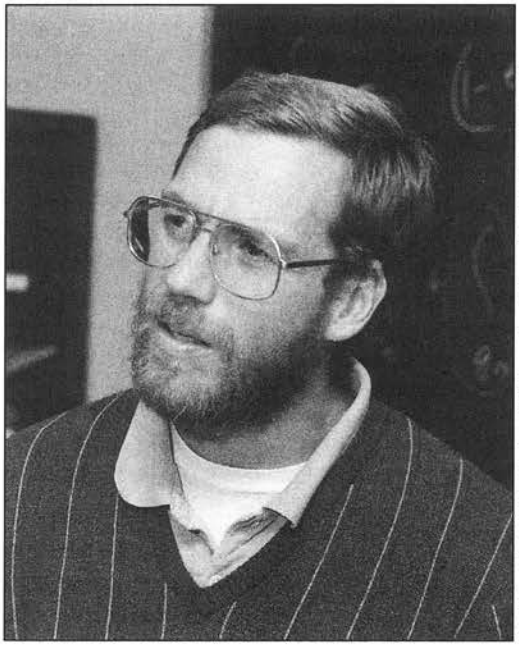
Microsoft makes its home in the Seattle suburb of Redmond. Seen at a distance, the company grounds bear some resemblance to a modern college campus. Up close one realizes that most colleges couldn't afford this kind of meticulous landscaping. And there are too few battered old Volvos and too many sparkling new BMWs for this to be academia. The glossy modern buildings, as well as several bustling construction sites, connote high-tech wealth. The moneyed atmosphere continues inside Building 9, home of Microsoft Research, where original works by well-known artists such as Richard Diebenkorn hang on the walls. According to Chayes, the artwork also serves a practical purpose as signposts to help the staff find their way through the building. For here the luxury slows down, giving way to a maze of corridors with rows of offices that come in a standard size (tiny) and are generally crammed with computer terminals, books, gadgets, and other paraphernalia. Microsoft Research isn't so far from academia after all. In fact, Chayes drove a group to lunch in her well-worn Honda.

When she moved to Microsoft in January 1997, Chayes left behind a position as professor of mathematics at the University of California, Los Angeles. Christian Borgs, who is married to Chayes, was a professor of physics at the University of Leipzig in Germany, where he headed a group in statistical physics. In trying to solve their intercontinental two-body problem, they considered an offer from AT&T Research. But when Nathan Myhrvold, an old friend of Chayes from their days as graduate students in Princeton, asked her and Borgs to launch the Theory Group at Microsoft Research, they jumped at the opportunity. Joining the group shortly thereafter was Jeong Han Kim, who had been at AT&T Research for four years and was chafing a bit under what he felt was pressure to shift his research into more applied directions. The group got an enormous boost in prestige when Michael Freedman decided in July 1997 to leave UC San Diego and come to Microsoft. (Borgs, Chayes, and Freedman have not yet resigned their academic positions, and during the 1997–98 academic year Freedman was spending only one week a month at Microsoft. He plans to be there full-time by next fall.)

Why couldn't Microsoft rely on academia to do the theoretical research it needed? Kajiya says that Microsoft is in fact stepping up its support of university research; a prime example is the $80 million computer science research center it has started at the University of Cambridge[1]. "But it's just not enough," he says. "If there isn't someone on the industry side who is capable of appreciating the result, then technology transfer may be impeded." In addition, Borgs points out, academia can be slow to respond to new opportunities in research, especially in interdisciplinary areas. As Chayes puts it, "I could not go to UCLA and say, 'These areas of research are very important, and if we bring these twelve people together, we can really have an impact. So can you please give me twelve positions?' That wouldn't go over well with my colleagues."

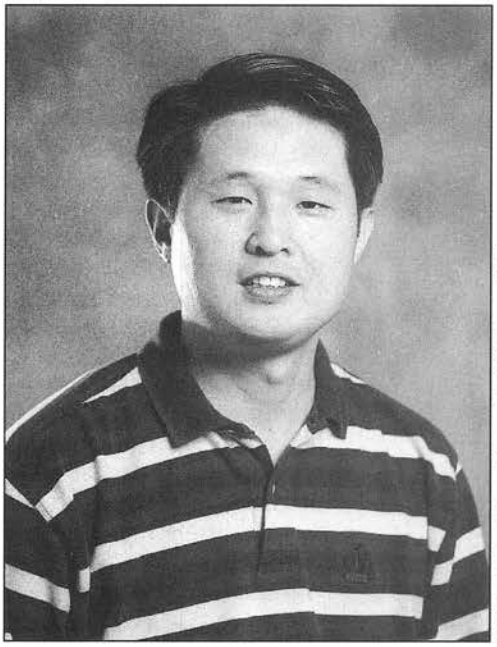
But at Microsoft Research, this is exactly what she and Borgs are able to do: They are aiming for a steady state of twelve mathematicians on staff who, among other things, will make a headlong as-

[1] *The April 24, 1998, issue of* The Chronicle of Higher Education *contains a special collection of articles about the influence of Microsoft on college and university campuses.*



Photograph courtesy Dept. of Mathematics, University of California, San Diego.

Michael Freedman



Photograph by Michael Moore. © 1998 Microsoft Corp.

Jeong Han Kim

sault on one of the central problems in theoretical computer science, the question of whether P equals NP (that is, whether certain algorithms that run in exponential time can be improved to run in polynomial time). Chayes says that the Theory Group is not as concerned about hiring in certain specified areas of mathematics as about getting excellent researchers with enthusiasm for fundamental problems in computer science. Joining the group at any one time will be eight to ten visitors, and perhaps four or five one- to two-year postdocs. Already the Theory Group has had a total of fifty visitors over the past year, for stays of anywhere from a half a day to six months. Sometimes long-term visitors are brought in to give courses on particular topics. When Borgs and Chayes wanted to learn more about the critical behavior of high-dimensional models in statistical physics, they bought out the teaching of Gordon Slade of McMaster University, who is an expert in the subject, and he gave them a four-month course on it. Slade also brought along a postdoc, Remco van der Hofstad, who received his Ph.D. in probability in Holland about a year ago.

With its visitors and postdocs, the Theory Group resembles a mini-mathematics institute. But unlike federally funded institutes that are accountable to the public, the Theory Group is accountable to the Microsoft shareholders. Therefore the group does not need the kind of formal scientific advisory boards one finds at publicly funded institutes (though it gets advice informally from many people in the mathematical sciences community). It also has a great deal more flexibility in how it spends money. In fact, according to Borgs and Chayes, the Theory Group spends as much as it wants on whatever it needs for its work. "We have no budget," Chayes says simply. At the beginning of the fiscal year, the Theory Group is asked to provide an estimate of big-ticket items; last year they bought some expensive computers and $50,000 worth of subscriptions to mathematics journals. Aside from such estimates, says Borgs, "from our point of view, it's essentially an unlimited pot. Whenever we need something, we just ask for it." Visitors are well paid, receiving a consulting fee of $300 per day, in addition to money to cover travel expenses. Theory Group members will not comment on their salaries, except to say that they are comparable to "healthy" academic salaries, but not "superstar" academic salaries. They also will not reveal the total cost of their group, but it is clear that they could easily run up a bill of over a million dollars a year.

While Borgs and Chayes are clearly thrilled with the opportunities they have at Microsoft, there are some tradeoffs. They made a big leap in leaving academia: she had tenure at UCLA, and he had a lifetime job as a civil servant in Germany. Making the move from industry back to academia is not always easy. For Freedman the risk is smaller, because a Fields Medal is pretty good insurance that he could return to academia if and when he wants to. All Microsoft employees are "at will employees", meaning that they could be fired at any time. This is a big change from the security that academic tenure offers. Microsoft does not provide pension plans of the kind one finds in academia, though the legendary Microsoft stock options could provide a comfortable retirement. As in academia, the staff at Microsoft Research are free to publish their work wherever they like. Decisions about when a patent is needed to protect intellectual property are made by the researchers themselves.

Microsoft wants to give the Theory Group plenty of freedom, but it still needs to be sure that its investment is worthwhile. How will it make such an evaluation? Largely on the quality of the group's research, as measured in the usual ways such things are measured in academia and by research funding agencies. According to Chayes, right now the Theory Group evaluates itself by writing reports akin to progress reports on research grants. One important factor will be the level of interactions

with other groups in Microsoft Research, which so far has been high. Might there be some kind of review in, say, five years, to assess how well the Theory Group has done? Myhrvold says no. "If three years from now people in that group all want to do something else, why should I make them wait five? Conversely, if they're going great and the question never comes up, well, terrific, more power to them."

"Managing research is always tricky," Myhrvold continues. The researchers "know more about their specialty than anybody else, so how are you going to measure them on that?" In such an endeavor one has to embrace a certain amount of uncertainty, and Microsoft is willing to do so. Even if the Theory Group were to succeed in its audacious quest to crack the problem of whether P equals NP, it is not clear what the payoff would be to Microsoft. "Broadly speaking, the theoretical implications of work like that could affect lots of our products," Myhrvold says. "And we could make lots of money on it. Now, exactly how is hard to say, because we don't have the result yet. And in any piece of research it's possible that you won't succeed. It's possible we'll succeed on a theoretical basis, but won't succeed in transitioning to products. But that's the risk you have to take."

P, NP, and All That

Michael Freedman is known for being an enthusiastic outdoorsman, and at forty-seven he looks the part, tanned and wiry. Enamored of big ideas, he is not one to sweat the small stuff. While the merits of stock options versus pension funds can elicit serious discussion from Borgs and Chayes, the subject only kindles Freedman's irreverence. "I used to think I was much more likely to be buried in an avalanche than to retire," he says. "Mount Rainier is very near Seattle, so that's a draw. It might reduce the risk of retiring." Like retirement, departure from academia was something he hadn't thought about. He is not leaving San Diego out of any dissatisfaction with the university. However, he finds the research environment at Microsoft more enticing than that in academia. At most university mathematics talks, he says, there is a "polite distance" between the audience and the speaker. The audience doesn't expect to learn much, but only to get a flavor of what the talk is about. "It's a little like watching television," he says ruefully. By contrast, when he went to speak at Microsoft, many people came up afterward, immediately wanting to nail down the details. "And I found that really exciting," he said. "They wanted to know if this was going to work or not, that day."

It might seem strange that Microsoft would want to hire Freedman, who is best known for his solution of the four-dimensional Poincaré conjecture and his classification of simply connected four manifolds, feats that won him a Fields Medal in 1986. In recent years his research interests have widened to include theoretical computer science and, in particular, the question of whether P equals NP. What follows is a brief description of some of the ideas that he and the other members of the Theory Group are working on.

A problem is in the class P (standing for "deterministic polynomial time") if there exists an algorithm that solves the problem within an amount of time that is bounded by a polynomial function of the size of the problem (i.e., the number of input bits). The algorithm is assumed to run on a computer based on the Turing machine model. The class NP (standing for "nondeterministic polynomial time") is defined as the class of problems for which it takes polynomial time to check whether a proposed solution actually is a solution. The naïve approach of trying out all possible solutions to an NP problem could take exponential time, since there are potentially many possible solutions to a typical NP problem. The question of whether or not there exist more clever algorithms that can find solutions in polynomial time—that is, whether P=NP—is the most fundamental problem in theoretical computer science. In 1972 Richard Karp showed that a host of hard-to-solve problems in computer science were in NP. Around that same time, Stephen Cook showed that problems in NP are all equivalent, in the sense that an algorithm that would solve one of them could be used to solve any of them.

In 1988 Edward Witten produced a physics interpretation of the knot polynomials discovered by Vaughan Jones, leading to what is now known as Jones-Witten theory. That same year, in a development that received less notice, computer scientists connected the Jones polynomial to the world of NP problems. The connection is rather simple: Take a fifth root of unity, $e^{2\pi i/5}$, and plug it into the Jones polynomials for links to produce a function that takes links to the set of algebraic integers. As Freedman puts it, "If you had an oracle that could tell you, when you inputted the link, what that algebraic integer was, then modulo that oracle, P would equal NP." This calculation is hard because the time required to carry it out rises exponentially with the complexity of the links.

Freedman began to wonder if there was a connection between this computer science result and Witten's work. "I remember in the fall of 1988 being struck by this idea that if Witten is telling us that the values of the Jones polynomial are physics, and the computer scientists are telling us that the values of the Jones polynomial represent universal computation, then one should try to build a computer which measures the physics in its computational step—the computer should somehow measure, certainly not calculate, the Jones polynomial." But he quickly found out that such a plan would be extremely difficult to carry

out. Nevertheless, he remained fascinated by the connection between physics and computation and had these ideas simmering on the "back burner" as he continued to work in topology. "But then I thought somehow it just couldn't sit on the back burner," he remarks. "At some point I felt that I needed to take five years and figure out whether something could be done with this." He has been working on it ever since.

The question of whether P equals NP arises for computers based on the Turing machine model. Are there other computing architectures in which P equals NP? One possibility is known as "quantum computing". In analogy to what happens in quantum mechanics, a quantum computer produces not one answer, but a superposition of all possible answers, with different probabilities of occurring. "That makes the game much more lively, because it means you have to be clever with your algorithms," says Freedman. "You have to arrange for the interesting information to be reinforced and the boring answers to somehow interfere in the sense of wave mechanics." Of course, such answers have a nonzero probability of being wrong. "From the point of view of a mathematician coming from a Platonic ideal with absolute precision, there's a little hurdle to get over," Freedman concedes. "That kind of small beauty mark definitely lies on quantum computation."

Christian Borgs and Jennifer Chayes are looking at related problems but from a very different viewpoint. They became interested in computer science about three years ago when they attended a talk by Scott Kirkpatrick on work he did with Bart Selman that revealed an affinity between phase transitions in statistical mechanics and NP problems. Cook's work in the 1970s showed that any problem in NP could be reduced to what is known as the k-satisfiability problem. Given N Boolean variables, form M clauses of length k by linking the variables within each clause with the "or" operator, and form a function F by linking the clauses with the "and" operator. The question is whether one can find values of the Boolean variables that make F a true statement. If N is large compared to M, there are many variables and few constraints, so generally it is easy to satisfy F. Conversely, if M is large compared to N, there are many constraints and few variables, so generally it is easy to show that it is impossible to satisfy F. But there is a certain value of the ratio M/N for which it is very difficult to say whether or not one can satisfy the function. Graphing M/N against the probability of solving the problem gives a curve that tends to a step function that takes values 1 and 0 as N tends to infinity.

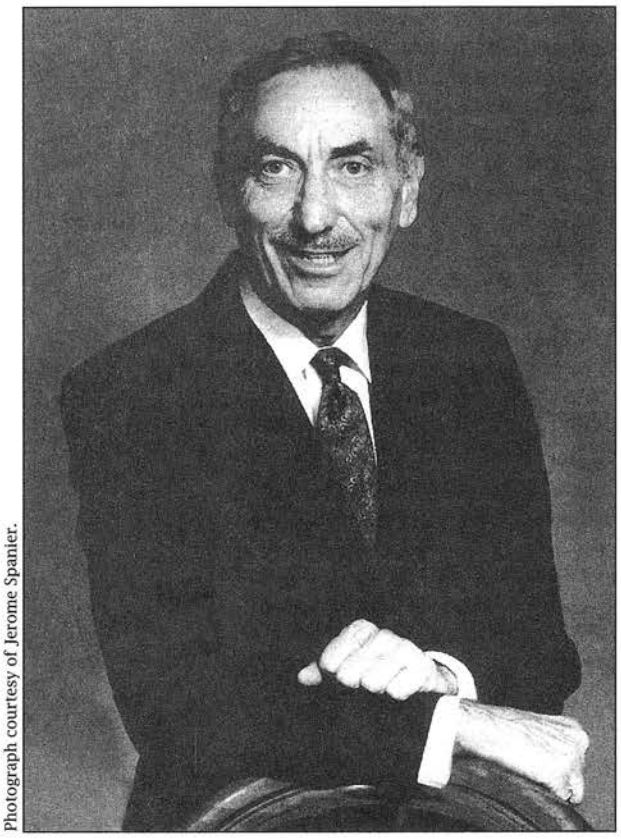
What fascinated Borgs and Chayes was the fact that this graph resembles the phase transitions they have studied in physics. For example, if one heats water and graphs temperature against volume, one gets a graph that develops a jump discontinuity as the volume tends to infinity, with the sharp change occurring at the boiling point for water. The k-satisfiability problem has applications to problems like airline scheduling, where there are many variables and constraints to be juggled. It turns out that the most efficient scheduling scenarios occur right at the phase transition. As Borgs puts it, "economics drives it toward the phase transition." This is an example of what is known in statistical physics as "self-organized criticality", in which the dynamics of the system tend to drive it toward the phase transition. These critical configurations are among the most fascinating problems in statistical mechanics.

While the difficulty of solving the k-satisfiability problem is bad news for airline schedulers, it may be good news for cryptographers. Rather than avoiding the hard instances of such problems, cryptographers want to home in on them, because the sheer difficulty of solving the problems provides a means for encryption. Borgs and Chayes are working on ways to apply their understanding of critical configurations of phase transitions in physics to helping cryptographers develop new codes. It was their interactions with the cryptographers at Microsoft Research that led Borgs and Chayes to consider this new dimension on their work. The connection to cryptography "is something that we never would have realized had we not come to Microsoft," says Chayes.

In contrast to the research of Borgs, Chayes, and Freedman, which has a distinct physics flavor, the work of Jeong Han Kim is in the areas of extremal graph theory, probabilistic methods, combinatorial optimization, and neural networks. He has worked in the area of "semi-random" methods in graph theory, which he used to settle a famous problem that had been open for sixty years. For this result he received the 1997 Fulkerson Prize, which is jointly sponsored by the AMS and the Mathematical Programming Society. Although Kim works in areas that have traditionally been close to theoretical computer science, his research is still quite distant from immediate application to something that Microsoft might sell. Asked what connection his work might have to Microsoft products, Kim describes a philosophy that might sum up the entire purpose of the Theory Group. "I can't say that in five years I am going to invent something. But I am going to research something, and I'm going to have something....If I find the truth, then the truth eventually will be useful."

Edwin Henry Spanier (1921–1996)

Morris W. Hirsch



Photograph courtesy of Jerome Spanier.

Edwin Spanier

Edwin Henry Spanier died of cancer in Scottsdale, Arizona, on October 11, 1996. Born in Washington, D.C., on August 8, 1921, he was graduated from the University of Minnesota in 1941 and then spent three years as a mathematician in the U. S. Army Signal Corps. He received his doctorate in mathematics in 1947 from the University of Michigan under the direction of Norman Steenrod. After a postdoctoral fellowship at the Institute for Advanced Study in Princeton, New Jersey, he joined the faculty at the University of Chicago in 1948. He was a Guggenheim Fellow in Paris in the academic year 1952–53, a member of the Institute for Advanced Study in 1958–59, and a Miller Research Fellow at Berkeley in 1961–62. His visiting appointments include positions in Argentina, Brazil, Canada, Chile, France, Germany, Italy, Spain, and Switzerland, and at UCSD and UCLA.

Spanier was appointed professor of mathematics at Berkeley in 1959 at the beginning of a period of rapid expansion of the mathematics department. An internationally recognized authority in the swiftly developing field of topology, he attracted first-class mathematicians as visitors and new faculty members. He played a major role in organizing new programs in geometry and topology, subjects in which Berkeley soon achieved preeminence. He served several times as vice chair and acting chair of the department and directed fourteen doctoral dissertations at Berkeley in addition to three at Chicago. In 1991 he became professor emeritus.

From his doctoral dissertation through the mid-1960s, and again in the last fifteen years of his life, Spanier's research was concentrated in algebraic topology. This subject, founded a century ago by Henri Poincaré to aid in the qualitative analysis of differential equations, was little known to most mathematicians when Spanier started his career. His dissertation supervisor, Norman Steenrod, together with Samuel Eilenberg, had just set out simple and powerful axioms for the main tool, homology theory; this cleared up much of the confusion endemic in a subject that combines geometry, algebra, and analysis. Spanier was at the forefront of the explosive development of algebraic topology during the next decade. The importance of his work was quickly recognized; in

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1950 he gave an Invited Address to the International Congress of Mathematicians at Harvard. Spanier's interest in topology continued throughout his career. Both his first paper in 1948 and one of his last, published in 1992, dealt with the Eilenberg-Steenrod axioms.

Spanier's first major contribution in topology was the theory of cohomotopy groups, which gave an algebraic classification of maps of polyhedra into spheres [4]. Together with S. S. Chern he pioneered the analysis of the homology groups of fibre spaces [1]. In a series of papers with the English topologist J. H. C. Whitehead, Spanier developed the new algebraic tool of duality in homotopy theory [5]. In 1966 his long-awaited book *Algebraic Topology* [3] was published. The first comprehensive modern treatment of the subject, it is still a fundamental source.

Ph.D. Students of Edwin Spanier

Clair Miller (1951)
Morris W. Hirsch (1958)
Elon Lima (1958)
Alphonse Thomas Vasquez (1962)
Robert Emmett Williamson Jr. (1963)
Samuel Feder (1964)
John Ucci (1964)
Benson Brown (1965)
Jose Alves (1965)
David Kraines (1965)
Denis Sjerve (1967)
Jon Goldstine (1970)
John Paul Alexander (1971)
Mark Luker (1975)
Kenneth Klingenstein (1975)
Gerald Eisman (1977)
Richard B. Hull (1980)

In all, Spanier published more than forty papers in algebraic topology, contributing to most of the major research areas in the field, including cohomology operations, obstruction theory, homotopy theory, imbeddability of polyhedra in Euclidean spaces, and topology of function spaces. Many of his results are now standard tools in all fields that utilize global geometrical reasoning. These include not only various subjects in pure mathematics, but also diverse areas in applied mathematics, including computer science, mathematical physics, economic models, and game theory. Interestingly, one of Spanier's theories, now called Alexander-Spanier homology, is currently being applied to analyze differential equations—a return to Poincaré's original use of algebraic topology.

In 1961 Spanier began a fruitful collaboration with Seymour Ginsburg of the University of Southern California, resulting in more than a score of papers on the structure of formal languages. This subject is of importance in several mathematical disciplines, including theoretical computer science and foundations of mathematics. Recently it has been applied in dynamical systems theory. Their work was driven by an operational perspective on formal languages: What formal operations on these objects are reasonable, and what are their effects? This view led them to abstract and study families of languages closed under specific operations. They also investigated abstract families of languages from this viewpoint and obtained a number of impressive results. In another approach, they investigated families of languages generated from a single grammar, machine, or structure using simple substitution operations.

The importance of their work can be seen from the review[1] of a 1983 article [2] by Spanier, S. Ginsburg, and J. Goldstine, "On the equality of grammatical families". The review states: "This paper presents a major and difficult decidability result in grammar form theory. It is proved that, given two arbitrary context-free grammar forms, it is decidable whether or not the family of one is contained in the other. This leads immediately to the decidability of the equality of two context-free grammar forms." This result is based on an earlier paper, "A prime decomposition theorem for grammatical families", in which the same authors obtained a prime decomposition for formal language families, closely analogous in form to the decomposition of whole numbers into prime factors.

Spanier's publications, as were his lectures, are characterized by unusual lucidity and precision and an even rarer quality of naturalness and simplicity. No matter how complex the subject, at the end the reader feels the theorems are the right ones, the hypotheses natural, and the methods as simple as possible.

Ed Spanier will be remembered as a gifted researcher, an inspiring teacher, an able administrator, and as a modest, friendly, wise, and helpful colleague.

References

[1] S. S. Chern and E. Spanier, *The homology structure of sphere bundles*, Proc. Nat. Acad. Sci. U.S.A. **36** (1950), 248–255.

[2] S. Ginsburg, J. Goldstine, and E. Spanier, *On the equality of grammatical families*, J. Comput. System Sci. **26** (1983), 171–196.

[3] E. Spanier, *Algebraic topology*, McGraw-Hill, New York, 1966.

[4] E. Spanier, *Borsuk's cohomotopy groups*, Ann. Math. **50** (1949), 203–245.

[5] E. Spanier and J. H. C. Whitehead, *Duality in homotopy theory*, Mathematika **2** (1955), 56–80.

[1] *Mathematical Reviews 85g:68037.*

Eugene Barry Fabes (1937–1997)

Carlos E. Kenig and Daniel W. Stroock

Editor's Note: *Eugene Barry Fabes was born in Detroit on February 6, 1937, obtained a Ph.D. from the University of Chicago in 1965, spent two years at Rice University, and then spent the rest of his professional career at the University of Minnesota. He was a student of Antoni Zygmund, wrote more than seventy-five papers in real and harmonic analysis, and was a longtime collaborator of Nestor Rivière. His death on May 18, 1997, was premature and unexpected.*

On May 18, 1997, Eugene B. Fabes died in Minneapolis of a heart attack that he had suffered a couple of days before. At the time of his death he was sixty years old. Everyone, even someone too young to sense mortality, knows that sixty is not very old.

In many ways Gene was an archetypical representative of his generation of Americans who went into mathematics in the 1960s. He grew up in Kansas City, majored in mathematics at Harvard, married Esther (his hometown girl), and headed into the family suitcase manufacturing business. Going into the family business meant going down to Atlanta, Georgia, in 1959. After a year of frustration with the family business and a culture of racial discrimination, Gene applied to graduate schools in mathematics. The following winter, Gene and Esther, together with their five-month-old child, decamped for Chicago. There she and Gene spent the next four and a half years of their lives: Gene studying mathematics under Antoni Zygmund, while Esther tended the family, which, by the time they left Chicago, included a second child and would eventually include a third.

What Gene's move to Chicago represents to a person depends heavily on the era in which that person grew up. To a child of the Great Depression the decision to abandon a secure job devoid of intellectual excitement in favor of an insecure existence filled with intellectual stimulation is an act of either grand heroism or equally grand stupidity. Unfortunately, in view of the job prospects, someone either applying to or emerging from graduate school in 1998 is increasingly likely to share this assessment. In fact, with increasing frequency we watch our own students follow Gene's steps in the opposite direction: that is, go to graduate school, get a Ph.D. in mathematics, and proceed to the "quant" department in an investment house. Thus, Gene's experience serves as a stark reminder of just how incredibly lucky Gene and his generation of Americans were.

According to Esther, Gene knew in high school that he loved mathematics. Presumably that is why he chose to major in mathematics at college. Be that as it may, Gene and his family expected that after graduation Gene would revert to mainstream behavior: go to work in the family business. None of this is so remarkable. On the contrary, the world has been and still is full of people who abandon their academic aspirations in favor of more practical goals. Nonetheless, even though many of these people experience an occasional twinge of regret about their choice, nearly none of them does what Gene did.

The fact that Gene felt that he could make such a decision is a tribute to his personal courage. Esther says that Gene's expectations at the time of his decision to leave business and enter graduate school were modest: he wanted out of the family business, he loved mathematics, and he was ready to take his chances, even if he had not spent a lot

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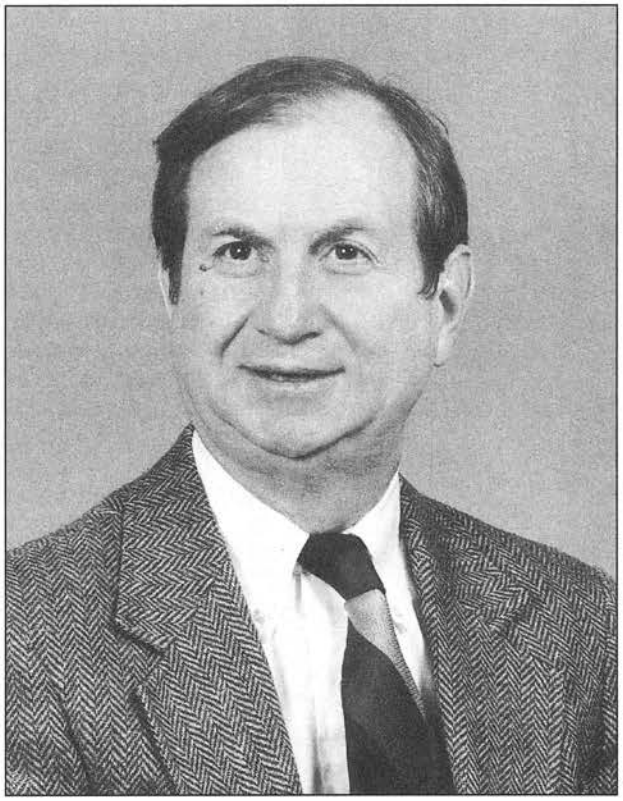
of time calculating what they might be. As it turned out, his chances were far better than he or anyone else had a right to predict, and this fact is a tribute to both Gene's native talent and the golden era of opportunity in which he and his generation of Americans lived.

First, the mathematics department that Gene entered at the University of Chicago was superb. Its faculty boasted several of the finest mathematicians of the time, and the Chicago graduate program had already produced much of the talent on which American mathematics would rely in the coming decades. Second, Gene soon found a niche for himself in the wonderful group attending the "Calderón-Zygmund Seminar", and it was there that Gene met Nestor Rivière, the first name to appear on what was to become a long list of collaborators. Gene chose Zygmund as his thesis advisor. Whether his selection reflects prescience or just dumb luck is hard to say, but Zygmund turned out to be an ideal thesis advisor for Gene. In fact, Zygmund turned out to be an ideal thesis advisor for a surprising number and variety of students. In particular, he possessed an uncanny knack for wedding the right student with the right problem, and Gene was no exception.

Toward the end of Gene's graduate career he and Nestor started to collaborate on a program that was to consume most of their energies for the next decade. Their collaboration made a fine spectator sport. Borrowing (and abusing) Isaiah Berlin's terminology, Gene played "hedgehog" to Nestor's "fox". Nestor was given to (occasionally ingenious) flights of fancy that would leave Gene depressed and unhappy. But Gene's revenge would come the next day, when, after a night of hard and meticulous calculation, he would confront Nestor with the cold facts. In this way they produced a string of papers in which they took mutual and justifiable pride. In fact, many of the papers in this series have become "classics". With hindsight one realizes that Gene's collaboration with Nestor also set the pattern that Gene would follow throughout his career. Namely, Gene never had any truck with the old adage warning against the evils of mixing business with pleasure. For Gene mathematics was both an intellectual stimulant and a social lubricant, and because he thoroughly enjoyed both these aspects, he saw no reason to separate them.

From the very beginning Gene's mathematical work centered on the development and application of real variable methods in the study of partial differential equations. This was to become Gene's lifelong scientific direction, and he was one of the leading researchers in this area. His influence continues to be strongly felt through several sources: his more than seventy-five articles, his twenty-one Ph.D. students (some of whom have become leading analysts), the many postdoctoral fellows who had the good fortune to work with him, his more

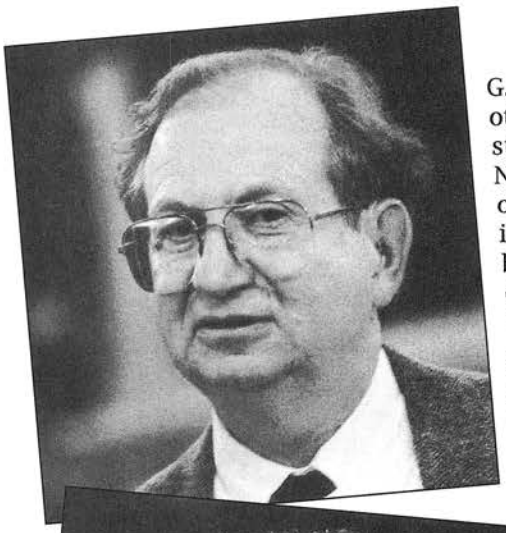


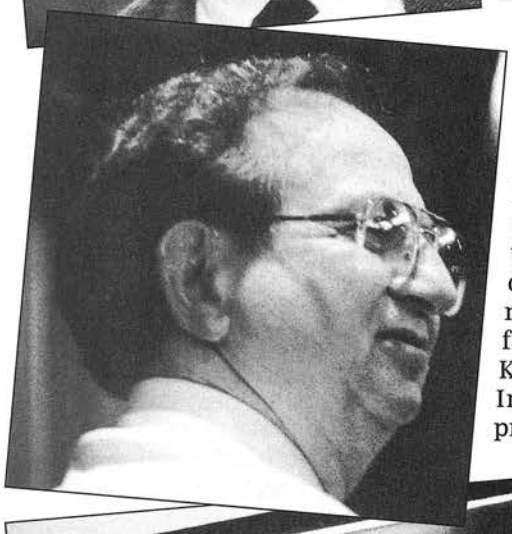
Photograph courtesy of Mrs. Eugene Fabes.

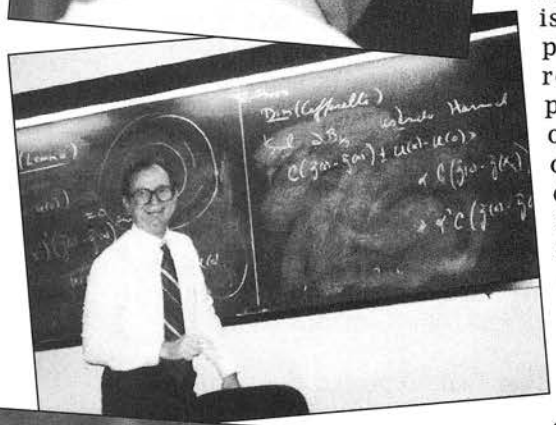
Eugene Fabes

than forty collaborators, and the many colleagues whom he inspired. All of these reflect Gene's remarkable vision, which gave him the knack to detect rich areas for research before they had been thoroughly mined by others. Once he had spotted such an area, he would, by dint of sheer determination and hard calculations, work out some particular case or partial result. These calculations would get the ball rolling. Next, Gene, in collaboration with students or colleagues, would seek the hidden structure and depth that underlay his original calculations. When, as they often did, these efforts met with success, new horizons would be opened.

During his career Gene repeated the pattern just outlined many times. Excellent examples are provided by his extension jointly with Rivière of the Calderon-Zygmund Theorem to allow for kernels having mixed degrees of homogeneity, his initiation of the study of singular integrals along curves, his pioneering study of the initial Dirichlet problem for parabolic equations (under optimal regularity conditions on the coefficients), his detailed study (with M. Jodeit and J. Lewis) of the Dirichlet problem for Laplace's equation (on sectors and quadrants), and his later study of the same problem on C^1 domains (with Jodeit and Rivière). These articles led to the development of the theory of boundary value problems on Lipschitz domains, work to which many people eventually contributed: Gene himself, A. P. Calderón, B. Dahlberg, D. Jerison, J. Pipher, Gene's student







Photographs courtesy of the School of Mathematics, University of Minnesota.

G. Verchota, and many others. More recently his study (with his student N. Garofalo and S. Salsa) of "backward Harnack inequalities" for parabolic equations led (partly in collaboration with Gene) to outstanding developments in the work of M. Safonov and his student Y. Yuan. Finally, in work with his Ph.D. students Cerutti and Escauriaza, Gene defined a "good solution" to nondivergence form equations by regularizing the coefficients and passing to the limit on a subsequence, a procedure made possible by the famous estimates of Krylov and Safonov. In this work they proved that the solution thus obtained is unique (independently of the regularization) provided the set of discontinuities of the coefficients is very small. Such results are very delicate, especially in view of Nadirashvili's recent example that, in the case of general discontinuities, uniqueness of the "good solution" may fail.

Gene was a man who generated enormous excitement for mathematical ideas, and he found great joy in communicating both the ideas and the excitement to others. As a consequence he was a wonderful teacher, at all levels and all over the world. In particular he and Italy had a mutual admiration pact that was a joy to behold. The summer before Gene died his grateful Italian students and postdoctoral visitors hosted a conference under the title "Twenty Years of Eugene Fabes at Cortona".

In spite of his commitment to teaching and research, Gene never shirked his administrative responsibilities. At the University of Minnesota's School of Mathematics he served at various times as director of graduate studies, associate head, head, and was at the time of his death deputy director of the Geometry Center.

Ph.D. Students of Eugene Fabes:
Max Jodeit (1967)
Julio Bouillet (1972)
Steve Sroka (1975)
Angel Gutierrez (1979)
Patricia Bauman (1982)
Gregory Verchota (1982)
Russell Brown (1987)
Nicola Garofalo (1987)
Gail Nelson (1988)
Wilfredo Urbina (1988)
Wenjie Gao (1988)
Maria Cristina Cerutti (1990)
Luis Escauriaza Zubiria (1990)
Santiago Marin-Malave (1990)
Bartolome Barcelo (1991)
Mark Patrick Sand (1991)
Jin Keun Seo (1991)
Roberto Scotto (1993)
Raymond Spencer (1994)
Dorina Mitrea (1996)
Osvaldo Mendez (1997)

In summary, the mathematics community was fortunate indeed that Gene made the decision he did when he left Atlanta those many years ago. For those of us who knew him personally, Gene's death is a tragedy. Even for those who did not know him, it is sad to recognize the passing of the era in which his decision to choose mathematics over suitcases seemed reasonable.

Privacy on the Line

Reviewed by Stewart Baker and Peter G. Neumann

Editor's Note: U.S. cryptography policy has become a highly controversial issue. For this reason the *Notices* intentionally solicited two independent reviews of *Privacy on the Line*. The reviewers were chosen in order to provide two different perspectives on the issues raised in the book.

One of the book's coauthors, Susan Landau, is a member of the *Notices* Editorial Board. To prevent a conflict of interest, she did not participate in the decision to review the book, the choice of reviewers, or any other aspect of the preparation of these reviews.

Privacy on the Line: The Politics of Wiretapping and Encryption
Whitfield Diffie and *Susan Landau*
MIT Press, 1998
342 pages
Hardcover $25.00 (ISBN 0-262-04167-7)

Stewart Baker

I wasn't sure I would like this book, but I knew I had to read it. It's the story of my life—the last several years, anyway.

In the early 1990s I was the general counsel of the National Security Agency (NSA), a job that required me among other things to sell key escrow encryption and the Clipper Chip to the Clinton Administration (mission accomplished) and to the rest of the country (er, the less said about that, the better). I had the chance, too, to work closely with the Federal Bureau of Investigation (FBI), especially on the problem of how to conduct wiretaps in a new and far more demanding environment.

One of the surprising results of breaking up AT&T was to create a slow-motion crisis for law enforcement. So long as communications were controlled by one company—with a heavy stake in demonstrating its good citizenship—planning for and providing wiretap access was easy. AT&T knew what the FBI needed, and it could build those requirements into its products, passing the cost along to consumers. But deregulation put a

(Continued on following page)

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Peter G. Neumann

Mathematically, cryptography is an incredibly complex and fascinating subject. However, from many other perspectives—political, legal, diplomatic, social, and economic—cryptography policy is also incredibly complex; as *Privacy on the Line* demonstrates, it is fascinating from these perspectives as well. This book performs an extraordinary service for readers wishing to understand how we got to where we are today with respect to privacy and the uses of cryptography and wiretapping, and what the potential implications are for the future.

Privacy on the Line is beautifully written and makes complex issues readily understandable to the reader who is curious and eager to learn; in some chapters it almost has the appeal of a spy thriller. On the other hand, it is carefully researched and documented with copious references that should whet the appetites of the most intense and knowledgeable readers.

(Continued on page 711)

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(**Baker** *continued from previous page*)

premium on getting to market quickly, reducing overhead, and building lightweight innovative products. Law enforcement wasn't the customer, and it was increasingly left behind in the explosion of new products and services. Often law enforcement didn't have the technical expertise or the funds to adapt to the new technologies, and sometimes even expertise and money weren't enough.

After several years of trying to jawbone industry into compliance with its requirements, the FBI decided in the early 1990s that it needed a big stick—it needed a law. The law would not try to sort out all the technical problems that industry said were preventing wiretaps. It would solve the problem by fiat, simply requiring that all telecommunications carriers and manufacturers design wiretap capabilities into all their products and services.

Privacy advocates were horrified. The press was hostile. Industry jeered. Not one member of Congress could be found who would introduce the FBI's bill.

The FBI, however, never gave up. They showed up for every debate, they mobilized local police, they lobbied Congress relentlessly.

Three years later the Senate passed the Communications Assistance to Law Enforcement Act (CALEA), with the FBI's requirement, by a voice vote of 98-0.

That was round one. Round two, for the FBI, is encryption. Most of the computer software and hardware industry sat out the fight over CALEA, and those companies haven't grasped how much the CALEA debate shaped the FBI's view of encryption.

Thanks to CALEA, the FBI is undaunted by the technical complexity of building key recovery into encryption, or by the claims of industry that it can't be done. They heard the same thing from telecommunications companies—all of whom are now building wiretap capabilities into their products.

And thanks to CALEA, the FBI is not too troubled by the bad press it's getting over encryption or by the privacy and industry complaints—or even by the congressional harrumphing. They've heard all that before, too. In the CALEA debate it was patience that paid off, and in the end the Bureau believes that Congress will have to mandate crypto controls just as it had to mandate wiretap requirements.

Since leaving government I've advised dozens of companies on how to live not just with encryption controls and key recovery but also with CALEA. I've started to joke that my law practice consists of being the first lawyer to discover that the country's main technology and telecommunications regulatory body is the Federal Bureau of Investigation.

So any book that deals with the politics of wiretapping and encryption is hard to resist. If I took it to the beach to read, I could probably deduct the trip.

Still, I had my doubts. Whitfield Diffie is a famous cryptographer, of course, but I knew him first as NSA's single most determined and effective opponent. I can't defend every aspect of the government's current policies on encryption and wiretapping, but I still have a deep reservoir of sympathy for that point of view. Wiretapping is an important criminal investigation tool, particularly when law enforcement is targeting the leaders of organized crime, who usually don't commit crimes so much as order them committed. There is no doubt that a wired society needs ubiquitous encryption, but it's equally true that ubiquitous encryption will give wired criminals new protections from the law.

That's why I still bridle at too-simplistic Silicon Valley retorts to law enforcement concerns—especially those that run along the lines of "We're smart. We're rich. They're not. We win." I wasn't looking forward to reading a self-congratulatory book about clueless cops being outsmarted by liberty-loving technologists.

To my surprise, that's not what Diffie and Landau have written. They've produced something quieter and more useful. Like a handful of others (mostly professional privacy advocates and FBI officials), they see the entire picture—something the high-tech industry has so far only seen in bits and pieces. Ready or not, the FBI is determined to force us all into a debate over how and whether we will shape the direction of technological change.

This book draws together the elements of that story in a fashion that is scholarly, though it's too well written to deserve that adjective. Diffie and Landau don't quite popularize the issue—this is still a book only a policy wonk could love—but they ease the reader gracefully into some remarkably complex material as though it were a warm bath.

The book begins with an admirably simple introduction to cryptography that carries the reader deep into the topic. I have to confess that I never knew how "S-boxes" got their name until I worked my way through Diffie and Landau's description of the Digital Encryption Standard and its historical debt to Vingenere ciphers. (I told you this was a wonk's book.) The authors next march the reader through a history of crypto policy, laying out the interests of the NSA, the public cryptography movement, law enforcement, the National Institute of Standards and Technology, and privacy advocates.

With the groundwork laid, the book then plunges into wiretapping, its history, value, and abuses. It sketches the FBI's five-year fight to enact CALEA. The closing chapter traces the evolution of the en-

cryption debate from a fight between the software industry and the NSA into a fight that pits the FBI against the likes of Americans for Tax Reform and the National Association of Manufacturers.

Throughout this tour, there isn't any doubt where the authors' sympathies lie. They linger almost lovingly over thirty- and forty-year-old stories of how the FBI once abused its wiretap authority. They insist on a long and not entirely persuasive discussion of why wiretaps aren't that useful to law enforcement. Government arguments tend to get much shorter shrift than civil libertarian rebuttals. But it is perhaps a sign of how bitter the encryption battle has become that Diffie and Landau deserve credit for including the government's arguments at all.

They deserve praise as well for avoiding dishonest arguments that support their point of view. Not everyone in this debate is so careful. Lawyers for industry, for example, can still be heard to argue that there's no need for encryption controls because the FBI hasn't offered evidence that it has lost any cases because of good crypto. Of course this is the kind of Catch-22 argument that is hard to resist because the lawyers know it can't lose. If the FBI found a way to read the files, then the industry lawyers can say, "See, crypto wasn't a problem." And if the FBI is truly stymied and can't read the files, then the lawyers can say either, "The defendant was acquitted, and there's no proof the encrypted files were related to a crime," or "The defendant was convicted, so the FBI didn't need to decrypt the files." Unlike some of their allies, Diffie and Landau never insult our intelligence.

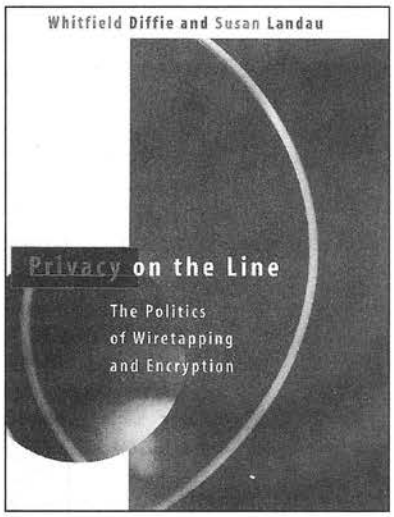
In short, it's hard to imagine a better introduction to an issue that will be with us for years to come.

*(**Neumann** continued from page 709)*

Wiretapping and cryptography are sometimes depicted as a classical conflict between good and evil, depending on which side the supposed protagonist is on. *Privacy on the Line* makes it quite clear that the picture is not quite so simple—indeed, there are also elements of good versus good and evil versus evil. The good news is that crypto can be used for good; the bad news is that it can also be used for evil.

The real question is which of two capabilities is more important: (1) protecting our civilization from widespread losses of privacy and violations of personal integrity that can result when cryptography is applied inadequately or not at all, or (2) guaranteeing the law enforcement and national security communities the power of rapid surreptitious access to essentially all communicated or stored information. Ideally we might believe that there could be a solution that does both; however, that appears to be wishful thinking, especially because the key-recovery technology is likely to be inherently vulnerable to misuse. The debate to date seems to suggest that there is no easy middle ground and that any solution will be a tenuous one at best.

The first nine chapters are rather well balanced, presenting with equal care the viewpoints of national security, law enforcement, and ordinary citizens. However, the final chapter comes down strongly on the side of humanity and comes to grips with the question posed above. The answers given in the book make sound sense if you have read the first nine chapters and thus understand the basis for the reasoning given in the last chapter.



Several quotes from Chapter 10 are worth noting here:

"In pursuing policies that limit the use of cryptography for business purposes, out of fear that it will be used for criminal ones, we deny ourselves one benefit without achieving the other." (page 242)

"It is generally accepted that rights are not absolute. If private access to high-grade encryption presented a clear and present danger to society, there would be little political opposition to controlling it. The reason there is so much disagreement is that there is so little evidence of a problem." (page 244)

"The availability of cryptography for criminal uses may not turn out to matter all that much. ... Criminals today make far more use of covert means of communication (most notably cloned cell phones) rather than of overtly secure means." (page 245)

Much of the controversy in the past few years centers on cryptographic techniques (known as key-recovery or key-escrow schemes) that contain intentional trapdoors whose purpose is to permit law enforcement and national security personnel to gain surreptitious access to encrypted communications and stored information. Given the inherent security weaknesses in our computer and communication infrastructures (which in the past have been separate, but which are rapidly converging), such trapdoors could easily lead to misuse. In addition, proponents of such systems that permit stealthy access to keys have made little if any effort to examine the long-term costs and risks of creating and operating the infrastructures necessary to enable almost immediate surreptitious access. William Reinsch of the U.S. Commerce Department has enumerated several reasons why law

enforcement itself is reluctant to use key-recovery crypto[1], although he carefully skirted discussion of the inherent security risks arising from trapdoor access. Also, serious questions remain unanswered about whether the actual needs for such capabilities are justified by existing conditions. Furthermore, there could be serious risks for electronic commerce and for misuse of information about innocent individuals; very few of these risks have been considered in any detail. My own book (*Computer-Related Risks*, Addison-Wesley, 1995) suggests that many of the risks of misapplying computer-communication technology are simply not avoidable in practice, even in the presence of great perseverance.

It is clear that law enforcement needs to explore some other approaches. The book does a good job in exploring some of the alternatives to wiretaps and trapdoor encryption schemes that could avoid many of the risks that might otherwise arise. Such alternatives include pen registers and trap-and-trace devices for telephony, radio communications, video cameras, computer systems themselves, tracking of credit card usage, materials transport, etc. A section on electronic surveillance concludes with this sentence: "On balance, the impact of technology is so weighted on the side of law enforcement as to make it remarkable that crime has survived at all." Although that comment might seem facetious, it perhaps suggests that law enforcement has not taken optimal advantage of the tools at its disposal.

Potential misuse by government employees is also a serious concern. Chapters 6 ("Privacy: Protections and Threats") and 7 ("Wiretapping") include numerous examples of misuse that have occurred in the past and that must be addressed honestly in future policy considerations. Perhaps most prescient is a 1928 quote from Justice Louis Brandeis:

"'In the application of a constitution, our contemplation cannot be only of what has been but of what may be.' The progress of science in furnishing the government with means of espionage is not likely to stop with wiretapping. Ways may some day be developed by which the government, without removing papers from secret drawers, can reproduce them in court, and by which it will be enabled to expose to a jury the most intimate occurrences of the home. ... Can it be that the Constitution affords no protection against such invasions of individual security?" (pages 148–149)

The credentials of the authors are impeccable. Whitfield Diffie is the coinventor of public key cryptography (with Martin Hellman and Ralph Merkle), extraordinarily knowledgeable on the total history of unclassified manifestations of cryptography and an articulate spokesman for noncompromisable strong cryptography. Susan Landau was the responsible author for the 1994 ACM (Association for Computing Machinery) report, "Codes, Keys, and Conflicts: Issues in U.S. Crypto Policy", finding common ground among a diverse study group that included Diffie and this reviewer as well as representatives of NSA and the Department of Justice. That report clearly laid out the basic questions. (Landau has also written about cryptography policy for the *Notices*, beginning in 1983.) Diffie and Landau each briefed the National Research Council (NRC) cryptography study panel that produced the unclassified 1996 National Academy Press report, "Cryptography's Role in Securing the Information Infrastructure (CRISIS)". (The NRC group operated under high-level U.S. Government clearances and included several distinguished former government officials.) *Privacy on the Line* provides in-depth background that goes beyond what can be found in the ACM and NRC reports. Its fundamental conclusions begin in essence where the NRC study left off. The CRISIS report concluded that the "debate over national cryptography policy can be carried out in a reasonable manner on an unclassified basis." The conclusions of the final chapter of *Privacy on the Line* are even stronger and, in my opinion, are well supported by the first nine chapters of the book.

Cryptographic policy is an international issue. The debate in the U.S. and elsewhere is likely to go on for a long time, even if it is seemingly legislated one way or the other. But deeper understanding of the issues is urgently needed before any policy is invoked. *Privacy on the Line* is a major step in that direction.

My view is that noncompromisable strong cryptography will become widely available around the world irrespective of intended controls, and that is, on balance, in the best interests of national and world stability. Instead of seeking restrictive cryptographic policies and potentially dangerous trapdoors, law enforcement and intelligence communities urgently need to pursue some of the alternatives—which may turn out to be more cost effective anyway. (My own extremely mixed metaphor on the subject is that Pandora's cat is out of the barn, and the genie won't go back in the closet.)

[1] *"Non-Key Recovery Exports after Two Years", memo to Deputies Subgroup on Cryptography, November 25, 1996, obtained by the Electronic Privacy Information Center under the Freedom of Information Act.*

JSTOR, A Great Leap Forward in Electronic Journal Access

Wouldn't it be great if someone took those old, brittle, yellowing journals that take up so much library space and put them on the World Wide Web? Wouldn't it be great if they set it up so you could print out from your desktop computer high-quality copies of exact replicas of the pages of those journals? And wouldn't it be great if they also made available a text-search capability?

This is not some futuristic fantasy—this is JSTOR. JSTOR, which stands for Journal Storage, has developed a database that provides Internet access to some of the most important scholarly journals in a variety of academic fields, including the mathematical sciences. JSTOR is a not-for-profit organization whose aim is to parlay digital technologies into new ways of preserving and making accessible scholarly journal literature. Certainly JSTOR is no panacea for the resource and storage problems facing academic libraries: At present JSTOR comprises only 76 journals, while statistics from the Association of Research Libraries indicate that a typical university purchased about 16,000 serials in 1997. Nevertheless, JSTOR represents an ambitious first step toward bringing journal literature into the digital age.

JSTOR started in 1994 as a pilot project, funded by the Andrew W. Mellon Foundation, to scan 750,000 pages from ten journals and make the pages accessible through computer networks. By 1995 JSTOR was established as an independent not-for-profit organization and had assembled the staff and computer resources needed to carry out a production scheme that currently processes approximately 100,000 pages a month. With the establishment of a new production facility at Princeton University, this capacity is expected to triple by the end of the year.

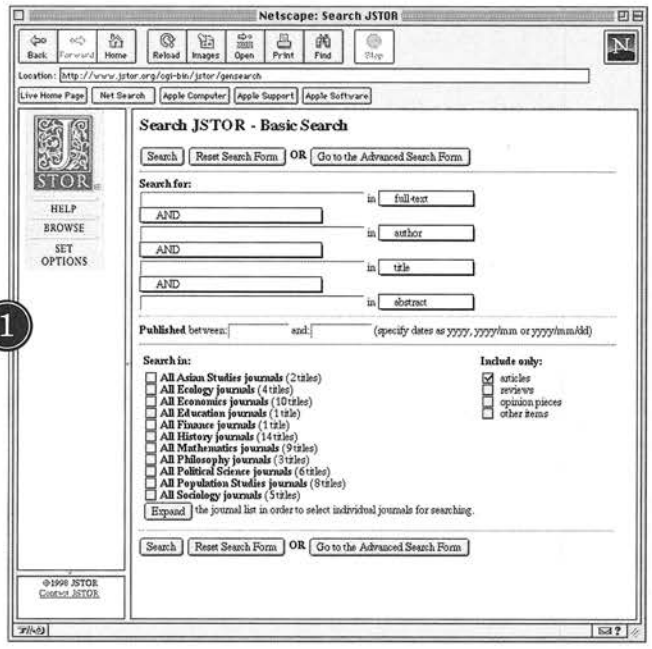
The JSTOR production process begins with journal acquisition. Full runs of journals are usually obtained from publishers, who often find it beneficial to cooperate with JSTOR, because they are unlikely to obtain further revenue from older back issues of journals and because storage on JSTOR helps to make their publications more widely accessible. The journals are sent to JSTOR's Ann Arbor office, which inspects the sets of journals to be sure they are complete and in good condition. The Ann Arbor office also establishes indexing guidelines for each journal so that there is consistency in how the bibliographic information is presented on JSTOR.

From Ann Arbor the journals go to an outside firm for scanning. The scanning is done at high resolution (600 dpi) and with meticulous care: The intention is that the quality of the scanned images is sufficiently high to meet the needs of whatever use the images might find in the future. Optical character recognition (OCR) software is used to convert each page into a text file, with an accuracy of 99.95%; these files permit text searches of the journals. Abstracts and bibliographic information are keyed in manually. At the end of this process, the data is stored on CD-ROMs and sent back to Ann Arbor, where quality control checks are performed before the journals are made available to subscribers on the Web.

JSTOR is now in phase I of its development, which aims to build a collection of at least one hundred important journal titles in a variety of fields by the year 2000. Decisions about which journals

to include in JSTOR depend on a number of factors. One is the amount of time a journal has been in existence: Libraries benefit more if JSTOR concentrates on journals with a large number of back issues rather than newer journals that take up less shelf space. Another is the impact of the journal, as measured by such things as the number of subscriptions and the number of citations its articles have received. JSTOR also consults with specialists in the various fields to decide which journals are the most important to include. The availability of full runs of back issues and the cooperation of publishers are considerations in many cases. In phase II, JSTOR will continue to expand its collection, adding journals that are clustered in certain fields; it is likely that one of these phase II clusters will include mathematics journals. Libraries will have the option to choose clusters most suited to their needs.

While scanning the journals is a large part of the cost of producing JSTOR, there are other costs as well, such as indexing and quality control, developing software, maintaining and upgrading hardware, user support, and administration and oversight. JSTOR has developed an economic model based on the idea that the costs of developing and maintaining this archival resource can be spread among a large number of participating institutions. The fee these institutions pay to JSTOR can be justified by reduced storage costs, savings in long-term capital purchases, and improved service to library patrons. Currently, over 260 libraries in the U.S. and Canada participate. A new mirror site established at the University of Manchester will provide access to the JSTOR database in the United Kingdom. JSTOR has a sliding scale of prices based on the Carnegie Classification of the participating institution. There is a one-time "Database Development Fee", which guarantees participating institutions perpetual rights to information in the phase I archive. This fee ranges from $10,000 for very small institutions to $40,000 for large ones.



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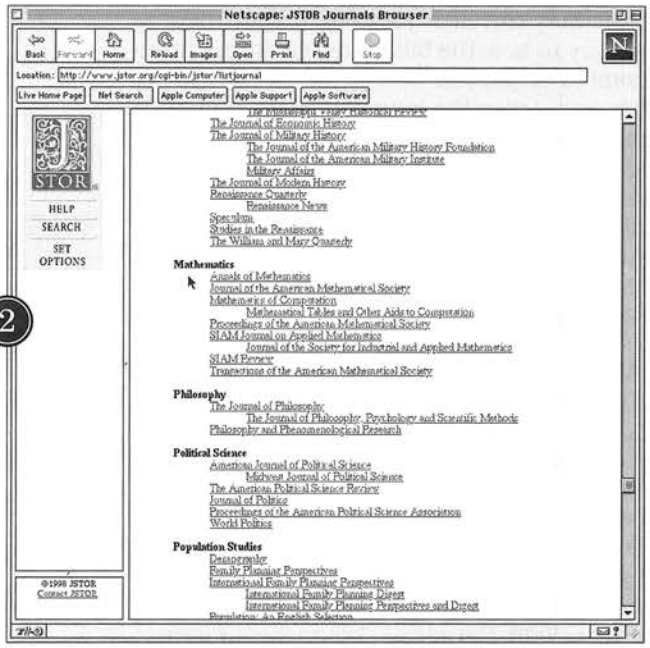

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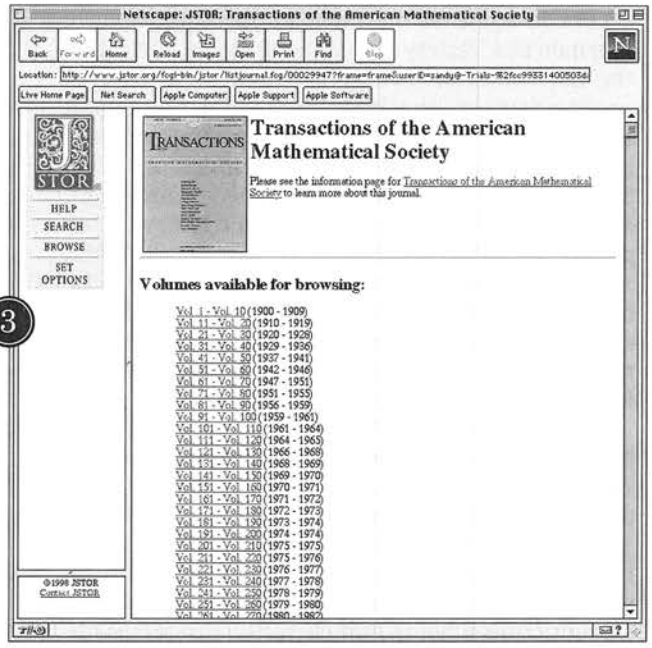

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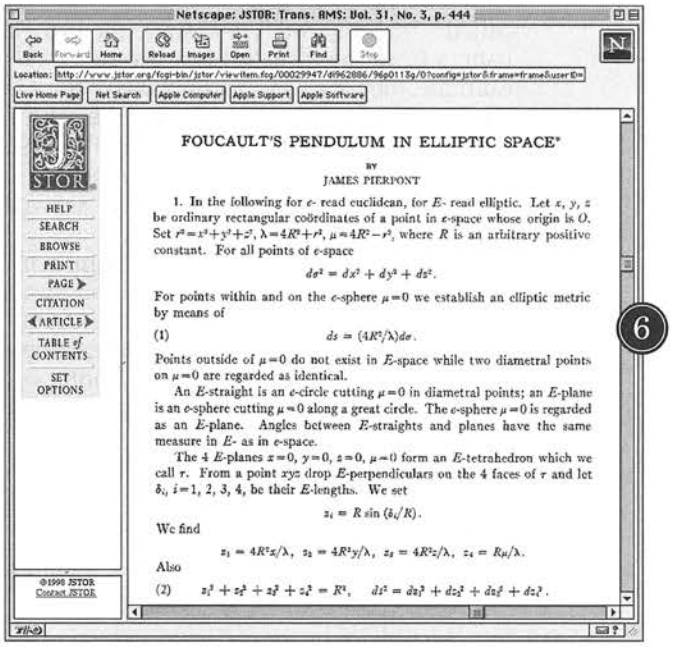
Counterclockwise from upper left, illustrations show (1) a search sequence starting with the basic JSTOR search screen, followed by (2) a portion of the Browse All Journals screen, (3) choice of available volumes for browsing of *Transactions of the American Mathematical Society*, (4) available issues of Volume 31 of *Transactions*, (5) contents of Volume 31, No. 3, and finally (6) a sample article from Volume 31, No. 3.

There is also an "Annual Access Fee" of $2,000 to $5,000.

JSTOR and the AMS have enjoyed fruitful cooperation from the start. Former AMS president Cathleen Morawetz serves on the JSTOR Board of Trustees, and AMS executive director John Ewing has had extensive discussions with JSTOR. Right now JSTOR is cooperating with *Mathematical Reviews* to develop a way to provide links from reviews in MathSciNet directly to the articles stored on JSTOR. This would add about 35,000 links. There is also a project under way to add the bibliographic data of about 3,000 pre-1940 mathematics articles from JSTOR to the MR database.

The JSTOR Web site is nicely designed and easy to navigate. There are various routes to find what you are looking for. You can browse through journal articles, clicking to flip from one page to the next or from one article to the next. You can do text searches on the full article text, author names, titles, and abstracts. You can also use an advanced search form to search with strings of text linked by Boolean operators. The images of article pages are stored as tiff files and load fairly quickly, and the quality of the images is quite good. A special application, called JPRINT, has been developed to facilitate printing articles from JSTOR. JPRINT can be downloaded from the JSTOR Web site; the instructions for doing so are ample and clear. JPRINT provides two options: fast printing at low resolution and high-quality printing that takes longer and has higher resolution. Samples of pages from *Proceedings of the AMS* printed on a laser printer were both perfectly legible, with the high-resolution copy being very close in quality to the printed journal. There is also a PDF option for viewing and printing.

JSTOR decided to offer only images of journal pages to be downloaded or printed, not the actual text. This decision was based on a number of factors, one being the large number of graphics, tables, and special symbols used in scholarly journals. There is currently no standard way to present these characters using typical Web browsers. In addition, it is expensive and difficult to use OCR to convert a scanned image into text with 100% accuracy (though the accuracy of OCR is just fine for generating a text file for searches). Making available 100%-accurate text files would have meant essentially republishing the journals from scratch.



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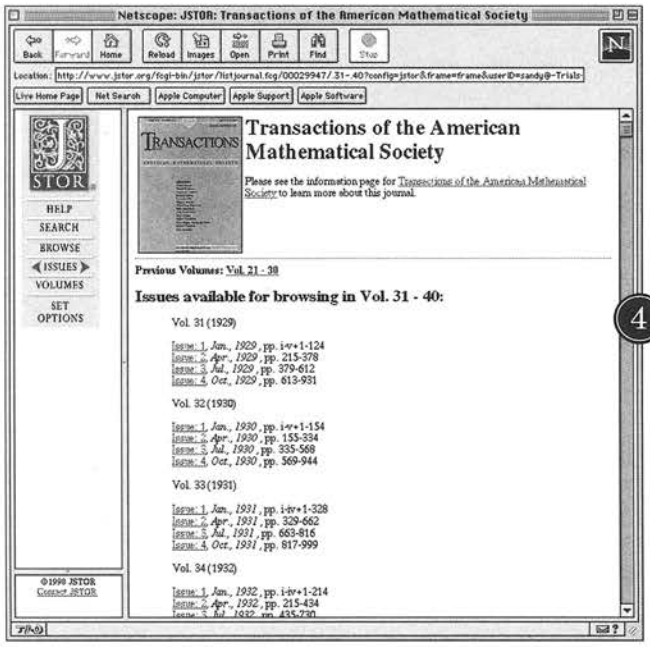

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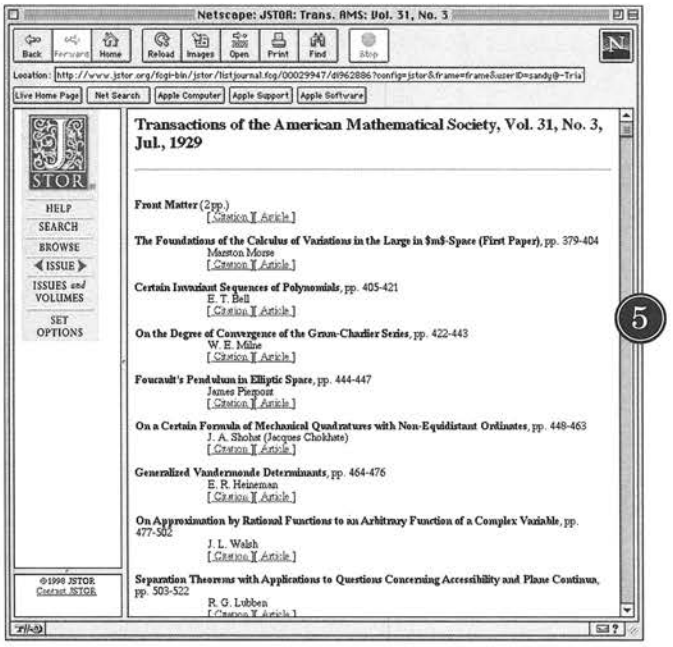

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The primary drawback of JSTOR for mathematics (and probably for other fields as well) is that so few journals are included. Consider that about 575 journals are reviewed cover-to-cover by *Mathematical Reviews* (not to mention the hundreds more that contain individual items selected for review), and the 9 mathematical sciences journals contained in JSTOR look like small drops in a very large bucket. Another difficulty is that JSTOR does not include the most recent volumes of journals. It provides access to the complete backfiles of every journal available in the database, but has agreements with the publishers to remain from two to five years behind current issues. At the beginning of each calendar year JSTOR extends coverage of each journal by one year. This scheme, called a "moving wall", is designed to protect publishers from the threat of lost revenues. Thus, for example, the issues of *Transactions of the AMS* that are available on JSTOR start with the establishment of the journal in 1900, but only go up to 1992. One can link from JSTOR to the Web site of *Transactions*, where issues starting in 1996 are available online.

These difficulties, far from rendering JSTOR useless, indicate how sorely a tool of its type is needed. As it continues to expand, JSTOR is likely to become an indispensable tool for scholars and librarians everywhere.

—Allyn Jackson

JSTOR

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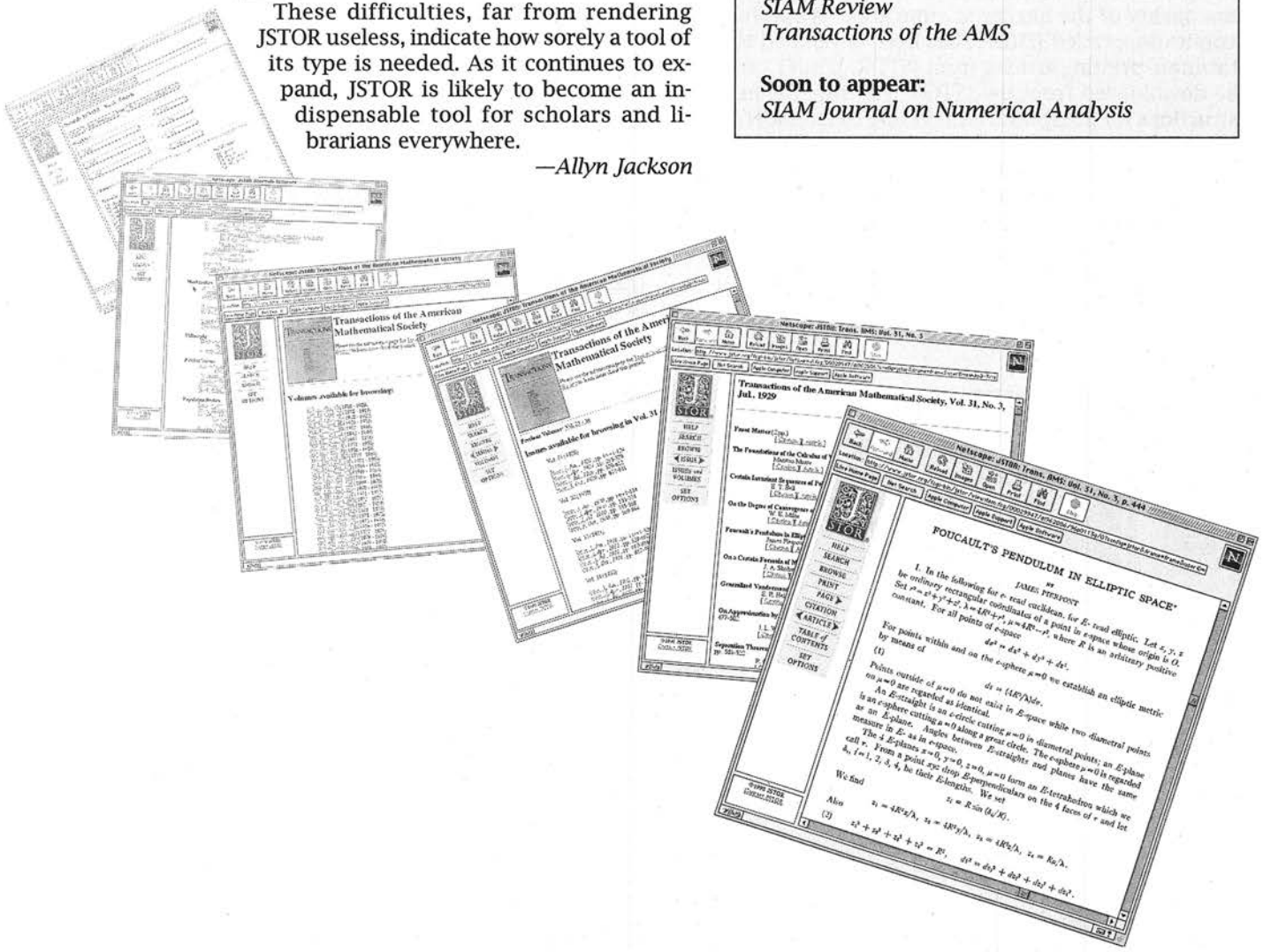
World Wide Web: `http://www.jstor.org`

Kevin Guthrie, President
Margit A. E. Dementi, Associate Director, Library Relations

Mathematics Journals on JSTOR:
Annals of Mathematics
Journal of the AMS
Mathematics of Computation
Mathematical Tables and Other Aids to Computation
Proceedings of the AMS
SIAM Journal on Applied Mathematics
Journal of the Society for Industrial and Applied Mathematics
SIAM Review
Transactions of the AMS

Soon to appear:
SIAM Journal on Numerical Analysis



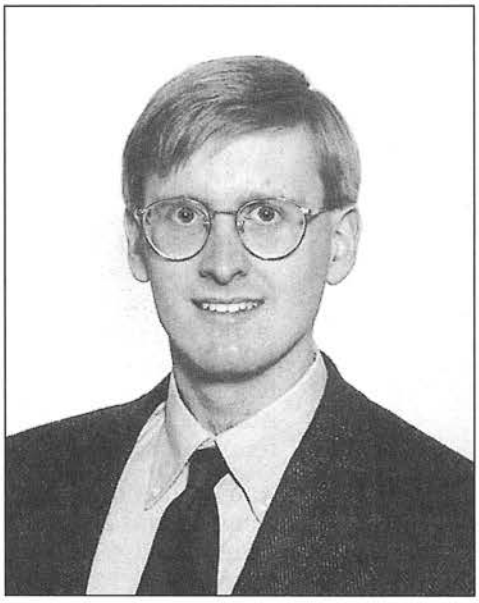
1998 Morgan Prize Awarded

JADE VINSON, a 1997 graduate of Washington University in St. Louis, Missouri, and currently a graduate student in the Department of Mathematics at Princeton University, is the third recipient of the AMS-MAA-SIAM Frank and Brennie Morgan Prize for outstanding research by an undergraduate student. He will receive the award at the 1998 Annual Meeting of the Society for Industrial and Applied Mathematics (SIAM) in July in Toronto. The award is cosponsored by SIAM, the AMS, and the Mathematical Association of America, with the three organizations rotating the annual awarding of the prize.

According to the 1997 Morgan Prize Committee, Vinson completed "wide-ranging research in analysis and geometry" during his undergraduate studies. His work, which included the study of fractals, sphere packing, and other areas of discrete geometry, answered difficult mathematical questions "at a high level of sophistication," says the prize citation.

As an undergraduate at Washington University, Vinson was a member of the university's award-winning team in the 1997 Mathematical Contest in Modeling, was an active participant in the Research Experiences for Undergraduates program at Cornell University in 1996, and spent the summers of 1995 and 1997 working on mathematical problems at the National Security Agency. In addition, he has made presentations at eight mathematics conferences and colloquia and has authored or coauthored nine articles that have appeared in or been submitted to journals in the field.

For Vinson, his computing skills, especially his willingness to learn computer programming, have served as invaluable aids to his mathematical research. "I think that computers create an opportunity for undergraduates to collaborate successfully with mathematics professors," says Vinson. "Math professors who did not grow up using computers often have ideas that they are unable to test because of the complexity of the calculations involved. Enlisting the help of an undergraduate to implement [a professor's] idea on a computer can not only test the original idea, but it can also draw the student into the research, with the hope, of course, that the student would eventually begin to contribute his or her own ideas."



Photograph courtesy of Jade Vinson.

Jade Vinson

The Morgan Prize Committee also awarded Honorable Mention to VIKAAS SOHAL, who graduated from Harvard University in 1997. Sohal was cited for his work in the use of mathematical methods to study biological processes within the hippocampus and the cortex; according to the prize citation, he used model building and simulation to investigate the role of two neuromodulators in the formation of new memories, episodic memory functions, and spatial navigation. Sohal is currently a Henry Fellow studying applied mathematics at the University of Cambridge. He will enter the joint M.D./Ph.D. Program at Stanford University in the fall of 1998.

Editor's Note: For information on how to nominate students for the Morgan prize, see the "Mathematics Opportunities" section of this issue of the *Notices*.

—from SIAM News Release

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NORTHWESTERN UNIVERSITY WILL AWARD THE FOURTH NEMMERS PRIZE IN MATHEMATICS IN 2000, WITH NOMINATIONS DUE ON NOVEMBER 30, 1999. FOR FURTHER INFORMATION, PLEASE WRITE

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Mathematics People

1998 AMS Centennial Fellowships Awarded

The AMS has awarded four Centennial Fellowships for 1998–99. The recipients are MARK ANDREA A. DE CATALDO, STAVROS GAROUFALIDIS, SÁNDOR J. KOVÁCS, and YANGUANG LI.

Mark Andrea A. de Cataldo

Mark Andrea A. de Cataldo received his Ph.D. from the University of Notre Dame in 1995 under the direction of Andrew J. Sommese. He has been a visiting assistant professor at Washington University in St. Louis and a research fellow at the Max-Planck-Institut für Mathematik in Bonn.

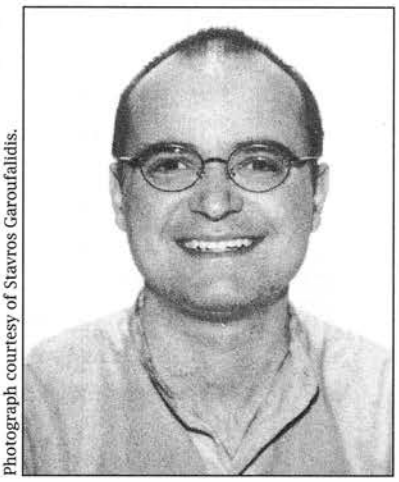
Photograph courtesy of Fotoatelier, Bonn, Germany.

de Cataldo's area of research is algebraic geometry. His earlier activity has been in classical projective geometry and low codimension embeddings of projective varieties in homogeneous spaces. His recent work is on notions of singular hermitian metrics and of semipositivity for holomorphic vector bundles with applications to effectivity problems in algebraic geometry by the use of algebraic and analytic techniques.

He plans to use the Centennial Fellowship to visit Harvard University.

Stavros Garoufalidis

Stavros Garoufalidis received his Ph.D. in 1992 from the University of Chicago under the guidance of Melvin Rothenberg. After a year at MSRI he spent two years at MIT as a Moore Instructor. Since then he has held one-year visiting positions at Brown University (1995–96) and Harvard University (1996–97) and is currently at Brandeis University (1997–98).



Photograph courtesy of Stavros Garoufalidis.

Garoufalidis's research has been in the interaction of 3-dimensional topology and mathematical physics. Motivated by the ideas of Chern-Simons exact and perturbative theory, he has given applications of topological quantum field theory invariants to 3-dimensional topology and knot theory. In addition, he has studied relations between new (Jones polynomial) and old (Alexander polynomial) invariants of knots. In the past three years he has been involved in the development of a theory of finite type 3-manifold invariants, with applications in the structure of the mapping class group and in quantum cohomology.

His research plans include a study of Chern-Simons theory, deformation quantization, and quantum cohomology, with a view towards applications to 3-dimensional topology. He will use his Centennial Fellowship to visit Harvard University and the Georgia Institute of Technology.

Sándor J. Kovács

Sándor J. Kovács received his Ph.D. from the University of Utah in 1995 under the supervision of János Kollár. Since then he has been a C. L. E. Moore Instructor at the Massachusetts Institute of Technology.

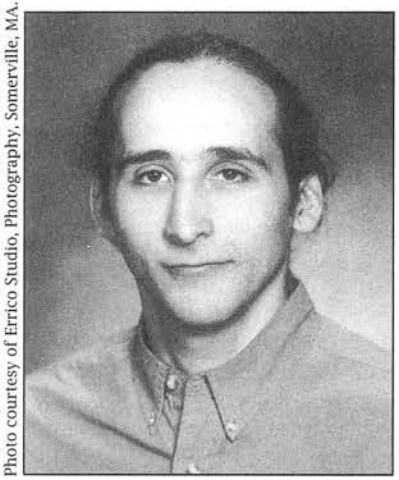


Photo courtesy of Errico Studio, Photography, Somerville, MA.

Kovács's area of research is higher-dimensional algebraic geometry. His works include results toward the Catanese-Schneider-Shokurov conjecture for families of varieties of general type and proofs of Steenbrink's conjecture on rational singularities in general and of Kollár's conjecture on log canonical singularities in dimension 3.

He plans to use his Centennial Fellowship to visit the University of Chicago and the Research Institute for Mathematical Sciences in Kyoto, Japan.

Yanguang Li

Yanguang (Charles) Li received his Ph.D. from Princeton University in 1993 under the supervision of David McLaughlin. For three years Li was a Hedrick assistant professor at the University of California, Los Angeles, and he visited the Mathematical Sciences Research Institute in Berkeley in 1994. Currently he is an instructor at the Massachusetts Institute of Technology. He plans to use the Centennial Fellowship at MSRI.

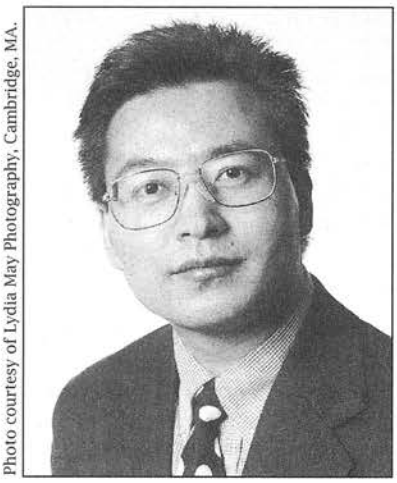


Photo courtesy of Lydia May Photography, Cambridge, MA.

Li's research has focused on chaos in partial differential equations. In particular, he proved the existence of chaos in perturbed soliton systems. Recently he has become interested in dynamical systems studies on two-dimensional turbulence.

Please note: Information about the competition for the 1999–2000 AMS Centennial Fellowships will be published in the "Mathematics Opportunities" section of an upcoming issue of the *Notices*.

—Allyn Jackson

Guggenheim Fellowships Awarded

The John Simon Guggenheim Memorial Foundation has announced the names of 168 scholars, artists, and scientists who were selected as Guggenheim Fellows in the 1998 competition. The fellows are appointed on the basis of unusually distinguished achievement in the past and exceptional promise for future accomplishment. The awards total $5,376,000.

The following lists those awardees who work in the mathematical sciences, together with their affiliations and research areas.

BRUCE C. BERNDT, University of Illinois at Urbana-Champaign: Ramanujan's lost notebook; JIN-YI CAI, State University of New York at Buffalo: Computational complexity theory; SUN-YUNG ALICE CHANG, University of California, Los Angeles: Studies of the Paneitz operator; DEMETRIOS CHRISTODOULOU, Princeton University: Black holes and spacetime singularities; ROBERT LAZARSFELD, University of Michigan: Linear series on algebraic varieties; GOPAL PRASAD, University of Michigan: Representation theory of reductive p-adic groups; and JOSEPH H. SILVERMAN, Brown University: Number theory and diophantine equations.

—from Guggenheim Foundation News Release

Seiberg and Witten Receive Heineman Prize

EDWARD WITTEN and NATHAN SEIBERG, both of the Institute for Advanced Study (IAS) in Princeton, have received the 1997 Dannie Heineman Prize for Mathematical Physics. The prize of $7,500 is presented to recognize outstanding publications in the field of mathematical physics. They received the prize "for their decisive advances in elucidating the dynamics of strongly coupled supersymmetric field and string theories. The deep physical and mathematical consequences of the electric-magnetic duality they exploited have broadened the scope of mathematical physics."

Edward Witten received his B.A. from Brandeis University in 1971 and his Ph.D. from Princeton University in 1976. After four years as a postdoctoral fellow and Junior Fellow at Harvard University, he joined the faculty at Princeton. He has been a professor of physics at the IAS since 1987. Witten is known for his work in elementary particle theory, especially quantum field theory and string theory and their mathematical implications. He has received the Alan T. Waterman Award from the National Science Foundation and the Award in Physical and Mathematical Sciences from the New York Academy of Sciences. In 1990 Witten received the Fields Medal.

Nathan Seiberg completed his undergraduate education in 1977 at Tel Aviv University and received his Ph.D. from the Weizmann Institute of Science in Israel in 1987. He spent several years as a member at the IAS and was a professor of physics at the Weizmann Institute and at Rutgers Uni-

versity. Currently he is a professor at the IAS. His research interests are in string theory, field theory, and particle physics phenomenology. During the last year Seiberg has been working with various collaborators on exact solutions of supersymmetric field theories and string theories in various dimensions. In 1996 he was awarded a fellowship from the John D. and Catherine T. MacArthur Foundation.

The Heineman Prize was established in 1959 by the Heineman Foundation for Research, Educational, Charitable, and Scientific Purposes, Inc., and is administered jointly by the American Physical Society and the American Institute of Physics. The prize is presented annually.

Nominations for the 1998 Heineman Prize should be sent to: Edward Ott, Department of Physics and Astronomy, University of Maryland, College Park, MD 20742; telephone 301-454-3180; e-mail: e_ott@umail.umd.edu. The deadline for nominations is **July 1, 1998**. Nomination guidelines are available on the Web site of the American Physical Society, http://www.aps.org/.

—from APS Announcement

Garabedian Receives NAS Award

PAUL R. GARABEDIAN has received the National Academy of Sciences (NAS) Award in Applied Mathematics and Numerical Analysis. This $10,000 award, established in 1972 by IBM Corporation, is presented every three years for outstanding work in applied mathematics and numerical analysis by a candidate whose research has been carried out in an institution in North America. Garabedian is on the faculty of the Courant Institute of Mathematical Sciences at New York University. He was chosen "for his spectacular contributions to computational fluid dynamics, especially the mathematical design of the first shock-free transonic airfoil, and for future controlled thermonuclear fusion, the first stellarator with an almost smooth magnetic field."

—from NAS News Release

Le Gall Receives Loève Prize

The 1997 Line and Michel Loève International Prize in Probability has been awarded to JEAN-FRANÇOIS LE GALL, professor at the École Normale Supérieure, Paris. The prize carries a monetary award of about $30,000.

Biographical Sketch

Jean-François Le Gall was born on November 15, 1959, in Morlaix, France. He was a student at the École Normale Supérieure de Paris (1978–82), where he received his Agrégation de Mathématiques (rank 1) (1980). He finished his Ph.D. in 1982, under the direction of Marc Yor, and five years later his Thèse d'État de Mathématiques, both at Université Paris VI. In 1982 Le Gall became Chargé de Recherches of the Centre National de la Recherche Scientifique at Paris VI. He was a professor at Paris VI from 1988 to 1997, when he took his present position as professor at ENS. He received the Rollo Davidson Prize (1986), the Cours Peccot Prize of the Collège de France (1989), and was a junior member of the Institut Universitaire de France (1992–97). In 1992 he was an invited speaker at the first European Congress of Mathematics in Paris. He has been selected as an invited speaker at the International Congress of Mathematicians in Berlin in August 1998.

The Work of Le Gall

Le Gall's early work was mainly concerned with fine properties of Brownian motion, particularly those that relate to cone points and multiple points for the Brownian path, intersection local times, and the Wiener sausage. It is only possible to describe a small selection of Le Gall's results in this area.

A cone point is a point t in time for a planar Brownian motion B such that $B(s) - B(t) \in C_\alpha$ for $0 \le s \le t$, where C_α is a fixed cone with angle α. Le Gall showed that if $\alpha > \pi/2$, then the set of cone points is a regenerative set that is the range of a stable subordinator with index $1 - \pi/2\alpha$. This is an extension of a celebrated result of Spitzer.

A multiple point for the planar Brownian path is a point z in the plane such that the set $\{t \in [0,1] : B(t) = z\}$ has two or more elements. A classical theorem of Dvoretsky, Erdős, and Kakutani states that there exist points z such that the set $\{t \in [0,1] : B(t) = z\}$ has the same cardinality as $[0,1]$. Le Gall established a far-reaching generalization of this result by showing that given any totally disconnected compact subset $K \subset R$, there exists with probability one a point z such that $\{t \in [0,1] : B(t) = z\}$ has the same order type as K.

For each integer $p \ge 2$, the set of multiple points z for which the pre-image $\{t \in [0,1] : B(t) = z\}$ has cardinality p supports a random measure called a renormalized self-intersection local time. Le Gall established a remarkable asymptotic expansion as $\epsilon \downarrow 0$ of the area of the Wiener sausage $\{x : \exists 0 \le t \le 1, |x - B(t)| \le \epsilon\}$ in terms of these objects.

Le Gall's more recent work has focused on measure-valued diffusion processes, particularly the Dawson-Watanabe super Brownian motion. Super Brownian motion arises as the high density limit of a system of branching Brownian motions with critical, finite-variance branching mechanism. Le Gall has introduced a new representation of super Brownian motion with finite variance branching mechanism in terms of the *Brownian snake*, a process that takes values in the space of continuous paths in R^d. The basic idea of the snake is deceptively simple: it is essentially an attempt to carry over to a continuous setting the notion of a depth-first search of a tree. However, the snake turns out to be a powerful tool that enables techniques from Markovian potential theory and excursion theory to be brought to bear on super Brownian motion.

Super Brownian motion is connected with the potential theory of the nonlinear operator $u \mapsto \Delta u - u^2$ in a manner that is somewhat analogous to the connection between or-

dinary Brownian motion and the Laplace operator Δ. Le Gall has shown in a series of papers how the snake can be used to explore this connection and obtain new analytic results using probabilistic tools. Also, Le Gall and Perkins used the snake to give an extremely delicate analysis of the exact Hausdorff measure properties of the support of planar super Brownian motion.

In recent work with Le Jan, Le Gall has found an analogue of the snake that is useful for studying super processes with arbitrary branching mechanisms. Moreover, this work establishes new connections between Lévy processes and continuous state branching processes that are deep extensions of the classical interrelationship between random walks, branching processes, and queues.

About the Prize

The Line and Michel Loève International Prize in Probability was established in 1992 by Mrs. Line Loève and the Department of Statistics at the University of California, Berkeley. It is meant to recognize outstanding contributions of young researchers in probability, where "young" means less than forty-five years of age.

The committee awarding the prize consists of approximately thirty internationally recognized probabilists who are more than forty-five years of age. The committee is selected by a small subcommittee, under the present direction of Lucien LeCam, emeritus, Berkeley. The prize is awarded in alternate years. Past recipients are David Aldous (1993) and Michel Talagrand (1995).

Michel Loève was professor of mathematics and statistics at the University of California, Berkeley, from 1948 until his unexpected death in February 1979. He was the author of a well-received graduate text, *Probability Theory*, published by Springer-Verlag in 1977. Mrs. Line Loève, a psychologist, died very shortly after establishing the prize in July 1992.

—Steven N. Evans and Lucien LeCam, U.C. Berkeley

National Academy of Sciences Elections

The National Academy of Sciences has announced the election of sixty new members and fifteen foreign associates. Among those elected were a number who work in the mathematical sciences. Their names and affiliations are: RONALD R. COIFMAN, Yale University; INGRID DAUBECHIES, Princeton University; DAVID L. DONOHO, Stanford University; and PAUL H. RABINOWITZ, University of Wisconsin, Madison. Elected as foreign associates were KIYOSI ITO, Kyoto University, and ROGER PENROSE, Oxford University.

—National Academy of Sciences Announcement

Sloan Fellows Announced

The Alfred P. Sloan Foundation has announced the names of one hundred outstanding young scientists and economists who have been selected to receive Sloan Research Fellowships. Grants of $35,000 for a two-year period are administered by each Fellow's institution. Once chosen, Fellows are free to pursue whatever lines of inquiry most interest them, and they are permitted to employ fellowship funds in a wide variety of ways to further their research aims.

More than four hundred nominations for the 1998 awards were reviewed by a committee of distinguished scientists. The mathematicians on the committee were David W. McLaughlin, New York University; Peter Sarnak, Princeton University; and Karen Uhlenbeck, University of Texas at Austin.

The Sloan Fellows in mathematics are: YU CHEN, New York University; PANAGIOTA DASKALOPOULOS, University of California, Irvine; MING GU, University of California, Los Angeles; YAN GUO, Brown University; MATTHEW J. GURSKY, Indiana University; LARS HESSELHOLT, Massachusetts Institute of Technology; LIZHEN JI, University of Michigan; LUDMIL KATZARKOV, University of California, Irvine; GREGORY J. KUPERBERG, University of California, Davis; KEFENG LIU, Stanford University; WILLIAM P. MINICOZZI, The Johns Hopkins University; MICHAEL L. MINION, University of North Carolina; WIESLAWA NIZIOL, University of Utah; FELIX OTTO, University of California, Santa Barbara; GEORGE PAPPAS, Princeton University; ARLIE PETTERS, Princeton Univesity; BJORN POONEN, University of California, Berkeley; ZOLTÁN SZABÓ, Princeton University; SUSAN TOLMAN, University of Illinois at Urbana-Champaign; and FERNANDO R. VILLEGAS, University of Texas at Austin.

—Alfred P. Sloan Foundation Announcement

Mathematician Wins Westinghouse Competition

CHRISTOPHER COLIN MIHELICH, seventeen years old and first in his class at Park Tudor School in Indianapolis, Indiana, has won the first place $40,000 scholarship in the Westinghouse Science Talent Search.

The Westinghouse competition is the nation's oldest and most respected high school science scholarship competition. Five Westinghouse winners have gone on to receive Nobel Prizes. Fields Medalists Paul J. Cohen and David B. Mumford were Westinghouse awardees.

Christopher Mihelich, motivated by questions in theoretical physics, studied certain properties of polynomials having applications to geometry and combinatorics. Mihelich hopes to attend Harvard next year to begin work toward a doctorate in mathematics. He would eventually like to teach math at the university level and work as a number theorist.

Placing fifth and receiving a $15,000 scholarship is TRAVIS SCHEDLER, who attends the Illinois Mathematics and

Science Academy in Aurora, Illinois. Schedler's project involved quantum group theory, a subject at the interface of mathematics and physics. Schedler plans to study mathematics and physics at Harvard.

—Westinghouse Foundation Announcement

Deaths

EDWARD F. ASSMUS JR., professor emeritus, Lehigh University, Bethlehem, PA, died in March 1998. Born on April 19, 1931, he was a member of the Society for 43 years.

KURT BING, professor emeritus, Rensselaer Polytechnic University, Troy, NY, died on September 24, 1997. Born on April 30, 1914, he was a member of the Society for 47 years.

ALBERTO P. CALDERÓN, professor emeritus, University of Chicago, died on April 16, 1998. Born on September 14, 1920, he was a member of the Society for 49 years.

WILLIAM W. FLEXNER, of London, England, died on April 4, 1998. Born in October 1904, he was a member of the Society for 70 years.

PATRICIA A. FOX, of Cambridge, MA, died on February 28, 1998. Born on June 5, 1952, she was a member of the Society for 19 years.

THOMAS N. E. GREVILLE, of Charlottesville, VA, died on February 18, 1998. Born on December 27, 1910, he was a member of the Society for 65 years.

SHENG WU HE, professor, East China Normal University, Shanghai, People's Republic of China, died on January 23, 1998. Born on July 10, 1940, he was a member of the Society for 5 years.

ROBERT C. HOOPER, associate professor, University of Nevada, Reno, died on March 18, 1998. Born in September 1938, he was a member of the Society for 33 years.

CHARLES W. HUFF, professor emeritus, Winthrop University, Rock Hill, SC, died on March 17, 1998. Born on June 6, 1920, he was a member of the Society for 44 years.

PATRICK J. C. LAMONT, of Macomb, IL, died on March 4, 1998. Born on August 29, 1936, he was a member of the Society for 27 years.

S. A. PARAMHANS, research scientist at the Univ. Grants Commission, Varanasi, India, died on February 9, 1998. Born on July 31, 1941, he was a member of the Society for 17 years.

GRACE S. QUINN, professor emeritus, American University, died on February 4, 1998. Born on December 20, 1906, she was a member of the Society for 69 years.

ABRAHAM SINKOV, professor emeritus, Arizona State University, died on January 19, 1998. Born on August 21, 1907, he was a member of the Society for 35 years.

ELVIRA RAPAPORT STRASSER, professor emeritus, SUNY Stony Brook, died on April 22, 1998. Born on August 29, 1913, she was a member of the Society for 42 years.

A. I. SUBBOTIN, of the Institute of Mathematics and Mechanics, Ekaterinburg, Russia, died on October 14, 1997. He was a member of the Society for 22 years.

Mathematics Opportunities

Call for Nominations for Fermat Prize

The Fermat Prize for Mathematics Research rewards research works in fields where the contributions of Pierre de Fermat have been decisive: statements of variational principles, foundations of probability and analytic geometry, and number theory. The spirit of the prize is focused on rewarding the results of research accessible to the greatest number of professional mathematicians within these fields.

The amount of the Fermat Prize is FF100,000 (approximately $17,000). Sponsored by the Matra Marconi Space Company and Université Paul Sabatier, the prize is awarded every two years in Toulouse. The sixth award will be announced in October 1999.

Rules governing the award and nominations are available by writing to: Prix Fermat de Recherche en Mathématiques, Services des Relations Publiques, Université Paul Sabatier, 118 route de Narbonne, 31062 Toulouse Cedex 4, France. Information is also available on the Web at `http://www.ups-tlse.fr/PrixFermat/`. The deadline for nominations is **June 30, 1999**.

—Fermat Prize Committee Announcement

Call for Nominations for Morgan Prize

The Frank and Brennie Morgan Prize is given each year to reward outstanding research by an undergraduate student. The application deadline is **June 30, 1998**. Students who were undergraduates in December 1997 are eligible for this award. One award is given each year, although the selection committee for the prize has also given one or more honorable mentions. The amount of the prize is $1,000.

A nomination for the prize should include at least one research paper and at least one letter of recommendation. The papers submitted do not have to be published papers, but the work must have been performed while the nominee was an undergraduate student.

Students who would like to submit their work for consideration should send an application to: Morgan Prize Committee, c/o Robert M. Fossum, Secretary, American Mathematical Society, Department of Mathematics, University of Illinois, 1409 West Green Street, Urbana, IL 61801-2975.

For further information about the prize, contact: Kelly Black, Chair of the Morgan Prize Committee, Department of Mathematics, University of New Hampshire, Durham, NH 03824; e-mail: `black@vidalia.unh.edu`.

—from Morgan Prize Committee Announcement

Call for Nominations for Sloan Fellowships

Nominations for candidates for Sloan Research Fellowships, sponsored by the Alfred P. Sloan Foundation, are due by **September 15, 1998**. A candidate must be a member of the regular faculty at a college or university in the United States or Canada and must be at an early stage of his or her research career. For information, write to: Sloan Research Fellowships, Alfred P. Sloan Foundation, 630 Fifth Avenue, Suite 2550, New York, NY 10111; e-mail: `gassman@sloan.org`; World Wide Web: `http://www.sloan.org/`.

—Sloan Foundation Announcement

Call for Proposals for Newton Institute Programs

The Isaac Newton Institute for Mathematical Sciences in Cambridge, UK, invites new proposals for programs for 2000 onwards, particularly from areas which have been underrepresented so far (e.g., partial differential equations, analysis, computational mathematics, combinatorics). From

1999, a choice of six-month or four-month programs will be available. In addition, from 2000, short programs of three weeks' duration will be available during July and August each year. These short programs are intended for more narrowly focused topics or for subjects that may be at an embryonic stage of development, and for which a longer program might not be as yet justified.

Proposals should be addressed to the director, H. K. Moffatt, Isaac Newton Institute for Mathematical Sciences, 20 Clarkson Road, Cambridge CB3 0EH, UK. Proposers should state whether they would prefer a four-month, six-month, or three-week program. The Institute is pleased to receive proposals at any time. Proposals for consideration at the next meeting of the Scientific Steering Committee should be received by July 31, 1998.

The Web address for the Newton Institute is http://www.newton.cam.ac.uk/.

—Newton Institute Announcement

Integrative Graduate Education and Research Training

The challenges of educating scientists, mathematicians, and engineers for the twenty-first century mandate a new paradigm for training graduate students. To meet the need for a cadre of broadly prepared Ph.D.s with multidisciplinary backgrounds and the technical, professional, and personal skills essential to addressing the varied career demands of the future, the National Science Foundation (NSF) announces an agency-wide, multidisciplinary, graduate training program.

The goal of the Integrative Graduate Education and Research Training (IGERT) Program is to enable the development of innovative, research-based, graduate education and training activities that will produce a diverse group of new scientists and engineers well-prepared for a broad spectrum of career opportunities in industry, government and academe. Supported projects must be based upon a multidisciplinary research theme and organized around a diverse group of investigators from U.S. Ph.D.-granting institutions with appropriate research and teaching interests and expertise.

For the 1998 competition, the preproposal deadline is **July 1, 1998**, and the full proposal deadline is **November 23, 1998**. For the 1999 competition, the preproposal deadline is **April 15, 1999**, and the full proposal deadline is **September 7, 1999**.

For further information, consult the Web page of the NSF's Division of Mathematical Sciences, http://www.nsf.gov/mps/dms/. The postal address is: Division of Mathematical Sciences, Room 1025, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230. The telephone number is 703-306-1870.

—from DMS Announcement

For Your Information

AMS President Arthur Jaffe, Congressman George Brown Jr., and AMS President-elect Felix Browder at the Capitol Hill briefing.

Capitol Hill Briefing Draws a Crowd

Encouraged by the success of a pilot event held last year, the AMS Washington Office organized its second annual lunch briefing for members of Congress and staff on March 4, 1998, in the Rayburn Building on Capitol Hill.

A crowd even larger than last year's showed up to hear Carl Pomerance of the University of Georgia speak on "Eavesdropping on the Internet: Mathematics and Policy". Fields Medalist Efim Zelmanov of Yale University introduced the talk by Pomerance, and AMS President Arthur Jaffe acted as master of ceremonies.

Because this topic is related to some important policy issues facing Congress, the event attracted almost ninety attendees. Most were congressional staffers with responsibility for handling science/technology issues, but also in attendance were three champions of science on Capitol Hill: Congressmen James Sensenbrenner (chair of the House Science Committee), Vernon Ehlers (head of the House Science Policy Study), and George Brown Jr. (ranking Democrat on the House Science Committee). The three congressmen each spoke briefly and thanked the AMS for sponsoring the briefing.

Pomerance presented a lively talk, suited to the audience of nonmathematicians. He started out by describing the problem of secure communications and the need for cryptography. Pointing to important advances during World War II, he discussed how cryptography has become a part of mathematics. He mentioned a number of current problems in cryptography and explained how some of these might be attacked using elliptic curves. One of the strongest points he made was that number theory, which was first developed because of its beauty, has now been shown to have extremely important applications.

"It was a very interesting experience," says Pomerance. "Once I got started talking, it was just like any talk, and I felt I could connect with the audience." Afterwards there were a number of questions, ranging from the very simple ("What is a 'bit'?") to ones that got into the controversial territory of export restrictions on products with strong cryptography.

According to AMS executive director John H. Ewing, "This was the most successful event of this type that the AMS has ever organized. Everything went perfectly—there was a good turnout, Zelmanov gave a wonderful introduction, and Pomerance did a great job with the talk."

Arthur Jaffe agreed. "This was a significant event that shows that the mathematical community can connect with the general public to demonstrate the impact that our field has on important issues facing the country. We showed that mathematics has a contribution to make, and I believe we left the audience with a very positive impression of the field."

—Allyn Jackson

AMS Adds New Reviews to MathSciNet

The AMS has announced that over 175,000 reviews that appeared in *Mathematical Reviews* during 1975–79 have recently been added to the MR database. Previously, only reviews going back to 1980 were available in electronic form.

The addition of these reviews marks a milestone in the Society's multiyear project to make available electronically full reviews from the early years of MR. When completed, the project will add over 500,000 reviews to the 800,000 that were in the MR database prior to the start of the project. All reviews in MR, going back to its first issue in 1940, will be accessible online by the summer of 1999.

Newly added reviews are now accessible to subscribers of MathSciNet, the Web delivery version of MR (`http://www.ams.org/mathscinet/`).

—from AMS News Release

New IAS Program in Theoretical Biology

The Institute for Advanced Study has announced that it will begin a new program in theoretical biology, to be headed by Martin Nowak, one of the world's leading researchers in this area. Nowak, presently professor of mathematical biology at Oxford University, will come to the Institute this fall to lead the research initiative. The program is made possible in part by a new initiatives fund at the Institute, established by Institute trustee Leon Levy, to provide greater flexibility in exploring promising new areas not already represented within the Institute.

The use of mathematical ideas, models, and techniques in the biosciences has been growing rapidly and becoming increasingly important. Applied mathematicians have traditionally used mathematical methods to address a wide range of problems in the physical sciences, especially physics and engineering, in the belief that the underlying laws of physics are of a precise nature and therefore capable of being described mathematically. Although mathematical biology actually began in the 1920s with the work of Fischer, Haldane and Wright in genetics, Lotka and Volterra in ecology, and Kermack and McKendrick in epidemiology, biology does not have the same mathematical/theoretical tradition as the physical sciences and instead has been more focused on laboratory work. However, several areas of biology have gradually developed an understanding of the important role that mathematical approaches can play. Such approaches are often in the hands of people who collaborate with experimentalists but do not themselves work in the laboratory.

"The Institute's new initiative is a tremendous opportunity for theoretical biology and an important recognition of the whole field," Nowak commented. "The main objective of the new program will be to undertake world-class research in diverse areas of mathematical biology, ranging from evolutionary biology and ecology to infectious diseases of humans. The emphasis will be on maintaining research collaborations with leading experimental groups, as mathematical theory in biology is usually at its best when in close conjunction with experimental data. Furthermore," Nowak continued, "there is the definitive chance to introduce bright young physicists and mathematicians to a scientific field which is full of open questions and unexplored areas."

The research goals of the new initiative will include work on the evolution and dynamics of infectious disease. The human immunodeficiency virus (HIV) will be an area of focus, because more quantitative data are available for HIV than for any other infectious disease. The research will include topics such as anti-viral treatment, viral population genetics, and the complex interaction between the virus and the immune system. A quantitative understanding of anti-HIV immune responses should greatly strengthen the research efforts for an HIV vaccine. Along similar lines, mathematical models will be developed to illuminate the dynamics of prion infections.

Other important research goals in the area of evolutionary biology will focus on the mathematical analysis of complex biological systems, such as the evolution of cooperation, development, and genetic systems. Evolution of cooperation based on direct and indirect reciprocity is crucial for understanding problems ranging from the interaction among genes and cells to the origin and integration of human societies. Of similar importance are mathematical models for the evolution of human language.

Among the IAS faculty who played important roles in developing the initiative are Frank Wilczek and Stephen Adler of the School of Natural Sciences and Thomas Spencer of the School of Mathematics. Four people have been invited to the Institute to work in the initiative: biologists David Krakauer and Dominik Wodarz, engineer Linda Wahl, and mathematician Alun Llyod.

Martin Nowak, who holds degrees in biochemistry and mathematics, was born in Austria and educated at the University of Vienna, where he received his Ph.D. with highest honors in 1989. He subsequently went to Oxford University, where he has worked closely for the past nine years with Professor Sir Robert May, now England's chief scientific advisor and head of the Office of Science and Technology, developing a wide variety of mathematical models to address a broad range of problems in evolutionary biology and infectious diseases. Since 1992 Nowak has been a Wellcome Trust Senior Research Fellow in Biomedical Sciences and a Fellow of Keble College, Oxford, becoming head of the Mathematical Biology Group in 1995 and professor of mathematical biology in 1997. He serves as an editor of a number of scientific journals and is the author or coauthor of over one hundred papers.

—from IAS News Release

Graduate Enrollments in Science and Engineering Continue Downward Move

Following fifteen years of consistent gains, graduate enrollments in science and engineering for 1996 declined for a third straight year, according to a newly published National Science Foundation (NSF) Data Brief.

NSF figures show that enrollment of women in graduate science and engineering (S&E) programs, which has been rising consistently since 1980, went up again by about 1 percent over the 12-month period ending in the fall of 1996. Meanwhile, graduate S&E enrollments for men, which started downward in 1992, continued its slide, down 3.3 percent from 1995 to 1996.

Another telling figure in the data brief is that for the 1995–96 period there was a drop of nearly 7,000 graduate enrollments in S&E among white men.

Overall there were more than 20,000 fewer S&E graduate enrollments from 1993 to 1996. Enrollments have declined consistently in the physical sciences (3 percent) and in engineering (4 percent).

The data brief is produced by NSF's Division of Science Resources Studies. For more information see `http://www.nsf.gov/sbe/srs/stats.htm`.

—NSF News Release

Science Board Approves Utah Graphics/Visualization Center

The National Science Board, the governing body of the National Science Foundation (NSF), has approved a 48-month grant worth almost $13 million for the Center for Graphics and Visualization at the University of Utah, an NSF Science and Technology Center.

The center is distributed among five universities: the Utah site, Brown, Cornell, CalTech, and the University of North Carolina at Chapel Hill. The center was established in 1991 and has received continued funding totalling nearly $28 million overall—nearly $21 million of that from NSF. The center has four core missions in computer graphics and scientific visualization: modeling, rendering, interaction, and performance.

Research in the four core areas is centered on two applications: telecollaboration and visualization. The center's telecollaboration research is directed at the pacing problem of remote design and manufacturing. This focus spans the entire center and includes the four core research areas as well as scene acquisition and reconstruction, and design of display devices.

—NSF

Visiting Mathematicians

American Mathematicians Visiting Abroad

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Burns, John A. (U.S.A.)	University of Trier, Germany	Optimal Design and Control	3/99
Burns, John A. (U.S.A.)	Karl-Franzens-Universitat, Austria	Optimal Design and Control	4/99
Fornberg, Bengt (U.S.A.)	University of Stellenbosch, South Africa	Numerical Methods	8/98
Huneke, Craig (U.S.A.)	Max Planck Institute, Germany	Commutative Algebra	8/98-12/98
Protter, Philip (U.S.A.)	INRIA, France	Probability and Numerical Analysis	8/98- 1/99

Visiting Foreign Mathematicians

Anderson, Erik (Sweden)	Purdue University	Several Complex Variables	8/97- 8/99
Androulakis, George (Greece)	Texas A&M University	Banach Spaces	9/98- 5/00
Anker, Jean-Philippe (France)	University of Wisconsin-Madison	Harmonic Analysis	1/99- 5/99
Ashino, Ryuichi (Japan)	University of Ottawa	Wavelets	8/99
Belogay, Eugene (Bulgaria)	Purdue University	Applied Analysis	8/98- 5/00
Bernasconi, Jakob (Switzerland)	University of Colorado, Boulder	Neural Networks	8/98-11/98
Berry, Daniel (Israel)	University of Waterloo	Programming Language Design	9/98- 8/99
Bernstein, Swanhild (Germany)	University of Arkansas, Fayetteville	Clifford Analysis	2/98- 2/99
Cai, Tianxin (People's Republic of China)	University of Georgia	Number Theory	10/97-10/98
Choi, YunSung (Korea)	Kent State University	Functional Analysis	8/98- 1/99
Coti Zelati, Vittorio (Italy)	University of Wisconsin-Madison	Nonlinear Analysis	8/98-12/98
Davey, Brian (Australia)	Vanderbilt University	Algebra	9/98
Doss, L. Jones Tarcius (India)	University of Tennessee	Numerical and Partial Differential Equations	8/98- 5/99
Eichhorn, Juergen (Germany)	Emory University	Geometry, Analysis	8/98- 9/98
Eilers, Soren (Denmark)	University of New Mexico	Analysis, Matrices and Operator Algebras	7/98-12/98
Feinstein, Joel (England)	Brown University	Functional Analysis, Complex Analysis	1/99- 5/99
Fock, Vladimir (Russia)	Brown University	Mathematical Physics/String Theory	7/98-12/98
Fuchs, Peter (Austria)	Texas A&M University	Near Rings	9/98- 5/99
Gekhtman, Michael (Israel)	University of Notre Dame	Optimization Theory	8/98- 5/99
Goncharov, Sergei (Russia)	University of Wisconsin-Madison	Logic	8/98-12/98
Groenewald, Nico J. (South Africa)	University of Southwestern Louisiana	Algebra	8/98
Guhring, Gabriele (Germany)	Vanderbilt University	Differential Equations	8/98-11/98
Györi, Ervin (Hungary)	Vanderbilt University	Graph Theory	1/99- 5/99
Hahn, Sang Geun (Korea)	Brown University	Number Theory	8/98- 1/99
Han, Song Ho (Korea)	Purdue University	Algebraic Topology	2/98- 1/99
Hu, Yijun (People's Republic of China)	University of Maryland, College Park	Probability	9/98- 9/99

The list of visiting mathematicians includes both foreign mathematicians visiting in the United States and Canada, and Americans visiting abroad. Note that there are two separate lists.

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Ikeda, Toshiharu (Japan)	University of Wisconsin-Madison	Lie Algebras	6/98 - 3/99
Jezek, Jaroslav (Czech Republic)	Vanderbilt University	Algebra	8/98 - 9/98
Karoński, Michal (Poland)	Emory University	Random Graphs and Algorithms	1/99 - 5/99
Khoussainov, Bakhadyr (New Zealand)	University of Wisconsin-Madison	Logic	8/98 - 12/98
Kolishkin, Andrei (Latvia)	University of Ottawa	Applied Mathematics	1/99 - 8/99
LeFloch, Philippe G. (France)	University of Wisconsin-Madison	Applied Mathematics	8/98 - 12/98
Leuenberger, Christoph (Switzerland)	Purdue University	Several Complex Variables	1/98 - 12/98
Łuczak, Tomasz (Poland)	Emory University	Random Graphs, Combinatorics	9/98 - 12/98
Maestre, Manuel (Spain)	Kent State University	Functional Analysis	8/98 - 8/99
Medeiros, Heloisa Bauzer (Brazil)	University of Colorado, Denver	Numerical Analysis, Partial Differential Equations	8/98 - 8/99
Meyberg, Kurt (Germany)	University of Wisconsin-Madison	Algebra	8/98 - 12/98
Narue-Domkul, Kanlaya (Thailand)	University of Waterloo	Machine Translation	3/98 - 12/99
Navarro, Gabriel (Spain)	University of Wisconsin-Madison	Algebra	8/98 - 9/98
Ni, Lei (People's Republic of China)	Purdue University	Geometric Analysis	8/98 - 5/00
Nitica, Viorel (Romania)	University of Notre Dame	Differential Geometry	8/98 - 5/99
Olivier, Werner (South Africa)	University of Southwestern Louisiana	Algebra	8/98
Ono, Kosuke (Japan)	Brown University	Nonlinear Wave Equations	10/98 - 9/99
Pani, Amiya (India)	Colorado School of Mines	Numerical Analysis	8/98 - 12/98
Park, Suk Bong (Korea)	University of Wisconsin-Madison	Orthogonal Polynomials	2/98 - 2/99
Patrizio, Giorgio (Italy)	University of Notre Dame	Complex Analysis	1/99 - 5/99
Peretyat'kin, Mikhail (Kazakhstan)	University of Wisconsin-Madison	Logic	8/98 - 12/98
Plaskota, Leszek (Poland)	Boston University	Complexity Theory and Neural Network Theory	9/98 - 6/99
Rybowicz, Marc (France)	University of Waterloo	Maple	9/97 - 8/98
Sato, Enji (Japan)	University of Waterloo	Critical Points and Point Derivations on M(G)	5/98 - 8/98
Schmidt, Ralf (Germany)	Purdue University	Automorphic Forms	5/98 - 4/99
Shami, Ziv (Israel)	University of Notre Dame	Model Theory	8/98 - 5/99
Shen, Quan (People's Republic of China)	Purdue University	Applied Mathematics	8/98 - 5/00
Strakoš, Zdeněk (Czech Republic)	Emory University	Numerical Linear Algebra	9/98 - 8/00
Studer, Leo (Switzerland)	N.J. Institute of Technology	Bio. Math.	11/97 - 11/98
Swart, Henda (South Africa)	Vanderbilt University	Graph Theory	9/98 - 12/98
Swart, John (South Africa)	Vanderbilt University	Differential Equations	9/98 - 12/98
Symanzik, Jürgen (Germany)	George Mason University	Visualization, Virtual Reality	8/97 - 8/99
Thomas, Robert (Canada)	Oxford University, England	Geometry, Philosophy of Mathematics	10/98 - 6/99
Turner, Stephen (England)	University of Ottawa	Probability Theory with Applications to Telecommunications	6/98 - 12/98
Ursini, Aldo (Italy)	Vanderbilt University	Algebra	9/98
Vondracek, Zoran (Croatia)	University of Florida	Probability	8/98 - 5/99
Walther, Bjorn (Sweden)	Brown University	Partial Differential Equations	1/99 - 5/99
Wang, Jin Fang (Japan)	University of Waterloo	Statistics	3/98 - 3/99
Xie, Zhenghui (People's Republic of China)	University of Tennessee	Numerical Fluid Dynamics	8/98 - 5/99
Yeh, Li-Ming (Taiwan)	Purdue University	Numerical Analysis	8/98 - 5/99
Zalesskii, Alexandre (Belarus)	University of Wisconsin-Madison	Algebra	1/99 - 5/99
Zima, Eugene (Russia)	University of Waterloo	Computer Algebra, Symbolic Numerical Interface	9/97 - 8/98
Zhu, Shu (People's Republic of China)	Purdue University	Applied Mathematics	8/98 - 11/98

Add this Cover Sheet to all of your Academic Job Applications

How to use this form

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

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

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

Mathematics Departments in Bachelor's, Master's and Doctorate granting institutions have been contacted and are expecting to receive the form from each applicant, along with any other application materials they require. Obviously, not all departments will utilize the cover form information in the same manner. Please direct all general questions and comments about the form to:
`emp-info@ams.org`
or call the Professional Programs and Services Department, AMS, at 800-321-4267 extension 4105.

JCEO Recommendations for Professional Standards in Hiring Practices

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

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

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

Academic Employment in Mathematics

AMS Standard Cover Sheet

Last Name _____

First Name _____

Middle Names _____

Address *through June 1998* **Home Phone**

_____ _____

_____ **e-mail Address**

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Current Institutional Affiliation **Work Phone**

_____ _____

Highest Degree and Source _____

Year of Ph.D. (optional) _____

Ph.D. Advisor _____

If the Ph.D. is not presently held, date on which you expect to receive _____

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

Primary Interest _____

Secondary Interests *optional* _____

Give a brief synopsis *of your current research interests (e.g. finite group actions on four-manifolds). Avoid special mathematical symbols and please do not write outside of the boxed area.*

_____

_____

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

University or Company _____

Position Title _____ Dates _____

Indicate the position for which you are applying and position posting code, if applicable

_____

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

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

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

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

☐ _____

☐ _____

☐ _____

☐ _____

This form is provided courtesy of the American Mathematical Society.

This cover sheet is provided as an aid to departments in processing job applications. It should be included with your application material.

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1991 Mathematics Subject Classification

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

From the AMS

1997 Reports of the AMS Policy Committees

In 1992 the Council of the AMS decided to reorganize its committee structure. At that time there were already two so-called "policy committees": one on education policy and the other on science policy. To these were added three more policy committees: one on the profession, one on meetings and conferences, and one on publications. The skeleton charge given to all of these committees was as follows:

a. to provide advice to the leadership of the Society and to make recommendations as to Society policy;

b. to be responsible for taking a long-range view in their areas;

c. to conduct an annual high-level review of activities and structure within their areas and evaluate progress towards Society goals;

d. to report regularly to the membership, both in writing and by presentations at meetings;

e. to maintain communications with the membership and to keep aware of their views;

f. to coordinate with other professional organizations.

The *Notices of the AMS* conceived of itself, as the journal of record for the Society, as an appropriate vehicle to execute (d): reporting regularly to the membership in writing.

Committee on Publications (CPUB)

Susan Montgomery, Chair

CPUB met twice last year, on March 8 and on October 18, 1997.

Much of our time in both meetings was devoted to a discussion of the health of the *Bulletin*. In March we received the report of a special subcommittee (chaired by Brian Conrey) set up in late 1996 to look at the member journals (BAMS and *Notices*); we delayed taking any action until this fall after further e-mail discussion and consultation with various other people. Our recommendations appeared as Item 2.6.1 on the ECBT agenda and are on the Council agenda, along with some background material.

Each year CPUB is charged with reviewing part of the AMS publication program, on a four-year schedule. In 1996 our charge was to review the AMS primary journals (JAMS, *Math of Comp*, PAMS, TAMS). A task force to do this was established by Steve Krantz, the 1996 chair of CPUB, though it did not report to us until our meeting in March 1997, since CPUB did not meet in the fall of 1996. Although in general the task force (chaired by Eric Bedford) felt that the primary journals were in good health, they did have several concerns, in particular the large backlogs of PAMS and TAMS and the large size of the PAMS editorial board. CPUB accepted the report of the task force without recommending any further action.

In 1997 CPUB was charged with reviewing AMS e-only journals (*Electronic Research Announcements*, a free journal; *Conformal Geometry and Dynamics* and *Representation Theory*, subscription journals). A subcommittee was appointed by the current CPUB chair to carry out this review; the chair of this subcommittee was Fan Chung Graham. This committee's recommendations were in three parts. The first was directed to the editors of the e-only journals, the main point being to encourage the editors to broaden the scope of the type of articles they consider for publication. CPUB approved these recommendations and will pass them on to the editors.

The second set of recommendations was directed to the AMS staff; most were specific suggestions for more widely publicizing the existence and virtues of the AMS e-only journals. The committee recommended that a backlog report for all journals, including all e-only journals, be maintained on e-MATH. CPUB approved these recommendations. The third set of recommendations was not directly

concerned with the review of the AMS e-only journals but was more generally concerned about electronic publishing. CPUB had been concerned about most of these issues already.

In both meetings we received reports from Don Babbitt and Keith Dennis about the most noteworthy activities taking place in the Publication Division and *Mathematical Reviews*. The book program is doing well, with many more titles, and is now bringing in some income to the Society. Recently the AMS acquired Chelsea, including its inventory; some titles will be reprinted in an AMS/Chelsea series. At our October meeting CPUB discussed and endorsed an AMS Undergraduate Book Series proposal; this was Item 2.14 of the ECBT agenda and is on the Council agenda. *Math Reviews* is also doing well, and MathSciNet is increasingly popular. Slowly the older reviews are being added to the database, and eventually all will be on it.

Finally, we continued our discussions of access/ownership/archiving issues, in particular for e-journals. CPUB, as a matter of policy, wants to extend the current ownership policy so that the AMS site license will allow the subscriber to download the year's subscription so as to make it available electronically to authorized users and/or make a paper copy of articles for that year. See Item 2.6.2 for CPUB's specific recommendation to the Council.

Concerning electronic archiving, the AMS already has a policy of maintaining in perpetuity an online accessible electronic archive of all of its electronic journal articles. A question arises about the relation of this type of archiving and the ownership policy discussed above. CPUB endorsed a policy which says that if a subscriber had an online subscription in a certain year and articles from that year subsequently had to be reformatted, then that subscriber could have access to the reformatted archive for a fee determined by cost plus a small profit.

Committee on Education (CoE)

Hyman Bass, Chair

The full committee now meets only once a year, so much of this report is a report on its September 26–27, 1997, meeting, based on notes of Monica Foulkes, and on activities pursuant thereto.

Proposed National Test in Mathematics

As a result of the request from CSP and CoE to involve more mathematicians in the development of the test, the Department of Education appointed several mathematicians to the numerous advisory panels being set up. Invited to discuss the progress of the project at this meeting were Gary Phillips (director of the test project), and Judy Wurtzel and Pat O'Connell Ross (Office of Educational Research and Improvement). Support in Congress for the proposed test has been mixed, and the day before the meeting Secretary of Education Richard Riley issued a statement that development of the test has been halted until a final appropriations bill is signed. There was discussion of the ways mathematicians have been involved in the process, and Phillips promised to look into the concerns expressed. CoE members were encouraged to submit names of mathematicians to the Department of Education representatives for future involvement. This was done, and a substantial list was sent by the chair to Gary Phillips.

Judy Sunley (NSF) reported on the work of the joint NSF/Department of Education working group on plans for the support needed in conjunction with the test in areas such as teacher preparation and enhancement, development of instructional material, and public information and encouragement. There was discussion of emerging public backlash to the test and what professional organizations could do to calm the rhetoric. Daniel Goroff reported on the work of the administration's Office for Science and Technology Policy (OSTP) to support the president's initiative, which was motivated by the poor performance of U.S. eighth-grade students in the Third International Mathematics and Science Study (TIMSS). It was President Clinton's intention to "set the bar high" and set world-class standards in the test in order to "ratchet up the system", rather than to produce a test based on an assessment of what current eighth-grade students could pass.

Secretary of Education Richard Riley has accepted an invitation to speak to the Joint Mathematics Meetings in Baltimore in January 1998. He is jointly sponsored by CoE and CSP.

NCTM Standards 2000

Roger Howe, chair of the subcommittee appointed by CoE to act as an Association Resource Group (ARG) to the writing teams working on the revision of the Standards, reported that the ARG had already submitted two reports to the National Council of Teachers of Mathematics. A public report will soon appear in the *Notices* and on the AMS Web site, and a joint panel session with the MAA ARG will be held at the Baltimore meetings. CoE members who are also members of NCTM's writing teams reported that the AMS ARG's comments had been well received. The subcommittee was thanked for its hard work—which is still ongoing—and thoughtful reports, and CoE will express its appreciation to NCTM for setting up a process to involve the whole mathematical community in the rewriting of the Standards.

National Science Foundation–Division of Undergraduate Education

Norman Fortenberry, interim division director while Robert Watson is on assignment, informed CoE about the restructuring of DUE programs into a new entity, to be announced December 1. Programs will be: Course, Curriculum and Laboratory Improvement (CCLI), Advanced Technological Education (ATE), and Collaboratives for Excellence in Teacher Preparation. This restructuring reflects the recommendations made in the 1996 Review of Undergraduate Education. Fortenberry posed four questions for CoE comments: (1) What can we do to better prepare future mathematics teachers? (2) What can be done to change the institutional climate? (3) Is the M.S. degree likely to become a more accepted terminal degree in the mathematics community? (4) What are your perceptions about the

Calculus Reform backlash, and how do we best address the issues raised? CoE appointed a subgroup, chaired by David Bressoud, to respond. The subgroup's report was received with great appreciation by Fortenberry and the staff at NSF.

National Science Foundation–Division of Mathematical Sciences

Ann Boyle described the new VIGRE program (Vertical Integration of Research and Education in the Mathematical Sciences) to support departmental, as opposed to individual, activities. This new and complex program will subsume the GIG program (Group Infrastructure Grants) as a response to the recommendations of the 1995 Workshop on Graduate Education. Boyle reported that NSF was pleased with the response to the interdisciplinary grants program that provides sabbatical support for mathematicians to work in other departments.

Preparation of Future Mathematics Teachers

A common theme in all the above discussions was an increased emphasis on improvements in the preparation of mathematics teachers. C. Lacampagne, Department of Education, reported that funding had been approved for an MAA proposal ("Mathematics Education of Teachers Project") that the department wished to see expanded to include other mathematical societies. This proposal will be discussed at the December CBMS meeting, and CoE appointed a subgroup to explore AMS involvement and proposals for the design of the project and to make recommendations at the CBMS meeting. The Department of Education is also interested in developing departmental workshops with the AMS and other interested societies.

New Criteria for Accreditation of Engineering Programs

William Kelly gave an overview of the Accreditation Board for Engineering and Technology's (ABET) new accreditation criteria, currently in a pilot phase, but to be compulsory by 2001. Kelly did not feel that the new criteria would impact mathematics departments. CoE will continue to monitor the implementation of the new criteria for possible impact.

CoE Focus

There was discussion of the focus on K–12 mathematics education, which has taken up most of CoE's energy recently. In connection with what was felt to be CoE's core concern, graduate education, there was discussion of data on decreasing enrollments by U.S. students in upper-level and graduate courses and the resultant impact on education. There was also debate about the structure of CoE meetings. CoE has agreed to meet September 11–12, 1998.

Reports from Other Groups

Naomi Fisher reported on MER (Mathematicians for Education Reform) projects, including a joint AMS/MER proposal for workshops on professional master's degrees. Ron Rosier reported that the 1995 CBMS Survey had been published, reporting that enrollments in four-year college mathematics courses had decreased by 9% from 1990 to 1995, but those in two-year colleges had increased 12%. Almost half (46%) of all undergraduate mathematics is now taught in two-year colleges. John Tucker reported on plans for the Board on Mathematical Sciences Department Chairs Colloquium and other projects. Gerald Kulm reported on the American Association for the Advancement of Science Project 2061, concerning middle-school mathematics curriculum. The CoE subcommittee appointed to make recommendations to the *Math Reviews* Editorial Committee on a possible classification for research in mathematics education is close to a final recommendation. Representatives from other organizations making short presentations included: Mathematical Association of America, Education Development Council, National Association of State Science and Mathematics Coalitions, and the Joint Policy Board for Mathematics.

MR Coverage of Undergraduate Education Research

A subcommittee of the CoE, chaired by Joan Ferrini-Mundy, is looking into the possibility of MR listings of work in undergraduate education research. It has produced a draft classification scheme that is compatible, as required, with that of Zentralblatt. This is currently under review by MREC. Once a classification scheme is adopted, there remains the question of the scope of possible coverage by MR.

Committee on Meetings and Conferences (COMC)

Joel H. Spencer, Chair

COMC met September 20, 1997, in Chicago. In attendance were Roy L. Adler, Bettye Anne Case, Robert Daverman, John H. Ewing, Robert M. Fossum, Susan Friedlander, Bill Harris, Isom Herron, Evan Houston, Arthur M. Jaffe, Leslie M. Sibner, Joel H. Spencer, Karen Vogtmann, Sylvia Wiegand, Jim Maxwell, Hope Daly, and Robin Hagan Aguiar.

There were four basic issues. Here is a brief report card:

AMS Sectional Meetings: A-OK.

AMS Sessions at Meetings of Other Organizations: OK, but not done very often.

AMS Summer Conference Programs: Troublesome, survival problematic.

AMS National Meeting: Positive, optimistic, with perennial concerns of size and focus.

1. AMS Sectional Meetings

A subcommittee consisting of Bettye Anne Case, Robert Daverman, Evan Houston (chair), and Deborah Sulsky submitted its report, Evan Houston giving an oral summary.

The heart of the report (both written and oral) was a strong vote of confidence in the current system and, most particularly, in the Secretariat. The associate secretary in charge of each meeting is the key person. They have con-

siderable leeway. They encourage formation of special sessions, and they can experiment with new formats. This is all going very well.

Some technical matters in format had already been agreed to by the Secretariat. No action was necessary.

Moderate financial losses have been sustained at these meetings for the past few years. Steps are in place to correct this, but even if these problems persist, the importance of these meetings to the community far outweighs these concerns.

There was a discussion concerning putting abstracts on the Web. John Ewing pointed out potential technical problems with doing this. COMC felt this would be a significant aid to mathematicians planning or deciding on a trip to a sectional meeting. Further, seeing an abstract might lead to fruitful mathematical collaboration. The printed program remains the program of record. But a Web page that is updated daily (as is already done with authors, titles, and times), even if the formatting is less than perfect, is highly desirable. In the end we voted unanimously: COMC endorses assigning a high priority to the development of a system for putting abstracts on the Web in a timely fashion. (Staff is now investigating costs for implementing this new service, with the intention of implementing with modest effort.)

2. AMS Sessions at Meetings of Other Organizations

A subcommittee consisting of Isom Herron (chair), Jerrold Marsden, and James Hyman presented its report, Isom Herron giving the oral report.

The key connection of this type is with AAAS. There is a mathematics component in their annual meeting, Warren Paige heading their mathematics section. In discussion this was seen as a very positive collaboration so long as the mathematical content was interesting to a broad audience. A February 1997 session on geometry with Frank Morgan on soap bubbles, Doris Schattschneider on Escher, and other fine speakers was considered a model. Other sessions, such as one on mathematics education reform, were much less successful. COMC encourages continued support of this project.

There were few other such sessions, and that led to discussion of other possible venues. For example, in the report Jerrold Marsden writes of possible interaction with the IEEE CDC (control) meeting. Without endorsing any particular such sessions, COMC feels that the AMS should look favorably at holding such sessions when the opportunity presents itself.

3. AMS Summer Conference Programs

Here we have a problem. We concentrated on the AMS-IMS-SIAM Summer Research Conferences, which are run by the AMS. These consist of five to seven different one-week conferences held in the same place during the summer.

A timeline: Summer 1998 is set; funding for summer 1999 is set, and the committee is currently at work. The issue is really beyond that date, at which time a new funding proposal will have to be made.

On the positive side, these are good conferences. They attract typically fifty to seventy mathematicians, they concentrate in one area, and there is fruitful collaboration. This writer, Arthur Jaffe, and others reported very positive experiences at such meetings. Isom Herron noted the particularly good effect such conferences have on younger mathematicians.

The problem is the lack of applications. Over the past three years no proposals were rejected, and the committee itself went to considerable effort to get good people to submit proposals. The committee (now chaired by Barbara Keyfitz) is doing an excellent job. The AMS staff handles pretty much all of the chores of housing, finances, etc., so that the organizers do not have a particularly onerous burden.

We were somewhat at a loss to explain the lack of applications. Our general feeling was that it was connected to the great abundance of meetings and workshops that now exist. Both MSRI and IMA run many workshops, as do more specialized centers like DIMACS. Further, there is more opportunity for meetings in other countries. The feeling, though we were not at all certain, was that the AMS program was being crowded out. Then again, perhaps the program has simply run out of steam.

Still, on the mathematical side, there was relative agreement. While the programs are mathematically interesting, the lack of enthusiasm among potential applicants is a very serious drawback. If mathematics is not to be an enthusiastic enterprise, then it is hard to see the point of it. Ways to fix the program may be devised, but we cannot in good conscience recommend pushing for refunding of a program that our community itself seems so reticent to endorse.

4. The Annual Meeting: Size and Focus

The annual meeting is certainly a success. But is it too big? Is it focused enough on our core mission? Are researchers avoiding the meeting? A lively discussion of this perennial issue produced no clear results. Data giving participation from top research institutions over the past ten years indicate no diminishment of interest. The number of research papers given is strong, particularly in the Special Sessions, which now predominate. Some feel the program is too full, with far too many evening sessions. Others say that that is fine, as they can pick and choose what they want.

We are concerned that the control mechanism for the meetings has broken down. De jure, the National Program Committee must approve all events. But that committee (chaired by this writer 1994–96) sees its main mission as selection of Invited Speakers and, secondarily, of Special Sessions. Bob Daverman pointed out that they simply do not have the context in which to decide which new panels, forums, special events, or whatever to let in. De facto, these decisions are now being made by the Secretariat.

5. Future Projects

Karen Vogtmann will chair a subcommittee to examine Special Lectures and Special Projects in 1998.

COMC will meet again in Chicago on September 26, 1998.

6. COMC Membership

As of November 1997 the members of COMC are:

Roy L. Adler, Bettye Anne Case, John H. Ewing (ex-officio/AMS executive director), Robert M. Fossum (ex-officio/AMS secretary), Isom H. Herron, Evan G. Houston, James M. Hyman, Arthur M. Jaffe (ex-officio/AMS president), Jerrold E. Marsden, Joel H. Spencer, Karen Vogtmann, Sylvia M. Wiegand.

Permanent invited guests: Robert J. Daverman (Associate Secretary, Southeastern Section), Susan J. Friedlander (Associate Secretary, Central Section), William Harris (Associate Secretary, Western Section), Lesley M. Sibner (Associate Secretary, Northeastern Section).

AMS Staff: Hope Daly (staff support), Robin Hagan Aguiar (staff support), and James Maxwell (senior staff liaison).

This report was prepared by Joel H. Spencer, chair of COMC, with the assistance of the committee.

Committee on the Profession (CoProf)

Joseph Lipman, Chair

Committee Meetings

CoProf held a face-to-face meeting on March 22–23. Additional business was conducted by e-mail. The committee was not able to settle substantive issues through this medium.

Mathematics Department's Role in the University

What did the Rochester episode suggest about how mathematics departments can best function in a changing academic environment? Mathematics departments are still being eroded in a quiet way—"death by a thousand cuts". CoProf sponsored a panel discussion, organized by Frank Gilfeather, on this question at the 1997 annual AMS meeting in San Diego. (Several other sessions on "survival" were held at the same meeting.) The question remains a high priority for the profession.

Contact has been made with BMS about the possibility of a workshop on the subject, but little progress has yet been made in this respect. It is hoped that the long-awaited report of the AMS Task Force on Excellence in Mathematics Scholarship will provide further stimulus.

CoProf has been discussing ways in which the AMS might offer assistance to individual mathematics departments. CoProf is working on a document on why and how departments might conduct both internal and external reviews and what to do with the results. See also the section below on "Relations with Other Disciplines".

Public Awareness

Following up on its public awareness report (`http://www.ams.org/committee/profession/pubaware.html`), CoProf established a Working Group on Public Awareness in Mathematics (WGPAM), chaired by Steven Weintraub, to serve as a focal point for public awareness efforts. Though initially WGPAM will be a subcommittee of CoProf, it is anticipated that it will develop into a more autonomous AMS entity.

WGPAM's What's New in Mathematics (WNIM) page, the public awareness component of e-MATH (`http://www.ams.org/new-in-math/`), began operation in November 1996. WNIM aims to have a wide variety of items of interest to both mathematicians and nonmathematicians: articles specially written for WNIM, links to other parts of e-MATH, links to other Web sites, and references to print media. AMS statistics show that WNIM is one of the most heavily accessed areas of e-MATH, with numerous hits from many countries and from nonacademic domains such as .com and .net.

Relations with Other Disciplines

For the area of its 1997 review of AMS activities, CoProf chose "Relations with Other Disciplines". (The two preceding reviews have been on Employment and Public Awareness; see `http://www.ams.org/committee/profession`.) The report was discussed both at the March meeting and by e-mail over the summer. The noncontroversial part of the report enumerates and praises efforts of Arthur Jaffe and Sam Rankin in the Washington arena to bring mathematics into closer contact with professional organizations representing other disciplines and with the federal government. AMS activities to make nonacademic employment opportunities more visible are also noted. The rest of the report raises questions which are important and complex. For example, should the AMS advocate for more interdisciplinary research and correspondingly broadened graduate programs, and if so, how? This has resulted in the report remaining internal to CoProf, as a basis for further face-to-face discussion, without which no consensus on the hard issues can be reached.

One result of the review is that CoProf is sponsoring a panel at the Baltimore meetings on "Building Connections to Industry within Graduate Departments". The panel has been organized by Annalisa Crannell. Panelists will discuss examples of industrial and commercial projects in traditional mathematics graduate programs—how and why these project were started and the implications for graduate students and faculty involved. The goals are to provide information on professional development to the mathematics community, to stimulate senior mathematicians' awareness of opportunities for working with industry, and to enhance graduate advisors' abilities to help their students cross from academia into industry.

Employment

CoProf oversees the maintenance of employment- and career-related information on e-MATH at `http://www.ams.org/committee/profession/`.

CoProf sponsored a three-hour program, organized by Annalisa Crannell, on "Preparing Ourselves and Our Students for Careers in Mathematics" at the 1996 Mathfest in Seattle. A video of the sessions was distributed in June of 1997 to all Ph.D.-granting mathematics departments.

CoProf sponsored a panel, organized by Ruth Williams, on "Careers for Mathematicians in Industry, Government, and Business" at the 1997 annual meeting in San Diego.

Participation

Pursuant to Council approval of a CoProf resolution in January 1995, the AMS established a Task Force on Participation for Underrepresented Minorities in Mathematics, chaired by James Turner. A major Task Force recommendation on the establishment of a Washington Office of Minority Affairs has been actively pursued by the AMS, at first with MAA and NCTM, now also with SACNAS, NAM, Benjamin Banaeker, and AISIS; but difficulties in coordinating objectives and financial commitments with such a large group of sponsors has up to now hindered the process of defining what the operation should be.

Professional Development

CoProf cosponsored a panel, organized by Curtis Bennett, on "Continuing Professional Development" at the 1997 annual meeting in San Diego.

The possibility of an AMS publication on professional development, based on articles from the *Concerns of Young Mathematicians* electronic newsletter, is being discussed.

Tenure, Adjuncts, ...

CoProf subcommittees are currently considering questions having to do with changing attitudes toward tenure and with the use of adjuncts, especially in the teaching of lower-level mathematics courses. These are large questions affecting all of academia. At its next meeting CoProf will discuss proposals to the Council for statements on these matters.

Membership, Dues

Could membership levels of certain groups of mathematicians be improved? Don McClure is currently investigating some characteristics of tenured and tenure-track faculty which may help to determine how representative the AMS membership is and where opportunities for increased membership might lie.

Should the dues structure be changed? After considerable discussion of a Providence staff study on the financial impact of changing to a single-tier dues structure at the lower dues level and on various partially compensating measures, CoProf recommended that there be no change in the current dues structure.

It was also recommended that the *Abstracts* should be removed as a benefit of Contributing Membership, thereby making the extra dues amount a tax-deductible contribution.

Prizes

The ECBT requested that CoProf prepare a proposal for a Public Service Award, to be presented periodically by the AMS together with the American Chemical and Physical Societies to a member of Congress in recognition of work done in support of mathematics, science, and engineering. An e-mail discussion brought out several problems with the idea, among them the possibility of undesirable political overtones. Consequently, any proposal will have to wait for face-to-face discussion.

Committee on Science Policy (CSP)

Jim Lewis, Chair

Invited Speakers at National Meetings

CSP activities began in January with the science policy addresses at the Joint Mathematics Meetings in San Diego. We were honored to have invited addresses by Neal Lane, director, National Science Foundation, and Congressman George E. Brown Jr., ranking Democrat on the House Committee on Science and longtime supporter of science. The talks were well attended and rank among the most successful science policy addresses that the Committee has sponsored. Encouraged by that success, CSP invited two government speakers to address the January 1998 Joint Meetings in Baltimore—U.S. Secretary of Education Richard Riley, and Lt. General Kenneth Minihan, director of the National Security Agency.

At the San Diego meetings CSP also hosted two focus group discussions with Don Lewis, director of the Division of Mathematical Sciences at the National Science Foundation, providing exchange of information and comments from leaders in the mathematics community about the (then) proposed changes to NSF's merit review criteria, as well as issues related to the support of graduate students. The CSP also sponsored a panel discussion on public awareness opportunities in the classroom and, jointly with the Joint Policy Board for Mathematics, sponsored a workshop on how to meet with members of Congress.

Involvement in Congressional Activities

Lunch Briefing on Mathematics for Congressional Staff: In March the CSP chair joined other mathematicians for a lunch briefing on mathematics for congressional staffers on Capitol Hill, organized by President Jaffe and the AMS Washington Office. The speaker was Ronald Coifman of Yale University.

Joint Statement on Federal Support for Science Research: The briefing followed by one day a press conference of presidents of science societies, organized by President Jaffe and other society presidents, who released a statement calling for a 7% increase in FY 1998 in federal support for science (a significant increase over the 3% requested by President Clinton). This press conference was the kickoff activity of a year of coordinated activity by professional scientific groups to advocate for stronger support for science in the federal budget. Looking back from the end of the year, President Jaffe, the Washington Office, and the other societies with whom they have worked are to be congratulated for their success (one result of their efforts was a 4.9% increase in NSF's budget).

Visits to Members of Congress: The date of the April CSP meeting was chosen to coincide with Congressional Visits

Day (CVD) sponsored by the Science and Technology Work Group. Under Sam Rankin's leadership, the AMS Washington Office was heavily involved in the organization of Congressional Visits Day, and CSP congratulates them on the success of the event. Among the over two hundred scientists who participated in CVD were ten mathematicians, including six members of CSP. The day was spent visiting members of Congress and advocating for the 7% budget increase for scientific research that had been urged by the presidents of the scientific societies in March.

Calls for Action: Several calls for action by AMS members were issued (usually via e-mail or the AMS Web pages; see address below) over the course of the year by CSP's support staff, based at the AMS Washington Office, often in liaison with the Joint Policy Board for Mathematics and other scientific groups and coalitions. Providing background information on the issues involved and advice on how to contact members of Congress, these alerts increasingly involve AMS members in national issues affecting mathematics. Over the last two years the AMS has worked to improve its connections with other scientific societies in order to increase the visibility of science and mathematics in Washington circles. The most recent alert called for support for the "Unified Statement" issued in October 1997 by leaders of scientific groups calling for the doubling of federal investment in science research over the next ten years. Anyone wishing to participate in our AMS Contact Group and to receive these e-mail alerts should contact the AMS Washington Office (e-mail to `mxf@ams.org`).

CSP Meeting, April 1997

CSP meetings now have a two-pronged focus: (1) to use our presence in Washington to discuss science policy issues with federal agency officials and congressional experts, and (2) to conduct internal AMS committee business.

The first day of our meeting was devoted to invitees from federal agencies, congressional committee staff, and government relations staff from other scientific societies who provided information and expertise on issues related to advocating for mathematics on the federal scene. Among this year's visitors were former Congressman Doug Walgren, who provided an insider's view of how to influence Congress, John Crowley of MIT's Washington Office, who discussed the Science Coalition and its efforts to bring the scientific community into closer contact with Congress, and Janis Tabor of the Council for Chemical Research, who discussed a "town meeting" approach for grass roots communication by scientists in the local districts and states of members of Congress.

The CSP also heard from James Turner, a staff member of the House Science Committee, and Tim Peterson of the House Appropriations Subcommittee with oversight responsibility for NSF. The Committee presented a certificate of appreciation to Turner for his advice and counsel over the past few years. Beverly Hartline of the Office of Science and Technology Policy presented an overview of the Clinton Administration's support for science and technology and discussed the stress that such discretionary funds were under because of efforts to balance the federal budget. Mike Lubell of the American Physical Society gave an overview of APS efforts to involve their members in grassroots activities in support of science.

During CSP's second day of meetings we heard from Judy Sunley of NSF regarding NSF's involvement in the proposed national voluntary eighth-grade mathematics test. Following the discussion, CSP directed the chair (in cooperation with the chair of the Committee on Education) to write to the Department of Education and to NSF advocating a larger role for mathematicians in the development of the national test. The one noticeable result of this letter was that both AMS chairs were appointed to the Mathematics Committee which developed the specifications for the voluntary national test of mathematics at grade eight.

The CSP considered the AMS Council's resolution on AMS involvement with the U.S. National Committee on Mathematics (USNCM) and appointed CSP member Cora Sadosky to stay in contact with the USNCM chair, Mike Artin. The CSP was concerned, and remains concerned, that groups such as the CSP, or even the AMS Council, have very little input into issues such as how the U.S. delegation will vote on the location of ICM 2002. This is a matter that the Council should consider further for how best to influence the activities of the USNCM. One further concern of the CSP is the fact that the USNCM will now be housed at the International Relations branch of NAS, further distancing it from the mathematics community.

Future Plans

A revised AMS National Policy Agenda is planned. In the meantime, that document and statements by the president on specific issues are available on the Web at the AMS site's Government Affairs section (see address below).

CSP also will actively support the AMS Washington Office's efforts to increase grassroots involvement by AMS members in support of funding for science.

Continued involvement is planned in the bipartisan congressional long-range Science and Technology Policy Study, conducted by Congressman Vernon Ehlers. AMS president Arthur Jaffe has taken part in initial discussions by the scientific community with Study staff. Members of the science community are invited to send comments about the future needs of science and technology via the House Science Committee's Web page (`http://www.house.gov/science/science_policy_study.htm`).

Science Policy on the Web

In 1997 increased news and information about science policy has been posted on the AMS Web site (`http://www.ams.org/government`), where you will find news on developments in Congress concerning science funding; alerts to AMS members to contact their members or senators about specific legislation; advice on how to contact Congress; latest federal budget information; text of addresses by CSP-sponsored speakers at national meetings; links to useful sites, such as the Ehlers' Study site listed above; and information on membership of CSP, our charge, and copies of our annual reports.

Reference

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

Upcoming Deadlines

August 15, 1998: Deadlines for applications for NRC Associateship Programs. Information available at the Web site `http://rap.nas.edu/`.

September 15, 1998: Deadline for nominations for candidates for Sloan Research Fellowships in Mathematics. For information write Sloan Research Fellowships, Alfred P. Sloan Foundation, 630 Fifth Avenue–Suite 2550, New York, NY 10111. World Wide Web: `http://www.sloan.org/`.

September 15, 1998: Deadline for nominations for AWM Alice T. Schafer Mathematics Prize. For information—phone: 301-405-7892; e-mail: `awm@math.umd.edu`.

December 1, 1998: Deadline for applications for fellowship opportunities in Asia offered by the NSF. World Wide Web: `http://www.twics.com/~nsftokyo/home.html` or by e-mail: `JKPinfo@nsf.gov`.

Where to Find It

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

Mathematics Calendar

The most comprehensive and up-to-date Mathematics Calendar information is available on e-MATH at `http://www.ams.org/mathcal/`.

June 1998

June–July **MODELLING '98, 1st IMACS Conference on Mathematical Modelling and Computational Methods in Mechanics and Geodynamics**, Prague, Czech Republic. (Oct. 1997, p. 1157)

*1–3 **Romanian-German Seminar on Approximation Theory (ROGER-98)**, Mathematical Department of the Faculty of Sciences, Universitatea "Lucian Blaga", Sibiu, Romania.

Organizing Committee: I. Gavrea, H. H. Gonska (Duisburg), M. Ivan (Cluj-Napoca), A. Lupas, L. Lupas (Sibiu).

Aim: The aim of the seminar is to bring up some unsolved and open problems from the fields of constructive function theory, approximation theory, numerical analysis, or special functions.

Information: Information and registration may be obtained from A. Lupas, Univ. of Sibiu, Faculty of Sciences, Dept. of Mathematics, Str. I. Ratiu nr. 7, RO-2400 Sibiu, Romania, or via e-mail at `lupas@cs.sibiu.ro`.

1–4 **IASTED International Conference on Computer Graphics and Imaging**, Halifax, Canada. (Dec. 1997, p. 1497)

1–4 **Mathematics and Design 98**, The University of the Basque Country, San Sebastian, Spain. (Dec. 1997, p. 1497)

1–5 **IMA Workshop: Animal Locomotion and Robotics**, University of Minnesota, Minneapolis, Minnesota. (May 1998, p. 636)

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

1–5 **Fourth International Conference on Mathematical and Numerical Aspects of Wave Propagation**, Colorado School of Mines, Golden, Colorado. (Jan. 1998, p. 110)

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

1–6 **Shape Optimization**, Troia, Portugal. (May 1998, p. 636)

1–6 **Table Ronde de Géométrie Pseudo-Riemannienne Globale**, Institut Élie Cartan (IECN), Université Henri Poincaré, Nancy I, France. (May 1998, p. 636)

*1–10 **Advanced Course and Workshop on Mathematical Control Theory**, Grand Hotel Bellavista, Levico Terme (Trento), Italy.

Sponsors: This event is also sponsored by G.N.A.F.A.-C.N.R. and M.U.R.S.T. project "Problemi nonlineari nell'Analisi e nelle Applicazioni". The advanced course (June 1–6) will be followed by a workshop (June 8–10).

Scientific Organizers: Advanced course: M. Bardi (Padova); workshop: M. Bardi, P. Cannarsa (Roma II), and I. Capuzzo Dolcetta (Roma I).

Courses: The school includes the following 5 courses, of 5 hours each: (1) P. Cannarsa (Roma II): *Dynamic programming methods for optimal control of evolution equations*; (2) I. Capuzzo Dolcetta (Roma I): *Viscosity solutions of dynamic programming equations: The finite dimensional case*; (3) F. H. Clarke (Lyon I): *Nonsmooth analysis and the control of ordinary differential equations*; (4) A. Isidori (Roma I): *Stabilization of nonlinear systems*; (5) H. J. Sussmann (Rutgers): *Differential-geometric and nonsmooth methods in finite-dimensional optimal control.*

Invited Speakers: O. Alvarez (Rouen), A. Bacciotti (Torino), G. Buttazzo (Pisa), M. Falcone (Roma I), H. Frankowska (Paris-Dauphine), H. Ishii (Tokyo), R. Jensen (Chicago), V. Komornik (Strasbourg), Y. S. Ledyaev (Kalamazoo), P. L. Lions (Paris-Dauphine), P. Loreti (IAC-CNR Roma), L. Pandolfi (Torino), J. P. Puel (Versailles), F. Rampazzo (Padova), A. Siconolfi (Roma I), C. Sinestrari (Roma II), P. Soravia (Padova), G. Stefani (Firenze), S. Zagatti (SISSA Trieste), T. Zolezzi (Genova), E. Zuazua (Madrid).

This section contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings and symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete list of meetings of the Society can be found on the last page of each issue.

An announcement will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in every third issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

In general, announcements of meetings and conferences held in North America carry only the date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the *Notices* in care of the American Mathematical Society in Providence or electronically to `notices@ams.org` or `mathcal@ams.org`.

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

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

The Mathematics Calendar, as well as Meetings and Conferences of the AMS, is now available electronically through e-MATH on the World Wide Web. To access e-MATH, use the URL: `http://e-math.ams.org/` (or `http://www.ams.org/`). (For those with VT100-type terminals or for those without WWW browsing software, connect to e-MATH via Telnet (`telnet e-math.ams.org`; login and password `e-math`) and use the Lynx option from the main menu.)

Deadline: Application deadline: April 23, 1998.
Information: A. Micheletti, Secretary of CIRM, Centro Internazionale per la Ricerca Matematica, Istituto Trentino di Cultura, 38050 Povo (Trento), Italy; tel: +39-461-881628; fax: +39-461-810629; e-mail: michelet@science.unitn.it.

3-6 **Seventh Conference of the International Linear Algebra Society, The Hans Schneider Linear Algebra Conference**, University of Wisconsin-Madison, Madison, Wisconsin. (Nov. 1997, p. 1362)

4-6 **Basle Geometry Days**, University of Basle, Basel, Switzerland. (May 1998, p. 636)

4-10 **1998 Barcelona Conference on Algebraic Topology**, Centre de Recerca Matemàtica, Bellaterra, Spain. (Feb. 1998, p. 293)

*5-8 **VIIth Oporto Meeting on Geometry, Topology and Physics**, Faculdade de Ciencias da Universidade do Porto, Oporto, Portugal.
Aim: The aim of the Oporto meetings is to bring together mathematicians and physicists interested in the interrelation between geometry, topology, and physics and to provide them with a pleasant and informal environment for scientific interchange.
Topics: The main topics will be: Topological Quantum Field Theory; Strings and Dualities; and Deformation Quantization. The meeting will consist largely of short courses, of approximately three lectures each, given by the main speakers, supplemented by a limited number of seminars, details of which will be announced later. The talks are at the advanced graduate or postdoctoral level, and should be of interest to all researchers wishing to learn about recent developments in the overlap between geometry, topology, and physics.
Speakers: The main speakers together with the titles of their minicourses are as follows: J. Baez (Univ. of California, Riverside): Spin Foam Models of Quantum Gravity; B. Greene (Columbia Univ.): String Theory on Calabi-Yau Manifolds; L. Takhtajan (State Univ. of New York, Stony Brook): Deformation Quantization of Complex Poisson Manifolds; B. Tsygan (Pennsylvania State Univ.): Recent Developments in Deformation Quantization; D. Yetter (Kansas State Univ.): Deformation Theory for Categories with Structure.
Organizing Committee: P. Gothen (pbgothen@fc.up.pt), J. Mourao (jmourao@galaxia.ist.utl.pt), R. Picken (picken@math.ist.utl.pt), J. N. Tavares (jntavar@fc.up.pt).
Information: For updated information see the Internet page: http://www.fisica.ist.utl.pt/~jmourao/om/omvii/om98b.html.

7-19 **NATO ASI—1998 CRM Summer School**, Banff, Alberta, Canada. (Feb. 1998, p. 293)

*8-10 **From Erdős to Algorithms: Applications of the Probabilistic Method (A joint DIMACS-DIMATIA workshop)**, DIMACS Center, Rutgers University, Piscataway, New Jersey
Contact: J. Spencer, spencer@cs.nyu.edu.
Local Arrangements: P. Pravato, DIMACS Center; pravato@dimacs.rutgers.edu; tel: 732-445-5929.
Focus: The "probabilistic method" is a legacy of Paul Erdős that continues to grow and flourish and have powerful applications in all parts of the mathematical sciences. We will explore current results in discrete mathematics that use probabilistic existence arguments and require the use of sophisticated probability concepts. We will further explore the connection to modern issues in computer science by examining the possible implementations of probabilistic existence arguments by randomized or deterministic algorithms.
Information: http://dimacs.rutgers.edu/Workshops/index.html.

8-12 **IMA Workshop: Continuum Mechanics and Nonlinear Partial Differential Equations**, University of Minnesota, Minneapolis, Minnesota. (may 1998, p. 636)

8-12 **The 1998 Barrett Memorial Lectures: Discrete Conformal Geometry**, University of Tennessee, Knoxville, Tennessee. (Mar. 1998, p. 420)

9-11 **1998 International Conference on Dynamic Systems and Differential Equations**, Shanghai Jiao Tong University, Shanghai, The People's Republic of China. (Sept. 1997, p. 1028)

*10-12 **Workshop on European Scientific and Industrial Collaboration on Promoting Advanced Technologies in Manufacturing (WESIC'98)**, Girona, Spain.
Aim: The aim of the First WESIC is to provide a forum where companies, universities, institutes, and research centers may interchange experiences in meeting the needs of advanced technology in manufacturing systems. The workshop will be of particular interest to those companies and institutions that are interested in collaborating in scientific projects in their sector. The intention is to identify common points of interest in order to participate in collaborative actions such as: research agreements, integration of Ph.D. students in European companies, transfer of technology, thematic networks, European Community research projects, ets.
Focus: The program will consist of two days of presentation per sector (15 minutes for each presentation), and one day of specific meetings and round table discussions.
Topics: The workshop will focus on control and related technologies applied to the following subjects: Robotics integated in manufacturing; Control of mechatronic systems; Computer integrated manufacturing; Image processing and computer vision; Intelligent systems in manufacturing and control; Quality control; Communications and distributed systems.
Program Committee: J. van Amerongen (Univ. Twente, The Netherlands), J. Batlle (Univ. of Girona, Spain; chair), S. Boverie (Siemens Automotive, France), C. Cappadozzi (Consorzio AURORA, Italy), A. Casals (Polytechnical Univ. Catalunya, Spain), V. Graefe (Univ. der Bundeswehr, Germany), A. Halme (Helsinki Univ. of Tech., Finland), J.-C. Laprie (Dir. du LAAS-CNRS, France), R. Milne (Intelligent Appl. Ltd., Scotland), E. M. Mouaddib (Univ. Jules Verne, France), M. Polkinghorne (South West Innovation Relay Centre, UK), J. de la Riva (Integral Interface, Spain), G. Roberts (Univ. of Wales Coll., UK), U. Stenta (Univ. Rome, Italy), M. Vassilaki (SPEED Co., Greece).
Organizing Committee: J. Aguilar, J. Amat, R. Bischoff, L. Kaiser, A. B. Michael, J. Salvi, T. Schunberg.
Information: WESIC'98, P. Eyskens, EIA Dept., e-mail: patricia@eia.udg.es; tel: +34-72-418474; +34-72-418956; fax: +34-72-418098; http://eia.udg.es/wesic98/.

11-13 **Lehigh University Geometry/Topology Conference**, Lehigh University, Bethlehem, Pennsylvania. (May 1998, p. 636)

11-16 **Venice-2/Symposium on Applied and Industrial Mathematics**, Venice, Italy. (May 1998, p. 637)

*12-13 **A Workshop on Industrial Mathematics**, Utah State University, Logan, Utah.
Invited Speakers: E. Cumberbatch (Claremont Graduate Univ., Claremont, CA), I. L. Davis (Thiokol Corp, Ogden, UT), G. Forest (Univ. of North Carolina), K. E. Jordan (IBM T. J. Watson Research Center), S. P. Keeler (The Boeing Company), D. S. Ross (Kodak Research Labs.), F. Santosa (Univ. of Minnesota, Minneapolis).
Information: See the Web site http://www.jk.math.usu.edu/IMS/, or contact any of the following: J. Koebbe, koebbe@sunfs.math.usu.edu; X. Ren, ren@sunfs.math.usu.edu; or E. Stone, stone@sunfs.math.usu.edu.

12-13 **The Third Biennial Symposium on Mathematical Modeling in the Undergraduate Curriculum**, University of Wisconsin, La Crosse, Wisconsin. (Jan. 1998, p. 111)

12-18 **NSF/CBMS Regional Conference in the Mathematical Sciences**, Fort Collins, Colorado. (Mar. 1998, p. 421)

13-15 **CMS Summer 1998 Meeting**, University of New Brunswick, Saint John, New Brunswick. (Mar. 1998, p. 421)

13-20 **Dynamical Systems and Small Divisors**, Grand Hotel San Michele, Cetraro (Cosenza), Italy. (May 1998, p. 637)

15-17 **Conference on Advances in Applied and Computational Mathematics**, Mathematical Sciences Research Institute, Berkeley, California. (Feb. 1998, p. 293)

*15-18 **Hopf Algebras and Quantum**

Groups, Free University of Brussels (VUB), Brussels, Belgium.
Scientific Committee: S. Caenepeel (Brussels), S. Dascalescu (Bucharest), S. Montgomery (Univ. of Southern California), H.-J. Schneider (München), M. Van den Bergh (Hasselt), F. Van Oystaeyen (Antwerp).
Organizing Committee: S. Caenepeel (Brussels), G. Militaru (Bucharest), Z. Shenglin (Fudan Univ.).
Invited Lecturers: N. Andruskiewitsch, S. Dascalescu, C. Kassel, L. Lebruyn, A. Masuoka, S. Montgomery, G. Militaru, H.-J. Schneider, D. Stefan, A. Van Daele, S. Woronowicz, Y. Zhang.
Registration: The deadline for registration is May 4, 1998. After this date hotel accommodation at the special congress rate cannot be guaranteed. There will be no registration fee. Lunches and a Congress dinner will be organized, and a contribution will be asked to those who want to join the group for lunch or Congress dinner. These contributions should be paid at the beginning of the conference.
Proceedings: The Proceedings of the conference will be submitted for publication in Marcel Dekker's blue series "Lecture Notes in Pure and Applied Mathematics". Each paper will be refereed individually. The deadline for submitting a paper for the proceedings is November 30, 1998. If you intend to submit a paper, please let the organizers know, so that they can mention your name and the title of your paper in the first proposal to Marcel Dekker.
Information: S. Caenepeel, Faculty of Applied Sciences, Free Univ. of Brussels (VUB), Pleinlaan 2, B-1050 Brussels, Belgium; fax: 32-2-629-28-59; e-mail: scaenepe@vub.ac.be.

*15-19 **International Conference on Integral Quadratic Forms and Lattices**, Seoul National University, Seoul, Korea.
Topics: Recent developments in the theory of integral quadratic forms and lattices and its applications will be discussed.
Organizers: J. S. Hsia (Ohio State Univ., jshsia@math.ohio-state.edu), M.-H. Kim (Seoul National Univ., mhkim@math.snu.ac.kr), Y. Kitaoka (Nagoya Univ., kitaoka@math.nagoya-u.ac.jp), and R. Schulze-Pillot (Univ. of Saarlandes, schulzep@count.math.univ-sb.de).
Invited Speakers: C. Bachoc (Univ. of Bordeaux), A. M. Berge (Univ. of Bordeaux), W.-K. Chan (Univ. of Southern California), N. Dummigan (Northern Illinois Univ.), A. Earnest (Southern Illinois Univ.), D. Estes (Univ. of Southern California), K. Hashimoto (Waseda Univ.), Y. Hironaka (Shinshu Univ.), J. S. Hsia (Ohio State Univ.), D. James (Pennsylvania State Univ.), M. Joechner (Germany), H. Katsurada (Muroran Inst. Tech.), M.-H. Kim (Seoul National Univ.), Y. Kitaoka (Nagoya Univ.), J. Martinet (Univ. Bordeaux), G. Nebe (RWTH Aachen), V. Nikulin (Steklov Inst. Math.), R. Schulze-Pillot (Univ. of Saarlandes), P. Sole (Univ. of Sophia-Antipolis), P. -H. Tiep (Ohio State Univ.), T.-H. Yang (Univ. of Michigan), F. Xu (China), and more.
Information: http://www.garc.snu.ac.kr/seminar/lattices.html.

15-19 **International Conference on Local Differentiable Dynamics and Applications to Bifurcation Theory**, Limburgs Universitair Centrum (L.U.C.), Diepenbeek, Belgium. (Mar. 1998, p. 421)

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

16-19 **Conference on the Theory of Phase Transitions and Free Boundary Problems**, Center for Mathematical Sciences, Zhejiang University, Hangzhou, China. (Mar. 1998, p. 421)

17-23 **6th Purdue International Symposium on Statistics**, West Lafayette, Indiana. (Sept. 1997, p. 1028)

19-22 **Conference on Control of Distributed Parameter and Stochastic Systems**, Hangzhou, China. (Mar. 1998, p. 422)

19-23 **International Interdisciplinary Symposium: Mathematics in the Sciences**, Leipzig, Germany. (Mar. 1998, p. 422)

21-24 **LICS'98 (The Thirteenth Annual IEEE Symposium on Logic in Computer Science**, Indiana University Conference Center, Indianapolis. (Sept. 1997, p. 1029)

21-26 **5th International Conference on Teaching Statistics (ICOTS-5)**, Singapore, Malaysia. (Apr. 1998, p. 531)

21-26 **Thirteenth U.S. National Congress of Theoretical & Applied Mechanics**, University of Florida, Gainesville, Florida. (Sept. 1997, p. 1029)

*21-27 **EC Summer School on Astrophysical Discs**, Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom.
Aim: This summer school, directed towards advanced graduate students, postdoctoral fellows, and researchers is intended to cover the physical processes that occur in astrophysical discs. Hydromagnetic processes, turbulence, and external forcing will be considered. Discs in the context of active galactic nuclei, galaxy discs, protostars, and close binary systems will be discussed.
Organizing Committee: J. Goodman (Princeton), J. Papaloizou (QMW), J. Pringle (Cambridge), and J. Sellwood (Rutgers).
Lecturers (tent.): A. Fridman, C. Gammie, G. Laughlin, D. N. C. Lin, B. Mathieu, R. Narayan, E. Ostriker, J. Papaloizou, J. Pringle, R. Pudritz, J. Sellwood, A. Toomre, and I. Yi.
Grants: The conference is supported by a grant from the European Community, which will provide funding towards the registration, travel, and subsistence costs of selected young (under 35 years) participants. Applications from women and anyone living in Greece, Ireland, and Portugal and other less-favoured regions of the European Community are particularly encouraged. Early application for grants is advisable. Other limited funds exist for participants from outside the EC. Self-supporting participants of any age and nationality are welcome to apply.
Applications: The workshop will take place at the Newton Institute, and accommodations for participants will be provided at Wolfson Court, adjacent to the Institute. The conference package costs £350, which includes registration fees, accommodations, breakfast and evening meals, plus lunch and refreshments during the days that the workshop takes place. Closing date for the receipt of applications is April 20, 1998.
Information: Further information and application forms are available from the World Wide Web at http://www.newton.cam.ac.uk/programs/dad.html, where information about the main program and general information about the Newton Institute can also be found. Completed application forms should be sent to H. Hughes, Isaac Newton Institute for Mathematical Sciences, 20 Clarkson Road, Cambridge CB3 0EH, UK; tel: (01223) 335999; fax: (01223) 330508; e-mail: h.hughes@newton.cam.ac.uk.

21-27 **Groups of Finite Morley Rank**, Anogia, Crete, Greece. (May 1998, p. 637)

22-25 **IMACS International Symposium on Soft Computing in Engineering Applications (SOFTCOM'98)**, Athens, Greece. (Apr. 1998, p. 531)

22-26 **Low Dimensional Topology—The KirbyFest**, Mathematical Sciences Research Institute, Berkeley, California. (May 1998, p. 637)

22-26 **The Eighth International Conference on Fibonacci Numbers and Their Applications**, Rochester, New York. (Sept. 1997, p. 1029)

22-26 **Mathematical Results in Quantum Mechanics (QMath7)**, Doppler Institute of the Czech Technical University, Prague, Czech Republic. (Mar. 1998, p. 422)

*22-26 **Positivity and Its Applications (In Memory of C. B. Huijmans)**, Middle East Technical University, Ankara, Turkey.
Sponsor: Scientific and Research Council of Turkey.
Organizing Committee: Y. Abramovich, yabramovich@math.inpui.edu; C. D. Aliprantis, raliprantis@math.inpui.edu; S. Alpay, safak@rorqual.cc.metu.edu.tr; and A. Wickstead, A.Wickstead@Queens-Belfast.AC.UK.
Speakers: Y. Abramovich, C. D. Aliprantis, S. Alpay, W. Arendt, A. Bukhvalov, G. Buskes, P. Dodds, Z. Ercan, W. A. Feldman, Y. Gordon, H. Gurcay, F. Hernandez, V. Khudalov, A. Kitover, A. G. Kusraev, S. S. Kutateladze, W. Luxemburg, P. Meyer-Nieberg, R. Nagel, V. Oliker, M. Orhon, B. de Pagter, M. Pliev, I. Polyrakis, A. C. M. Van Rooij, A. R. Schep, G. Stotaev, V. C. Troitsky, B. Turan, L. Tzafriri, A. Wickstead.

22–26 **Third International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing**, The Claremont Colleges, Claremont, California. (Oct. 1997, p. 1158)

*22–27 **The Fifth International Symposium on Effective Methods in Algebraic Geometry (MEGA 98)**, Universite de Rennes, Saint Malo, France.
Topics: Effective methods and theoretical and practical complexity issues in: commutative algebra, geometry, real geometry, algebraic number theory, algebraic geometry and related fields; algebraic analysis of differential equations, differential geometry, associative algebras, group theory, algebraic groups and Lie algebras, algebraic and differential topology, as well as applications of these fields.
Conference Committee: A. M. Cohen (Eindhoven), J. H. Davenport (Bath), A. Galligo (Nice), D. Yu. Grigoriev (Univ. Park/St. Petersburg), J. Heintz (Santander, Buenos Aires), D. Lazard (Paris), T. Mora (Genova), M. Pohst (Berlin), M. van der Put (Groningen), T. Recio (Santander), M.-F. Roy (Rennes, chairwoman), B. Sturmfels (Berkeley/Kyoto), C. Traverso (Pisa).
Program: The program will include invited lectures, accepted papers, software demonstrations.
Invited Lectures: H. Kerksen (Basel/Brandeis): Constructive invariant theory; J.-C. Faugere (CNRS, Paris VI): New generations of Groebner basis algorithms; A. Mac Intyre (Oxford Univ.): o-minimal expansions of the Real: Characterization and Pfaffian closure; V. Retakh (Arkansas St. Univ.): Noncommutative algebra and geometry: A down-to-earth approach; N. Takayma (Kobe Univ.): Algorithms for differential operators and their applications to algebraic geometry.
Information: For any further information related to the conference, or any special problem or request, please contact directly: by e-mail: `mega98@univ-rennes1.fr`; by fax to Mega 98: 33 (0) 2-99-28-67-90; by ordinary mail at the following address: mega98, IRMAR, Campus de Beaulieu, 35042 Rennes CEDEX, France. Information about Mega 98 can be found at `http://www.maths.univ-rennes1.fr/~mega98/`.

22–27 **Third Siberian Congress on Industrial and Applied Mathematics (INPRIM-98) dedicated to the memory of S. L. Sobolev (1908–1989)**, Novosibirsk Akademgorodok, Russia. (Sept. 1997, p. 1029)

*22–28 **Workshop on Mathematical Finance**, Sophus Lie Center, Nordfjordeid, Norway.
Focus: The purpose of the workshop is to bring together established researchers and students to discuss the latest results in this active and fast-developing area of stochastic analysis. The program will consist of lectures given by the main speakers, as well as contributed talks from other participants.
Main Speakers: M. H. A. Davis (Tokyo-Mitsubishi International) and I. Karatzas (Columbia Univ.).
Organizing Committee: K. Aase (NHH, Bergen), B. Oksendal (Univ. of Oslo), J. Paulsen (Univ. of Bergen), K. Reikvam (Univ. of Oslo).
Sponsors: NorFa, NFR, Dept.of Mathematics, University of Oslo and Sogn og Fjordane Fylkeskommune.
Information: Contact either B. Oksendal or K. Reikvam at Dept. of Mathematics, Univ. of Oslo, Box 1053 Blindern, N-0316 Oslo, Norway; `oksendal@math.uio.no` or `kre@math.uio.no`; fax: +47-22854349.

22–July 3 **Mathematics and Molecular Biology: Science for the 21st Century**, University of California at Berkeley, California. (Mar. 1998, p. 422)

22–July 10 **Foundations and Developments of Mathematical Economics**, Accademia Aeronautica, Pozzuoli-Napoli, Italy. (Apr. 1998, p. 531)

22–August 28 **Astrophysical and Geophysical Flows as Dynamical Systems, GFD Summer Study Program**, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts. (Mar. 1998, p. 422)

23–27 **Twenty-second Summer Symposium in Real Analysis**, University of California, Santa Barbara, California. (May 1998, p. 637)

24–26 **Centennial Congress on M. C. Escher (1898–1972)**, University of Rome "La Sapienza", Rome, Italy. (Feb. 1998, p. 293)

24–27 **Thirteenth Summer Conference on Topology and Its Applications with Workshops on Set-Theoretic Topology and Topological Groups**, Universidad Nacional Autónoma de México (UNAM), Mexico City, D.F. Mexico. (Mar. 1998, p. 423)

25 **LICS'98 Workshop on Formal Methods and Security Protocols**, Indianapolis, Indiana. (Jan. 1998, p. 111)

25 **LICS'98 Workshop on Logic and Diagrammatic Information (LDI'98)**, Indianapolis, Indiana. (Jan. 1998, p. 111)

25–26 **8th Stockholm Optimization Days**, KTH (Royal Institute of Technology), Stockholm, Sweden. (Apr. 1998, p. 532)

25–27 **International Conference on Scientific Computing and Mathematical Modeling IMACS'98**, Alicante, Spain. (Jan. 1998, p. 111)

*25–27 **7th National Conference: Creating Undergraduate Research Opportunities in Changing Communities**, Occidental College, Los Angeles, California.
Information: E. L. Montgomery, Membership & Meetings Coordinator, Council on Undergraduate Research, 734 15th Street, NW, Suite 550, Washington, DC 20005; tel: 202-783-4810; fax: 202-783-4811; Web site: `http://www.cur.org/`; e-mail: `cur@cur.org`.

*26–27 **DIMACS Workshop on Combinatorial Clustering and Multi-Domain Protein Structure Analysis**, DIMACS Center, Rutgers University, Piscataway, New Jersey.
Goal: The combinatorics, graph theory and algorithms branches of discrete mathematics are powerful techniques for use in analysis of diverse sets of data. Combinatorics introduces clustering models, forms a basis for the interpretation of results, and brings new ideas to clustering methods. The area of combinatorial clustering provides new opportunities for systematic (routine) and comprehensive study of very large databases containing highly complex non-regular elements. However, researchers developing methods for combinatorial clustering often do not collaborate with specialists in the creation, management, and analysis of large, complex databases. The goal of this workshop is to foster and facilitate such a collaboration by focusing on a particular application. The specific problem we wish to address is in the area of protein structure and analysis of multi-domain proteins (as an example for other type of interactions among large bio-molecules). By hosting this workshop, our aim is not only to stimulate research at the interface between these disciplines, but also to stimulate development of ideas and methods in each field.
Organizers: I. Dubchak (Lawrence Berkeley Nat. Lab., National Energy Res. Scientific Comp. Div.), C. A. Kulikowski (Rutgers Univ.), I. Muchnik (Rutgers Univ., DIMACS), F. Roberts (Rutgers Univ., DIMACS), S. Spengler (Lawrence Berkeley Nat. Lab., Life Sciences Div.), M. D. Zorn (Lawrence Berkeley Nat. Lab., National Energy Res. Scientific Comp. Div.).
Invited Speakers: I. Gelfand (Rutgers Univ.), A. Kister (Rutgers Univ.), A. Shneider (Invention-Machine Co., MA), and M. Zorn (Lawrence Berkeley Nat. Lab.).
Local Arrangements: P. Pravato, DIMACS Center, e-mail: `pravato@dimacs.rutgers.edu`, 732-445-5929.
Information: Contact I. Muchnik, e-mail: `muchnik@dimacs.rutgers.edu`. WWW: `http://dimacs.rutgers.edu/Workshops/CombCluster/`.

28–July 1 **A Conference in Probability in Honor of Harry Kesten**, Cornell University, Ithaca, New York. (Apr. 1998, p. 532)

28–July 2 **Pacific Rim Geometry Conference**, Univeristy of British Columbia, Vancouver, British Columbia. (Dec. 1997, p. 1498)

28–July 3 **Conference on Computer-Aided Verification (CAV'98)**, Vancouver, British Columbia. (Jan. 1998, p. 111)

28–July 3 **The Third St. Petersburg Workshop on Simulation**, St. Petersburg, Russia. (Jan. 1998, p. 112)

*28–July 3 **Summer School on K-Theory and Algebraic Groups**, Grand Hotel Bellavista, Levico Terme (Trento), Italy.
Scientific Organizers: M. Karoubi (Paris

VII), C. Pedrini (Genova), and U. Rehmann (Bielefeld).
Sponsor: The European Research Project TMR FM RX - CT 970107 co-sponsors this school.
Topics: There will be 4 main series of lectures in the morning and research talks in the afternoon. Each lecture series will consist of 5 hours of lectures covering the following topics: (1) E. Friedlander: *An introduction to K-theory and its recent developments*; (2) A. Merkurjev: *K-theory and algebraic groups*; (3) M. Kolster: *K-theory of algebraic integers*; (4) B. Kahn: *K-theory and quadratic forms over fields.*
Deadline: Application deadline: May 15, 1998.
Information: A. Micheletti, Secretary of CIRM, Centro Internazionale per la Ricerca Matematica, Istituto Trentino di Cultura, 38050 Povo (Trento), Italy; tel: +39-461-881628, fax: +39-461-810629, e-mail: michelet@science.unitn.it.

29-July 1 **Parallel Computing and Algorithms in Economics and Finance (Call for Papers)**, University of Cambridge, Cambridge, United Kingdom. (Feb. 1998, p. 293)

29-July 2 **The First International Conference on Functional Differential Equations (FDE1)**, The Research Institute, The College of Judea and Samaria, Ariel, Israel. (Apr. 1998, p. 532)

29-July 2 **International Workshop on Orthogonal Polynomials: Numerical and Symbolic Algorithms**, Madrid, Spain. (Mar. 1998, p. 423)

29-July 3 **Arakelov Theory, Values of L-Functions**, Newton Institute, Cambridge, United Kingdom. (Jan. 1998, p. 112)

29-July 3 **Second International Conference on Bifurcation Theory and its Numerical Analysis**, Xi'an Jiaotong University, Xi'an, P.R. China. (Dec. 1997, p. 1498)

*29-July 4 **International Conference on Representation Theory**, East China Normal University, Shanghai, China.
Sponsors: National Natural Science Foundation of China and Mathematical Center of State Education Commission of China.
Program: To present new research results in the representation theory of finite and infinite dimensional algebras, Lie algebras, algebraic groups, quantum groups, superalgebras, vertex operator algebras, and related applications to other fields of mathematics and physics.
Speakers: H. H. Andersen (Aarhus Univ., Denmark), M. Broué (Paris 7), J. Carlson (Univ. of Georgia), E. Cline (Univ. of Oklahoma), R. Dipper (Univ. of Stuttgart, Germany), S. Donkin (Queen Mary College, London), J. E. Humphreys (Univ. of Massachusetts, Amherst), P. Littelmann (Univ. de Strasbourg, France), G. Lusztig (MIT), G. Mason (UC Santa Cruz), B. Parshall (Univ. of Virginia), A. Premet (Univ. of Manchester), C. M. Ringel (Bielefeld), L. Scott (Univ. of Virginia), T. Tanisaki (Hiroshima Univ., Japan).
Deadline: Application deadline: May 15, 1998.
Information: e-mail: zlin@math.ksu.edu, Web: http://www.math.ksu.edu/~zlin/repconf.html.

29-July 4 **School-Conference on Dynamical Systems: From Crystal to Chaos**, Marseille-Luminy, France. (May 1998, p. 637)

July 1998

2-3 **European Women in Mathematics Workshop on Moduli Spaces in Mathematics and Physics**, Oxford, England. (May 1998, p. 637)

*3-5 **GAMM-Workshop on Iterative Processes for Solving Equations**, Mathematisches Seminar, Christian-Albrechts-University, Kiel, Germany.
Aim: The goal of this symposium is to bring together mathematicians working in all fields of iterative processes with the aim of approximating the zeros of singles or systems of equations.
Topics: Topics include, but are not restricted to: optimization, control theory, calculus of variation, plasticity, partial differential equations, contact, microstructures.
List of Speakers: O. Axelsson (Nijmegen), M. Dryja (Warsaw), B. Fischer (Luebeck), W. Hackbusch (Kiel), A. Hoffman (Ilmenau), R. Kornhuber (Stuttgart), M. S. Petkovic (Nis), P. Plechac (Oxford), M. Reinders (Hannover), T. Roubicek (Prague), T. Sakurai (Japan), H. Schwetlick (Dresden).
Organizers: C. Carstensen, P. Kosmol, M. S. Petkovic.
Information: All correspondence in connection with the workshop, including registration and submission of abstracts, is to be made via e-mail to: saf@numerik.uni-kiel.de. For information on hotel reservations and a registration form, visit the home page at http://www.numerik.uni-kiel.de/cc/work98.html.

3-6 **International Conference on the Teaching of Mathematics**, Village of Pythagorion, Samos, Greece. (Mar. 1998, p. 423)

5-9 **1998 New Zealand Mathematics Colloquium**, Victoria University of Wellington, New Zealand. (Dec. 1997, p. 1498)

5-10 **15th International Conference on Automated Deduction (CADE-15)**, Lindau, Germany. (Jan. 1998, p. 112)

5-17 **DIMACS Workshops: Reconnect Conference: Reconnecting Teaching Faculty to the Mathematical Sciences Enterprise**, DIMACS Center, Rutgers University, Piscataway, New Jersey. (Apr. 1998, p. 532)

5-18 **NATO Advanced Study Institute on Signal Processing for Multimedia**, Il Ciocco Resort Hotel, Tuscany, Italy. (May 1998, p. 638)

6-9 **Second International Conference Finite-Difference Methods: Theory and Applications**, Minsk, Belarus. (Apr. 1998, p. 532)

6-10 **International Conference on Ordered Algebraic Structures and Related Areas (OAS '98)**, The Center for Chinese and American Studies, Nanjing University, Nanjing, P. R. China. (Jan. 1998, p. 112)

6-10 **Systèmes Dynamiques: Du Cristal Au Chaos (to honour the sixtieth birthday of Gérard Rauzy)**, Marseille-CIRM, France. (May 1998, p. 638)

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

*6-11 **5th Czech-Slovak International Symposium on Combinatorics, Graph Theory, Algorithms and Applications**, DIMATIA Charles University, Prague, Czech Republic.
Information: Topics cover all aspects of contemporary combinatorics and graph theory from both the theoretical and applied viewpoints. Deadline for registration and abstracts is May 15, 1998. Contact cs98@kam.ms.mff.cuni.cz, http://www.ms.mff.cuni.cz/acad/kam/conferences/c-s98.html.

6-17 **Mathematical Models in Population Biology and Epidemiology: From Elementary to the Frontier**, University of Wyoming, Laramie, Wyoming. (Jan. 1998, p. 112)

6-18 **IMA Summer Program: Coding and Cryptography**, University of Minnesota, Minneapolis, Minnesota. (May 1998, p. 638)

7-9 **Thirteenth International Conference on Artificial Intelligence in Engineering (AIENG 98)**, Galway, Ireland. (Dec. 1997, p. 1498)

7-11 (Note: NEW DATE) **The 1st IMACS Conference on Mathematical Modelling and Computational Methods in Mechanics and Geodynamics Modelling '98**, Prague, Czech Republic. (Oct. 1997, p. 1157)

7-11 **Chance Workshop**, Dartmouth College, Hanover, New Hampshire. (Mar. 1998, p. 424)

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

8-10 **4th International Conference on Lattice Paths Combinatorics and Applications**, University of Vienna, Vienna, Austria (Dec. 1997, p. 1498)

8-11 **IFAC-LSS '98, Symposium on Large Scale Systems: Theory and Applications**, Patras, Greece. (Oct. 1997, p. 1158)

9-10 **Workshop on New Methods in Applied and Computational Mathematics (NEMACOM'98)**, Hervey Bay, Queensland, Australia. (Feb. 1998, p. 294)

*12-15 **Ninth SIAM Conference on Discrete Mathematics**, University of Toronto,

Toronto, Canada.
Sponsor: SIAM Activity Group on Discrete Mathematics.
Organizer: D. Corneil (Univ. of Toronto, Canada).
Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; e-mail: meetings@siam.org; SIAM home page: http://www.siam.org/conf.htm.

12-August 1 **IAS/Park City Mathematics Institute**, Park City, Utah. (Jan. 1998, p. 113)

*13-15 **4th Conference on Mathematics and Computers in Sport**, Bond University, Queensland, Australia.
Information: N. de Mestre, School of Information Technology, Bond Univ., Gold Coast, Queensland 4229, Australia; e-mail: neville_de_mestre@bond.edu.au.

13-16 **3rd (Biennial International) Engineering Mathematics and Applications Conference (EMAC'98)**, Adelaide, Australia. (Apr. 1998, p. 532)

13-17 **International Colloquium on Automata, Languages, and Programming (ICALP'98)**, Aalborg, Denmark. (Jan. 1998, p. 113)

13-17 **1998 SIAM Annual Meeting**, University of Toronto, Toronto, Ontario, Canada. (Jan. 1998, p. 113)

*13-18 **Workshop on Mathematics Related to Arrangements of Hyperplanes**, Tokyo Metropolitan University, Tokyo, Japan.
Topics: Topics of the workshop, which celebrates the 60th birthyear of Professor Peter Orlik, include various aspects of hyperplane or subspace arrangements themselves, topological properties of the complements of hypersurfaces, hyperplane arrangements as singularities, hypergeometric functions, combinatorial aspects of hyperplane arrangements as matroid realizations, reflection groups, etc.
Featured Speakers: K. Aomoto, C. Athanasiadis, D. Cohen, J. Damon, M. Falk, E. Hironaka, K. Iwasaki, T. Kohno, M. Oka, P. Orlik, R. Randell, B. Sagan, K. Saito, R. Silvotti, R. Stanley, H. Terao, B. Tessier, A. Varchenko, M. Yoshida, S. Yuzvinsky, G. Ziegler.
Organizers: M. Oka (Tokyo Metropolitan Univ.), oka@math.metro-u.ac.jp; H. Terao (Hokkaido Univ.), terao@math.sci.hokudai.ac.jp.
Program Committee: M. Falk (Northern Arizona Univ.), michael.falk@nau.edu; R. Randell (Univ. of Iowa), randell@math.uiowa.edu.
Information: http://megalo.math.metro-u.ac.jp/~hterao/hyparr98.html.

13-31 **The Beijing Workshop on Universal Algebra, Logic and Computer Science**, Institute of Software, Beijing, China. (Apr. 1998, p. 533)

15-18 **MAA Mathfest 98**, Ryerson Polytechnic College, Toronto, Canada. (May 1998, p. 638)

15-22 **Mathematical Problems in Semiconductor Physics**, Grand Hotel San Michele, Cetraro (Cosenza), Italy. (May 1998, p. 638)

19-24 **International Symposium on Optical Science, Engineering, and Instrumentation, Vision Geometry VII (SD91)**, San Diego, California. (Jan. 1998, p. 113)

19-25 **IV International Conference on Non-Associative Algebra and Its Applications**, Institute of Mathematics and Statistics, University of Sao Paulo, Sao Paulo, Brazil. (Mar. 1998, p. 424)

19-25 **Galois Representations in Arithmetic Geometry**, Anogia, Crete, Greece. (May 1998, p. 638)

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

*20-22 **9th Annual Conference on Combinatorial Pattern Matching**, DIMACS, Rutgers University, Piscataway, New Jersey.
Information: http://dimacs.rutgers.edu/Workshops/ComPM/index.html.

*20-24 **The Fourth International Seminar on Average-Case Analysis of Algorithms**, Computer Science Dept., Princeton University, Princeton, New Jersey.
Sponsor: DIMACS Center.
Organizers: P. Flajolet (INRIA), R. Kemp (Johann Wolfgang Goether-Univ.), H. Mahmoud (George Washington Univ.), H. Prodinger (Vienna Univ. of Tech.), R. Sedgewick (Princeton Univ.), and W. Szpankowski (Purdue Univ.).
Focus: This is the fourth in an ongoing series of meetings on the analysis of algorithms, which have been held in Dagstuhl, Germany, in the past and are planned for Barcelona and other locations in the future. The 1998 meeting is intended to attract more researchers from the U.S. to the field of analysis of algorithms. The focus of this workshop is the average-case analysis of algorithms and its relation to the wider areas of analytic combinatorics, exact and limiting distributions, formal techniques, probability theory, combinatorics, and computer science.
Local Arrangements: S. Barbu, Princeton Univ.; barbu@cs.princeton.edu; tel: 609-609-1771.
Information: http://dimacs.rutgers.edu/Workshops/AverageCase/index.html.

20-August 7 **DIMACS Research and Education Institute 1998 Graph Theory and Combinatorial Optimization**, DIMACS Center, Rutgers University, Piscataway, New Jersey. (May 1998, p. 638)

*21-24 **Workshop on State of the Art in Finite Element Method—Theory, Algorithm and Applications**, City University of Hong Kong, Hong Kong, Republic of China.
Organizers: B. Guo (Manitoba, Canada, bguo@newton.amath.umanitoba.ca) and W. Sun (City Univ., HK, maweiw@math.cityu.edu.hk).
Objective: The goal of this workshop is to survey the remarkable progress of the finite element methods in the past half century and the current challenging issues on aspects of analysis, algorithms, applications, and implementations. The workshop is also aimed at getting both mathematicians and engineers to participate in discussing the mathematical and industrial perspective of the finite element method in the twenty-first century.
Participation: Open to mathematicians and engineers working on the finite element methods and their applications. Those wishing to attend and contribute a talk should contact the organizers. Graduate students with interest in numerical analysis and scientific computation are also encouraged to participate. There is no registration fee for the workshop. Please contact W. Sun for accommodations booking.
Invited Lectures: Q. Du (HKUST, Hong Kong), Numerical Methods for the Ginzburg-Landau Equations; R. Falk (Rutgers, USA), Finite Element Approximation of the Reissner-Mindlin Plate Model, and Mixed Formulation for the Plate and Shell; J. Osborn (Maryland, USA), Eignevalue Problems; L. Qun (Academia Sinica, China), High Accuracy Methods for Finite Elements; M. Wheeler (Austin, USA), Locally Conservative Algorithms for Modeling Fluid Flow: Theory, Implementation, and Application.
Topics: The p and h-p finite element method, discontinuous Galerkin method, eigenvalue problems, mixed formulation, computational mechanics, parallel and iterative solvers, multigrid and domain decomposition method, computational geosciences, partition of unity finite element method, integral equation and boundary element method, A-posteriori error estimation and adaptivity.
Information: http://www.cityu.edu.hk/ma/hypna.html.

22-31 **Mathematical Modeling in Industry, A Workshop for Graduate Students**, University of Minnesota, Minneapolis, Minnesota. (May 1998, p. 639)

23-31 **International Centre for Mathematical Sciences: Computation and Geometric Aspects of Modern Algebra**, Heriot-Watt University, Edinburgh, Scotland. (Apr. 1998, p. 533)

24-25 **Second International Conference on Matrix-Analytic Methods in Stochastic Models**, Winnipeg, Manitoba, Canada. (Sept. 1997, p. 1029)

26-31 **III Iberoamerican Congress of Mathematics Education (III CIBEM)**, Universidad Central de Venezuela, Caracas, Venezuela. (Mar. 1998, p. 424)

26-August 1 **Front Propagation: Theory and Applications**, Anogia, Crete, Greece. (May 1998, p. 639)

26-August 1 **XV Escola de Algebra**, Canela,

Rio Grande do Sul, Brazil. (Feb. 1998, p. 294)

27-31 **Calculus Enhanced with Computer-Algebra and Graphing Using the TI-92**, Department of Mathematical Sciences, United States Military Academy, West Point, New York. (Apr. 1998, p. 533)

27-August 7 **SMS-NATO ASI: Nonlinear Analysis, Differential Equations, and Control**, Université de Montreal, Montreal, Canada. (Dec. 1997, p. 1498)

29-August 7 **Frontiers of Combinatorics**, Los Alamos National Laboratory, Los Alamos, New Mexico. (Feb. 1998, p. 294)

August 1998

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

2-14 **Difference Sets, Sequences and Their Correlation Properties. A NATO Advanced Study Institute**, Bad Windsheim, Germany. (Apr. 1998, p. 533)

3-7 **Art and Mathematics Conference (AM98)**, University of California at Berkeley, Berkeley, California. (Mar. 1998, p.425)

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

3-7 **XI - Brazilian Meeting of Topology**, Departamento de Matematica do Instituto de Geociencias e Ciencias Exatas da UNESP - Rio Claro, Sao Paulo, Brazil. (Dec. 1997, p. 1499)

*3-8 (NOTE: NEW DATE) **Exactly Solvable Models in Mathematical Physics**, Chelyabinsk University of Technology, Chelyabinsk, Russia
Workshop Topics: Multidimensional integrability, tetrahedron equation, functional tetrahedron equation and quantization of its solutions, connection with quantum strings; low-dimensional integrability.
Sponsors: South Ural State Univ., Russian Foundation for Basic Research, and the Institute for Mathematics and Mechanics (Ekaterinburg, Russia).
Proceedings: The proceedings of the conference will be published in "Theoretical and Mathematical Physics". This is a journal of Russian Academy of Sciences published in both English and Russian. The proceedings volume may contain up to 192 pages.
Information: Contact I. G. Korepanov, Dept. of Algebra and Geometry, South Ural State Univ., 76 Lenin Ave., Chelyabinsk 454080, Russia; e-mail: `igor@prima.tu-chel.ac.ru`; Web page: `http://at.yorku.ca/c/a/a/w/01.htm`.

3-21 **Mathematical Geophysics Summer School**, Department of Mathematics, Stanford University, Stanford, California. (Mar. 1998, p. 425)

4-15 **Summer School on Low Dimensional Topology**, Budapest, Hungary. (Mar. 1998, p. 425)

6-10 **Stokes Summer School**, County Sligo, Skreen, Ireland. (May 1997, p. 639)

7-10 **European Summer School: Markov Chain Monte Carlo Methods**, Rebild, Denmark. (Feb. 1998, p. 294)

9-11 **Fifth International Symposium on Solving Irregularly Structured Problems in Parallel (IRREGULAR'98)**, NERSC, Lawrence Berkeley National Laboratory, Berkeley, California. (May 1998, p. 639)

9-11 **The Fourth International IMACS Conference on Applications of Computer Algebra**, Czech Technical University, Prague, Czech Republic. (Mar. 1998, p. 425)

9-15 **Conference on Geometry and Topology**, University of Aarhus, Aarhus, Denmark. (Dec. 1997, p. 1499)

9-16 **The 1998 ASL European Summer Meeting (Logic Colloquium '98)**, Prague, Czech Republic. (May 1998, p. 639)

10-12 **Conference on Combinatorics and Physics**, Los Alamos National Laboratory, Los Alamos, New Mexico. (May 1998, p. 639)

10-13 **Integral Methods in Science and Engineering '98**, Michigan Technological University, Houghton, Michigan. (Dec. 1997, p. 1499)

*10-13 **The Fifth International Conference on Integral Methods in Science and Engineering (IMSE98)**, Houghton, Michigan.
Invited Speakers: G. Beylkin (Univ. of Colorado), A. G. Gibson (Univ. of New Mexico), G. R. Ierley (Scripps Inst.), S. Kim (Univ. of Wisconsin), M. Z. Nashed (Univ. of Delaware), J. C. Nedelec (Ecole Polytechnique), B. D. Sleeman (Univ. of Leeds).
Topics: Analytic and numerical methods, hybrid approaches, ordinary and partial differential equations, population dynamics, boundary element methods, image and signal processing, wavelets and multiresolution analysis, rheology, quantum mechanical physics, integral equations, finite element methods, vortex methods, computational fluid dynamics, and inverse problems.
Grants: NSF/DMS has provided registration/travel grants for graduate students and junior researchers.
Deadlines: Registration: May 31, 1998; Fee: US $150; Abstract deadline: April 30, 1998.
Information: `http://www.math.mtu.edu/~imse/`; or contact B. Bertram, IMSE98, Math, Michigan Technological University, 1400 Townsend Dr., Houghton, MI 49931-1295; tel: 906-487-2211; fax: 906-487-3133; e-mail: `imse@mtu.edu`.

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

10-14 **7th International Conference "Differential Geometry and Applications", Satellite Conference of ICM in Berlin**, Masaryk University, Brno, Czech Republic. (May 1998, p. 639)

*10-14 **Representations of finite groups and combinatorics**, Otto-von-Guericke University Magdeburg, Magdeburg, Germany.
Focus: This is a satellite conference to the ICM98 - International Congress of Mathematicians Berlin 1998 - taking place in Magdeburg, located about 150 km west of Berlin; it focuses on those areas of representation theory of finite groups which have strong connections with combinatorics, the related combinatorics of partitions and tableaux, the theory of symmetric functions, and related areas.
Organizers: C. Bessenrodt (Magdeburg), A. O. Morris (Aberystwyth), J. B. Olsson (Copenhagen).
Scientific Committee: C. Bessenrodt, K. Erdmann, P. Hanlon, G. D. James, A. O. Morris, J. B. Olsson and R. Stanley.
Principal Speakers (as of April 1998): S. Donkin (London), K. Erdmann (Oxford), A. Garsia (San Diego), M. Geck (Paris), P. Hanlon (Ann Arbor), G. James (London), A. Kleshchev (Eugene), P. Littelmann (Strasbourg), G. Malle (Heidelberg), A. Ram (Princeton), B. Srinivasan (Chicago), R. Stanley (Boston).
Additional Talks: In addition to the one-hour lectures by the principal speakers it is planned to have further talks by the participants on the following topics: Representation theory of symmetric and related groups; Representations of finite groups of Lie type; Representations of Hecke algebras and q-Schur algebras; Combinatorics of partitions and tableaux; New combinatorial concepts for studying representations; Symmetric functions; Relations to other areas, such as invariant theory and physics.
Registration: Deadline: May 31, 1998.
Information: ICM Satellite Conference, Institut für Algebra und Geometrie, Fakultdt für Mathematik, Otto-von-Guericke-Univ. Magdeburg D-39016 Magdeburg, Germany; e-mail: `icmsat98@uni-magdeburg.de`; conference Web site: `http://www.math.ku.dk/~olsson/announc.htm`.

10-17 **The 4th International Conference on Theory of Groups (GROUP-KOREA 1998)**, Pusan National University, Pusan, Korea. (Feb. 1998, p. 294)

12-16 **Georgia Topology Conference**, University of Georgia, Athens, Georgia. (May 1998, p. 639)

13-15 **International Symposium on Symbolic and Algebraic Computation (ISSAC'98 Rostock)**, Universität Rostock, Rostock, Germany. (Mar. 1998, p. 425)

13-16 **Conference on Commutative Algebra in Honour of David Rees's 80th Year (a satellite conference of ICM-98)**, Exeter, United Kingdom. (Mar. 1998, p. 425)

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

15-23 **International Workshop on Nonlinear and Improperly Posed Problems**,

Kocaeli, Turkey. (Feb. 1998, p. 294)

16–21 **1998 IEEE International Symposium on Information Theory**, Massachusetts Institute of Technology, Cambridge, Massachusetts. (Sept. 1997, p. 1030)

17–26 **Introductory Workshop in Foundations of Computational Mathematics and Symbolic Computation in Geometry and Analysis**, Mathematical Sciences Research Institute, Berkeley, California. (May 1998, p. 640)

17–September 2 **XXVIIIth Probability Summer School**, Saint-Flour, Cantal, France. (Mar. 1998, p. 425)

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

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

19–21 **20th Anniversary of Boundary Elements Conference (BEM 20)**, University of Central Florida, Orlando, Florida. (Dec. 1997, p. 1499)

19–23 **4th International Conference on Numerical Methods and Applications**, Sofia, Bulgaria. (Dec. 1997, p. 1499)

* 19–23 **The Second Palestinian International Conference on Mathematics**, Birzeit University, Birzeit, Palestine.
Organizers: The Palestinian Society for Mathematical Sciences and the Department of Mathematics at Birzeit University are organizing the Second Palestinian International Conference on Mathematics at Birzeit University, which is located about 20 miles north of Jerusalem.
Topics: Applied mathematics, pure mathematics, statistics, mathematics education, and curriculum developments.
Organizing Committee: In Palestine: A. Abdulmohsen, F. M. Allan (chairman), M. El Amleh, A. Elayyan, T. Mughrabi, M. Saleh, M. Shabat, S. Yaseen, and H. Yousef. In the United States: S. Elaydi, A. Elkhader, M. Ismail, Z. Nashed.
Scientific Committee: T. Abu Kaf, M. Awartani, S. Elaydi (chairman), A. Elkhader, M. Hamdan, M. Ismail, and Z. Nashed.
Call for Papers: A person wishing to present a paper in the conference may submit an abstract along with a registration form to the organizing committee no later than June 1, 1998.
Information: F. Allan, Department of Mathematics and Computer Science, Birzeit Univ., Box 14, Birzeit, Palestine, via Israel; e-mail: fathi@math.birzeit.edu; S. Elaydi, Department of Mathematics, Trinity Univ., San Antonio, TX 78212; e-mail: selaydi@trinity.edu.

24–29 **Fields Institute Workshop on Mathematical Physics of Polymers and Percolation**, The Fields Institute for Research in Mathematical Sciences, Toronto, Ontario, Canada. (Feb. 1998, p. 294)

24–September 1 **Filtration in Porous Media and Industrial Applications**, Grand Hotel San Michele, Cetraro, Italy. (May 1998, p. 640)

24–September 1 **Stochastic PDEs and Kolmogorov Equations in Infinite Dimensions**, Grand Hotel San Michele, Cetraro, Italy. (May 1998, p. 640)

26–28 **Randomized Algorithms, a Satellite Workshop to MFCS'98**, Brno, Czech Republic. (May 1998, p. 640)

* 27–31 **Discrete Groups and Conformal Geometry**, Malardalen University, Vasteras, Sweden.
Organizers: B. Baumslag (Malardalen Univ.), G. Bergqvist (Malardalen Univ.), and M. Izquierdo (Malardalen Univ.).
Deadline: For registration: June 1, 1998.
Information: http://www.ima.mdh.se/geometry/.

27–31 **ICDEA98 Fourth International Conference on Difference Equations and Applications**, Institute of Mathematics, Poznan University of Technology, Poland. (Mar. 1998, p. 426)

* 28–September 2 **Convex and Discrete Geometry**, Instytut Matematyki i Fizyki ATR, Bydgoszcz, Poland.
Organizer: M. Lassak, e-mail: lassak@atr.bydgoszcz.pl.
Honorary Committee: P. M. Gruber (Vienna), P. McMullen (London), J. Pach (New York), A. Pełczyński (Warsaw), R. Schneider (Freiburg) G. F. Tóth (Budapest), J. M. Wills (Siegen), V. A. Zalgaller (St. Petersburg).
Invited Speakers: K. Bezdek (Budapest), J. Bokowski (Darmstadt), W. Kuperberg (Auburn), E. Schulte (Boston). It is likely that one or two additional lecturers will be invited.
Abstracts and Talks: Before August 1, 1998, please send camera-ready abstracts for making Xerox copies. Every abstract should be on an A4-size page with all the margins being 4 cm. Under the title printed in capital letters please write the author(s)' name(s). The text should be double spaced. You can also send a TEX file of your abstract by e-mail. A booklet with the abstracts will be given to the participants at the beginning of the conference. An overhead projector and a large blackboard will be available during the participants' 20-minute talks.
Fees: The total fee is $175. It includes registration, full board (including a single room in a hostel) from the afternoon of August 27 (Thur.) to the morning of September 3 (Thur.), and two excursions (on Sun., August 30, and on Wed., September 2).
Information: Correspondence concerning the conference should be sent to M. Lassak, Instytut Matematyki i Fizyki ATR, Kaliskiego 7, 85–791 Bydgoszcz, Poland; e-mail: lassak@atr.bydgoszcz.pl; tel: (48) (52) 3408646, or 3433990 in evenings; fax: 48-52-3408063.

28–September 3 **Fractal Geometry and Stochastics II**, Univ of Greifswald, Greifswald, Germany. (Mar. 1998, p. 426)

28–September 3 **Function Spaces V**, Poznan, Poland. (Apr. 1998, p. 533)

30–September 4 **XII Conference on Analytic Functions**, Lublin, Poland. (Mar. 1998, p. 426)

30–September 5 **Algebraic Number Theory and Diophantine Analysis**, Graz, Austria. (Sept. 1997, p. 1030)

31–September 4 **Conference on Functional Analysis, Partial Differential Equations and Applications, in honor of V. Mazya**, Rostock, Germany. (Dec. 1997, p. 1500)

31–September 5 **An International Conference on Representation Theory of Algebras**, University of Bielefeld, Bielefeld, Germany. (Apr. 1998, p. 533)

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

31–September 18 **Workshop on Dynamical Systems**, Trieste, Italy. (Apr. 1998, p. 534)

September 1998

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

* 1–10 **Advanced Course on Dynamical Systems**, Centre de Recerca Matematica, Bellaterra, Spain.
Speakers: R. Devaney (Boston Univ.): Dynamics and topology of entire functions; A. van den Essen (Univ. of Nijmegen): The Jacobian conjecture and dynamical systems; S. van Strien (Univ. of Warwick): Complex dynamics of real polynomials.
Information: Centre de Recerca Matemàtica (IEC), Apartat 50, 08193 Bellaterra, Spain; e-mail: crm@crm.es.

2–5 **1998 Conference on Computational Physics (CCP 1998)**, Granada, Spain. (Feb. 1998, p. 295)

* 3–4 **Mathematical and Computational Issues in Pattern Formation**, University of Minnesota, Minneapolis, Minnesota.
Speakers: P. Maini, J. Murray, and H. Othmer.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, Web page: http://www.ima.umn.edu/biology/.

* 6–18 **A NATO Advanced Study Institute; Genes, Fossils and Behaviour: An Integrated Approach to Human Evolution**, University of Cambridge, Isaac Newton Institute for Mathematical Sciences, Cambridge,

United Kingdom.
Aim: While the basic pattern of hominid evolution is well documented, the recent evolutionary history of homo sapiens is less clear. Application of molecular genetics techniques has great potential for resolving issues over this period, but as the complexity of such data increases, the quantitative methods used for its analysis become more important. This phase is also one of the richest for biological and behavioral evidence derived from both fossils and archaeology. The ASI aims to bring together experts from these diverse areas and through survey and research lectures to inform participants of the latest developments in the field, covering data and its interpretation and experimental and analytical techniques. The program will be aimed at research scientists at postdoctoral level and beyond, though it will also be accessible to advanced graduate students.
Organizing Committee: P. Donnelly (Oxford, director), R. Foley (Cambridge), S. Pääbo (Munich), A. Rogers (Utah).
Invited Speakers: G. Barbujani (Ferrara), J. Bertranpetit (Barcelona), R. Dunbar (Liverpool), R. Griffiths (Monash), J.-J. Hublin (Paris), L. Jorde (Utah), M. Lahr (Sao Paulo), M. Stoneking (Penn State), Y. Takahata (Kanagawa), R. Ward (Oxford).
Applications: To participate in the NATO ASI, please complete and return an application form, and for students and postdoctoral fellows arrange for a letter of reference from a senior scientist. Limited financial support is available for participants from appropriate countries, and the usual guidelines for the NATO ASI series will be followed in the selection of participants.
Location and Costs: The workshop will take place at the Isaac Newton Institute and accommodations for participants will be provided at Wolfson Court, adjacent to the Institute. The conference package costs £600 for academics and £1,000 for others, which includes accommodations from September 6–18, together with breakfast and evening meals, plus lunch and refreshments during the days that lectures take place.
Information: Application forms are available from the WWW at `http://www.newton.cam.ac.uk/programs/bfg.html`. Completed forms and letters of recommendation should be sent to H. Hughes, Univ. of Cambridge, Isaac Newton Institute for Mathematical Sciences, 20 Clarkson Rd., Cambridge, CB3 0EH, UK; tel: (01223)335999; fax: (01223)330508; e-mail: `h.hughes@newton.cam.ac.uk`. Closing date for receipt of applications and letters of recommendation is **April 30, 1998**.

7–10 **Undergraduate Mathematics Teaching Conference (UMTC98)**, Sheffield Hallam University, Sheffield, England. (May 1998, p. 640)

7–11 **A Euroconference on Infinite Length Modules**, University of Bielefeld, Bielefeld, Germany. (Apr. 1998, p. 534)

* 7–12 **International Conference on Partial Differential Equations and Related Topics**, Mission Beach, Queensland, Australia.
Themes: Nonlinear elliptic and parabolic problems, variational problems, geometric analysis, nonlinear waves.
Invited Speakers: K.-S. Chou (Chinese Univ. of Hong Kong), O. Costin (M.S.R.I), P. Deift (Courant Inst.), B. Fuchssteiner (Paderborn), N. Fusco (Florence), M. Giaquinta (Pisa), B. Gulliver (Minnesota), G. Huisken (Tuebingen), H. Ishii (Tokyo), N. Ivochkina (St. Petersburg), H. Jiaxing (Fudan), C. H. Jun (Korea Advanced Inst. of Science and Technology), B. Kawohl (Cologne), Y. Li (Rutgers), C. S. Lin (National Chung Cheng Univ., Taiwan), T.-P. Liu (Stanford), M. Safonov (Minnesota), C. Sbordone (Naples), M. Struwe (ETH), G. Tian (MIT), J. Toland (Bath).
Information: PDE98 Conference, Centre for Mathematics and Its Applications, School of Mathematical Sciences, Australian National Univ., Canberra A.C.T. 0200, Australia; fax: 61-2-62495549; e-mail: `pde98@maths.anu.edu.au`; see Web page: `http://wwwmaths.anu.edu.au/~pde98/`.

* 7–14 **Voronoi Conference on Analytic Number Theory and Space Tilings**, Kyiv, Ukraine
Aim: The conference is in honor of Ukrainian mathematician G. Voronoi (1868–1908).
Topics: Analytic number theory, algebraic number theory, Voronoi method of summability, probabilistic models for Voronoi tessellations, space tilings, applications of Voronoi domains in natural sciences.
Information: H. Syta, Voronoi Conference, Inst. of Mathematics Nat. Acad. Sci. Ukraine, 252601 Kyiv-4, Tereshchenkivska str., 3, Ukraine; e-mail: `syta@imath.kiev.ua`.

* 8–12 **Pattern Formation and Morphogenesis: The Basic Process**, University of Minnesota, Minneapolis, Minnesota.
Organizers: P. Maini, J. Murray, and H. Othmer.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: `staff@ima.umn.edu` or Web page: `http://www.ima.umn.edu/biology/`.

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

* 12–14 **Symplectic Geometry and Micro-Local Analysis in honor of Victor Guillemin's 60th Birthday**, Massachusetts Institute of Technology, Cambridge, Massachusetts.
Speakers: R. Bott (Harvard Univ.), L. Boutet de Monvel (Univ. Pierre et Marie Curie), Y. Colin de Verdiere (Inst. Fourier), J. J. Duistermaat (Univ. of Utrecht), Y. Eliashberg (Stanford Univ.), B. Kostant (MIT), I. Singer (MIT), M. Vergne (Univ. de Paris), A. Weinstein (Univ. of California, Berkeley).
Organizers: A. Cannas da Silva, R. Melrose, E. Meinrenken, J. Weitsman.
Information: `http://www-math.mit.edu/~woodward/victor.html`.

* 14–18 **International Congress on Numerical Methods for Partial Differential Equations**, Marrakech, Morocco.
Topics: Finite difference methods, finite element methods, spectral methods, multigrids and domain decomposition methods, multilevel methods, nonlinear Galerkin methods and inertial manifolds, solution of systems of linear and nonlinear equations, preconditioning techniques.
Invited Speakers: O. Axelsson (The Netherlands), T. F. Chan (USA), M. Pierre (France), O. Widlund (USA), H. Yserentant (Germany).
Organizing Committee: C. Brezinski (Univ. des Sci. et Techn. de Lille, France), H. El Alaoui (Fac. des Sci. Semlalia, Marrakech, Morocco), A. Hilali (Inst. Nat. des Postes et Telecom., Rabat, Morocco), A. Lembarki (Fac. des Sci. Semlalia, Marrakech, Morocco), A. Messaoudi (École Normale Sup., Rabat, Morocco), H. Sadok (Univ. du Littoral, Calais, France).
Information: ICNMPDE, Laboratoire de Mathematiques Appliquees, Universite du Littoral, Centre Universtaire de la Mi-voix, Batiment H. Poincare, 50 rue F. Buisson, BP 699, 62228 Calais cedex, France; e-mail: `marrak@lma.univ-littoral.fr`; phone: +33-3-21-46-36-56; fax: +33-3-21-46-36-61; WWW pages: `http://www-lma.univ-littoral.fr`.

* 14–18 **Pattern Formation and Morphogenesis: Model Systems**, University of Minnesota, Minneapolis, Minnesota.
Organizers: P. Maini, J. Murray, H. Othmer, and L. Segel.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: `staff@ima.umn.edu`, or Web page: `http://www.ima.umn.edu/biology/`.

* 14–18 **Solving Systems of Equations**, Mathematical Sciences Research Institute, Berkeley, California.
Focus: As part of its two fall 1998 programs on Foundations of Computational Mathematics and Symbolic Computation, MSRI will host a weeklong workshop on Solving Systems of Equations.
Organizers: J.-P. Dedieu, M.-F. Roy, M. Shub, and B. Sturmfels.
Invited Speakers: The following lectures are invited for the mornings: D. Bini (Univ. of Pisa, Italy), Numerical approximation of polynomial roots; W. Decker (Univ. des Saarlandes, Germany), Primary decomposition: The state of the art; J.-C. Faugere (CNRS, Univ. of Paris VI, France), New generations of Gröbner basis algorithms; L. Gonzalez-Vega (Univ. of Santander, Spain), Polynomial systems in industry: Some concrete examples; T. Y. Li (Michigan State Univ.), Polyhedral homotopies; J.-P. Merlet (INRIA, Nice, France), Applications to mechanism

theory, molecular chemistry and signal processing; L. M. Pardo (Univ. of Santander, Spain), Symbolic solving: Getting closer to the barrier; S. Smale (City Univ. of Hong Kong, China), Some aspects of complexity for equation solving; F. Sottile (Univ. of Toronto, Canada), Schubert calculus and control theory; M. Todd (Cornell Univ.), Designing efficient homotopy algorithms using Riemannian geometry. The program will include other lectures and software demonstrations during the afternoons.

Financial Support: A limited amount of funding is available for partial support of people wishing to attend. Students, recent Ph.D.s, women, and minorities are particularly encouraged to apply. To apply for funding, send a letter explaining your interest in the workshop together with a vita or bibliography and a budget for travel/living expenses. If you are a student, also solicit a letter from a faculty advisor. All information should be received by June 19, 1998.

Information: Communications about this workshop should be sent either by e-mail to `solvsys@msri.org` or by regular mail to: Solving Systems of Equations, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, CA 94720-5070; `http://www.msri.org/activities/programs/9899/solvsys/`.

14–19 **6th International Conference on Evolution Equations and Their Applications in Physical and Life Sciences**, Bad Herrenalb, Germany. (May 1998, p. 641)

14–December 18 **Mathematical Questions in Signal and Image Processing**, Institut Henri Poincaré, Paris, France. (May 1998, p. 641)

*15–December 15 **Semester on Dynamical Systems**, Centre de Recerca Matematica, Barcelona, Spain.

Organizers: L. Alsedà, A. Gasull, J. Llibre.

Invited Speakers: B. Branner (The Technical Univ. of Denmark), L. Cherkas (Belarusian State Univ.), H. Giacomini (Université de Tours), J. Guaschi (Université Toulouse III), E. Lacomba (Universidad Autónoma Metropolitana, México), L. Chengzhi (Beijing Univ.), L. Wei-gu (Beijing Univ.), J. Los (Univesité de Nice-Sophia Antipolis), E. Pérez-Chavela (Universidad Autónoma Metropolitana, México), C. L. Petersen (Roskilde Univ.), J. A. Rodríguez (Universidad de Oviedo), Z. Zhifen (Beijing Univ.).

Information: Centre de Recerca Matemàtica (IEC), Apartat 50, 08193 Bellaterra, Spain; e-mail: `crm@crm.es`.

16–18 **Seventh International Conference on Hydraulic Engineering Software (HYDROSOFT 98)**, Centro di in Como, Italy. (Dec. 1997, p. 1500)

17–20 **The Third Annual Conference on Research in Undergraduate Mathematics Education**, Century Center, South Bend, Indiana. (Feb. 1998, p. 295)

17–29 **Ninth Crimean Autumn Mathematical Symposium on Spectral and Evolutionary Problems**, Crimea, Ukraine. (Mar. 1998, p. 426)

*20–25 **Real Analytic and Algebraic Geometry**, Grand Hotel Bellavista, Levico Terme (Trento), Italy.

Scientific Organizers: F. Acquistapace (Pisa), F. Broglia (Pisa), and M. Coste (Rennes).

Speakers (tent.): S. Karlamov (Strasbourg), M. A. Marshall (Saskatoon), C. Scheiderer (Regensburg), M. Shiota (Nagoya), A. Tognoli (Trento).

Deadline: Application deadline: July 31, 1998.

Information: A. Micheletti, Secretary of CIRM, Centro Internazionale per la Ricerca Matematica, Istituto Trentino di Cultura, 38050 Povo (Trento), Italy; tel: +39-461-881628, fax: +39-461-810629, e-mail: `michelet@science.unitn.it`.

*22–26 **Eighth Meeting on Real Analysis and Measure Theory**, Hotel Panorama, Maiori (Naples), Italy.

Focus: Since 1984 the meeting on Real Analysis and Measure Theory has been a biennal event of European relevance where established scientists and young researchers discuss their recent work in fundamental mathematical disciplines such as measure theory, stochastic processes, differential equations, functional analysis, real analysis, lattice theory, and game theory, taking into consideration their role in applications to decision theory, engineering, economics, mathematical finance, risk theory, statistics, and theoretical physics. The meeting is also an occasion for discussing new developments, unexpected relations with other mathematical fields, and new connections with applications. With a program of scientific talks of reasonable density, we wish to fix the state of the art in the topics the meeting covers and, simultaneously, to give young scientists a concrete occasion to start/test their research in cooperation with world-famous specialists.

Call for Papers: Any participant is invited to submit a paper concerning its oral communication (if any). After a standard referee process the article will be published in the Italian mathematical journal *Atti Seminario Matematico Fisico Università di Modena*. All papers appearing in this way will also be collected in a unique volume of proceedings which will be distributed to all participants.

Scientific Committee: V. Aversa (Univ. of Naples), A. Basile (Univ. of Naples), B. Bongiorno (Univ. of Palermo), M. Boni (Univ. of Modena), D. Candeloro (Univ. of Perugia), P. de Lucia (Univ. of Naples), E. De Pascale (Univ. of Calabria), G. Santagati (Univ. of Catania), H. Weber (Univ. of Udine), A. Volcic (Univ. of Trieste).

Organizing Committee: V. Aversa, A. Basile, P. de Lucia.

Information: More detailed information (about hotel, deadlines, registration form, fee, and such) will be given in March. For any request, please contact `delucia@matna3.dma.unina.it`.

24–26 **4th Hellenic European Conference on Computer Mathematics and Its Applications (HERCMA '98)**, Athens, Greece. (Oct. 1997, p. 1158)

*25–26 **Developments of Mathematics at the Eve of the Year 2000**, Luxembourg.

Organizer: Luxembourg Mathematical Society.

Speakers: J.-P. Bourguignon (IHES), C. Houzel (Univ. Paris VII), V. Kac (MIT, Boston), J.-P. Kahane (Univ. Paris-Orsay), J. Mawhin (Univ. Catholique Louvain), N. Nikolskii (Univ. Bordeaux I), R. Penrose (Oxford Univ.), J.-P. Pier (Centre Univ. Luxembourg), R. Remmert (Univ. Münster).

Information: Séminaire de Mathématique, Centre Univ. de Luxembourg, 162a Avenue de la Faïencerie, L-1511 Luxembourg; tel: (352) 46.66.44.236; fax: (352) 46.66.44.237; e-mail: `pier@cu.lu`.

26–28 **Interdisciplinary Conference on Waves and Continuation Methods in Biology**, University of Pittsburgh, Pennsylvania. (Apr. 1998, p. 534)

28–30 **International Conference on Ordinal and Symbolic Data Analysis (OSDA98)**, University of Massachusetts, Lincoln Campus Center, Amherst, Massachusetts. (Dec. 1997, p. 1500)

28–October 4 **International Conference "Dynamical Systems: Stability, Control, Optimization (DSSCO'98)"**, Minsk, Belarus. (Oct. 1997, p. 1158)

October 1998

2–4 **Midwest Conference on the History of Mathematics (with a special session on History of Logic)**, Iowa State University, Ames, Iowa. (Feb. 1998, p. 295)

*2–3 **Twenty-sixth Annual Mathematics and Statistics Conference**, Miami University, Oxford, Ohio.

Program: Mathematics classroom demonstrations.

Principal Speakers: T. Banchoff (Brown Univ.), P. Casazza (Univ. of Missouri), F. Morgan (Williams Coll.).

Call for Papers: Abstracts for 20-minute contributed papers should be sent to M. A. Smith, Dept. of Math. and Stat., Miami Univ., Oxford, OH 45056, voice: (513) 529-5818; fax: (513) 529-1493; e-mail: `smithma@muohio.edu`; Website: `http://miavx1.muohio.edu/~mstwis/events.html`.

Information: Conference programs with information concerning preregistration and housing will be available after August 1, 1998, from the address above.

*4–10 **Clifford Analysis and Its Applications**, Cetraro, Calabria, Italy.

Topics: Topics of the conference include, but are not limited to, the following: function theory of Dirac operators over euclidean space and Riemannian manifolds,

and several complex variables, their associated Hardy spaces and conformal group structures; applications to singular integral operator theory over non-smooth surfaces, and boundary value problems; function theory over several quaternionic and Clifford variables, and applications in quantum mechanics.
Invited Speakers: C. Baer, T. Branson, J. Gilbert, J. Lakey, M. Mitrea, V. Palamadov, T. Qian, N. Salinas, P. van Lancker, Z. Wu.
Contributed Talks: The organizers are soliciting contributed talks of 20 minutes' duration within the topics of the conference. Abstracts should be sent by May 20, 1998, to one of the members of the organizing committee.
Organizing Committee: J. Ryan (Univ. of Arkansas, e-mail: jryan@comp.uark.edu), V. Soucek (Charles Univ., Czech Republic, e-mail: soucek@karlin.mff.cuni.cz), and D. Struppa (George Mason Univ., e-mail: dstruppa@osf1.gmu.edu).

* 5-7 **Codes and Trees: Algorithmic and Information Theoretic Approaches**, DIMACS Center, Rutgers University, Piscataway, New Jersey.
Organizers: J. Abrahams (Rutgers Univ., DIMACS), M. Golin (Hong Kong Univ., Comp. Sci. Dept.).
Focus: We see considerable overlap in research interests between information theory and algorithm design in the area of coding problems for data compression, with particular focus on lossless tree structured codes such as Huffmann codes and its variants. Unfortunately, there is not as much overlap in our perspectives. Information theorists are more concerned with entropy-based performance bounds and tradeoffs with respect to additional criteria of interest in the context of data compression systems, e.g., synchronization or buffer management. Computer scientists are more concerned with questions of efficiency and algorithm design. These very different perspectives on similar problems has led to a lack of communication, occasionally resulting in situations in which problems considered difficult by one community are actually solvable using tools well developed and understood by the other. This workshop will be on codes and trees discussing both the algorthmic and information theoretic approaches. (This workshop is related to DIMACS Special Year on Massive Data Sets.)
Contact: M. Golin, golin@cs.ust.uk.
Local Arrangements: P. Pravato, DIMACS Center, pravato@dimacs.rutgers.edu, 732-445-5929.
Information: WWW: http://dimacs.rutgers.edu/Workshops/index.html.

5-10 **Fields Institute Workshop on Hydrodynamic Limits**, The Fields Institute for Research in Mathematical Sciences, Toronto, Ontario, Canada. (Feb. 1998, p. 295)

* 5-10 **Optimal Regularity in Elliptic, Hypoelliptic, and Parabolic Problems**, Grand Hotel Bellavista, Levico Terme (Trento), Italy.
Scientific Organizer: A. Lunardi (Parma).
Sponsor: The meeting is also sponsored by G.N.A.F.A.-C.N.R.
Speakers (tent.): P. Acquistapace (Pisa), W. Arendt (Ulm), P. Auscher (Amiens), M. Biroli (Milano), P. Cannarsa (Roma II), S. Cerrai (Firenze), P. Clement (Delft), A. Cutri (Roma II), G. Da Prato (Pisa), E. Di Benedetto (Evanston), J. Escher (Kassel), A. Favini (Bologna), M. G. Garroni (Roma I), U. Gianazza (Pavia), P. Guidotti (CalTech), M. Hieber (Karlsruhe), R. Labbas (Le Havre), E. Lanconelli (Bologna), G. M. Lieberman (Ames), S. Lototsky (Cambridge), A. G. R. Macintosh (Macquarie), S. Maier (Zürich), A. Maugeri (Catania), S. Monniaux (Ulm), A. Parmeggiani (Bologna), S. Polidoro (Bologna), J. Prüss (Halle), S. Romanelli (Bari), G. Simonett (Nashville), N. S. Trudinger (Canberra), V. Vespri (Firenze).
Deadline: Application deadline: July 31, 1998.
Information: A. Micheletti, Secretary of CIRM, Centro Internazionale per la Ricerca Matematica, Istituto Trentino di Cultura, 38050 Povo (Trento), Italy; tel: +39-461-881628, fax: +39-461-810629, e-mail: michelet@science.unitn.it.

7-11 **International Conference on Operator Theory and Its Applications to Scientific and Industrial Problems**, Winnipeg, Canada. (May 1998, p. 641)

* 8-9 **Immunology, Cell Signaling, the Physiology of the Immune System and the Dynamics of the Immune Response**, University of Minnesota, Minneapolis, Minnesota.
Speakers: B. Goldstein, A. Perelson.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minnesota, MN 55455; tel: 612-624-6066, e-mail: staff@imu.umn.edu, or Web page: http://www.imu.umn.edu/biology/.

8-9 **Third International Conference on Mathematical Modelling and Analysis (MMA-98)**, Institute of Mathematics, Riga, Latvia. (May 1998, p. 641)

* 8-10 **23rd Meeting of the Euro Working Group on Financial Modelling**, Cracow, Poland.
Contributed Papers: According to the general rules of the EURO Working Group on Financial Modelling, participants who wish to present a paper should send an abstract (100-150 words) by July 1, 1998, specifying if they wish to present it in a refereed or unrefereed session. Papers from all areas of financial modelling are solicited, including the following: pricing of derivative securities, time series analysis and forecasting, capital and currency market models, portfolio management and optimization, financial and bank risk management, enterprise modelling, multicriteria decision making in finance, other applications of mathematical modelling in finance and economy. Abstracts should be sent preferably by e-mail in LaTeX format or in Winword6 format as attachment. Participants will be notified of acceptance of their paper by August 1, 1998. Those who wish to present a paper in a refereed session should send a copy of the paper to the organizers by August 20, 1998. Authors should make a copy of their complete papers available to other participants by choosing one of the following two routes: Send 20 copies to A. M. J. Skulimowski at the address below to arrive by October 1, 1998; directly bring 80 copies to the meeting for on-spot distribution. The time for each presentation will be approximately 20 minutes with additional 5-10 minutes for discussion. The conference room is equipped with an overhead projector. Should you have any special further requirement, please let us know when sending your abstract.
Fee: The registration fee for the meeting is US$300 if paid by September 1, 1998, and US$350 afterwards.
Organizing and Program Committee: (tentative) J. A. Dzieza, I. Kaliszewski, A. M. J. Skulimowski (chairman), T. Trzaskalik.
Hotel Accommodations: The organizers reserved 30 rooms at the student hostel at the conference site, which can be used as twin or single rooms. All rooms are equipped with a toilet and a bath or shower. The price will be approximately US$30 per day for a place in a twin room, and US$40 for a single occupancy. Rooms must be booked for the full period of the conference, i.e., from October 7 to October 10 (three nights). An additional night can be booked for the same price. Due to the limited number of rooms in the student hostel, an early registration is strongly recommended. A special arrangement for meeting participants has been made with the Continental Hotel (three star), which is located within about 10 minutes' driving. Please specify the exact dates of your stay in Cracow and the requested hotel, and send it together with the full payment (student hostel) or an advance deposit equal to the price of one night (other hotels) before September 20, 1998.
Social Program: The conference fee includes the meeting lunches, the welcome reception, a social dinner, and an excursion on Saturday, October 10. Guided tours will be organized after the meeting.
Information: Contact either I. Filo or A. Madura, tel: +48-12-421-7011, +48-12-421-7154; fax: +48-12-421-7411; e-mail: finmod23@uci.agh.edu.pl, pbf@uci.agh.edu.pl; WWW: http://galaxy.uci.agh.edu.pl/~finmod23/.

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

* 12-16 **Immune System Modeling & Cell Signaling**, University of Minnesota, Minneapolis, Minnesota.
Organizers: B. Goldstein, D. Kirschner,

A. Perelson, L. Segel.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu or Web page: http://www.ima.umn.edu/biology/.

*12-16 **Symbolic Computation in Geometry and Analysis**, Mathematical Sciences Research Institute, Berkeley, California.
Focus: As part of the fall 1998 program on Symbolic Computation in Geometry and Analysis (SCGA), MSRI will host a weeklong workshop on Symbolic Computation.
Organizers: E. Becker (becker@math.uni-dortmund.de), Y. Lakshman (ylakshma@mcs.drexel.edu), M. Singer (singer@math.ncsu.edu), and P. Stiller (stiller@math.tamu.edu).
Aim: The aim of the workshop is to stimulate interaction between the long-term participants in the SCGA program and other members of the symbolic computation and general mathematical community who have not been able to come for an extended stay. It is hoped that holding such a workshop halfway through the special semester will increase the impact that the special semester will make on the mathematical community as well as allow for that community to influence the direction of research at MSRI.
Invited Speakers: D. Bayer, J. Buchmann, H. Derkson, Y.N. Lakshman, D. Manocha, P. Olver, B. Roth, and D. Zeilberger.
Financial Support: A limited amount of funding is available for partial support of people wishing to attend. Students, recent Ph.D.s, women, and minorities are particularly encouraged to apply. To apply for funding, send a letter explaining your interest in the workshop together with a vita or bibliography and a budget for travel/living expenses. If you are a student, also solicit a letter from a faculty advisor. All information should be received by July 1, 1998.
Information: Communications about this workshop should be sent either by e-mail to scga@msri.org or by regular mail to: Symbolic Computation Workshop, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, CA 94720-5070; http://www.msri.org/activities/programs/9899/symbcomp/scga/.

12-30 **Third School on Nonlinear Functional Analysis and Applications to Differential Equations**, Trieste, Italy. (Apr. 1998, p. 534)

14-17 **Trends in Mathematical Physics**, University of Tennessee, Knoxville, Tennessee. (Mar. 1998, p. 427)

*16-17 **18th Annual Southeastern-Atlantic Regional Conference on Differential Equations**, Auburn University, Auburn, Alabama.
Forum: The conference is an annual meeting which was envisioned by members of the Department of Mathematics at Virginia Tech and began in 1981. Since then its location has rotated among the institutions in the Southeast-Atlantic region.
Scope: These meetings afford established and new researchers, including advanced graduate students, the opportunity of meeting and exchanging ideas and discussing the wide variety of mathematics encompassed within the title "differential equations".
Topics: The conference will consist of a series of 4 plenary one-hour lectures and sessions for contributed papers. Topics presented during these conferences have been diverse in providing a unique opportunity to see the variety of problems in which differential equations play a critical role. Among subjects presented are ordinary and partial differential equations, integral and functional equations, numerical methods and applications to biology, physics, and engineering.
Invited Speakers: J. McLaughlin (Rensselaer Polytechnic Inst.), D. Shaeffer (Duke Univ.), R. Shivaji (Mississippi State Univ.), E. Yanagida (Univ. of Tokyo and Georgia Inst. of Tech.).
Financial Assistance: Contingent on NSF funding, some financial assistance may be available to offset travel and housing expenses for graduate students and recent Ph.D. recipients. Requests postmarked by September 18, 1998, are guaranteed consideration. People who belong to currently underrepresented groups are encouraged to apply to the conference for financial assistance.
Information: Updated information can be found at the conference Web site: http://www.auburn.edu/searcde/. Information can also be obtained by contacting: A. J. Meir, SEARCDE Coordinator, Department of Mathematics, Auburn Univ., Auburn, AL 36849; tel: 334-844-4290; fax: 334-844-6555; e-mail: ajm@math.auburn.edu.

18-20 **Fourth IMACS International Symposium on Iterative Methods in Scientific Computation**, Austin, Texas. (Apr. 1998, p. 534)

18-23 **IEEE Visualization 1998 (Vis98)**, Sheraton Imperial Hotel, Research Triangle Park, North Carolina. (May 1998, p. 642)

*19-23 **Forging an Appropriate Immune Response as a Problem in Distributed Artificial Intelligence**, University of Minnesota, Minneapolis, Minnesota.
Organizers: S. Forrest, L. Segel.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@imu.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*20-22 **International Conference on Number Theory and Related Topics**, Yonsei University, Seoul 120-749, Republic of Korea.
Sponsors: Natural Science Research Institute, Yonsei University, Korean Mathematical Society, and Korea Science and Engineering Foundation (KOSEF).
Organizers: K. S. Chang (chair, Yonsei Univ.), Y. Ihara (RIMS), H. J. Ko (Yonsei Univ.), J. K. Koo (KAIST), and J. H. Yang (Inha Univ.).
Invited Speakers: S. Bae (KAIST), Y. J. Choie (POSTECH), C. Deninger (Munster), Y. Ihara (RIMS), S.-J. Kang (Seoul), D. S. Kim (Sogang) S. Kudla (Maryland), J. B. Lee (Yonsei), S. Mochizuki (RIMS), D. Prasad (MRI), B. Ramakrishnan (MRI).
Call for Papers: We invite submissions for 30-minute presentations on any aspect of number theory. A one-page abstract typed by $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX or LATEX must be received before October 1, 1998, to be considered for inclusion in the program. A refereed proceedings is planned to be published soon after the conference. Deadline for submitting papers for the proceedings is October 19, 1998. Send submissions to: J. H. Yang, Department of Mathematics, Inha Univ., Incheon 402-751, Korea, e-mail to jhyang@math.inha.ac.kr, fax: 82-32-874-5615, or H. J. Ko, Department of Mathematics, Yonsei Univ., Seoul 120-749, Korea, e-mail to hjko@bubble.Yonsei.ac.kr, fax: 82-2-392-6634.
Financial Support: Local accommodations are provided to participants whose papers are accepted for publication of the proceedings.
Information: For further information call 82-32-860-7626 or 82-2-361-2594 or e-mail and fax above.

22-23 **SIAM Workshop on Mathematical Foundations for Features in CAD, Engineering, and Manufacturing**, Somerset Inn, Troy, Michigan. (Jan. 1998, p. 113)

23-24 **The 20th Midwest Probabilty Colloquium**, Northwestern University, Evanston, Illinois. (May 1998, p. 642)

24-25 **AMS Eastern Sectional Meeting**, Pennsylvania State University, State College, PA. (Sept. 1997, p. 1031)
Information: R. Cascella, rgc@ams.org.

25-28 **Fractal 98, Complexity and Fractals in the Sciences**, Valletta, Malta. (Dec. 1997, p. 1500)

25-29 **Fields Institute Workshop on Monte Carlo Methods**, The Fields Institute for Research in Mathematical Sciences, Toronto, Ontario, Canada. (Feb. 1998, p. 295)

26-28 **2nd International Circuits, Systems and Computers'98 (CSC'98)**, Military Institutions of University Education (MIUE), Hellenic Naval Academy, Terma Hatzikyriakou, 18539, Piraeus, Greece. (Apr. 1998, p. 534)

*26-30 **Fourth International Conference on Principles and Practice of Constraint Programming (CP98)**, Pisa, Italy.
Scope: The conference is concerned with all aspects of computing with constraints including: algorithms, applications, environments, languages, models, systems. Contributions are welcome from any discipline concerned with constraints, includ-

ing: artificial intelligence, combinatorial algorithms, computational logic, concurrent computation, databases, discrete mathematics, operations research, programming languages, symbolic computation. Papers that bridge disciplines or combine theory and practice are especially welcome.

Conference Chair: F. Rossi.

Program Co-Chairs: M. Maher and J.-F. Puget.

Workshop Chair: R. Yap.

Workshops: Satellite workshops will be organized on Friday, October 30, 1998. The details can be found in the call for workshop proposal, which can be seen on the CP98 Web page.

Information: `http://www.di.unipi.it/~bista/cp98/`.

*26-30 **School on Complex Tori, Integrable Systems and Seiberg-Witten Theory**, Grand Hotel Bellavista, Levico Terme (Trento), Italy.

Scientific Organizer: G. Bolondi (Milano).

Lectures: There will be 4 series of lectures held by: C. Birkenhake (Erlangen), R. Donagi (Philadelphia), B. van Geemen (Torino), and H. Lange (Erlangen).

Information: Contact G. Bolondi, e-mail: `bolondi@science.unitn.it`. Deadline for applications is July 31, 1998.

November 1998

*2-6 **Complexity of Continuous and Algebraic Mathematics**, Mathematical Sciences Research Institute, Berkeley, California.

Focus: Complexity theory has become a cornerstone in many areas involving computation. The workshop will emphasize areas for which the computational problems are especially mathematical, particularly areas resting on continuous mathematics and algebra. A spectrum of viewpoints will be represented, including those arising from algebraic complexity, numerical analysis (e.g., using condition numbers as complexity parameters), information-based complexity, and optimization (particularly linear programming).

Organizers: F. Cucker and J. Renegar.

Invited Speakers: A. Barvinok (Michigan), L. Blum (Hong Kong), F. Cucker (Barcelona and Hong Kong), J.-P. Dedieu (Toulouse), R. Freund (MIT), L. Khachiyan (Rutgers), P. Koiran (Lyon), T. Krick (Buenos Aires), H. W. Lenstra (Berkeley), J. Renegar (Cornell), S. Smale (Hong Kong), H. Wozniakowski (New York and Warzaw).

Financial Support: A limited amount of funding is available for partial support of people wishing to attend. Students, recent Ph.D.s, women, and minorities are particularly encouraged to apply. To apply for funding, send a letter explaining your interest in the workshop together with a vita or bibliography and a budget for travel/living expenses. If you are a student, also solicit a letter from a faculty advisor. All information should be received by August 19, 1998.

Information: Communications about this workshop should be sent either by e-mail to `ccam@msri.org` or by regular mail to: Complexity of Continuous and Algebraic Mathematics, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, CA 94720-5070; `http://www.damtp.cam.ac.uk/user/na/FoCM/MSRI_wshop.html`.

2-7 **International Conference on Potential Analysis**, Hammamet, Tunisia. (Mar. 1998, p. 427)

*8-11 **1998 IEEE Symposium on Foundations of Computer Science (FOCS'98)**, Palo Alto, California.

Topics: Algorithms and data structures, complexity theory, computational algebra and geometry, computational biology, cryptography, databases, machine learning, algorithmic graph theory and combinatorics, applications of logic, parallel and distributed computation, probabilistic computations, computer architectures, and robotics.

Submission: An abstract not exceeding 10 pages must be received by the program chair, R. Motwani (Gates Computer Science Building, 4B, Dept. of Comp. Sci., Stanford Univ., Stanford, CA 94305-9045). Electronic submission will be possible.

Machtey Award: This prize will be given to the best paper written solely by one or more students. An abstract is eligible if all authors are full-time students at the time of submission. This should be indicated in the submission letter. The program committee may decline to make the award, or may split it among several papers.

Program Committee: M. Ajtai, M. Bellare, A. Borodin, E. Cohen, S. Goldman, D. Karger, J. Kleinberg, R. Motwani, S. Naor, C. Papadimitriou, T. Pitassi, D. Spielman, E. Upfa, E. Welzl, D. Williamson, and F. Yao.

Information: `http://theory.stanford.edu/~focs98/`.

*9-13 **Dynamics and Control of AIDS**, University of Minnesota, Minneapolis, Minnesota.

Organizers: D. Kirschner, A. Perelson.

Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: `staff@ima.umn.edu`, or Web page: `http://www.ima.umn.edu/biology/`.

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

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

*15-20 **ASME Forum on Parallel Computing Methods**, Anaheim, California.

Call for Papers: Papers are solicited on all aspects of parallel computing methodology, including new and innovative methods. Papers on parallel strategies for shared and distributed memory architectures, heterogeneous clusters of workstations, and Pile-of-PCs are sought. Of particular interest are papers discussing applications of parallel algorithms and the effective use of parallel computing methods in industrial applications. Paper abstracts are due to the organizer by March 13, 1998, and may be submitted digitally or by hardcopy format. Notification of abstract acceptance is by April 3, 1998, and the final paper is due to the organizer by June 29, 1998.

Organizers: Fluids Engineering Division, as part of the American Society of Mechanical Engineers (ASME) 1998 International Mechanical Engineering Congress and Exposition (IMECE).

Information and Submission: C. J. Freitas, Principal Engineer—Computational Mechanics, Southwest Research Institute, 6220 Culebra Road, San Antonio, TX 78238-5166; tel: 210-522-2137; fax: 210-522-3042; e-mail: `cfreitas@swri.edu`.

*17-19 **Mal'tsev Meeting**, The Institute of Mathematics, Novosibirsk, Russia.

Topics: Algebra and logic.

Organizers: The Siberian Foundation for Algebra and Logic, together with the Institute of Mathematics (Siberian Branch of the Russian Academy of Sciences) and the Research Institute for Mathematical and Information Bases of Education (Novosibirsk State University).

Information: `http://math.nsc.ru/conference/malmeet/`.

21-22 **DIMACS Workshops: Reconnecting Two-Year College Faculty to the Mathematical Sciences Enterprise**, DIMACS Center, Rutgers University, Piscataway, New Jersey. (Apr. 1998, p. 534)

*30-December 5 **Neural Information Processing Systems: Natural and Synthetic**, Denver, Colorado.

Forum: This is the twelfth meeting of an interdisciplinary conference which brings together cognitive scientists, computer scientists, engineers, neuroscientists, physicists, and mathematicians interested in all aspects of neural processing and computation. The conference will include invited talks and oral and poster presentations of refereed papers. The conference is single track and is highly selective. Preceding the main session there will be one day of tutorial presentations (Nov. 30), and following it there will be two days of focused workshops on topical issues at a nearby ski area (Dec. 4-5).

Topics: Major categories for paper submission are as follows: Algorithms and Architectures, Applications, Artificial Intelligence, Cognitive Science, Implementation, Neuroscience, Reinforcement Learning and Control, Speech and Signal Processing, Theory, and Visual Processing.

Organizing Committee: D. Baker (Carnegie Mellon Univ.), J. Baxter (Australian National Univ.), S. Becker (McMaster Univ.), G. Blasdel (Harvard Medical School), D. Cohn (Harlequin), S. Hanson (Rutgers Univ.),

M. Kearns (AT&T Labs Research), S. Kirkpatrick (IBM), B. Mel (Univ. of Southern California), K. Mueller (GMD First), S. Solla (Northwestern Univ.), and G. Tesauro (IBM).
Program Committee: A. Barto (Univ. of Massachusetts), J. Buhmann (Univ. of Bonn), Y. Freund (AT&T Labs Research), L. K. Hansen (Danish Technical Univ.), N. Intrator (Brown Univ.), R. Jacobs (Univ. of Rochester), E. Levin (AT&T Labs Research), A. Pouget (Georgetown Univ.), D. Saad (Aston Univ.), L. Saul (AT&T Labs Research), S. Solla (Northwestern Univ., chair), S. Thrun (Carnegie Mellon Univ.), Y. Weiss (MIT).
Review Criteria: All submitted papers will be thoroughly refereed on the basis of technical quality, significance, and clarity. Novelty of the work is also a strong consideration in paper selection, but to encourage interdisciplinary contributions, we will consider work which has been submitted or presented in part elsewhere if it is unlikely to have been seen by the NIPS audience. Authors should not be dissuaded from submitting recent work, as there will be an opportunity after the meeting to revise accepted manuscripts before submitting final camera-ready copy.
Paper Format: Submitted papers may be up to seven pages in length, including figures and references, using a font no smaller than 10 point. Text is to be confined within an 8.25 in. by 5 in. rectangle. Submissions failing to follow these guidelines will not be considered. Authors are strongly encouraged to use the NIPS LaTeX style files obtainable by anonymous FTP at the site given below. Papers must indicate (1) physical and e-mail addresses of all authors; (2) one of the nine major categories listed above, and a subcategory if desired; (3) if the work, or any substantial part thereof, has been submitted to or has appeared in other scientific conferences; (4) the authors' preference, if any, for oral or poster presentation (this preference will play no role in paper acceptance); and (5) author to whom correspondence should be addressed.
Submission Instructions: Send eight copies of submitted papers to the address below; electronic or fax submission is not acceptable. Include one additional copy of the abstract only, to be used for preparation of the abstracts booklet distributed at the meeting. Submissions must be received by **May 22, 1998**. From within the U.S., submissions will be accepted if mailed first class and postmarked by May 19, 1998. Mail submissions to: S. A. Solla, NIPS*98 Program Chair, Dept. of Physiology, Ward Building 5-003, MC211, Northwestern University Medical School, 303 E. Chicago Avenue, Chicago, IL 60611-3008. Copies of the LaTeX style files for NIPS are available via anonymous FTP at `ftp.cs.cmu.edu` (128.2.206.173) in `/afs/cs/Web/Groups/NIPS/formatting`. The style files and other conference information may also be retrieved via World Wide Web at `http://www.cs.cmu.edu/Web/Groups/NIPS`.
Information: Mail general inquiries and requests for registration material to: NIPS Foundation, Computational Neurobiology Laboratory, Salk Institute for Biological Studies, 10010 North Torrey Pines Road, La Jolla, CA 92037; fax: 619-587-0417; e-mail: `nipsinfo@salk.edu`.

December 1998

* 4-5 **NIPS*98 Post Conference Workshops**, Breckenridge, Colorado.
Call for Proposals: Following the regular program of the Neural Information Processing Systems 1998 conference, workshops on current topics in neural information processing will be held on December 4 and 5, 1998, in Breckenridge, Colorado. Proposals by qualified individuals interested in chairing one of these workshops are solicited. Past topics have included: Active Learning, Architectural Issues, Attention, Audition, Bayesian Analysis, Bayesian Networks, Benchmarking, Brain Imaging, Computational Complexity, Computational Molecular Biology, Control, Genetic Algorithms, Graphical Models, Hippocampus and Memory, Hybrid HMM/ANN Systems, Implementations, Music, Neural Plasticity, Language Processing, Lexical Acquisition, Network Dynamics, On-Line Learning, Optimization, Recurrent Nets, Robot Learning, Rule Extraction, Self-Organization, Sensory Biophysics, Signal Processing, Support Vectors, Speech, Time Series, Topological Maps, and Vision Models and Applications. Workshop organizers will have responsibilities including: (1) coordinating workshop participation and content, which involves arranging short informal presentations by experts working in an area, arranging for expert commentators to sit on a discussion panel, and formulating a set of discussion topics, etc.; (2) moderating or leading the discussion and reporting its high points, findings, and conclusions to the group during evening plenary sessions; and (3) writing a brief summary and/or coordinating submitted material for postconference electronic dissemination.
Goal: The goal of the workshops is to provide an informal forum for researchers to discuss important issues of current interest. There will be two workshop sessions a day, for a total of six hours, with free time in between for ongoing individual exchange or outdoor activities. Concrete open and/or controversial issues are encouraged and preferred as workshop topics. Representation of alternative viewpoints and panel-style discussions are particularly encouraged.
Submission Instructions: Interested parties should submit via e-mail a short proposal for a workshop of interest by May 29, 1998. Proposals should include a title, a description of what the workshop is to address and accomplish, the proposed length of the workshop (one day or two days), the planned format (miniconference, panel discussion, or group discussion, combinations of the above, etc.), and the proposed number of speakers. Where possible, please also indicate potential invitees (particularly for panel discussions). Please note that this year we are looking for fewer "miniconference" workshops and a greater variety of workshop formats. The time allotted to workshops is six hours each day in two sessions of three hours each. We strongly encourage the organizers to reserve a significant portion of time for open discussion. The proposal should explain why the topic is of interest or controversial, why it should be discussed, and who the targeted group of participants is. In addition, please send a brief résumé of the prospective workshop chair, a list of publications, and evidence of scholarship in the field of interest. Submissions should include contact name, address, e-mail address, phone number, and fax number if available. Proposals should be mailed electronically to `zemel@u.arizona.edu`. All proposals must be received by **May 29, 1998**. If e-mail is unavailable, mail to arrive by the deadline to: NIPS*98 Workshops, c/o R. Zemel, Dept. of Psychology, Univ. of Arizona, Tucson, AZ 85721.
Information: Questions may be addressed to either of the workshop co-chairs: S. Becker, McMaster Univ., `becker@mcmaster.ca`, or R. Zemel at the above address.

14-18 **First International Conference on Semigroups of Operators, Theory and Applications**, Marriot Hotel, Newport Beach, California. (Feb. 1998, p. 296)

16-22 **Symmetry and Perturbation Theory II**, Rome, Italy. (Apr. 1998, p. 534)

19-21 **(ORSI Convention) International Conference on Operations Research and Industry**, Institute of Basic Science, Agra, India. (May 1998, p. 642)

* 23-25 **The Joint Annual Conference of the Bharat Ganita Parisad and the Jammu Mathematical Society-A symposium on functional analysis and applications**, Department of Mathematics, Lucknow University, Lucknow, India.
Information: Interested persons should contact R. K. Singh, President BGP and JMS, Dept. of Math., Univ. of Jammu, India, or S. Datta, Head, Dept. of Math. and Astronomy, Lucknow Univ., Lucknow, India.

January 1999

January-June **The Fields Institute for Research in Mathematical Sciences Program in Probability and Its Applications**, The Fields Institute, Toronto, Ontario, Canada. (Sept. 1997, p. 1031)

* 4-8 **Cell Adhesion and Motility**, University of Minnesota, Minneapolis, Minnesota.
Organizers: W. Alt, R. T. Tranquillo.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: `staff@ima.umn.edu`, or Web page: `http://www.ima.umn.edu/biology/`.

8-9 **Nonlinear Differential Equations: A Meeting Honoring Professor Alan Lazer on the Occasion of his 60th Birthday**, The University of Miami, Coral Gables, Florida. (Apr. 1998, p. 535)

8-12 **Twenty-third Holiday Symposium: Algebraic Structures For Logic**, New Mexico State University, Las Cruces, New Mexico. (May 1998, p. 642)

13-16 **Joint Mathematics Meeting**, San Antonio Convention Center, San Antonio, Texas. (Sept. 1997, p. 1031)

15-16 **ASL Winter Meeting (in conjunction with AMS meeting)**, San Antonio, Texas. (May 1998, p. 642)

*17-19 **Tenth Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'99)**, Omni Inner Harbor Hotel, Baltimore, Maryland.
Sponsor: ACM Special Interest Group on Algorithms and Computation Theory and SIAM Activity Group on Discrete Mathematics.
Organizer: To be determined.
Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; e-mail: meetings@siam.org; SIAM home page: http://www.siam.org/conf.htm.

*19-23 **Introductory Workshop in Random Matrix Models and their Applications**, Mathematical Sciences Research Institute, Berkeley, California.
Aim: The introductory workshop plays a pivotal role in the program, whose main goal is to create a common understanding of the various problems and new ideas which have recently arisen in the theory of random matrices. This workshop is not intended for the specialist, although many experts will be there to participate and interact with others interested in learning about this material, but rather for the mathematician in any field who would like to know more about these exciting areas and their applications in other parts of mathematics. The workshop will be a mini-version of the entire semester and is intended to give an overview of the whole program. To that end, several short series of lectures (one series = two or three one-hour lectures) given by the experts in the various aspects of the program and addressed to a broad audience will be organized. The topics of the lectures will be chosen to exhibit the relation of random matrix models to completely integrable systems; the Riemann-Hilbert and Virasoro algebra approaches; the related developments in topological field theories, exactly solvable statistical mechanics models, and representation theory of quantum affine algebras; relations to number theory and to quantum chaos. There will be four lectures each day supplemented by informal discussions and ad hoc seminars.
Invited Speakers: R. Baxter, E. Brizin, P. Deift, B. Dubrovin, M. Jimbo, M. Mehta, P. van Mverbeke, P. Sarnak, C. Tracy, H. Widom, and X. Zhou.
Financial Support: A limited amount of funding is available for partial support of people wishing to attend. The organisers have great interest in attracting to the workshop participants from all types of institutions and all backgrounds, including researchers from areas outside the main subjects of the workshop. They are in particular strongly encouraging mathematicians from traditionally underrepresented groups to apply. To apply for funding, send a letter explaining your interest in the workshop together with a vita or bibliography and a budget for travel/living expenses. If you are a student, also solicit a letter from a faculty advisor. All information should be received by October 9, 1998.
Information: Communications about this workshop should be sent either by e-mail to rmintro@msri.org or by regular mail to: Introductory Workshop in Random Matrix Models, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, CA 94720-5070; http://www.msri.org/activities/programs/9899/random/rmintro/.

*25-29 **Computational Modeling in Biological Fluid Dynamics**, University of Minnesota, Minneapolis, Minnesota.
Organizers: L. Fauci, S. Gueron.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

February 1999

7-11 **35th Australasian Applied Mathematics Conference**, Mollymook Golf Club, Ulladulla, New South Wales. (Dec. 1997, p. 1500)

*8-12 **Membrane Transport and Renal Physiology**, University of Minnesota, Minneapolis, Minnesota.
Organizers: H. Layton, A. Weinstein.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*13 **Hormones**, University of Minnesota, Minneapolis, Minnesota.
Organizers: J. Sneyd.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*15-19 **Endocrinology: Mechanism of Hormone Secretion and Control**, University of Minnesota, Minneapolis, Minnesota.
Organizers: A. Goldbeter, M. Mackey, A. Sherman, and J. Sneyd.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*22-26 **Random Matrices, Statistical Mechanics, and Integrable Systems**, Mathematical Sciences Research Institute, Berkeley, California.
Aim: This workshop will focus on the relations of random matrices to integrable systems and to exactly solvable statistical mechanics and topological field models.
Topics: The following three groups of topics will be of primary interest: (1) Random matrices, orthogonal polynomials, and integrable systems of differential equations of the Painlevi and KP types. The Riemann-Hilbert and isomonodromy approachies and their relations to semiclassical analysis. The vertex operators and Virasoro algebra techniques; (2) Correlation functions of exactly solvable quantum field and statistical mechanics models. The quantum Calogero-Sutherland and Calogero-Moser systems and the Knishnik-Zamolodchikov equation. XXX and XXZ models and the quantum Knishnik-Zamolodchikov equation. Relations to the q-special functions and to the representation theory of quantum affine algebras; (3) Matrix integrals and topology of the moduli spaces of algebraic curves. Relations to topological field theories. Frobenius manifolds, Painlevi transcendents, and isomonodromy deformations.
Objectives: The indicated directions share several common analytic and algebraic features, e.g. Riemann-Hilbert problem, integrable Fredholm operators, Virasoro algebra, KP and Toda hierarchies, etc. One of the principal objectives of the workshop is to discuss extensively these remarkable similarities and hence to advance in understanding of the basic mathematical structures that lie behind them.
Financial Support: To apply for funding, send a letter explaining your interest in the workshop together with a vita or bibliography and a budget for travel/living expenses. If you are a student, also solicit a letter from a faculty advisor. All information should be received by November 13, 1998.
Information: Communications about this workshop should be sent either by e-mail to statmech@msri.org or by regular mail to: Workshop in Random Matrices, Statistical Mechanics, and Integrable Systems, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, CA 94720-5070; http://www.msri.org/activities/programs/9899/random/statmech/.

March 1999

*5 **Audition**, University of Minnesota, Min-

neapolis, Minnesota.
Speaker: M. Reed.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*7-13 **Dirac Operators, Index Theorems and Numerical Invariants of Manifolds**, Greifswald University, Germany, Island of Usedom.
Topics: All relations between differential operators, geometry and topology of manifolds. There will be a short series of 1-3-hour talks, and a limited number of participants will have the possibility of presenting their own results.
Organizing Committee: J. Eichhorn (Greifswald), Th. Friedrich (Berlin), W. Lueck (Muenster).
Information: Applications should be sent to J. Eichhorn, Institut für Mathematik und Informatik, Jahnstrasse 15a, D-17487 Greifswald, Germany; e-mail: eichhorn@rz.uni-greifswald.de.

*8-12 **Audition**, University of Minnesota, Minneapolis, Minnesota.
Organizers: M. Reed, E. Young.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*12-13 **AMS Southeastern Section Meeting**, University of Florida, Gainesville, Florida.
Information: R. Coscella, rgc@ams.org.

*16-20 **1999 UAB-GIT International Conference on Differential Equations and Mathematical Physics**, University of Alabama at Birmingham, Birmingham, Alabama.
Aim: The Department of Mathematics at the Univ. of Alabama at Birmingham is hosting an international conference on differential equations and mathematical physics. This conference is part of a series held alternatively at UAB and the Georgia Institute of Technology in Atlanta.
Topics: Topics in the general area of linear and nonlinear differential equations and their relation to mathematical physics will be emphasized. This will include topics such as the analysis of multiparticle Schroedinger operators, stability of matter, relativity theory, spectral and scattering theory including inverse problems, fluid dynamics, and geometric analysis, as well as related topics.
Plenary Speakers: The conference will consist of ten plenary lectures, parallel special sessions for 30-minute invited talks, and contributed talks. The plenary speakers are: S. Y. A. Chang (UCLA), D. Christodoulou (Princeton), P. Lax (Courant Institute), E. Lieb (Princeton), P. L. Lions (Paris IX), A. I. Nachman (Rochester), S. P. Novikov (Steklov Institute), B. Simon (Cal Tech), J. Smoller (Ann Arbor), and J. Yngvason (Vienna).
Special Sessions: Special sessions on the following topics are planned: general relativity, integrable systems, PDEs in geometry, quantum mechanics, spectral theory, and inverse problems. Other special sessions may be planned.
Information: Further information and updates will be posted on the conference Web site http://www.math.uab.edu/uabgit99/.

18-21 **AMS Central Sectional Meeting**, University of Illinois-Urbana, Urbana, Illinois. (Aug. 1997, p. 846)

20-23 **ASL Annual Meeting**, San Diego, California. (May 1998, p. 642)

*22-24 **Ninth SIAM Conference on Parallel Processing for Scientific Computing**, Adam's Mark San Antonio-Riverwalk Hotel, San Antonio, Texas.
Sponsor: SIAM Activity Group on Supercomputing.
Organizers: B. Hendrickson (Sandia National Labs., Albuquerque) and K. Yelick (Univ. of California, Berkeley).
Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; e-mail: meetings@siam.org; SIAM home page: http://www.siam.org/conf.htm.

*24-27 **Fifth SIAM Conference on Mathematical and Computational Issues in the Geosciences**, Adam's Mark San Antonio-Riverwalk Hotel, San Antonio, Texas.
Sponsor: SIAM Activity Group on Geosciences.
Organizer: C. N. Dawson (Univ. of Texas, Austin).
Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; e-mail: meetings@siam.org; SIAM home page: http://www.siam.org/conf.htm.

April 1999

*7-9 **Fourth International Conference on Typed Lambda Calculi and Applications (TLCA'99)**, l'Aquila, Italy.
Aim: The TLCA series of conferences aims at providing a forum for the presentation and discussion of recent research in an area which was originally a rather restricted field but has now considerably expanded.
Topics: The following list of topics is nonlimitative: Proof-theory, cut-elimination and normalization, linear logic, semantic, denotational semantics, game semantics, operationality, abstract machines, parallel execution, typing, subtypes, type assignment systems, programming, proof search, type checking.
Program: The program of TLCA'99 will consist of about 30 selected presentations in plenary sessions.
Program Committee: S. Abramsky (Univ. of Edinburgh), T. Coquand (Göteborgs Univ.), J.-Y. Girard (IML/Marseille, chair), R. Hindley (Univ. of Wales Swansea), J.-L. Krivine (Univ. Paris VII), J. Reynolds (Carnegie-Mellon Univ., Pittsburgh), S. Ronchi (Univ. di Torino), A. Scedrov (Univ. of Pennsylvania), T. Streicher (Technische Univ. Darmstadt), M. Takahashi (Tôkyô Kôgyô Daigaku), P. Urzyczyn (Uniwersytet Warszawski).
Paper Submission: Original contributions should be sent by e-mail (PostScript files only) to tlca99@iml.univ-mrs.fr and a short abstract should be sent as a separate e-mail; it should use only standard ASCII characters. Hard copy (6 copies) is also acceptable, to the address: J.-Y. Girard, Institute de Mathématiques de Luminy, 163 Avenue de Luminy, case 907, 13288 Marseille cedex 9, France; fax: +33-491269655. All submissions must be received by Sept. 4, 1998. Papers should not exceed 15 standard A4 or U.S. quarto pages and should allow the Programme Committee to assess the merits of the work: in particular references and comparisons with related work should be included. Submission of material already published or submitted to other conferences with Proceedings is not allowed. The accepted papers will be published as a volume of Springer Lecture Notes in Computer Science.
Important Dates: Submissions: September 4, 1998; acceptance/rejection: November 16, 1998; definitive versions due: January 4, 1999.
Information: More details about the Conference will become available later from the Organizing Committee Chairman, B. Intrigila, Dipartimento di Matematica, Università di l'Aquila, Via Vetoio, Loc. Coppito, 67100 l'Aquila, Italy; e-mail: tlca99.aquila@univaq.it; fax: +39-862-433180; or at the home page: http://w3.dm.univaq.it/tlca99/.

10-11 **AMS Western Sectional Meeting**, University of Nevada, Las Vegas, NV. (Apr. 1997, p. 481)
Information: W. Drady, wsd@ams.org.

12-15 **Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory**, Athens, Georgia. (Apr. 1998, p. 535)

17-19 **Weekend Algebra Conference**, University of Southern Mississippi, Hattiesburg, Mississippi. (Jan. 1998, p. 113)

*19-23 **Local Interaction and Global Phenomena in Vegetation and Other Systems**, University of Minnesota, Minneapolis, Minnesota.
Organizers: S. Levin, C. Neuhauser.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu,

or Web page: http://www.ima.umn.edu/biology/.

24-25 **AMS Eastern Sectional Meeting**, State University of New York, Buffalo, NY. (Apr. 1997, p. 481)
Information: R. Cascella, rgc@ams.org.

May 1999

*10-12 **Sixth SIAM Conference on Optimization**, Radisson Atlanta Hotel, Atlanta, Georgia.
Sponsor: SIAM Activity Group on Optimization.
Organizers: P. E. Gill (Univ. of California, San Diego); C. T. Kelley (North Carolina State Univ.).
Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; e-mail: meetings@siam.org; SIAM home page: http://www.siam.org/conf.htm.

*12-15 **1999 SIAM Annual Meeting**, Radisson Atlanta Hotel, Atlanta, Georgia.
Organizers: F. R. K. Chung (Univ. of Pennsylvania) and J. J. Dongarra (Univ. of Tennessee, Knoxville, and Oak Ridge National Lab.).
Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; e-mail: meetings@siam.org; SIAM home page: http://www.siam.org/conf.htm.

*13-14 **Introduction to Epidemiology and Immunology**, University of Minnesota, Minneapolis, Minnesota.
Speakers: C. Castillo-Chavez, D. Kirschner, H. Thieme, J. Velasco-Hernandes.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*17-21 **Mathematical Approaches for Emerging and Reemerging Infectious Diseases**, University of Minnesota, Minneapolis, Minnesota.
Organizers: S. Blower, C. Castillo-Chavez, K. Cooke, D. Kirschner, P. van den Driessche.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*24-28 **Fifth SIAM Conference on Applications of Dynamical Systems**, Snowbird Ski and Summer Resort, Snowbird, Utah.
Sponsor: SIAM Activity Group on Dynamical Systems.
Organizers: D. Armbruster (Arizona St. Univ.) and E. Stone (Utah St. Univ.).
Information: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; e-mail: meetings@siam.org; SIAM home page: http://www.siam.org/conf.htm.

June 1999

*7-11 **From Individual to Aggregration: Modeling Animal Grouping**, University of Minnesota, Minneapolis, Minnesota.
Organizers: R. Durrett, L. Edelstein-Keshet, S. Levin, M. Lewis.
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/biology/.

*7-11 **Random Matrices and Their Applications: Quantum Chaos, GUE Conjecture for Zeros of Zeta Functions, Combinatorics, and All That**, Mathematical Sciences Research Institute, Berkeley, California.
Focus: This workshop will focus on problems arising in different fields: quantum mechanics, number theory, statistical mechanics, combinatorics, representation theory, and others, which demonstrate surprising universal behavior described by the ensembles of random matrices and random polynomials. The idea of the workshop is to bring together people working in different areas on the problems related to scaling limits and universality and discuss deep hidden connections between these problems.
Topics: The topics of this workshop will include: (1) GUE conjecture for zeros of zeta functions. Mathematical results in the theory of quantum chaos. Poisson conjecture and distribution of values of polynomial forms. Statistical properties of eigenfunctions of integrable and chaotic quantum systems; (2) Universal properties of distribution of eigenvalues and eigenvectors in ensembles of random matrices. Scaling limits, double scaling limits, and their relation to the Painlevi transcendents and their higher generalizations. Correlations between zeros of random polynomials and their application to the problem of universality of the eigenfunction statistics for chaotic quantum systems. Random matrices and noncommutative probability theory; (3) Random matrices in combinatorics and representation theory. Scaling and double scaling limits for the longest increasing subsequence, Young's diagrams, etc. and their relation to the Painlevi transcendents.
Financial Support: To apply for funding, send a letter explaining your interest in the workshop together with a vita or bibliography and a budget for travel/living expenses. If you are a student, also solicit a letter from a faculty advisor. All information should be received by February 12, 1999.
Information: Communications about this workshop should be sent either by e-mail to qc@msri.org or by regular mail to: Workshop in Quantum Chaos, GUE Conjecture, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, CA 94720-5070; http://www.msri.org/activities/programs/9899/random/qc/.

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

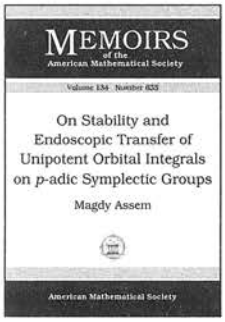
August 1999

*2-13 **IMA Summer Program: IMA Workshop on Codes, Systems and Graphical Models**, University of Minnesota, Minneapolis, Minnesota.
Organizers: D. Forney (Motorola), B. Marcus (IBM), J. Rosenthal (U. Notre Dame), A. Vardy (U. Illinois).
Information: Institute for Mathematics and its Applications, Univ. of Minnesota, 206 Church St. SE, Minneapolis, MN 55455; tel: 612-624-6066, e-mail: staff@ima.umn.edu, or Web page: http://www.ima.umn.edu/csg/.

*9-14 **Gyorgy Alexits Memorial Conference**, Budapest, Hungary.
Organizer: Janos Bolyai Mathematical Society.
Organizing Committee: K. Tandori, honorary chair, L. Leindler, F. Schipp and J. Szabados, co-chairs, F. Msricz, V. Totik, P. Virtesi, S. Fridli, secretary.
Topics: Function series, Fourier analysis, summability and expansions, interpolation, inequalities.
Information: S. Fridli, e-mail: fridli@ludens elte.hu.

New Publications Offered by the AMS

Algebra and Algebraic Geometry



On Stability and Endoscopic Transfer of Unipotent Orbital Integrals on p-adic Symplectic Groups

Magdy Assem

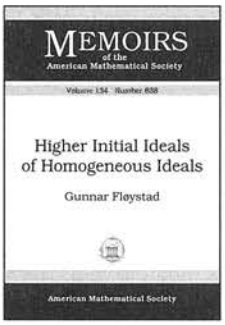
The theory of endoscopy is an intriguing part of the Langlands program, as it provides a way to attack the functoriality principle of Langlands for certain pairs of reductive groups (G, H), in which H is what is known as an endoscopic group for G. The starting point for this method is a close study of the relationship of orbital integrals on G with stable orbital integrals on H.

This volume investigates unipotent orbital integrals of spherical functions on p-adic symplectic groups. The results are then put into a conjectural framework, that predicts (for split classical groups) which linear combinations of unipotent orbital integrals are stable distributions.

Contents: Introduction; Unipotent orbits and prehomogeneous spaces; The Hecke algebra and some Igusa local orbital zeta functions; The evaluation of f^H at the identity; Matching of unipotent orbital integrals; Remarks on stability and endoscopic transfer; Appendix I; Appendix II; References.

Memoirs of the American Mathematical Society, Volume 134, Number 635

July 1998, 101 pages, Softcover, ISBN 0-8218-0765-X, LC 98-18262, 1991 *Mathematics Subject Classification*: 22E35, 22E50, **Individual member $24**, List $40, Institutional member $32, Order code MEMO/134/635N



Higher Initial Ideals of Homogeneous Ideals

Gunnar Fløystad, *University of Bergen, Norway*

Given a homogeneous ideal I and a monomial order, one may form the initial ideal $\text{in}(I)$. The initial ideal gives information about I, for instance I and $\text{in}(I)$ have the same Hilbert function. However, if $\mathcal{I}$ is the sheafification of I one cannot read the higher cohomological dimensions $h^i(\mathbf{P}^n, \mathcal{I}(\nu))$ from $\text{in}(I)$. This work remedies this by defining a series of higher initial ideals $\text{in}_s(I)$ for $s \geq 0$. Each cohomological dimension $h^i(\mathbf{P}^n, \mathcal{I}(\nu))$ may be read from the $\text{in}_s(I)$. The $\text{in}_s(I)$ are however more refined invariants and contain considerably more information about the ideal I.

This work considers in particular the case where I is the homogeneous ideal of a curve in $\mathbf{P}^3$ and the monomial order is reverse lexicographic. Then the ordinary initial ideal $\text{in}_0(I)$ and the higher initial ideal $\text{in}_1(I)$ have very simple representations in the form of plane diagrams.

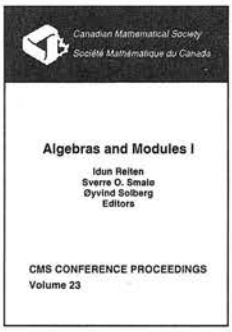
Features:
- enables one to visualize cohomology of projective schemes in $\mathbf{P}^n$
- provides an algebraic approach to studying projective schemes
- gives structures which are generalizations of initial ideals

Contents: Introduction; Borel-fixed ideals; Monomial orders; Some algebraic lemmas; Defining the higher initial ideals; Representing the higher initial ideals; Group action on $R^{s+1}(I)$; Describing the action on $R^{s+1}(I)$; Borel-fixedness; Higher initial ideals of hyperplane sections; Representing the higher initial ideals of general hyperplane sections; Higher initial ideals as combinatorial structures; Reading cohomological information; Examples: Points and curves in $\mathbf{P}^3$; References.

Memoirs of the American Mathematical Society, Volume 134, Number 638

July 1998, 68 pages, Softcover, ISBN 0-8218-0853-2, LC 98-18255, 1991 *Mathematics Subject Classification*: 13D25, 14H50; 13P10, 14J99, **Individual member $22**, List $36, Institutional member $29, Order code MEMO/134/638N

Algebras and Modules I



Idun Reiten, Sverre O. Smalø, and **Øyvind Solberg,** *Norwegian University of Science and Technology, Trondheim,* Editors

This volume contains recent results on geometric aspects of representations of algebras, a thorough treatment of the theory of quasitilted algebras, new developments on infinite dimensional representations of finite dimensional algebras, a bridge between representation of algebraic groups and representation theory of finite dimensional algebras, and recent discoveries on modular representation theory. In addition, the volume contains two papers devoted to some of Maurice Auslander's many contributions both in the representation theory of finite dimensional algebras and in commutative ring theory. The invited contributions to this volume are based on lectures given by leading researchers in the field at the Workshop on Representations of Algebras and Related Topics, Trondheim, Norway, in 1996.

Features:

- a unique collection of survey papers containing old and new developments in the representation theory of finite dimensional algebras and related topics
- an outstanding source for examples of different techniques developed in recent years in this area of research
- papers presented with emphasis on clarity and readability

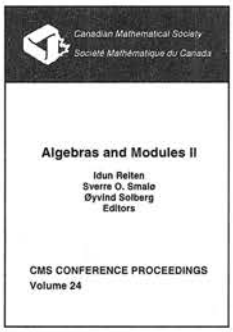
A general background in noncommutative algebra including rings, modules and homological algebra is required. Given that, parts of this volume would be suitable as a textbook for an advanced graduate course in algebra.

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

Contents: K. Bongartz, Some geometric aspects of representation theory; **W. Crawley-Boevey**, Infinite-dimensional modules in the representation theory of finite-dimensional algebras; **D. Happel**, Quasitilted algebras; **H. Lenzing**, Auslander's work on artin algebras; **B. Parshall**, Some finite dimensional algebras arising in group theory; **J. Rickard**, Some recent advances in modular representation theory; **Y. Yoshino**, Auslander's work on Cohen-Macaulay modules and recent development.

Conference Proceedings, Canadian Mathematical Society, Volume 23

June 1998, 198 pages, Softcover, ISBN 0-8218-0850-8, LC 98-3695, 1991 *Mathematics Subject Classification*: 16Gxx; 16Dxx, 16Exx, 18Gxx, 20Cxx, **Individual member $23**, List $39, Institutional member $31, Order code CMSAMS/23N



Algebras and Modules II

Idun Reiten, Sverre O. Smalø, and **Øyvind Solberg,** *Norwegian University of Science and Technology, Trondheim,* Editors

This volume contains 43 research papers based on results presented at the Eighth International Conference on Representations of Algebras (ICRA VIII) held in Geiranger, Norway, in 1996. The papers, written by experts in the field, cover the most recent developments in the representation theory of artin algebras and related topics.

The papers cover: representation of tame, biserial, cellular, factorial hereditary, Hopf, Koszul, non-polynomial growth, preprojective, Temperley-Lieb, tilted and quasitilted algebras. Other topics include: tilting/cotilting modules and generalizations as $*$-modules, exceptional sequences of modules and vector bundles, homological conjectures, Hochschild cohomology, cyclic homology, homologically finite subcategories, representations of posets, regular modules, vector space categories, triangulated categories, moduli spaces of representations of quivers, postprojective (and preprojective) partitions, stable and derived equivalences, and pure-injective, infinite dimensional, and endofinite representations. A general background in noncommutative algebra including rings, modules and homological algebra is required.

Features:

- a unique source for the developments in the representation theory of finite dimensional and artin algebras and related topics
- a wide variety of important papers by leading researchers in the field, with references to earlier developments in the field

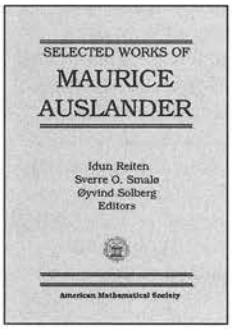
Members of the Canadian Mathematical Society may order at the AMS member price.

Contents: L. Angeleri-Hügel and **F. U. Coelho**, A note on a certain class of tilted algebras; **H. Asashiba**, Derived equivalence and stable equivalence of repetitions of algebras of finite global dimension; **I. Assem**, **A. Beligiannis**, and **N. Marmaridis**, Right triangulated categories with right semi-equivalences; **Ø. Bakke**, The existence of short exact sequences with some of the terms in given subcategories; **M. J. Bardzell** and **E. N. Marcos**, Induced boundary maps for the cohomology of monomial and Auslander algebras; **M. Barot**, The repetitive partition of the repetitive category of a tubular algebra; **A. V. Roiter**, **K. I. Belousov**, and **L. A. Nazarova**, Representations of finitely represented dyadic sets; **A. B. Buan** and **Ø. Solberg**, Relative cotilting theory and almost complete cotilting modules; **C. Cibils**, Hochschild cohomology algebra of radical square zero algebras; **R. Colpi** and **G. D'Este**, Equivalences represented by faithful non-tilting $*$-modules; **T. Dana-Picard** and **M. Schaps**, Non reduced components of Alg_n; **A. P. Dean** and **F. Okoh**, Extensionless modules of infinite rank; **B. Deng** and **J. Xiao**, A quiver description of hereditary categories and its application to the first Weyl algebra; **E. Dieterich**, Power-associative real division algebras; **P. Dräxler** and **C. Geiss**, A note on the $\mathbb{D}_n$-pattern; **Y. A. Drozd**, Representations of bisected posets and reflection functors; **O. Enge**, Quasitilted triangular algebras; **K. Erdmann** and **N. Snashall**, Preprojective algebras of Dynkin type, periodicity, and the second Hochschild cohomology; **J. Feldvoss** and

L. Klingler, Tensor powers and projective modules for Hopf algebras; **K. R. Goodearl** and **B. Huisgen-Zimmermann**, Repetitive resolutions over classical orders and finite dimensional algebras; **E. L. Green** and **R. Martínez-Villa**, Koszul and Yoneda algebras. II; **R. M. Green**, On representations of affine Temperley-Lieb algebras; **J. Y. Guo**, **R. Martínez-Villa**, and **M. Takane**, Koszul generalized Auslander regular algebras; **D. Happel** and **I. H. Slungård**, One-point extensions of hereditary algebras; **D. Happel** and **L. Unger**, Complements and the generalized Nakayama conjecture; **L. Hille**, Toric quiver varieties; **T. Hübner**, Hereditary module categories arising as categories perpendicular to exceptional vector bundles; **B. Keller**, An overview of results on cyclic homology of exact categories; **O. Kerner** and **M. Takane**, Universal filtrations for modules in perpendicular categories; **S. König** and **C. Xi**, On the structure of cellular algebras; **H. Krause**, Stable equivalence and representation type; **D. Kussin**, Factorial algebras, quaternions and preprojective algebras; **D. Madsen**, Almost split sequences for commutative artinian rings; **H. Meltzer**, Exceptional sequences and tilting complexes for hereditary algebras of type $\mathbb{A}_n$; **J. A. de la Peña** and **A. Skowroński**, Substructures of non-polynomial growth algebras with weakly non-negative Tits form; **M. I. Platzeck**, Relations and modules of finite projective dimension over algebras whose idempotent ideals are projective; **M. Prest**, Morphisms between finitely presented modules and infinite-dimensional representations; **I. Reiten**, Homological properties of almost split sequences; **C. M. Ringel**, The preprojective algebra of a quiver; **K. W. Roggenkamp**, Biserial algebras and graphs; **M. Schmidmeier**, Endofinite modules over hereditary artinian PI-rings; **C. Xi**, Twisted doubles of algebras. I: Deformations of algebras and the Jones index; **A. Zavadskij**, On tame vectorspace categories. II; **P. Zhang**, Selforthogonal radical algebras.

Conference Proceedings, Canadian Mathematical Society, Volume 24

July 1998, 569 pages, Softcover, ISBN 0-8218-1076-6, LC 98-6550, 1991 *Mathematics Subject Classification*: 16Gxx; 16Exx, 18Gxx, 20Cxx, **Individual member $59**, List $99, Institutional member $79, Order code CMSAMS/24N



Selected Works of Maurice Auslander

Idun Reiten, Sverre O. Smalø, Øyvind Solberg, *Norwegian University of Science and Technology, Trondheim,* Editors

In view of Maurice Auslander's important contributions to many parts of algebra, there is great interest in the present volume. This book features a broad selection of the core of his work, including commutative algebra, singularity theory, the theory of orders, and the representation theory of artin algebras.

Although Auslander worked in many areas, there are characteristics common to most of his research. Of particular note is his use of homological methods, including functor categories. While his early work was concerned mostly with commutative rings and his later work mainly with artin algebras, he was always interested in finding common features and common settings.

The broad range and impact of Auslander's contributions are reflected clearly in this volume. The editors have included background material, interrelationships between papers and indications of further developments. A paper of note and one that is not available readily is included: the Queen Mary College Notes on "Representation Dimension of Artin Algebras". This book is of interest for the historical development of algebra over a 40-year period and for the use of homological methods in algebra, covering both commutative ring theory and artin algebra theory.

Contents: *Part 1. Chapter I:* Homological dimension and local rings; On the dimension of modules and algebras. III: Global dimension; Commutator subgroups of free groups; On the dimension of modules and algebras. VI: Comparison of global and algebra dimension; On regular group rings; Homological dimension in local rings; Homological dimension in noetherian rings. II; Codimension and multiplicity; Codimension and multiplicity (corrections); Unique factorization in regular local rings; A remark on a paper of M. Hironaka; *Chapter II:* Ramification theory; On ramification theory in noetherian rings; Maximal orders; The Brauer group of a commutative ring; Modules over unramified regular local rings; On the purity of the branch locus; Ramification index and multiplicity; Modules over unramified regular local rings; Brauer groups of discrete valuation rings; Galois actions on rings and finite Galois coverings; *Chapter III:* Functors; Coherent functors; Stable equivalence of artin algebras; Stable equivalence of dualizing R-varieties; A functorial approach to representation theory; Adjoint functors and an extension of the Green correspondence for group representations; D Tr-periodic modules and functors; *Chapter IV:* Almost split sequences and artin algebras; Representation dimension of artin algebras; A characterization of orders of finite lattice type; Representation theory of artin algebras. I; Representation theory of artin algebras. II; Representation theory of artin algebras. III: Almost split sequences; Large modules over artin algebras; Representation theory of artin algebras. IV: Invariants given by almost split sequences; Representation theory of artin algebras. V: Methods for computing almost split sequences and irreducible morphisms; Representation theory of artin algebras. VI: A functorial approach to almost split sequences; Representation theory of hereditary artin algebras; Almost split sequences whose middle term has at most two indecomposable summands; Relations for Grothendieck groups of artin algebras; *Chapter V:* Some topics in representation theory; On a generalized version of the Nakayama conjecture; Modules with waists; Modules determined by their composition factors; Almost split sequences and group rings; On a theorem of E. Green on the dual of the transpose; *Part 2. Chapter VI:* Lattices over general orders; Functors and morphisms determined by objects; Applications of morphisms determined by modules; A survey of existence theorems for almost split sequences; *Chapter VII:* Tilting theory and homologically finite subcategories; Coxeter functors without diagrams; Preprojective modules over artin algebras; Almost split sequences in subcategories; Applications of contravariantly finite subcategories; Homological theory of idempotent ideals; *Chapter VIII:* Almost split sequences and commutative rings; Isolated singularities and existence of almost split sequences; Rational singularities and almost split sequences; Almost split sequences for rational double points; The Cohen-Macaulay type of Cohen-Macaulay rings; Almost split sequences for Cohen-Macaulay-modules; The what, where, and why of almost split sequences; Cohen-Macaulay modules for graded Cohen-Macaulay rings and their completions; Graded modules and their completions; *Chapter IX:* Grothendieck groups and Cohen-Macaulay approximations; Grothendieck groups of algebras and orders; Grothendieck

groups of algebras with nilpotent annihilators; The homological theory of maximal Cohen-Macaulay approximations; Liftings and weak liftings of modules; *Chapter X:* Relative theory and syzygy modules; Relative homology and representation theory. I: Relative homology and homologically finite subcategories; Relative homology and representation theory. II: Relative cotilting theory; k-Gorenstein algebras and syzygy modules; Syzygy modules for noetherian rings.

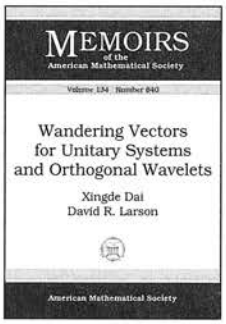
Collected Works, Volume 10

Part 1: August 1998, 895 pages, Hardcover, ISBN 0-8218-0998-9, LC 98-2926,1991 *Mathematics Subject Classification:* 13-XX, 14-XX, 16-XX, 18-XX, 19-XX, 20-XX, **Individual member $99**, List $165, Institutional member $132, Order code CWORKS/10.1N

Part 2: August 1998, 743 pages, Hardcover, ISBN 0-8218-1000-6, LC 98-2926, 1991 *Mathematics Subject Classification:* 13-XX, 14-XX, 16-XX, 18-XX, 19-XX, **Individual member $93**, List $155, Institutional member $124, Order code CWORKS/10.2N

Set: August 1998, 1638 pages, Hardcover, ISBN 0-8218-0679-3, LC 98-2926, 1991 *Mathematics Subject Classification:* 13-XX, 14-XX, 16-XX, 18-XX, 19-XX, 20-XX, **Individual member $179**, List $299, Institutional member $239, Order code CWORKS/10N

Analysis



Wandering Vectors for Unitary Systems and Orthogonal Wavelets

Xingde Dai, *University of North Carolina, Charlotte*, and **David R. Larson**, *Texas A&M, College Station*

This volume concerns some general methods for the analysis of those orthonormal bases for a separable complex infinite dimensional Hilbert space which are generated by the action of a system of unitary transformations on a single vector, which is called a complete wandering vector for the system. The main examples are the orthonormal wavelet bases. Topological and structural properties of the set of all orthonormal dyadic wavelets are investigated in this way by viewing them as complete wandering vectors for an affiliated unitary system and then applying techniques of operator algebra and operator theory.

Features:

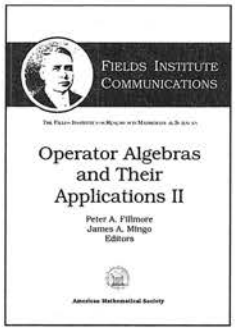
- describes an operator-theoretic perspective on wavelet theory that is accessible to functional analysts
- describes some natural generalizations of standard wavelet systems
- contains numerous examples of computationally elementary wavelets
- poses many open questions and directions for further research

This book is particularly accessible to operator theorists and operator algebraists who are interested in a functional analytic approach to some of the pure mathematics underlying wavelet theory.

Contents: Introduction; The local commutant; Structural theorems; The wavelet system $\langle D, T \rangle$; Wavelet sets; Operator interpolation of wavelets; Concluding remarks; Appendix: Examples of interpolation maps; Bibliography.

Memoirs of the American Mathematical Society, Volume 134, Number 640

July 1998, 68 pages, Softcover, ISBN 0-8218-0800-1, LC 98-4219, 1991 *Mathematics Subject Classification*: 46N99, 47N40, 47N99; 47D25, 47C05, 47D15, 46B28, **Individual member $22**, List $36, Institutional member $29, Order code MEMO/134/640N



Operator Algebras and Their Applications II

Peter A. Fillmore, *Dalhousie University, Halifax, NS, Canada*, and **James A. Mingo**, *Queens University, Kingston, ON, Canada*, Editors

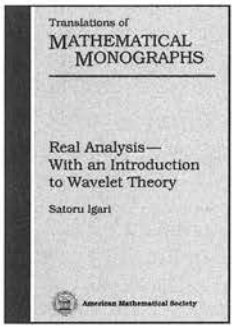
The study of operator algebras, which grew out of von Neumann's work in the 1920s and 30s on modelling quantum mechanics, has in recent years experienced tremendous growth and vitality, with significant applications in other areas both within mathematics and in other fields. For this reason, and because of the existence of a strong Canadian school in the subject, the topic was a natural candidate for an emphasis year at The Fields Institute.

This volume is the second selection of papers that arose from the seminars and workshops of a year-long program, "Operator Algebras and Applications", that took place at The Fields Institute. Topics covered include the classification of amenable C*-algebras, lifting theorems for completely positive maps, and automorphisms of von Neumann algebras of type III.

Contents: B. V. Rajarama Bhat, A generalized intertwining lifting theorem; **O. Bratteli, G. A. Elliott, D. E. Evans**, and **A. Kishimoto**, On the classification of C*-algebras of real rank zero, III: The infinite case; **G. A. Elliott, G. Gong**, and **H. Su**, On the classification of C*-algebras of real rank zero, IV: Reduction to local spectrum of dimension two; **I. Stevens**, Simple approximate circle algebras; **K. H. Stevens**, The classification of certain non-simple approximate interval algebras; **C. E. Sutherland** and **M. Takesaki**, Right inverse of the module of approximately finite dimensional factors of type III and approximately finite ergodic principal measured groupoids; Workshop speakers and titles.

Fields Institute Communications, Volume 20

September 1998, 170 pages, Hardcover, ISBN 0-8218-0908-3, 1991 *Mathematics Subject Classification*: 46-06, **Individual member $28**, List $46, Institutional member $37, Order code FIC/20



Real Analysis—With an Introduction to Wavelet Theory

Satoru Igari, *Tohoku University, Sendai, Japan*

This introduction to real analysis is based on a series of lectures by the author at Tohoku University. The text covers real numbers, the notion of general topology, and a brief treatment of the Riemann integral, followed by chapters on the classical theory of the Lebesgue integral on Euclidean spaces; the differentiation theorem and functions of bounded variation; Lebesgue spaces; distribution theory; the classical theory of the Fourier transform and Fourier series; and wavelet theory.

Features:

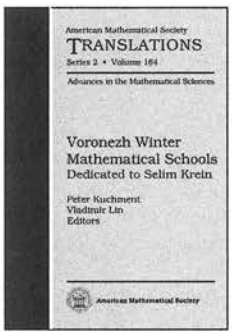
- presents the core subjects of real analysis
- provides the fundamentals for students who are interested in harmonic analysis, probability or partial differential equations
- introduces Fourier analysis
- introduces wavelet theory

This volume would be a suitable textbook for an advanced undergraduate or first year graduate courses in analysis.

Contents: Euclidean spaces and the Riemann integral; Lebesgue measure on Euclidean spaces; The Lebesgue integral on Euclidean spaces; Differentiation; Measures in abstract spaces; Lebesgue spaces and continuous functions; Schwartz space and distributions; Fourier analysis; Wavelet analysis; Appendix A; Appendix B; Solutions to problems; Bibliography; Index.

Translations of Mathematical Monographs

August 1998, approximately 272 pages, Hardcover, ISBN 0-8218-0864-8, LC 98-7552, 1991 *Mathematics Subject Classification*: 26-01, 28Axx; 42-01, 46Fxx, 42C15, **Individual member $53**, List $89, Institutional member $71, Order code MMONO-IGARIN



Voronezh Winter Mathematical Schools

Dedicated to Selim Krein

Peter Kuchment, *Wichita State University, KS*, and **Vladimir Lin**, *Technion—Israel Institute of Technology, Haifa*, Editors

This volume is devoted to the 25 year old Voronezh Winter Mathematical School and to the scientific work of its founder, Selim Krein. The Voronezh Winter Mathematical School was a unique annual event in the scientific life of the former Soviet Union. Over the years it attracted thousands of mathematicians, from undergraduates to world-renowned experts, and played a major role in spreading information about cutting edge results of mathematical research, triggering cooperation and educating new generations of mathematicians. The articles in this book, written by prominent mathematicians and former lecturers and participants of the school, cover a wide range of subjects in analysis and geometry, including global analysis, harmonic analysis, function theory, operator theory, spectral theory, dynamical systems, mathematical physics, homogenization, algebraic geometry, differential geometry, and geometric analysis.

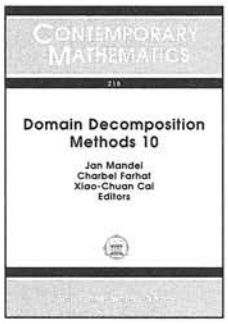
This text will also be of interest to those working in geometry and topology.

Contents: **G. Belitskii** and **V. Tkachenko**, Fredholm property of functional equations with affine transformations of argument; **Y. M. Berezansky**, Construction of generalized translation operators from the system of Appell characters; **D. Burghelea**, **L. Friedlander**, and **T. Kappeler**, Witten deformation of the analytic torsion and the Reidemeister torsion; **Y. L. Daletskii**, Formal operator power series and the noncommutative Taylor formula; **G. Dethloff**, **S. Orevkov**, and **M. Zaidenberg**, Plane curves with a big fundamental group of the complement; **B. Fridman**, **P. Kuchment**, **D. Ma**, and **V. G. Papanicolaou**, Solution of the linearized inverse conductivity problem in a half space via integral geometry; **M. Gelfand** and **I. M. Spitkovsky**, Almost periodic factorization: Applicability of the division algorithm; **V. Y. Lin** and **M. Zaidenberg**, Liouville and Carathéodory coverings in Riemannian and complex geometry; **M. Lyubich**, How big is the set of infinitely renormalizable quadratics?; **Y. Lyubich**, Linear operators in one-dimensional extensions of Banach spaces; **S. Montgomery-Smith** and **E. Semenov**, Random rearrangements and operators; **V. I. Ovchinnikov**, On reiteration theorems; **A. Pankov**, Statistical homogenization theorem for multivalued monotone elliptic operators; **I. Pesenson**, Reconstruction of Paley-Wiener functions on the Heisenberg group; **M. Shubin**, De Rham theorem for extended L^2-cohomology; **M. Solomyak**, On the discrete spectrum of a class of problems involving the Neumann Laplacian in unbounded domains; **N. Zobin**, Szegő-type extremal problems.

American Mathematical Society Translations—Series 2, (*Advances in the Mathematical Sciences*), Volume 184

May 1998, 263 pages, Hardcover, ISBN 0-8218-0976-8, LC 91-640741, 1991 *Mathematics Subject Classification*: 35-06, 47-06, 58-06, **Individual member $59**, List $99, Institutional member $79, Order code TRANS2/184N

Applications



Domain Decomposition Methods 10

Jan Mandel, *University of Colorado, Denver*, **Charbel Farhat** and **Xiao-Chuan Cai**, *University of Colorado, Boulder*, Editors

This volume contains the proceedings of the Tenth International Conference on Domain Decomposition Methods, which focused on the latest developments in realistic applications in structural mechanics, structural dynamics, computational fluid dynamics, and heat transfer. The proceedings of these conferences have become standard references in the field and contain seminal papers as well as the latest theoretical results and reports on practical applications.

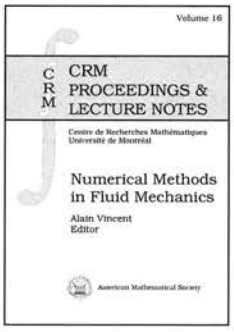
This volume is divided into four parts: the first part contains invited papers (some of which survey developments over the past decade), and the other parts gather material from minisymposia and contributed presentations under three headings: Algorithms, Theory, and Applications.

The electronic version is available at no additional charge to purchasers of the print volume. Access instructions are provided in the book. There is also the option to purchase only the electronic version.

Contents: *Invited presentations:* **Y. Achdou, G. Abdoulaev, J.-C. Hontand, Y. A. Kuznetsov, O. Pironneau,** and **C. Prud'homme**, Nonmatching grids for fluids; **T. J. Barth, T. F. Chan,** and **W.-P. Tang**, A parallel non-overlapping domain-decomposition algorithm for compressible fluid flow problems on triangulated domains; **A. de La Bourdonnaye, C. Farhat, A. Macedo, F. Magoulès,** and **F.-X. Roux**, A non-overlapping domain decomposition method for the exterior Helmholtz problem; **T. F. Chan, J. Xu,** and **L. Zikatanov**, An agglomeration multigrid method for unstructured grids; **Z. Dostál, A. Friedlander,** and **S. A. Santos**, Solution of coercive and semicoercive contact problems by FETI domain decomposition; **M. Dryja**, An iterative substructuring method for elliptic mortar finite element problems with discontinuous coefficients; **M. S. Espedal, K. J. Hersvik,** and **B. G. Ersland**, Domain decomposition methods for flow in heterogeneous porous media; **R. Glowinski, T.-W. Pan, T. I. Hesla, D. D. Joseph,** and **J. Periaux**, A fictitious domain method with distributed Lagrange multipliers for the numerical simulation of particulate flow; **L. F. Pavarino**, Domain decomposition algorithms for saddle point problems; **F.-X. Roux** and **C. Farhat**, Parallel implementation of direct solution strategies for the coarse grid solvers in 2-level FETI method; **Y. Saad, M. Sosonkina,** and **J. Zhang**, Domain decomposition and multi-level type techniques for general sparse linear systems; **S. J. Sherwin, T. C. E. Warburton,** and **G. E. Karniadakis**, Spectral/*hp* methods for elliptic problems on hybrid grids; **M. F. Wheeler** and **I. Yotov**, Physical and computational domain decompositions for modeling subsurface flows; *Algorithms:* 18 papers; *Theory:* 13 papers; *Applications:* 10 papers.

Contemporary Mathematics, Volume 218

August 1998, 554 pages, Softcover, ISBN 0-8218-0988-1, LC 98-15580, 1991 *Mathematics Subject Classification*: 65-06; 65N55, 65M55, 65Y05, 73-06, 76-06, *Print and Electronic:* **Individual member $66**, List $110, Institutional member $88, Order code CONM/218N
July 1998, ISBN 0-8218-1177-0, *Electronic only:* **Individual member $59**, List $99, Institutional member $79, Order code CONM/218.EN



Numerical Methods in Fluid Mechanics

Alain Vincent, *Université de Montreal, PQ, Canada,* Editor

After centuries of research, turbulence in fluids is still an unsolved problem. The graduate-level lectures in this volume cover the state of the art of numerical methods for fluid mechanics.

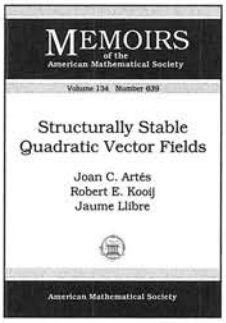
The research in this collection covers wavelet-based methods, the semi-Lagrangian method, the Lagrangian multi-pole method, continuous adaptation of curvilinear grids, finite volume methods, shock-capturing methods, and ENO schemes. The most recent research on large eddy simulations and Reynolds stress modeling is presented in a way that is accessible to engineers, postdoctoral researchers, and graduate students. Applications cover industrial flows, aerodynamics, two-phase flows, astrophysical flows, and meteorology. This volume would be suitable as a textbook for graduate students with a background in fluid mechanics.

Contents: C. Basdevant, Wavelet based methods for PDEs; **J. Côté, S. Gravel, M. Roch, A. Méthot, A. Patoine, J. Caveen, M. Valin, S. Thomas,** and **A. Staniforth**, Forecasting with a variable-resolution global model; **D. G. Dritschel**, The simulation and analysis of vortex dynamics in nearly-inviscid 2D and layerwise-2D flows; **J. H. Ferziger**, Direct and large eddy simulation of turbulence; **B. Fiedler**, Continuous adaptation of a curvilinear grid; **S. Gravel**, The semi-Lagrangian method; **B. E. Launder**, An introduction to single-point closure methodology; **M. Meneguzzi**, Numerical simulation of two-phase flows; **U.-L. Pen**, A high-resolution adaptive moving mesh hydrodynamic algorithm.

CRM Proceedings & Lecture Notes, Volume 16

August 1998, 201 pages, Softcover, ISBN 0-8218-0813-3, LC 98-15581, 1991 *Mathematics Subject Classification*: 76-XX, 76Fxx, 76Mxx, **Individual member $35**, List $59, Institutional member $47, Order code CRMP/16N

Differential Equations



Structurally Stable Quadratic Vector Fields

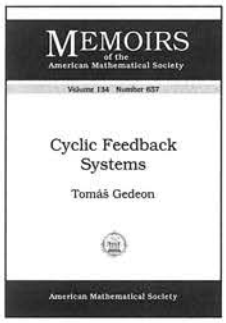
Joan C. Artés, *Universitat Autonoma de Barcelona, Spain,* **Robert E. Kooij,** *Technische Universiteit Delft, Netherlands,* and **Jaume Llibre,** *Universitat Autonoma de Barcelona, Spain*

This book solves a problem that has been open for over 20 years—the complete classification of structurally stable quadratic vector fields modulo limit cycles. The 1950s saw the first real impetus given to the development of the qualitative theory of quadratic vector fields, although prior and ongoing interest in the topic can be shown by the more than 800 papers that have been published on the subject. One of the problems in the qualitative theory of quadratic vector fields is the classification of all structurally stable ones: In this work the authors solve this problem completely modulo limit cycles and give all possible phase portraits for such structurally stable quadratic vector fields.

Contents: Introduction; Preliminary definitions; Structural stability theorems; Some preliminary tools; Proof of Theorem 1.1(a); Proof of Theorem 1.1(b); Proofs of Theorems 1.2, 1.3 and 1.4; Structural stability and the parameter space; Bibliography.

Memoirs of the American Mathematical Society, Volume 134, Number 639

July 1998, 108 pages, Softcover, ISBN 0-8218-0796-X, LC 98-4217, 1991 *Mathematics Subject Classification*: 34D30, 58F10, **Individual member $24**, List $40, Institutional member $32, Order code MEMO/134/639N



Cyclic Feedback Systems

Tomáš Gedeon, *Montana State University, Bozeman*

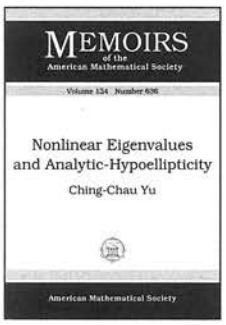
Study of dynamical systems usually concentrates on the properties and the structure of invariant sets, since the understanding of these is the first step in describing the long time behavior of orbits of the entire dynamical system. There are two different sets of problems related to the study of dynamical systems. One, the study of the dynamics in the neighborhood of the critical elements like fixed points or periodic orbits, is relatively well understood. This volume tackles the second set of problems, related to a global dynamics and the global bifurcations.

In this volume the author studies dynamics of cyclic feedback systems. The global dynamics is described by a Morse decomposition of the global attractor, defined with the help of a discrete Lyapunov function. The author shows that the dynamics inside individual Morse sets may be very complicated. A three-dimensional system of ODEs with two linear equations is constructed, such that the invariant set is at least as complicated as a suspension of a full shift on two symbols. The questions posed are perhaps as significant as the reported results.

Contents: Introduction; Linear theory; Main results; Proofs of the Lemmas; Proof of Theorem 1.13.

Memoirs of the American Mathematical Society, Volume 134, Number 637

July 1998, 73 pages, Softcover, ISBN 0-8218-0783-8, LC 98-18263, 1991 *Mathematics Subject Classification*: 34A26, 34C35, 58F12, 58F13, **Individual member $23**, List $38, Institutional member $30, Order code MEMO/134/637N



Nonlinear Eigenvalues and Analytic-Hypoellipticity

Ching-Chau Yu, *Federal Home Loan Bank of San Francisco, CA*

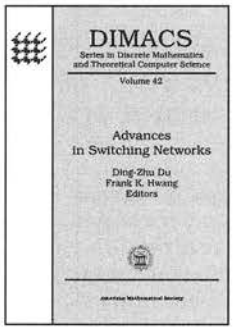
This work studies the failure of analytic-hypoellipticity, abbreviated AH, of two partial differential operators. The operators studied are sums of squares of real analytic vector fields and satisfy Hormander's condition; a condition on the rank of the Lie algebra generated by the brackets of the vector fields. These operators are necessarily C^∞-hypoelliptic. By reducing to an ordinary differential operator, the author shows the existence of nonlinear eigenvalues, which is used to disprove analytic-hypoellipticity of the original operators.

Contents: Statement of the problems and results; Sums of squares of vector fields on $\mathbb{R}^3$; Sums of squares of vector fields on $\mathbb{R}^5$; Bibliography.

Memoirs of the American Mathematical Society, Volume 134, Number 636

July 1998, 92 pages, Softcover, ISBN 0-8218-0784-6, LC 98-18251, 1991 *Mathematics Subject Classification*: 35B65; 35P20, 34E20, **Individual member $23**, List $39, Institutional member $31, Order code MEMO/134/636N

Discrete Mathematics and Combinatorics



Advances in Switching Networks

Ding-Zhu Du, *University of Minnesota, Minneapolis*, and **Frank K. Hwang**, *National Chiao Tung University, Hsinchu, Taiwan*, Editors

The articles collected in this book were presented at the DIMACS Workshop on Network Switching, held in July 1997 at Princeton University. These papers cover a variety of issues related to network switching, including network environment, routing, network topology, switching components, nonblockingness, and optimization.

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

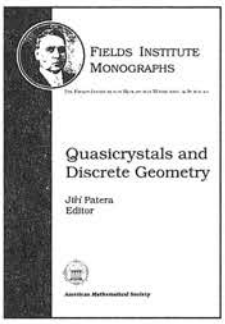
Contents: **N. Pippenger**, Average-case bounds for the complexity of path-search; **G. W. Richards** and **F. K. Hwang**, Extended generalized shuffle networks: Sufficient conditions for strictly nonblocking operation; **C.-F. Chan** and **C.-T. Lea**, Constructing nonblocking multicast switching networks with fanout reduction; **D. S. Kim** and **D.-Z. Du**, Multirate broadcast switching networks nonblocking in a wide sense; **A. Jajszczyk** and **M. Kubale**, Repackable networks–The concept and applications; **Y. Yang** and **N. H. Kessler**, Modeling the blocking behavior of Clos networks; **J. D. Carpinelli** and **C. B. Wang**, Performance of a new decomposition algorithm for rearrangeable fault-tolerant Clos interconnection networks under sub-maximal and no-fault conditions; **I. Busi** and **A. Pattavina**, Non-blocking multistage interconnection networks with limited depth; **M. D. McIlroy** and **J. P. Savicki**, Isomorphism of classical rearrangeable networks; **G. J. Chang**, **F. K. Hwang**, and **L.-D. Tong**, Characterizing bit permutation networks; **E. Gündüzhan** and **A. Y. Oruç**, Structure and density of sparse crossbar concentrators; **T. T. Lee** and **P. P. To**, Non-blocking routing properties of Clos networks; **S.-Y. R. Li**, **G. M. Koo**, and **H. Li**, An algorithm for the construction of concentrators from 2 x 2 sorters; **Y. Du** and **G. M. Masson**, Strictly nonblocking conferencing meshes; **E. S. Elmallah** and **C.-H. Lam**, An $O(N^{1.695})$ permutation routing algorithm on augmented data manipulators; **H. Çam**, Preventing conflicts in input buffering baseline-based ATM switches; **D. Huang** and **K. Kiasaleh**, Routing strategy and performance evaluation of multiple-ring

ShuffleNet topology for high speed wavelength-division multiplexed optical communications; **J. Gu, B. Du, D. H. K. Tsang,** and **W. Wang,** Multispace search for quorumcast routing; **G.-H. Lin, D.-Z. Du, W. Wu,** and **K. Yoo,** On 3-rate rearrangeability of Clos networks.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 42

May 1998, 333 pages, Hardcover, ISBN 0-8218-0831-1, LC 98-6284, 1991 *Mathematics Subject Classification*: 05C40, 05C90, **Individual member $42,** List $70, Institutional member $56, Order code DIMACS/42N

Geometry and Topology



Quasicrystals and Discrete Geometry

Jiří Patera, *Centre de Recherches Mathématiques, Université de Montréal, PQ, Canada,* Editor

The common topic of the eleven articles in this volume is ordered aperiodic systems realized either as point sets with the Delone property or as tilings of a Euclidean space. This emerging field of study is found at the crossroads of algebra, geometry, Fourier analysis, number theory, crystallography, and theoretical physics. The volume brings together contributions by leading specialists. Important advances in understanding the foundations of this new field are presented.

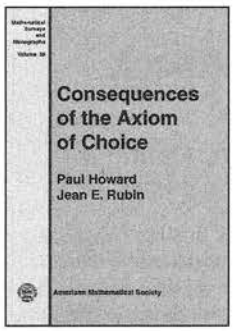
This text will also be of interest to those working in algebra and algebraic geometry.

Contents: M. Baake and **R. V. Moody,** Similarity submodules and semigroups; **D. Barache, B. Champagne,** and **J.-P. Gazeau,** Pisot-cyclotomic quasilattices and their symmetry semigroups; **N. A. Bulienkov,** Three possible branches of determinate modular generalization of crystallography; **L. Chen, R. V. Moody,** and **J. Patera,** Non-crystallographic root systems; **L. Danzer,** Upper bounds for the lengths of bridges based on Delone sets; **N. Dolbilin** and **D. Schattschneider,** The local theorem for tilings; **A. Hof,** Uniform distribution and the projection method; **D. Schattschneider** and **N. Dolbilin,** One corona is enough for the Euclidean plane; **M. Schlottmann,** Cut-and-project sets in locally compact Abelian groups; **B. Solomyak,** Spectrum of dynamical systems arising from Delone sets; **G. van Ophuysen,** Non-locality and aperiodicity of d-dimensional tilings; Index.

Fields Institute Monographs, Volume 10

August 1998, 289 pages, Hardcover, ISBN 0-8218-0682-3, LC 98-4530, 1991 *Mathematics Subject Classification*: 20H15, 52C07, 52C22, 11R06, 20M20, **Individual member $47,** List $79, Institutional member $63, Order code FIM/10N

Logic and Foundations



Consequences of the Axiom of Choice

Paul Howard, *Eastern Michigan University, Ypsilanti,* and **Jean E. Rubin,** *Purdue University, West Lafayette, IN*

This book, *Consequences of the Axiom of Choice,* is a comprehensive listing of statements that have been proved in the last 100 years using the axiom of choice. Each consequence, also referred to as a form of the axiom of choice, is assigned a number.

Part I is a listing of the forms by number. In this part each form is given together with a listing of all statements known to be equivalent to it (equivalent in set theory without the axiom of choice). In Part II the forms are arranged by topic. In Part III we describe the models of set theory which are used to show non-implications between forms. Part IV, the notes section, contains definitions, summaries of important sub-areas and proofs that are not readily available elsewhere. Part V gives references for the relationships between forms and Part VI is the bibliography.

Part VII is contained on the floppy disk which is enclosed in the book. It contains a table with form numbers as row and column headings. The entry in the table in row n, column k gives the status of the implication "form n implies form k". Software for easily extracting information from the table is also provided.

Features:

- complete summary of all the work done in the last 100 years on statements that are weaker than the axiom of choice
- software provided gives complete, convenient access to information about relationships between the various consequences of the axiom of choice and about the models of set theory
- descriptions of more than 100 models used in the study of the axiom of choice
- an extensive bibliography

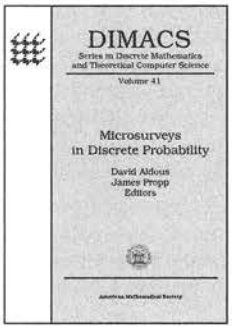
About the software: Tables 1 and 2 are accessible on the PC-compatible software included with the book. In addition, the program maketex.c in the software package will create TEX files containing copies of Table 1 and Table 2 which may then be printed. (Tables 1 and 2 are also available at the authors' Web sites: http://www.math.purdue.edu/~jer/ or http://www.emunix.emich.edu/~phoward/.) Detailed instructions for setting up and using the software are included in the book's Introduction, and technical support is available directly from the authors.

Contents: Numerical list of forms; Topical list of forms; Models; Notes; References for relations between forms; Bibliography; Table 1 and Table 2; Subject index; Author index; Software.

Mathematical Surveys and Monographs, Volume 59

August 1998, 432 pages, Hardcover, ISBN 0-8218-0977-6, LC 98-18622, 1991 *Mathematics Subject Classification*: 03E25, 04A25, **Individual member $53**, List $89, Institutional member $71, Order code SURV/59N

Probability



Microsurveys in Discrete Probability

David Aldous, *University of California, Berkeley*, and **James Propp**, *University of Wisconsin, Madison*, Editors

This book contains eleven articles surveying emerging topics in discrete probability. The papers are based on talks given by experts at the DIMACS "Microsurveys in Discrete Probability" workshop held at the Institute for Advanced Study, Princeton, NJ, in 1997. This compilation of current research in discrete probability provides a unique overview that is not available elsewhere in book or survey form.

Topics covered in the volume include: Markov chains (perfect sampling, coupling from the past, mixing times), random trees (spanning trees on infinite graphs, enumeration of trees and forests, tree-valued Markov chains), distributional estimates (method of bounded differences, Stein-Chen method for normal approximation), dynamical percolation, Poisson processes, and reconstructing random walk from scenery.

Features:

- surveys written and refereed by experts
- emerging areas of research in discrete probability theory not previously surveyed
- articles accessible to a broad readership

Contents: D. Aldous, Tree-valued Markov chains and Poisson-Galton-Watson distributions; **R. Arratia**, On the central role of scale invariant Poisson processes on $(0, \infty)$; **A. P. Godbole** and **P. Hitczenko**, Beyond the method of bounded differences; **O. Häggström**, Dynamical percolation: Early results and open problems; **H. Kesten**, Distinguishing and reconstructing sceneries from observations along random walk paths; **L. Lovász** and **P. Winkler**, Mixing times; **R. Lyons**, A bird's-eye view of uniform spanning trees and forests; **J. Pitman**, Enumerations of trees and forests related to branching processes and random walks; **J. Propp** and **D. Wilson**, Coupling from the past: A user's guide; **G. Reinert**, Couplings for normal approximations with Stein's method; **D. B. Wilson**, Annotated bibliography of perfectly random sampling with Markov chains.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 41

May 1998, 220 pages, Hardcover, ISBN 0-8218-0827-3, LC 98-4520, 1991 *Mathematics Subject Classification*: 60C05; 60J10, 05C05, **Individual member $23**, List $39, Institutional member $31, Order code DIMACS/41N

Vieweg Verlag Publications now distributed by the AMS

The American Mathematical Society is pleased to offer the following selection of English-language works in mathematics published by Vieweg Verlag. Friedrich Vieweg founded the publishing house in 1786 in Berlin, and since that time Vieweg has published first editions of some of the revolutionary scientific discoveries of Marie Curie, Ernest Rutherford and Albert Einstein and others. Among the works now distributed by the AMS are those from the *Aspects of Mathematics* and *Advanced Lectures in Mathematics* series.

The AMS is exclusive distributor in North America, and non-exclusive distributor worldwide except in Germany, Switzerland, Austria, and Japan.

Lie Group Actions in Complex Analysis

Dmitri N. Akhiezer, *University of Moscow, Russia*

The main topic of this book is the study of the interaction between two major subjects of modern mathematics, namely, the theory of Lie groups with its specific methods and ways of thinking as well as complex analysis with its analytic, algebraic and geometric aspects. More specifically, the author concentrates on the double role of Lie groups in complex analysis, namely, as groups of biholomorphic selfmaps of certain complex analytic objects on the one hand, and a special class of complex manifolds with an additional strong structure on the other. The book starts from the basics of this subject and introduces the reader into many fields of recent research.

Contents: Introduction; Lie theory; Automorphism groups; Compact homogeneous manifolds; Homogeneous vector bundles; Function theory on homogeneous manifolds; Concluding remarks; Bibliography; Index of notations; Index of terminology.

Vieweg Aspects of Mathematics, Volume 27

March 1998, 201 pages, Hardcover, ISBN 3-528-06420-X, 1991 *Mathematics Subject Classification*: 32M05; 22-02, 22E10, 32M10, **All AMS members $43**, List $48, Order code VWAM/27N

A History of Complex Dynamics

From Schröder to Fatou and Julia

Daniel S. Alexander, *Drake University, Des Moines, IA*

The contemporary study of complex dynamics, which has flourished so much in recent years, is based largely upon work by G. Julia (1918) and P. Fatou (1919–20). The goal of this book is to analyze this work from an historical perspective and show in detail how it grew out of a corpus regarding the iteration of complex analytic functions. This began with investigations by E. Schröder (1870–71), which he made when he studied Newton's method. In the 1880s, Gabriel Koenigs fashioned this study into a rigorous body of work and thereby strongly influenced the subsequent development. But only when Fatou and Julia applied set theory and Paul Montel's theory of normal families was it possible to develop a global approach to the iteration of rational maps. This book shows how this intriguing piece of modern mathematics became a reality.

Contents: Preface; Schröder, Cayley and Newton's Method; The next wave: Korkine and Farkas; Gabriel Koenigs; Iteration in

the 1890s: Grévy; Iteration in the 1890s: Leau; The Flower Theorem of Fatou and Julia; Fatou's 1906 note; Montel's theory of normal families; The contest; Lattès and Ritt; Fatou and Julia; Bibliography; Index.

Vieweg Aspects of Mathematics, Volume 24

March 1998, 165 pages, Hardcover, ISBN 3-528-06520-6, 1991 *Mathematics Subject Classification*: 01-02, 01A60, 01A55, 30D05, 30CXX, **All AMS members $38**, List $42, Order code VWAM/24N

The Riemann-Hilbert Problem

D. V. Anosov and **A. A. Bolibruch,** *Steklov Institute of Mathematics, Moscow, Russia*

The Riemann-Hilbert problem (Hilbert's 21st problem) belongs to the theory of linear systems of ordinary differential equations in the complex domain. The problem concerns the existence of a Fuchsian system with prescribed singularities and monodromy. Hilbert was convinced that such a system always exists. However, this turned out to be a rare case of a wrong forecast made by him. In 1989 the second author (A. B.) discovered a counterexample, thus obtaining a negative solution to Hilbert's 21st problem in its original form. A publication from the Steklov Institute of Mathematics. Adviser: Sergeev, Armen.

Contents: Introduction; Counterexample to Hilbert's 21st problem; The Plemelj theorem; Irreducible representations; Miscellaneous topics; The case $p = 3$; Fuchsian equations; Bibliography; Index.

Vieweg Aspects of Mathematics, Volume 22

March 1998, 190 pages, Hardcover, ISBN 3-528-06496-X, 1991 *Mathematics Subject Classification*: 34A20, **All AMS members $41**, List $46, Order code VWAM/22N

Models of the Real Projective Plane

Computer Graphics of Steiner and Boy Surfaces

François Apéry

In the present time, objects generated by computers are replacing models made from wood, wire and plaster. This book shows how computer graphics can help us to understand the geometry of surfaces and illustrates some recent results on representations of the real projective plane.

Contents: Preface; Introduction; Some representations of the real projective place before 1900; The boy surface; More about immersions in the 3-dimensional sphere; Appendix; Bibliography; Subject index; Plate index; Plates.

Vieweg Monographs

March 1998, 156 pages, Hardcover, ISBN 3-528-08955-5, **All AMS members $50**, List $56, Order code VW/7N

Das Fotoalbum für Weierstraß/A Photo Album for Weierstrass

Reinhard Bölling, *University of Potsdam, Germany*

... Faces from bygone days ... Some well-known faces are there, others are unknown ... many of these people had either studied in Berlin or had come to the city after finishing their education, in order to attend lectures at the Friedrich Wilhelm University given by Weierstrass and his two important colleagues Kummer (1810-1893) and Kronecker (1823-1891). In order to give some of the atmosphere of those days and to achieve more authenticity, several letters ... have been added to the information given about the background of the album and the birthday celebration (to let some of the performers from 1885 speak for themselves).

—***from the* Preface**

The photograph album that was given to Karl Weierstrass on the occasion of his 70th birthday in Berlin, 31 October 1885, was discovered by the author in 1986 while researching the correspondence of this prominent mathematician. This volume includes the album's 340 photos of students, colleagues and friends of Weierstrass, supplemented with introductory biographical information about Weierstrass and with selected letters. 'A Photo Album for Weierstrass' is an extraordinary document of the life and times of Karl Weierstrass and the mathematical community in Berlin in the second half of the 19th century.

Contents: Karl Weierstrass; The album; Letters; Sources and bibliography; List of people featured in the album; Sources for the list of people; References for the list of people; List of people in alphabetical order; The portraits.

Vieweg Monographs

March 1998, 116 pages, Hardcover, ISBN 3-528-06602-4, 1991 *Mathematics Subject Classification*: 01A05, 01A55, 01A70, 01A72, **All AMS members $63**, List $70, Order code VW/8N

Supplementary Reading

Exploring Curvature

James Casey, *University of California, Berkeley*

This introductory book, which is intuitive and exploratory in nature, is intended as a bridge between Euclid's geometry and the modern geometry of curved spaces. It is organized around a collection of simple experiments which the reader can perform at home or in a classroom setting. Methods for physically exploring the intrinsic geometry of commonplace curved objects (such as bowls, balls and watermelons) are described. The concepts of Gaussian curvature, parallel transport, and geodesics are treated. The book also contains biographical chapters on Gauss, Riemann, and Levi-Civita.

Contents: To the reader: How to use this book; List of experiments; The evolution of geometry; Basic operations; Intersecting with a closed ball; Mappings; Preserving closeness: Continuous mappings; Keeping track of magnitude, direction and sense: Vectors; Curves; Arc length; Tangent; Curvature of curves; Surfaces; Surface measurements; Intrinsic geometry of a surface; Gauss (1777–1855); Normal sections; Gaussian curvature; Riemann (1826–1866); Levi-Civita (1873–1941); Parallel transport of a vector on a surface; Geodesics; Geometry and reality; Bibliography.

Vieweg Monographs

March 1998, 291 pages, Hardcover, ISBN 3-528-06475-7, *Mathematics Subject Classification*: 53-01, 51-01, **All AMS members $43**, List $48, Order code VW/1N

Complex Analysis

Klas Diederich, *University of Wuppertal, Germany,* Editor

This volume contains the Proceedings of the International Workshop "Complex Analysis", which was held February 12–16, 1990, in Wuppertal (Germany) in honour of H. Grauert, one of the most creative mathematicians in Complex Analysis

of this century. In accordance with the scope of the work of Grauert, the book contains research notes and longer articles of many important mathematicians from all areas of Complex Analysis (Altogether there are 49 articles in the volume). Some of the main subjects are: Cauchy-Riemann Equations with estimates, q-convexity, CR structures, deformation theory, envelopes of holomorphy, function algebras, complex group actions, Hodge theory, instantons, Kähler geometry, Lefschetz theorems, holomorphic mappings, Nevanlinna theory, complex singularities, twistor theory, and uniformization.

Contents: **L. Alessandrini** and **G. Bassanelli**, Smooth proper modifications of compact Kähler manifolds; **E. Amar**, L^p-estimates for $\bar{\partial}$ in C; **V. Ancona** and **G. Ottaviani**, Canonical resolutions in sheaves on Schubert and Brieskorn varieties; **D. Bartlet**, La forme hermitienne canonique pour une singularité presque isolée; **D. E. Barrett** and **B. A. Taylor**, A generalized cousin problem for subvarieties of the bidisk; **P. de Bartolomeis** and **L. Migliorini**, Scalar curvature and twistor geometry; **B. Berndtsson**, Some remarks on weighted estimates for $\bar{\partial}$; **J. Bland** and **T. Duchamp**, Circular models and normal forms for convex domains; **A. Bonami**, L^p-estimates with loss for the Bergman-projection and the canonical solution to $\bar{\partial}$; **T. Bouché**, Distortion function and the heat kernel of a positive line bundle; **F. Campana**, Twistor spaces and non-hyperbolicity of certain symplectic Kähler manifolds; **E. C. Tarabusi** and **S. Trapani**, Envelopes of holomorphy of domains in C^n; **U. Cegrell**, Representing measures in the spectrum of $H^\infty(\Omega)$; **J. Chaumat** and **A.-M. Chollet**, Estimées $C^{k,\alpha}$ pour l'equation $\bar{\partial} = f$ dans les convexes; **M. Colţoiu**, Local hyperconvexity and local hyperconcavity; **M. Derridj**, Domaines à estimation maximale; **G. Dethloff**, Deformation of compact Rieman surfaces with distinguished points; **K. Diederich** and **G. Herbort**, Local extension of holomorphic L^2-functions with weights; **A. A. Fadlalla**, On the boundary behavior of the Caratheodory and Kobayashi distances in strongly pseudocnvex domains in C^n; **K. Fritzsche**, Zur klassifikation der 1-konvexen komplexen Räume; **I. Graham**, Holomorphic mappings into convex domains; **P. Greiner**, On second order hypoelliptic differential operators and the $\bar{\partial}$-Neumann problem; **Z. Hajto**, Equisingularity of analytically constructible sets; **M. Hickel**, Fonction de Artin d'un germe d'espace analytique; **A. Iordan**, Local peaks sets and maximum modulus sets in products of strictly pseudoconvex domains; **L. Kaup** and **K.-H. Fieseler**, Hyperbolic C^*-actions on affine surfaces; **A. Kodama**, On complex manifolds exhausted by biholomorphic images of generalized complex ellipsoids $E(n; n_1, \ldots, n_s; p_1, \ldots, p_s)$; **S. Kosarew**, The hard Lefschetz theorem for concave and convex algebraic manifolds; **Ch. Laurent-Thiebaut**, Sur la résolution des équations de Cauchy-Riemann tangentielles pour les formes à support compact dans les variétes; **L. Lempert**, Imbedding pseudohermitian manifolds into a sphere; **K. Miyajima**, Deformations of strongly pseudo-convex CR structures and deformations of normal isolated singularities; **A. M. Nadel**, The behavior of multiplier ideal sheaves under morphisms; **J. D. McNeal**, Local geometry of decoupled pseudoconvex domains; **T. Ohsawa**, A vanishing theorem on Kähler manifolds with certain stratified structures; **Th. Peternell**, Hodge-Kohomologie und steinsche mannigfaltigkeiten; **J. C. Polking**, The Cauchy-Riemann equations in convex domains; **R. M. Range**, Integral kernels and Hölder estimates for $\bar{\partial}$ on pseudoconvex domains of finite type on C^2; **R. Remmert**, Complex analysis in the golden fifties; **W. Schwarz**, On q-convex exhaustion functions of complements of CR-submanifolds; **S. Shimizu**, A characterization of homogeneous bounded domains; **J. Siciak**, Singular sets of separately analytic functions; **Y.-T. Siu**, Some recent results related to the uniformization problem in several complex variables; **K. Spallek**, Product decomposition of non-reduced space germs; **H. Stieber**, Modular subgerms and the isomorphism problem in deformation theory; **K. Takegoshi**, A new method to introduce a-priori estimates for the $\bar{\partial}$-Neumann problem; **M. Derridj** and **D. S. Tartakoff**, Maximal and semi-maximal estimates for $\bar{\partial}_b$ on pseudoconvex manifolds; **M. Manuyama** and **G. Trautmann**, Degenerations of instantons; **P. M. Wong**, Second main theorems in number theory and Nevanlinna theory; **T. Wurzbacher**, Symplectic techniques in holomorphic group actions.

Vieweg Aspects of Mathematics, Volume 17

March 1998, 341 pages, Hardcover, ISBN 3-528-06413-7, 1991 *Mathematics Subject Classification*: 32–06, **All AMS members $58**, List $64, Order code VWAM/17N

Independent Study

Lattices and Codes

A Course Partially Based on Lectures by F. Hirzebruch

Wolfgang Ebeling, *University of Hannover, Germany*

The purpose of coding theory is the design of efficient systems for the transmission of information. The mathematical treatment leads to certain finite structures: the error-correcting codes. Surprisingly, problems which are interesting for the design of codes turn out to be closely related to problems studied (partly) earlier and independently in pure mathematics. In this book, *A Course Partially Based on Lectures by F. Hirzebruch*, examples of such connections are presented. The relation between lattices studied in number theory and geometry and error-correcting codes is discussed. The book provides at the same time an introduction to the theory of integral lattices and modular forms and to coding theory.

Contents: Lattices and codes; Theta functions and weight enumerators; Even unimodular lattices; The Leech lattice; Lattices over integers of number fields and self-dual codes; Bibliography; Index.

Vieweg Advanced Lectures in Mathematics

March 1998, 178 pages, Hardcover, ISBN 3-528-06497-8, 1991 *Mathematics Subject Classification*: 11H06, 11H31, 11H55, 11F11, 11F41, 11R04, 11R18, 94B05, 94B15, 94B75, 51F15, 51E10, **All AMS members $31**, List $34, Order code VWALM/1N

Rational Points

Gerd Faltings, *Max-Planck-Institute for Mathematics, Bonn, Germany,* and **Gisbert Wüstholz,** *ETH Zentrum, Zürich, Switzerland*

This book originates from the notes of a seminar on Arithmetic Algebraic Geometry. It contains a proof for the Mordell conjecture and may be useful as an introduction to Arakelov's point of view in iophantine geometry. The third edition includes an appendix in which a detailed survey on the spectacular recent developments in arithmetic algebraic geometry is given. These beautiful new results have their roots in the material covered by this book. A publication of the Max-Planck-Institut für Mathematik, Bonn.

Contents: Moduli Spaces (Gerd Faltings); Heights (Gerd Faltings); Some facts from the theory of group schemes (Fritz Grunewald); Tate's conjecture on the endomorphisms of abelian varieties (Norbert Schappacher); The finiteness theorems of Faltings (Gisbert Wüstholz); Complements to Mordell

(Gerd Faltings); Intersection theory on arithmetic surfaces (Ulrich Stuhler); Appendix: New developments in Diophantine and arithmetic algebraic geometry (Gisbert Wüstholz).

Vieweg Aspects of Mathematics, Volume 6

March 1998, 311 pages, Hardcover, ISBN 3-528-28593-1, 1991 *Mathematics Subject Classification*: 10BXX, 14G13, 14K10, 14K15, **All AMS members $50**, List $56, Order code VWAM/6N

Topics in the Calculus of Variations

Martin Fuchs, *Universität des Saarlandes, Saarbrüchen, Germany*

This book illustrates two basic principles in the calculus of variations which are the question of existence of solutions and the closely related problem of regularity of minimizers. Chapter One studies variational problems for nonquadratic energy functionals defined on suitable classes of vector-valued functions where nonlinear constraints are incorporated. Problems of this type arise for mappings between Riemannian manifolds or in nonlinear elasticity. Using direct methods, the existence of generalized minimizers is rather easy to establish and it is then shown that regularity holds up to a set of small measure. Chapter two contains a short introduction into Geometric Measure Theory which serves as a basis for developing an existence theory for (generalized) manifolds with prescribed mean curvature and boundary in arbitrary dimensions and codimensions. One major aspect of the book is to concentrate on techniques and to present methods which turn out to be useful for applications in regularity theorems as well as for existence problems.

Contents: Degenerate variational integrals with nonlinear side conditions, p-harmonic maps and related topics; Manifolds of prescribed mean curvature in the setting of geometric measure theory; Bibliography; Index.

Vieweg Advanced Lectures in Mathematics

March 1998, 145 pages, Hardcover, ISBN 3-528-06623-7, 1991 *Mathematics Subject Classification*: 49N60, 49Q15, 49Q20, 58E20, 58E30, 58E35, 73C50, **All AMS members $25**, List $28, Order code VWALM/2N

Value Distribution Theory of the Gauss Map of Minimal Surfaces in $\mathbf{R}^m$

Hirotaka Fujimoto, *Kanazawa University, Japan*

This book presents in a systematic and almost self-contained way the striking analogy between classical function theory, in particular the value distribution theory of holomorphic curves in projective space, on the one hand, and important and beautiful properties of the Gauss map of minimal surfaces on the other. Both theories are developed in the text, including many results of recent research. The relations and analogies between them become completely clear. The book is written for interested graduate students and mathematicians, who want to become more familiar with this modern development in the two classical areas of mathematics, as well as those who intend to do further research on minimal surfaces.

Contents: The Gauss map of minimal surfaces in $\mathbf{R}^3$; The derived curves of a holomorphic curve; The classical defect relations for holomorphic curves; Modified defect relation for holomorphic curves; The Gauss map of complete minimal surfaces in $\mathbf{R}^m$; Bibliography; Index.

Vieweg Aspects of Mathematics, Volume 21

March 1998, 207 pages, Hardcover, ISBN 3-528-06467-6, 1991 *Mathematics Subject Classification*: 53-02, 53A10, 30-02, 30D35, **All AMS members $41**, List $46, Order code VWAM/21N

Singular Nonlinear Partial Differential Equations

Raymond Gérard, *Université Louis Pasteur, Strasbourg, France,* and **Hidetoshi Tahara,** *Sophia University, Tokyo, Japan*

The main purpose of this book is to present all known results on the existence of formal, holomorphic and singular solutions of singular nonlinear ordinary and partial differential equations in the complex domain. It contains a new approach to regular singularities for nonlinear PDE, Maillet type theorems for nonlinear PDE, Briot-Bouquet type PDE, higher order nonlinear Fuchsian PDE, Poincaré's and Siegel's results for vector fields, and also a general form of the Cauchy-Kowalewski theorem. Readers of the book are assumed to be familiar with only the basics on differential equations and function theory of complex variables.

Contents: Preface; Operators with regular singularities: One variable case; Operators with regular singularities: Several variables case; Formal and convergent solutions of singular partial differential equations; Local study of differential equations of the form $xy' = f(x, y)$ near $x = 0$; Holomorphic and singular solutions of non linear singular first order partial differential equations; Maillet's type theorems for non linear singular partial differential equations; Maillet's type theorems for non linear singular partial differential equations without linear part; Holomorphic and singular solutions of non linear singular partial differential equations; On the existence of holomorphic solutions of the Cauchy problem for non linear partial differential equations; Maillet's type theorems for non linear singular integro-differential equations; Bibliography; Index.

Vieweg Aspects of Mathematics, Volume 28

March 1998, 269 pages, Hardcover, ISBN 3-528-06659-8, 1991 *Mathematics Subject Classification*: 47E05, 47F05, 34A20, 34G20, 35A10, 35F20, **All AMS members $63**, List $70, Order code VWAM/28N

Inverse Problems in the Mathematical Sciences

Charles W. Groetsch, *University of Cincinnati, OH*

Inverse problems are immensely important in modern science and technology. However, the broad mathematical issues raised by inverse problems receive scant attention in the university curriculum. This book aims to remedy this state of affairs by supplying an accessible introduction, at a modest mathematical level, to the alluring field of inverse problems. Many models of inverse problems from science and engineering are dealt with and nearly a hundred exercises, of varying difficulty, involving mathematical analysis, numerical treatment, or modelling of inverse problems are provided. The main themes of the book are: causation problems modeled as integral equations; model identification problems, posed as coefficient determination problems in differential equations; the functional analytic framework for inverse problems; and a survey of the principal numerical methods for inverse problems. An extensive annotated bibliography furnishes leads on

the history of inverse problems and a guide to the frontiers of current research.

Contents: Introduction; Inverse problems modeled by integral equations of the first kind: Causation; Parameter estimation in differential equations: Model indentification; Mathematical background for inverse problems; Some methodology for inverse problems; An annotated bibliography on inverse problems; Index.

Vieweg Monographs

March 1998, 152 pages, Hardcover, ISBN 3-528-06545-1, 1991 *Mathematics Subject Classification*: 00A09, 45B05, 65R30, **All AMS members $27**, List $30, Order code VW/2N

Manifolds and Modular Forms

Friedrich Hirzebruch, *Max-Planck-Institute for Mathematics, Bonn, Germany,* **Thomas Berger,** and **Rainer Jung**

This book provides a comprehensive introduction to the theory of elliptic genera due to Ochanine, Landweber, Stong, and others. The theory describes a new cobordism invariant for manifolds in terms of modular forms. The book evolved from notes of a course given at the University of Bonn. After providing some background material, elliptic genera are constructed, including the classical genera signature and the index of the Dirac operator as special cases. Various properties of elliptic genera are discussed, especially their behavior in fiber bundles and rigidity for group actions. The text is in most parts self-contained. The results are illustrated by explicit examples and by comparison with well-known theorems. The relevant aspects of the theory of modular forms are derived in a separate appendix, providing also a useful reference for mathematicians working in this field. A publication of the Max-Planck-Institut für Mathematik, Bonn.

Contents: Background; Elliptic genera; A universal addition theorem for genera; Multiplicativity in fibre bundles; The Atiyah-Singer index theorem; Twisted operators and genera; Riemann-Roch and elliptic genera in the complex case; A divisibility theorem for elliptic genera; Appendix I: Modular forms; Appendix II: The Dirac operator; Appendix III: Elliptic genera of level N for complex manifolds; Appendix IV: Zolotarev polynomials and the modular curve $X_1(N)$; Bibliography; Index; Symbols.

Vieweg Aspects of Mathematics, Volume 20

March 1998, 211 pages, Hardcover, ISBN 3-528-16414-X, 1991 *Mathematics Subject Classification*: 57-02, 11F11, 33C45, 33E05, 55N22, 55R10, 57R20, 58G10, **All AMS members $43**, List $48, Order code VWAM/20N

Ball and Surface Arithmetics

Rolf-Peter Holzapfel, *Humboldt-Universität Berlin, Germany*

This monograph presents an arithmetic theory of orbital surfaces with cusp singularities. As main invariants, orbital heights are introduced, not only for the surfaces but also for the components of orbital cycles. These invariants are rational numbers with nice functorial properties allowing precise formulas of Hurwitz type and a fine intersection theory for orbital cycles. For ball quotient surfaces, they appear as volumes of fundamental domains. In the special case of Picard modular surfaces they are discovered by special values of Dirichlet L-series or higher Bernoulli numbers. As a central point of the monograph, a general Proportionality Theorem in terms of orbital heights is proved. It yields a strong criterion to decide effectively whether a surface with given cycle supports a ball quotient structure being Kaehler-Einstein with negative constant holomorphic sectional curvature outside of this cycle. The theory is applied to the classification of Picard modular surfaces and to surfaces geography.

Contents: Abelian points; Orbital curves; Orbital surfaces; Ball quotient surfaces; Picard modular surfaces; Volumes of fundamental domains of Picard modular groups; $\mathbb{Q}$-orbital surfaces; Index; Bibliography.

Vieweg Aspects of Mathematics, Volume 29

March 1998, 414 pages, Hardcover, ISBN 3-528-06511-7, 1991 *Mathematics Subject Classification*: 14-02, 14JXX, 11GXX, 11FXX, **All AMS members $76**, List $84, Order code VWAM/29N

Étale Cohomology of Rigid Analytic Varieties and Adic Spaces

Roland Huber, *Bergische Universität, Wuppertal, Germany*

Rigid analytic spaces were invented by Tate about thirty years ago as a p-adic analog of complex analytic spaces. Later Raynaud introduced relative rigid spaces via formal geometry. Adic spaces used in this book generalize Tate's analytic spaces but they also cover the relative rigid spaces. The étale cohomology of rigid spaces, modelled on Grothendieck's étale cohomology theory for schemes, has applications in geometry and arithmetic. The book aims to give an introduction to adic spaces and to develop systematically their étale cohomology. First, general properties of the étale topos of an adic space are studied, in particular the points and the constructible sheaves of this topos. After this the basic results on the étale cohomology of adic spaces are proved: base change theorems, finiteness, Poincaré duality, comparison theorems with the algebraic case.

Contents: Introduction; Étale cohomology of rigid analytic varieties (summary); Adic spaces; The étale site of a rigid analytic variety and an adic space; Comparison theorems; Base change theorems; Cohomology with compact support; Finiteness; Poincaré Duality; Partially proper sites of rigid analytic varieties and adic spaces; Appendix; Bibliography; Index of notations; Index of terminology.

Vieweg Aspects of Mathematics, Volume 30

March 1998, 450 pages, Hardcover, ISBN 3-528-06794-2, 1991 *Mathematics Subject Classification*: 14F20; 32P05, **All AMS members $82**, List $91, Order code VWAM/30N

The Geometry of Moduli Spaces of Sheaves

Daniel Huybrechts, *University of Essen, Germany,* and **Manfred Lehn,** *University of Göttingen, Germany*

This book is intended to serve as an introduction to the theory of semistable sheaves and at the same time to provide a survey of recent research results on the geometry of moduli spaces. The first part introduces the basic concepts in the theory: Hilbert polynomials, slope, stability, Harder-Narasimhan filtration, Grothendieck's Quot-scheme. It presents detailed proofs of the Grauert-Mülich Theorem, the Bogomolov Inequality, the semistability of tensor products, and the boundedness of the

family of semistable sheaves. It also gives a self-contained account of the construction of moduli spaces of semistable sheaves on a projective variety à la Gieseker, Maruyama, and Simpson. The second part presents some of the recent results of the geometry of moduli spaces of sheaves on an algebraic surface, following work of Mukai, O'Grady, Gieseker, Li and many others. In particular, moduli spaces of sheaves on K3 surfaces and determinant line bundles on the moduli spaces are treated in some detail. Other topics include the Serre correspondence, restriction of stable bundles to curves, symplectic structures, irreducibility and Kodaira-dimension of moduli spaces. A publication of the Max-Planck-Institut für Mathematik, Bonn.

Contents: *General Theory:* Preliminaries; Families of sheaves; The Grauert-Mülich Theorem; Moduli spaces; *Sheaves on surfaces:* Construction methods; Moduli spaces on K3 surfaces; Restriction of sheaves to curves; Line bundles on the moduli space; Irreducibility and smoothness; Symplectic structures; Birational properties; Bibliography; Index; Glossary of Notations.

Vieweg Aspects of Mathematics, Volume 31

March 1998, 269 pages, Hardcover, ISBN 3-528-06907-4, 1991 *Mathematics Subject Classification*: 14D20, 14D22, 14J60, **All AMS members $63**, List $70, Order code VWAM/31N

Supplementary Reading

Algebraic Structures

George R. Kempf, *Johns Hopkins University, Baltimore, MD*

In algebra there are four basic structures: groups, rings, fields and modules. In this book the theory of these basic structures is presented and the laws of composition—the basic operations of algebra—are studied. Essentially no previous knowledge is required, it is only assumed as background that the reader has learned some linear algebra over the real numbers.

Contents: Introduction; Fundamentals of groups; Fundamentals of rings and fields; Modules; A little more group theory; Fields; More field theory; Modern linear algebra; Quadratic and alternating forms; Ring and field extensions; Noetherian rings and localization; Dedekind domains; Representations of groups; More modules; Categories; Completion; Lie algebra; The Clifford algebra; Commutative rings; Logic; Tor's; Glossary; Index.

Vieweg Monographs

March 1998, 165 pages, Hardcover, ISBN 3-528-06583-4, 1991 *Mathematics Subject Classification*: 15A27, 15A69, 15A75, 16-01, **All AMS members $26**, List $29, Order code VW/3N

Martingale Spaces and Inequalities

Ruilin Long, *Academy Sinica, Beijing, People's Republic of China*

This book gives a systematic introduction to the theory of martingale spaces and inequalities. Except those mainly concerned with the martingale $Hp, p > 1$, most parts of the book reflect the developments in the field in the past twenty years. The material is self-contained, only a familiarity with basic analysis is required. Both graduate students and mathematicians who want to know about the interaction between analysis and probability will find this book to be a valuable reference and text.

Co-published in cooperation with Peking University Press.

Contents: Probabilistic preliminaries; $H_p(p \geq 1)$ martingales; Φ-inequalities on martingales; *BMO* martingales; Martingale transforms; Weight theory and weighted Φ-inequalities; Regular martingales; Some applications of martingale techniques in harmonic analysis; References; Symbols; Index.

Vieweg Monographs

March 1998, 344 pages, Hardcover, ISBN 3-528-08397-2, 1991 *Mathematics Subject Classification*: 60GXX, 60HXX, **All AMS members $58**, List $64, Order code VW/4N

The Steiner Tree Problem

A Tour through Graphs, Algorithms, and Complexity

Hans-Jürgen Prömel, *Humboldt-Universität Berlin, Germany* and **Angelika Steger,** *Institute for Informatics, Munich, Germany*

In recent years, algorithmic graph theory has become increasingly important since it serves as a link between discrete mathematics and theoretical computer science. This textbook introduces interested students of mathematics and computer science to the interrelated fields of graph theory, algorithms and complexity. No specific previous knowledge is assumed. The central theme of the book is a geometrical problem dating back to Jakob Steiner. This problem, now called the Steiner tree problem, was initially of importance only within the context of land surveying. Recent applications as diverse as VLSI-layout and the study of phylogenetic trees have, however, lead to significant interest in the problem. The resulting progress has uncovered fascinating connections to and among graph theory, the study of algorithms, and complexity. The single problem thus serves to bind and motivate these areas. The book's topics include: Exact Algorithms, Computational Complexity, Approximation Algorithms, Limits of Approximability, Randomness Helps, The Manhattan Steiner Problem, Heuristics, Packing of Steiner Trees, Applications. A fundamental feature of this book is that each chapter ends with an "excursion" into some related area. These excursions reinforce the concepts and methods introduced for the Steiner tree problem by putting them in a broader context.

Vieweg Advanced Lectures in Mathematics

September 1998, approximately 230 pages, Hardcover, ISBN 3-528-06762-4, 1991 *Mathematics Subject Classification*: 05CXX, 05C05, 05C90, **All AMS members $32**, List $35, Order code VWALM/3N

Lectures on Nonlinear Evolution Equations

Initial Value Problems

Reinhard Racke, *University of Konstanz, Germany*

This book serves as an elementary, self-contained introduction to some important aspects of the theory of global solutions to initial-value problems for nonlinear evolution equations. The presentation is made using the classical method of continuation of local solutions with the help of a priori estimates obtained for small data.

Contents: Introduction; Global solutions to wave equations — existence theorems; L^p–L^q-decay estimates for the linear wave equation; Linear symmetric hyperbolic systems; Some inequalities; Local existence for quasilinear symmetric hyperbolic systems; High energy estimates; Weighted a priori estimates

for small data; Global solutions to wave equations — proofs; Other methods; Development of singularities; More evolution equations; Further aspects and questions; Appendix; References; Notation; Index.

Vieweg Aspects of Mathematics, Volume 19

March 1998, 259 pages, Hardcover, ISBN 3-528-06421-8, 1991 *Mathematics Subject Classification*: 35B40, 35K05, 35K55, 35L05, 35L45, 35L70, 35Q55, 35Q60, 35Q72, 73B30, 73C50, **All AMS members $47**, List $52, Order code VWAM/19N

The Basic Theory of Power Series

Jesús M. Ruiz, *Universidad Complutense de Madrid, Spain*

Power series techniques are indispensable in many branches of mathematics, in particular in complex and in real analytic geometry, in commutative algebra, in algebraic geometry, and in real algebraic geometry. The book covers in a comprehensive way and at an elementary level essentially all the theorems and techniques which are commonly used and needed in any of these branches. In particular, it presents Rückert's complex Nullstellensätz, Risler's real Nullstellensätz, Tougerons's implicit function theorem, and Artin's approximation theorem, to name a few. Up to now, a student of any of these subjects usually had to learn about power series within the framework of the vast theory of the subject. The present book opens another path: one gets acquainted with power series in a direct and elementary way, and then develops a good set of tools and examples to penetrate any of the subjects mentioned above, plus some others.

Contents: Power series; Analytic rings and formal rings; Normalization; Nullstellensätze; Approximation theory; Local algebraic rings; Bibliographical note; Index.

Vieweg Advanced Lectures in Mathematics

March 1998, 134 pages, Hardcover, ISBN 3-528-06525-7, 1991 *Mathematics Subject Classification*: 13-01, 13F20, 13F25, 13J05, **All AMS members $23**, List $26, Order code VWALM/4N

Supplementary Reading

Lectures on the Mordell-Weil Theorem

Jean-Pierre Serre, *Collège de France, Paris*

The book is based on a course given by J.-P. Serre at the Collège de France in 1980 and 1981. Basic techniques in Diophantine geometry are covered, such as heights, the Mordell-Weil theorem, Siegel's and Baker's theorems, Hilbert's irreducibility theorem, and the large sieve. Included are applications to, for example, Mordell's conjecture, the construction of Galois extensions, and the classical class number 1 problem. Comprehensive bibliographical references are also included.

Contents: Summary; Heights; Normalised heights; The Mordell-Weil theorem; Mordell's conjecture; Local calculation of normalised heights; Siegel's method; Baker's method; Hilbert's irreducibility theorem; Construction of Galois extensions; Construction of elliptic curves of large rank; The large sieve; Applications of the large sieve to thin sets; Appendix: The class number 1 problem and integral points on modular curves; Bibliography; Index.

Vieweg Aspects of Mathematics, Volume 15

March 1998, 218 pages, Hardcover, ISBN 3-528-28968-6, 1991 *Mathematics Subject Classification*: 14G13, 14K10, 14K15, **All AMS members $41**, List $45, Order code VWAM/15N

Algebraic Geometry and Its Applications

Alexander Tikhomirov, *State Pedagogical Institute of Yaroslavl, Moscow, Russia,* and **Andrej Tyurin,** *Steklov Institute of Mathematics, Moscow, Russia,* Editors

This volume contains 18 papers presented at the Algebraic Geometry Conference, Yaroslavl', August 10-14, 1992. These conferences in algebraic geometry have a great tradition in Russia and have been held since 1979 in Yaroslavl' every second year. The present conference, the eighth, was the first in which several foreign mathematicians participated. From the Russian side, there was a large group of specialists in algebraic geometry and related fields (invariant theory, topology of manifolds, theory of categories, mathematical physics, etc.). The book contains lectures on modern directions in algebraic geometry, such as the theory of exceptional bundles and helices on algebraic varieties; moduli of vector bundles on algebraic surfaces with applications to Donaldson's theory; geometry of Hilbert schemes of points, twistor spaces and applications to string theory; and more traditional areas, such as birational geometry of manifolds, adjunction theory, Hodge theory, problems of rationality in the invariant theory, topology of complex algebraic varieties, and more. A publication from the Steklov Institute of Mathematics. Adviser: Sergeev, Armen.

Contents: W. L. Baily, Jr., Three problems on an exceptional domain; **M. C. Beltrametti, G. M. Besana**, and **A. J. Sommese**, On the dimension of the adjoint linear system for quadric fibrations; **D. C. Butler**, On the stability of M_E; **H. D'Souza**, On a class of Del Pezzo fiber spaces; **M. H. Gizatullin**, The decomposition, inertia and ramification groups in birational geometry; **A. L. Gorodentsev**, Helic theory and nonsymmetrical bilinear forms; **P. I. Katsylo**, On the unramified 2-covers of the curves of genus 3; **A. A. Klyachko**, Spatial polygons and stable configurations of points in the projective line; **S. A. Kuleshov**, Rigid sheaves on surfaces; **V. S. Kulikov**, The Alexander polynomials of algebraic curves in C^2; **V. V. Nikulin**, On the Brauer group of real algebraic surfaces; **A. D. Popov** and **A. G. Sergeev**, Symplectic twistors and geometric quantization of strings; **Y. G. Prokhorov**, Compactifications of C^4 of index 3; **A. N. Rudakov**, A note on cohomologies of exceptional bundles on a quadric surface; **A. N. Rudakov**, Exceptional vector bundles on a Del Pezzo surface; **A. S. Tikhomirov**, Standard bundles on a Hilbert scheme of points on a surface; **A. S. Tikhomirov** and **T. L. Troshina**, Top segre class of a standard vector bundle E_D^4 on the Hilbert scheme $Hilb^4S$ of a surface S; **A. N. Tyurin**, Almost canonical polynomials of algebraic surfaces.

Vieweg Aspects of Mathematics, Volume 25

March 1998, 251 pages, Hardcover, ISBN 3-528-06599-0, 1991 *Mathematics Subject Classification*: 14C05, 14C30, 14D25, 14E05, 14E07, 14F05, 14F25, 14F45, 14JXX, 14J10, 81EXX, 10DXX, **All AMS members $57**, List $63, Order code VWAM/25N

An Introduction to Algebraic Inverse Eigenvalue Problems

Shu-fang Xu, *University of Peking, People's Republic of China*

An inverse algebraic eigenvalue problem, roughly speaking, is how to determine the elements of a matrix from its spectrum data. This kind of problem has been of great value for many applications, including control theory, structure mechanics, geology, molecular spectroscopy, and so on. Therefore, in recent years, many authors have been devoted to the study of this kind of problem and some significant progress has been made. One of the purposes of this book is to provide the reader with the recent developments in this field. This book is written for graduate students, computational scientists and engineers, numerical analysts, and mathematicians seeking an introduction to inverse algebraic eigenvalue problems. The text is largely self-contained and is based on classical analysis and modern matrix computation techniques.

Co-published in cooperation with Peking University Press.

Vieweg Monographs

July 1998, approximately 330 pages, Hardcover, ISBN 3-528-06684-9, 1991 *Mathematics Subject Classification*: 15A18; 65F15, **All AMS members $62**, List $69, Order code VW/5N

Infinite Element Methods

Lung-an Ying

As its name indicates, in the infinite element method the underlying domain is divided into infinitely many pieces. This leads to a system of infinitely many equations for infinitely many unknowns; but these can be reduced by analytical techniques to a finite system when some sort of scaling is present in the original problem. The simplest illustrative example, described carefully at the beginning of the first chapter of the book, is the solution of the Dirichlet problem in the exterior of some polygon. The exterior is subdivided into annular regions by a sequence of geometrically expanding images of the given polygon; these annuli are then further subdivided. The resulting variational equations take the form of a block tridiagonal Toeplitz matrix, with an inhomogeneous term in the zero component. Various efficient methods are described for solving such systems of equations ... The infinite element method is, whereever applicable, an elegant and efficient approach to solving problems in physics and engineering. Professor Ying's welcome book makes it available to the community of numerical analysts and computational scientists.

—from the* Preface *by Peter D. Lax

Co-published in cooperation with Peking University Press.

Contents: Algorithm; Foundations of algorithm; Convergence; Examples; Bibliography.

Vieweg Monographs

March 1998, 209 pages, Hardcover, ISBN 3-528-06610-5, 1991 *Mathematics Subject Classification*: 65-XX, **All AMS members $56**, List $62, Order code VW/6N

Independent Study

Hypergeometric Functions, My Love

Modular Interpretations of Configuration Spaces

Masaaki Yoshida, *Kyushu University, Fukuoka, Japan*

The classical story of the hypergeometric functions—the configuration space of 4 points on the projective line, elliptic curves, elliptic modular functions and the theta functions—now evolves in this book to the story of hypergeometric functions in 4 variables, the configuration space of 6 points in the projective plane, K3 surfaces, theta functions in 4 variables. This modern theory has been established by the author and his collaborators in the 1990's; further development to different aspects is expected. It leads the reader to a fascinating 4-dimensional world. The author tells the story casually and visually in a plain language, starting from an elementary level such as equivalence relations, the exponential function, and so on. Undergraduate students should be able to enjoy the text.

Contents: *Part I: The Story of the Configuration Space $X(2,4)$ of Four Points on the Projective Line:* Configuration spaces - The simplest case; Elliptic curves; Modular interpretations of $X(2,4)$; Hypergeometric integrals and loaded cycles; *Part II: The Story of the Configuration Space $X(2,n)$ of n Points on the Projective Line:* The configuration space $X(2,5)$; Modular interpretation of the configuration space $X(2,n)$; *Part III: The Story of the Configuration Space $X(3,6)$ of Six Lines on the Projective Plane:* The configuration space $X(3,6)$; Hypergeometric functions of type $(3,6)$; Modular interpretation of the configuration space $X(3,6)$; Bibliography.

Vieweg Aspects of Mathematics, Volume 32

March 1998, 292 pages, Hardcover, ISBN 3-528-06925-2, 1991 *Mathematics Subject Classification*: 11F, 14D, 14J, 20F, 32G34, 33C, 51F15, 53B, **All AMS members $58**, List $64, Order code VWAM/32N

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The Department of Mathematics at North Carolina State University invites applications for the position of professor and head of the Department. The Department has 65 full-time faculty, 12 visiting faculty and postdocs, 106 graduate students, and 250 undergraduate majors, with annualized research expenditures in excess of $2 million. The Department has modern computing and communication facilities supporting research and instruction. It has strong research programs in both pure and applied mathematics and collaborations with other departments and institutions. Members of the Department provide leadership for an interdisciplinary center, the Center for Research in Scientific Computation, that provides a focal point for research in computational science, engineering, and applied mathematics. The Department and the Center jointly sponsor an Industrial Applied Mathematics program. For more information about the Department see: `http://www.math.ncsu.edu/`.

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Questions may be directed to gerig@stat.ncsu.edu. Review of applications will begin July 15, 1998, and will continue until the position is filled. North Carolina State University is an Equal Opportunity/Affirmative Action Employer and especially solicits applications from women, underrepresented minorities, and persons who are physically challenged.

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UNIVERSITY OF RHODE ISLAND
Lecturer
Mathematics

Ph.D. in mathematics required by starting date. Teaching experience required. Background, experience, and excellence in teaching both lower and upper division mathematics courses preferred. Preference given to applicants who have strong potential for research interaction with faculty members in the area of difference equations for the first position. One-year temporary position beginning in fall 1998, with possibility of renewal subject to performance review and budgetary approval. Candidates should submit a letter of application and curriculum vitae and arrange for three letters of reference to be sent by June 24, 1998, to: Nancy Eaton, Search Committee Chair, Log (#021324), University of Rhode Island, P. O. Box G, Kingston, RI 02881. The University of Rhode Island is an AA/EEO Employer and is committed to increasing the diversity of its faculty, staff, and students. People from underrepresented groups are encouraged to apply.

TEXAS

UNIVERSITY OF HOUSTON-CLEAR LAKE
Mathematics Education

The University of Houston-Clear Lake School of Natural and Applied Sciences invites applications for a position in mathematics education beginning August 1998. The position is at the visiting assistant professor level for the first year. It is anticipated that approval will be given for a tenure-track position, to begin in August 1999. The position requires a doctorate in mathematics education or a doctorate in mathematics with extensive experience teaching university mathematics education courses. Preference will be given to candidates with extensive public school teaching experience.

Duties will include teaching, research, and service. Responsibilities will include acting as director of the new Mathematics Center and teaching three courses per academic year. The mathematical sciences program at UHCL includes faculty in pure and applied mathematics, statistics, and mathematics education. Degrees are granted at the bachelor's and master's levels. Send the completed AMS Standard Cover Sheet, a letter of interest, vitae, transcripts, and three letters of recommendation to: Norman Richert, Chair, Search Committee, University of Houston-Clear Lake, Houston, TX 77058.

UHCL is an AA/EO institution.

JAPAN

KWANSEI GAKUIN UNIVERSITY
Faculty of Science
Japan

Applications are invited for one position at the rank of professor, associate professor, or assistant professor in the area of algebra, analysis, or probability beginning April 1, 1999. Kwansei Gakuin University is one of the leading private educational institutions in Japan, and the Faculty of Science offers undergraduate and graduate programs leading to B.S., M.S., and Ph.D. degrees.

Applicants must have a Ph.D. in mathematics and exceptional promise in research. In addition, a strong interest in teaching undergraduate and graduate mathematics including introductory courses is required. Applicants should submit (1) a curriculum vitae, (2) a publication list, (3) preprints (no more than 5 papers), (4) a summary of research and research plans (no more than two pages), (5) a description of the applicant's teaching philosophy at the undergraduate and graduate level (no more than one page), and (6) one letter of recommendation to:

Dean of the Faculty of Science
Kwansei Gakuin University
1-1-155 Uegahara
Nishinomiya, 662-8501 Japan

The application deadline is June 26, 1998. Further particulars may be obtained by writing to Yaichi Shinohara (fax: 0798-54-6391, e-mail: shinohara@kwansei.ac.jp).

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MATHEMATICIAN
U.S. Army Research Office (ARO)
Research Triangle Park, NC

Applications are being solicited for Mathematician, GS-1520-15, ARO. $76,456 - $99,397 pa based upon prior salary and qualifications.

The incumbent serves as Associate Director, Mathematical and Computer Sciences Division (MCS). He/she shares with the Director of the Engineering Sciences Directorate, the planning, directing, coordinating and reviewing of the efforts of Division scientists who are specialized in the broad fields of mathematical and computer sciences and directs the administration of extramural research programs in the math & comp science subfields. The incumbent monitors progress of Division activities toward the accomplishment of established math and comp science program goals and provides guidance and direction in important problem areas; devises resource allocation strategies for the Director of the Directorate's consideration; arranges for, integrates, and coordinates the efforts of other Division scientists and staff; assimilates material for briefings, reports, and responses to higher authority; represents the MCS Division at briefings, seminars, etc; participates in studies and committees assessing technical areas of importance to the ARO and to the math and computer science community; evaluates and disseminates the results of the research program of the Army and also those of other Gov and private agencies (domestic and foreign) which may be of significant interest to the Army; and pursues research and/or advanced study within locally available institutions on projects of personal interest and whose content is relevant to the mission of the Army.

Applicants must have a Ph.D. or equivalent doctoral degree or possess one year of specialized experience at a level of difficulty and responsibility equivalent to the GS-14 level. Applicant must show successful completion of a full 4-year course of study in an accredited college or university leading to a bachelor's or higher degree which includes at least 24 semester hours in mathematics. Experience must have been in or related to the work of the position and equipped the applicant with the knowledge, skills and abilities to successfully perform the duties of the position.

Applicants must be U.S. citizens, be able to obtain a top secret clearance, and comply with provisions of the Ethics in Gov. Act. Interested individuals may obtain a complete application package by calling Ms. Donna Letvinchik, (919) 549-4294. Applications must be postmarked by 30 June 1998.

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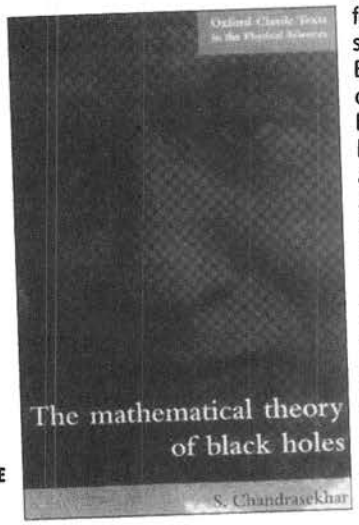

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Max Born, *late Nobel Laureate, University of Edinburgh, and* **Huang Kun**, *Beijing University, China*

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J. G. Semple, *late Professor Emeritus, King's College, London, and* **G. T. Kneebone**, *formerly Reader in Mathematics, Royal Holloway and Bedford College, London*

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Call for proposals

Partnership in North-South Cooperation

Since its creation in 1964, the Abdus Salam International Centre for Theoretical Physics (ICTP), an international research institute funded by the Italian government, UNESCO and IAEA, has sought to promote the advancement of science in developing countries as a vital instrument for economic progress and international cooperation. With this aim in mind, we implement several programmes both in Trieste and in the developing world.

Distinguished collaborators have found their association with the ICTP an inspiring experience. Our collaborators have had opportunities to meet thousands of people from diverse cultural backgrounds, share the common language of science and work together in research while at the same time addressing problems associated with economic inequities and global environmental degradation.

At this moment in our long and successful history, we feel a need for renewed input from the international community to encourage broader and more active participation of scientists from around the world. We call on all those who share our ideals to help us fulfil our mission.

To reach the largest number of scientists, the ICTP is issuing a *Call for Proposals* for many of our programmes in the calendar years 1999-2000. We also contemplate a second *Call for Proposals* for the remainder of our programmes (Associate and Federation Schemes, Affiliated Centres, Donation, Diploma, Networks and Training and Research in Italian Laboratories).

This first *Call for Proposals* covers:

1. Schools, Conferences, Workshops and Extended Research Workshops

Each year, the ICTP organizes about 40 training and research activities in all areas of physics and mathematics (both theoretical and experimental, including interdisciplinary areas that use mathematical tools). Since 1964, more than 65,000 scientists from developing and developed countries have participated in these activities. Schools normally cover general topics, are reasonably self-contained and last from 4 to 5 weeks. Workshops are shorter in length and deal with more specific subjects covering the latest developments in the field. Conferences are at most one week long and attract specialists from both developing and developed countries. We have recently implemented "Extended Research Workshops", in which some 20 researchers come to Trieste for 6 to 8 weeks to collaborate and exchange information on specific research subjects. Our *Call for Proposals* invites submissions for the organization of Schools, Conferences, Workshops (and/or Extended Research Workshops) in Trieste.

2. Partnership in the Associateship Scheme

The ICTP Associateship Scheme was created to enable renowned scientists, who were born and work in developing countries, to remain in contact with the most recent developments in their fields through visits to the ICTP. The Scheme also helps scientists to build scientific communities in their home countries that are designed to address local needs. This effort, which benefits between 500 and 600 scientists annually, is widely acknowledged to be one of our most effective programmes. The recognition we have received has led to substantial additional support from the Swedish International Development Cooperation Agency (Sida). In this *Call for Proposals,* we invite scientific institutions, research groups and individual scientists in developed countries to become "Partners in the Associateship Scheme". Successful applicants will be asked to host our Associates and make training programmes and research facilities available to them. The arrangement will take the form of a "Memorandum of Understanding" between the ICTP and the partner institution, which should be prepared to share the additional costs.

3. Research and Training at the Abdus Salam ICTP

Within the framework of its research activities in physics and mathematics, the ICTP makes available on a regular basis positions for post-doctorates and short- and long-term visiting scientists. Our *Call for Proposals* invites established physicists and mathematicians to apply for short- or long-term visits, including sabbatical leaves, to the ICTP. A key responsibility of our visitors will be to assist and interact with our younger scientists in residence.

4. Scholars-Consultants Programme

The ICTP's Office of External Activities offers substantial support for scientific activities and select institutions in developing countries. This *Call for Proposals* invites applications from scientists willing to make extended periodic visits at an institution in a developing country, particularly one of our Affiliated Centres. A primary purpose of these visits will be to initiate and develop joint research programmes.

5. Partners to Networks

The ICTP's Office of External Activities also oversees our Networking programme, which offers support for the mobility of scientists between developing country laboratories cooperating on the same scientific project. Our *Call for Proposals* invites research centres in developed countries to become partners in these Networks. The ICTP will continue to cover South-South mobility costs, while partner institutions will be expected to cover North-South mobility costs.

The guidelines for making proposals as well as deadlines and criteria can be found at: http//www.ictp.trieste.it/proposals

Please note that the preceding 1. to 5. modalities can be used separately or combined consistently in a structured project.

For additional information, please contact: **proposals@ictp.trieste.it**

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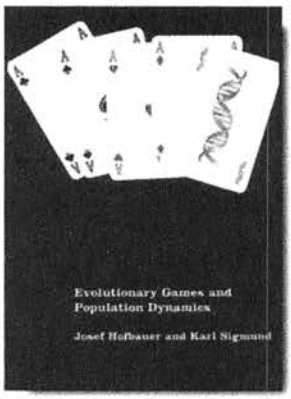

In this book the authors investigate the nonlinear dynamics of the self-regulation of social and economic behavior, and of the closely related interactions among species in ecological communities. Replicator equations describe how successful strategies spread and thereby create new conditions that can alter the basis of their success, i.e. to enable us to understand the strategic and genetic foundations of the endless chronicle of invasions and extinctions that punctuate evolution.

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From Foundations to Applications

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CSLI Lecture Notes 87

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Cambridge Tracts in Mathematics 132

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Cambridge Studies in Advanced Mathematics 60

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Cambridge Studies in Advanced Mathematics 30

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Cambridge Studies in Advanced Mathematics 31

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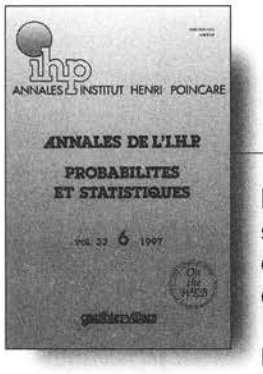

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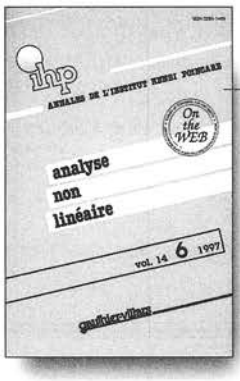

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*Members can purchase a **multi-year membership** by prepaying their current dues rate for either two, three, four or five years. This option is not available to category-S, unemployed, or student members.*

1998 Dues Schedule (January through December)

Ordinary member . . . . . ☐ $96 ☐ $128

CMS cooperative rate . . . . . ☐ $82 ☐ $109

Joint family member (full rate) . . . . . ☐ $96 ☐ $128

Joint family member (reduced rate) . . . . . ☐ $76 ☐ $108

Contributing member (minimum $192) . . . . . ☐

Student member (please verify)[1] . . . . . ☐ $32

Unemployed member (please verify)[2] . . . . . ☐ $32

Reciprocity member (please verify)[3] . . . . . ☐ $64 ☐ $96 ☐ $128

Category-S member[4] . . . . . ☐ $16

Multi-year membership . . . . . $ . . . . . for . . . . . years

[1] ***Student Verification*** (sign below)

I am a full-time student at . . . . . .

. . . . . *currently working toward a degree.*

[2] ***Unemployed Verification*** (sign below) *I am currently unemployed and actively seeking employment.*

[3] ***Reciprocity Membership Verification*** (sign below) *I am currently a member of the society indicated on the right and am therefore eligible for reciprocity membership.*

. . . . . .

Signature

[4] ☐ ***send*** **NOTICES** ☐ ***send*** **BULLETIN**

Reciprocating Societies

- ☐ Allahabad Mathematical Society
- ☐ Australian Mathematical Society
- ☐ Azerbaijan Mathematical Society
- ☐ Balkan Society of Geometers
- ☐ Berliner Mathematische Gessellschaft e.V.
- ☐ Calcutta Mathematical Society
- ☐ Croatian Mathematical Society
- ☐ Cyprus Mathematical Society
- ☐ Dansk Matematisk Forening
- ☐ Deutsche Mathematiker-Vereinigung e.V.
- ☐ Edinburgh Mathematical Society
- ☐ Egyptian Mathematical Society
- ☐ Gesellschaft für Angewandte Mathematik und Mechanik
- ☐ Glasgow Mathematical Association
- ☐ Hellenic Mathematical Society
- ☐ Icelandic Mathematical Society
- ☐ Indian Mathematical Society
- ☐ Iranian Mathematical Society
- ☐ Irish Mathematical Society
- ☐ Israel Mathematical Union
- ☐ János Bolyai Mathematical Society
- ☐ The Korean Mathematical Society
- ☐ London Mathematical Society
- ☐ Malaysian Mathematical Society
- ☐ Mathematical Society of Japan
- ☐ Mathematical Society of the Philippines
- ☐ Mathematical Society of the Republic of China
- ☐ Mongolian Mathematical Society
- ☐ Nepal Mathematical Society
- ☐ New Zealand Mathematical Society
- ☐ Nigerian Mathematical Society
- ☐ Norsk Matematisk Forening
- ☐ Österreichische Mathematische Gesellschaft
- ☐ Palestine Society for Mathematical Sciences
- ☐ Polskie Towarzystwo Matematyczne
- ☐ Punjab Mathematical Society
- ☐ Ramanujan Mathematical Society
- ☐ Real Sociedad Matemática Española
- ☐ Saudi Association for Mathematical Sciences
- ☐ Sociedad Colombiana de Matemáticas
- ☐ Sociedad Española de Matemática Aplicada
- ☐ Sociedad de Matemática de Chile
- ☐ Sociedad Matemática de la Republica Dominicana
- ☐ Sociedad Matemática Mexicana
- ☐ Sociedad Uruguaya de Matemática y Estadística
- ☐ Sociedade Brasileira Matemática
- ☐ Sociedade Brasileira de Matemática Aplicada e Computacional
- ☐ Sociedade Paranaense de Matemática
- ☐ Sociedade Portuguesa de Matemática
- ☐ Societat Catalana de Matemàtiques
- ☐ Societatea de Ştiinţe Matematice din România
- ☐ Societatea Matematicienilor din Romania
- ☐ Société de Mathématiques Appliquées et Industrielles
- ☐ Société Mathématique de Belgique
- ☐ Société Mathématique de France
- ☐ Société Mathématique Suisse
- ☐ Society of Associations of Mathematicians & Computer Science of Macedonia
- ☐ Society of Mathematicians, Physicists, and Astronomers of Slovenia
- ☐ South African Mathematical Society
- ☐ Southeast Asian Mathematical Society
- ☐ Suomen Matemaattinen Yhdistys
- ☐ Svenska Matematikersamfundet
- ☐ Ukrainian Mathematical Society
- ☐ Union Mathemática Argentina
- ☐ Union of Bulgarian Mathematicians
- ☐ Union of Czech Mathematicians and Physicists
- ☐ Union of Slovak Mathematicians and Physicists
- ☐ Unione Matematica Italiana
- ☐ Vijnana Parishad of India
- ☐ Wiskundig Genootschap

Meetings & Conferences of the AMS

PROGRAM ALERT: In order that AMS meeting programs include the most timely information for each speaker, abstract deadlines have been moved to dates much closer to the meeting. What this means is that most meeting programs will appear in the *Notices* ***after*** the meeting takes place. However, complete meeting programs will be available on e-MATH about two to three weeks after the abstract deadline. ***Remember***, e-MATH is your most comprehensive source for up-to-date meeting information. See `http://www.ams.org/meetings/`.

Manhattan, Kansas

Kansas State University

March 27–28, 1998

Meeting #932

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: January 1998
Program issue of *Notices*: June/July 1998, page 806
Issue of *Abstracts*: Volume 19, Issue 2

Philadelphia, Pennsylvania

Temple University

April 4–6, 1998

Meeting #933

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: February 1998
Program issue of *Notices*: June/July 1998, page 819
Issue of *Abstracts*: Volume 19, Issue 2

Davis, California

University of California

April 25–26, 1998

Meeting #934

Western Section
Associate secretary: Robert J. Daverman
Announcement issue of *Notices*: February 1998
Program issue of *Notices*: June/July 1998, page 831
Issue of *Abstracts*: Volume 19, Issue 2

Chicago, Illinois

DePaul University-Chicago

September 12–13, 1998

Meeting #935

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: June/July 1998
Program issue of *Notices*: November 1998
Issue of *Abstracts*: Volume 19, Issue 3

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions: Expired
For abstracts: July 21, 1998

Invited Addresses

Vitaly Bergelson, Ohio State University, *Title to be announced.*

Sheldon Katz, Oklahoma State University, *Title to be announced.*

Ralf Spatzier, University of Michigan, *Title to be announced.*

Vladimir Voevodsky, Northwestern University, *Title to be announced.*

Special Sessions

Algebraic Coding (Code: AMS SS C1), **William C. Huffman**, Loyola University of Chicago, and **Vera S. Pless**, University of Illinois at Chicago.

Algebraic Combinatorics: Association Schemes and Related Topics (Code: AMS SS L1), **Sung Yell Song**, Iowa State University.

Algebraic Geometry and Mirror Symmetry (Code: AMS SS N1), **Ezra Getzler** and **Mikhail Kapranov**, Northwestern University, and **Sheldon Katz**, Oklahoma State University.

Commutative Algebra (Code: AMS SS J1), **Irena V. Peeva**, Massachusetts Institute of Technology, and **Michael Stillman**, Cornell University.

Complex Dynamics (Code: AMS SS H1), **Shmuel Friedland**, University of Illinois at Chicago.

Complexity of Geometric Structures on Manifolds (Code: AMS SS F1), **Melvin G. Rothenberg** and **Shmuel A. Weinberger**, University of Chicago.

Ergodic Theory and Topological Dynamics (Code: AMS SS G1), **Roger L. Jones**, DePaul University, and **Randall McCutcheon**, Wesleyan College.

Fourier Analysis (Code: AMS SS E1), **Marshall Ash**, DePaul University, and **Mark A. Pinsky**, Northwestern University.

K-Theory and Motivic Cohomology (Code: AMS SS D1), **Kevin Knudson**, Northwestern University, and **Mark Walker**, University of Nebraska-Lincoln.

Nonlinear Partial Differential Equations (Code: AMS SS O1), **Gui-Qiang Chen** and **Konstantina Trivisa**, Northwestern University.

Number Theory (Code: AMS SS I1), **Jeremy T. Teitelbaum** and **Yuri Tschinkel**, University of Illinois at Chicago.

Orthogonal Polynomial Series, Summability and Conjugates (Code: AMS SS M1), **Calixto P. Calderon**, University of Illinois at Chicago, and **Luis A. Caffarelli**, University of Texas at Austin.

Rigidity in Geometry and Dynamics (Code: AMS SS K1), **Steven E. Hurder**, University of Illinois at Chicago, and **Ralf J. Spatzier**, University of Michigan.

Stochastic Analysis (Code: AMS SS A1), **Richard B. Sowers**, University of Illinois-Urbana, and **Elton P. Hsu**, Northwestern University.

Topics in Mathematics and Curriculum Reform (Code: AMS SS B1), **Richard J. Maher**, Loyola University Chicago.

Accommodations

Participants should make their own arrangements directly with the hotel of their choice and request the DePaul rate. **All rooms will be on a space available basis.** The AMS is not responsible for rate changes or for the quality of the accommodations.

Best Western Grant Park, 1100 S. Michigan Ave.; 312-922-2900; $62/single or double; two blocks from campus.

Palmer House Hilton, 17 E. Monroe Ave.; 312-917-7348; $149/single or double.

Ramada Congress Inn, 520 S. Michigan Ave.; 800-635-1666; $99/single or double; hotel parking.

Food Service

Campus dining facilities: 11th floor, DePaul Center, 7:30 a.m. to 2:30 p.m. Additional restaurants are located within short walking distance.

Local Information

Please visit the Web site maintained by DePaul University at `http://www.depaul.edu/`.

Other Activities

AMS Book Sale: Examine the newest titles from AMS! Most books will be available at a special 50% discount offered only at meetings. Complimentary coffee will be served, courtesy of AMS Membership Services.

Parking

Although DePaul University has no parking facilities of its own in the loop area, there are several municipal parking lots in the area. The cost of parking varies.

Registration and Meeting Information

Registration will take place in the lobby on the 8th floor of the DePaul Center, 1 E. Jackson Blvd., from 7:30 a.m. to 5:00 p.m., Saturday, September 12, and from 8:00 a.m. to 11:00 a.m. on Sunday, September 13. Invited addresses will take place in the Egan Urban Center located in the Administration Center at 243 South Wabash. Special Sessions will take place in the DePaul Center and the Lewis Center.

Registration Fees: (payable on-site only) $30/AMS members; $45/nonmembers; $10/emeritus members, students, or unemployed mathematicians. Fees are payable by cash, check, VISA, MasterCard, Discover, or American Express.

Travel

The DePaul Center is located at the intersection of State Street and Jackson Boulevard. It is well served by public transportation and has many nearby parking garages.

By Air: Inquire upon arrival at O'Hare Airport or Midway Airport for public transportation or car rentals. The following specially negotiated rates are available only for the period September 9–15: 5% discount off first-class and any published USAirways promotional round-trip fare, or 10% discount off unrestricted coach fares with seven-day advance reservations and ticketing required. These dis-

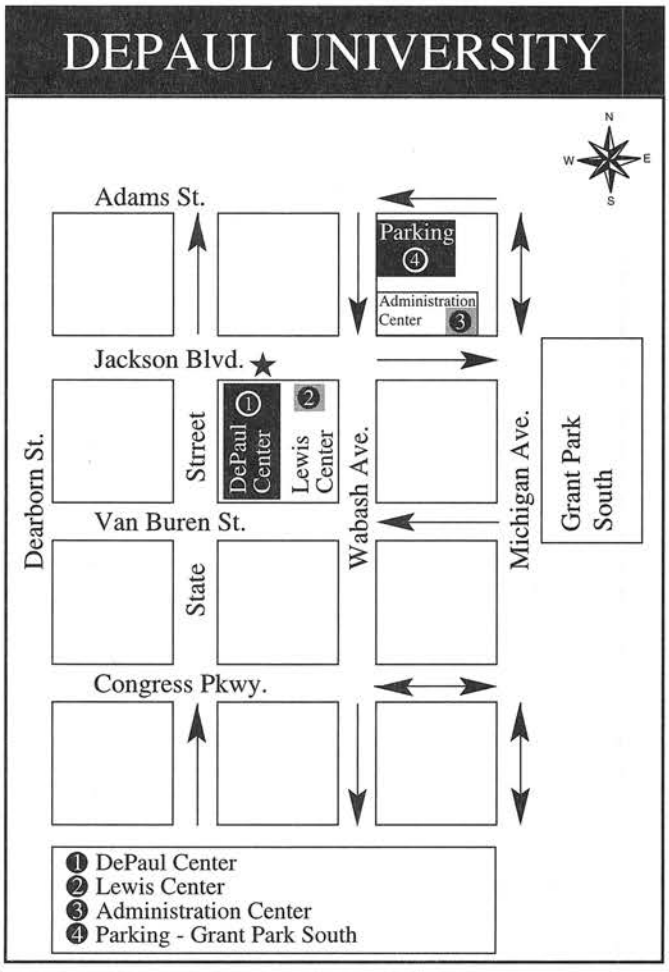
counts are valid providing all rules and restrictions are met and are applicable for travel from the continental U.S., Bahamas, Canada, and San Juan, P.R. Discounts are not combinable with other discounts or promotions. Additional restrictions may apply on international travel. For reservations call (or have your travel agent call) 800-334-8644 between 8:00 a.m. and 9:00 p.m. Eastern Daylight Time. **Refer to Gold File Number 73670341.**

Airport Express vans depart O'Hare every 10 minutes for the 45-minute trip downtown, and from Midway every 15 minutes for the 30-minute trip to downtown.

Driving: From the north and northwest: the campus is accessible from the John F. Kennedy Expressway (I-90/I-94); exit at Jackson Boulevard (300 South) and turn east. The campus is approximately one mile from the expressway at Jackson Blvd.

From the west: The campus is accessible from the Dwight D. Eisenhower Expressway (I-290). As you enter the downtown area, the expressway becomes Congress Parkway. Turn left (north) on Dearborn Street (50 West), go two blocks to Jackson Blvd. (300 South) and turn right (east). DePaul University is one block east on Jackson Blvd. at State Street.

From the south: Take I-90/I-94 exit at Jackson Blvd. (300 South) and turn east. The campus is approximately one mile from the expressway on Jackson Boulevard.



By Train or Bus: All six rapid transit train lines (CTA) service the campus and include the O'Hare/Congress/Douglas (Blue) and Midway/Loop (Orange). From the trains, exit at Jackson Boulevard (300 South). The fare from each airport is $1.50, and exact change is recommended to simplify entering the train stations.

Weather: The daytime temperatures typically range from 50–70 degrees Fahrenheit, and in the 50 degree range at night. Some light rain is possible.

Winston-Salem, North Carolina

Wake Forest University

October 9–10, 1998

Meeting #936

Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of *Notices*: August 1998
Program issue of *Notices*: December 1998
Issue of *Abstracts*: Volume 19, Issue 3

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: June 23, 1998
For abstracts: August 18, 1998

Invited Addresses

David F. Anderson, University of Tennessee, *Unique and nonunique factorization in integral domains.*

Idris Assani, University of Carolina, Chapel Hill, *A.e. multiple recurrence and Wiener Wintner dynamical systems.*

Marcy Barge, Montana State University, *Structure of attractors.*

Roger Temam, Indiana University, *Some mathematical problems related to the equations of the atmosphere and the oceans.*

Special Sessions

Abelian Groups and Modules (Code: AMS SS B1), **Ulrich Albrecht**, Auburn University.

Boundary Value Problems (Code: AMS SS K1), **John V. Baxley** and **Stephen B. Robinson**, Wake Forest University.

Combinatorics and Graph Theory (Code: AMS SS A1), **Bruce Landman**, University of North Carolina.

Commutative Ring Theory (Code: AMS SS E1), **David F. Anderson**, University of Tennessee, Knoxville, and **Evan Houston**, University of North Carolina, Charlotte.

Ergodic Theory (Code: AMS SS F1), **Idris Assani**, University of North Carolina, Chapel Hill.

Modern Methods in Set Theory and General Topology (Code: AMS SS H1), **Winfried Just** and **Paul Szeptycki**, Ohio University.

Noncommutatuve Algebra (Code: AMS SS C1), **Ellen Kirkman** and **James Kuzmanovich**, Wake Forest University.

Operator Theory and Holomorphic Spaces (Code: AMS SS L1), **Tavan T. Trent** and **Zhijian Wu**, University of Alabama.

Recent Results on the Topology of Three-Manifolds (Code: AMS SS D1), **Hugh Nelson Howards**, Wake Forest University.

Spectral Theory of Differential Equations and Applications (Code: AMS SS G1), **Dominic Clemence** and **Alexandra Kurepa**, North Carolina A&T University.

Topology in Dynamics (Code: AMS SS J1), **Marcy Barge**, Montana State University-Bozeman, and **Krystyna M. Kuperberg**, Auburn University.

State College, Pennsylvania

Pennsylvania State University

October 24–25, 1998

Meeting #937

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: August 1998
Program issue of *Notices*: January 1999
Issue of *Abstracts*: Volume 19, Issue 4

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: July 7, 1998
For abstracts: September 1, 1998

Invited Addresses

Jeffrey Adams, University of Maryland, College Park, *Title to be announced.*

Nigel D. Higson, Pennsylvania State University, *Title to be announced.*

Tasso J. Kaper, Boston University, *Title to be announced.*

Kate Okikiolu, University of California, San Diego, and MIT, *Title to be announced.*

Special Sessions

C-Algebraic Methods in Geometry and Topology* (Code: AMS SS B1), **Nigel D. Higson**, Pennsylvania State University, and **Erik Guentner** and **John D. Trout Jr.**, Dartmouth College.

Least Squares and Total Least Squares (Code: AMS SS G1), **Jesse L. Barlow**, Pennsylvania State University.

Mathematical Modeling of Inhomogeneous Materials: Homogenizaton and Related Topics (Code: AMS SS D1), **Leonid Berlyand**, Pennsylvania State University, and **Karl Voss**, Yale University.

Metric Topology (Code: AMS SS F1), **Steve Armentrout**, **Joseph Borzelino**, **Hossein Movahedi-Lankarani**, and **Robert Wells**, Pennsylvania State University.

Modeling of Phase Transitions of Partially Ordered Physical Systems (Code: AMS SS C1), **Maria-Carme T. Calderer**, Pennsylvania State University.

Partitions and q-Series (Code: AMS SS A1), **George E. Andrews** and **Ken Ono**, Pennsylvania State University.

Symplectic Geometry and Quantization (Code: AMS SS E1), **Jean-Luc Brylinski**, **Ranee Brylinski**, **Boris Tsygan**, and **Ping Xu**, Pennsylvania State University.

Tucson, Arizona

University of Arizona-Tucson

November 14–15, 1998

Meeting #938

Western Section
Associate secretary: Robert M. Fossum
Announcement issue of *Notices*: September 1998
Program issue of *Notices*: To be announced
Issue of *Abstracts*: Volume 19, Issue 4

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: July 29, 1998
For abstracts: September 23, 1998

San Antonio, Texas

Henry B. Gonzales Convention Center

January 13–16, 1999

Meeting #939

Joint Mathematics Meetings, including the 105th Annual Meeting of the AMS, 82nd Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: October 1998
Program issue of *Notices*: January 1999
Issue of *Abstracts*: Volume 20, Issue 1

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: August 6, 1998

For abstracts: October 1, 1998
For summaries of papers to MAA organizers: September 4, 1998

Joint Invited Addresses

Jennifer Tour Chayes, Microsoft, *Title to be announced.*

Joan Feigenbaum, AT&T Bell Laboratories, *Department head, algorithms & distributed data.*

Joint Special Sessions

Mathematics and Education Reform (Code: AMS SS M1), **William H. Barker**, Bowdoin College, **Jerry L. Bona**, University of Texas at Austin, **Naomi Fisher**, University of Illinois at Chicago, and **Kenneth C. Millett**, University of California, Santa Barbara.

Model Theory and Its Applications (Code: AMS SS S1), **Anand Pillay**, MSRI and University of Illinois, Urbana.

Research in Mathematics by Undergraduates (Code: AMS SS E1), **John E. Meier** and **Leonard A. VanWyk**, Lafayette College.

The History of Mathematics (Code: AMS SS L1), **Karen H. Parshall**, University of Virginia, and **Victor J. Katz**, University of the District of Columbia.

AMS Invited Addresses

Nancy J. Kopell, Boston University, *Title to be announced* (AMS Josiah Willard Gibbs Lecture).

Sorin Popa, University of California, Los Angeles, *Title to be announced.*

AMS Special Sessions

Banach Spaces of Holomorphic Functions and Operators on These Spaces (Code: AMS SS D1), **Benjamin A. Lotto**, Vassar College, and **Pamela B. Gorkin**, Bucknell University.

Bergman Spaces and Related Topics (Code: AMS SS B1), **Peter L. Duren**, University of Michigan, Ann Arbor, and **Michael Stessin**, SUNY at Albany.

Combinatorial Topology (Code: AMS SS K1), **Laura M. Anderson** and **Jonathan P. McCammond**, Texas A&M University.

Commutative Algebra (Code: AMS SS G1), **Scott Thomas Chapman**, Trinity University.

Commutative Algebra and Algebraic Geometry (Code: AMS SS J1), **Roger A. Wiegand**, University of Nebraska and Purdue University, and **Susan Elaine Morey**, Southwest Texas State University.

Computational Algebraic Geometry for Curves and Surfaces (Code: AMS SS R1), **Mika K. Seppala**, Florida State University, and **Emil J. Volcheck**, National Security Agency.

Development of Electronic Communications in Mathematics (Code: AMS SS N1), **Alfonso Castro**, University of North Texas, and **Rafael De La Llave**, University of Texas at Austin.

Discrete Models and Difference Equations (Code: AMS SS T1), **Saber Elaydi**, Trinity University, and **Gerry Ladas**, University of Rhode Island.

Dynamical, Spectral, and Arithmetic Zeta-Functions (Code: AMS SS H1), **Michel L. Lapidus**, University of California, Riverside, and **Machiel van Frankenhuysen**, Institut des Hautes Études Scientifiques.

Geometry in Dynamics (Code: AMS SS F1), **Krystyna Kuperberg**, Auburn University.

Hamiltonian Mechanics: Applications to Celestial Mechanics and Chemistry (Code: AMS SS Y1), **Michael K. Rudnev**, The University of Texas at Austin, and **Stephen R. Wiggins**, California Institute of Technology.

Mathematics Education and Mistaken Philosophies of Mathematics (Code: AMS SS U1), **Saunders Mac Lane**, University of Chicago, and **Richard A. Askey**, University of Wisconsin-Madison.

Operator Algebras and Applications (Code: AMS SS P1), **Allan P. Donsig**, University of Nebraska–Lincoln, and **Nik Weaver**, Washington University.

Probabilistic Combinatorics (Code: AMS SS C1), **Béla Bollobás**, University of Memphis.

Recent Developments in Differential Geometry (Code: AMS SS V1), **Huai-Dong Cao** and **Jianxin Zhou**, Texas A&M University.

Several Complex Variables (Code: AMS SS A1), **Emil J. Straube** and **Harold P. Boas**, Texas A&M University.

Singularities in Algebraic and Analytic Geometry (Code: AMS SS X1), **Caroline G. Grant**, U.S. Naval Academy, and **Ruth I. Michler**, University of North Texas.

The Functional and Harmonic Analysis of Wavelets (Code: AMS SS Q1), **Lawrence W. Baggett**, University of Colorado, and **David R. Larson**, Texas A&M University.

The Mathematics of the Navier-Stokes Equations (Code: AMS SS W1), **Peter A. Perry** and **Zhong-Wei Shen**, University of Kentucky.

MAA Contributed Papers in San Antonio

The Mathematical Association of America and the American Mathematical Society will hold their annual meetings at the Joint Mathematics Meetings from Wednesday, January 13, 1999, through Saturday, January 16, 1999, in San Antonio, Texas. The complete meetings program will appear in the October 1998 issues of *Focus* and *Notices*. This preliminary announcement is designed to alert participants about the MAA's contributed papers sessions and their deadlines. Please note that the dates scheduled for these sessions remain tentative. The organizers listed below solicit contributed papers pertinent to their sessions; proposals should be directed to the organizer whose name is followed by an asterisk (*). For additional instructions, see the "Submission Procedures" at the end of the list. Sessions generally limit presentations to ten minutes, but selected participants may extend their contributions up to twenty minutes. Each session room contains an overhead projector and screen; blackboards will not be available. You may request one additional overhead pro-

jector, a 35mm slide projector, or a 1/2-inch or 3/4-inch VHS VCR with one color monitor. Persons needing additional equipment should contact, as soon as possible but prior to October 2, 1998: Jim Tattersall, Department of Mathematics and Computer Science, Providence College, Providence, RI 02918; e-mail: tat@providence.edu.

The Use of Technology in Teaching Abstract Mathematics, Wednesday and Friday mornings. **Doug Ensley** (*), Department of Mathematics, Shippensburg University, Shippensburg, PA 17257; phone: 717-532-1431; fax: 717-530-4009; e-mail: deensl@ship.edu.

This session is to provide a forum for exchange among those using computational tools in the teaching of traditionally abstract mathematical topics. Courses affected might include discrete mathematics, abstract algebra, number theory, logic, or analysis. Of particular interest are tools which are built upon standard programming languages or computer algebra systems, since these might be used by a wide audience with minimal additional resources.

Quantitative Literacy, Wednesday and Friday mornings, **Barbara Jur** (*), Department of Mathematics, Macomb Community College, 14500 Twelve Mile Road, Warren, MI 48093; phone: 810-445-7105; fax: 810-445-7298; e-mail: jur@macomb.cc.mi.us; **Rick Gillman**, Valparaiso University; **Jimmy L. Solomon**, Allen E. Pulsion College of Science and Technology; **Linda Sons**, Northern Illinois University.

The session seeks papers describing quantitative literacy (QL) programs—programs that a college has to ensure literacy for ALL its graduates. Also considered will be papers describing lower-division courses, which could be recommendations on QL which will appear on MAA Online.

Teaching Statistics: Teaching the Reasoning and New Technological Tools, Wednesday and Friday mornings, **Dex Whittinghill** (*), Department of Mathematics, Rowan University, Glassboro, NJ 08028; phone: 609-256-4500, x3879; fax: 609-256-4921; e-mail: whittinghill@rowan.edu; **Frank Wattenberg**, National Science Foundation; **Mary Parker**, Austin Community College; **Don Bentley**, Pomona College.

The teaching of statistics has been evolving in recent years. This session will address two important aspects of that evolution. Some authors will discuss experiences teaching statistical reasoning in a variety of undergraduate settings, from Statistics I to the interdisciplinary course. Other authors will discuss novel ways in which they use technology in their courses, possibly including Java-based applet simulations, the TI calculator and the CBL, or interactive uses of the Web.

Mathematics Competitions, Wednesday and Friday mornings, **Harold B. Reiter** (*), Department of Mathematics, University of North Carolina-Charlotte, Charlotte, NC 28223; phone: 704-510-6461; fax: 704-510-6415; e-mail: hbreiter@email.uncc.edu; **Stephen B. Maurer**, Swarthmore College; **William P. Fox**, USMA; **Susan Schwartz Wildstrom**, Montgomery City Schools, MD.

There are many ways to pique student interest in mathematics through problem solving. The major national competitions are well known (Putnam and Mathematical Competition in Modeling at the college level; AHSME, AIME, and USAMO for high schools), but there are many other challenging activities of differing sorts and varying geographical sweep. We seek talks on various aspects of different sorts of competitions, at both the pre-college and college level. What is your format? How did you get started? How is it funded? How are minorities encouraged? Have you done any follow-up on participants? Do you use the Internet? The MAA Committee on Local and Regional Competitions is running this Special Session as part of a thrust that may also include development of a database on challenge events and a publication that will provide advice for people wishing to begin or improve such events.

Innovations in Teaching Abstract Algebra, Wednesday afternoon, **Vesna Kilibarda** (*), School of Education, Liberal Arts, and Science, University of Alaska Southeast, 11120 Glacier Highway, Juneau, AK 99801-8671; phone: 907-465-6408; fax: 907-465-5159; e-mail: jfvk@acad1.alaska.edu; **Allen C. Hibbard**, Central College; **Ellen Maycock Parker**, DePauw University.

This session invites papers about challenges and opportunities in making abstract algebra more accessible, meaningful, and applicable for our students while maintaining a major goal: to develop mathematical maturity by gradual introduction and development of concepts and careful and rigorous treatment of definitions and proofs. Where appropriate, each presenter is encouraged to describe the context for the talk (where does this fit into an abstract algebra course and what topics have been covered), the technology (if any) required, the method(s) implemented (demonstration, group work, discovery approach, outside project, etc.), and the effect (how did this impact conceptual understanding) of the innovation being discussed.

Ethical, Humanistic, and Artistic Mathematics, Wednesday and Friday afternoons, **Alvin White** (*), Department of Mathematics, Harvey Mudd College, Claremont, CA 91711-5990; phone: 909-621-8867; fax: 909-621-8366; e-mail: awhite@hmc.edu; **Robert P. Webber**, Longwood College; **Stefanos Gialamas**, Illinois Institute of Art.

This session will feature talks that relate mathematics and mathematics teaching to the culture in which they are embedded. Papers discussing any of the three following themes are welcome: (a) ethical dilemmas and considerations in mathematics, (b) humanistic mathematics, (c) teaching mathematics to art students integrating an iconistic approach, guided inquiry, or any other philosophy or methodology. Please state which of the three themes your paper addresses.

Proof in Mathematical Education, Friday afternoon, **Joseph Wimbish** (*), Department of Mathematical Education and Computer Sciences, Huntingdon College, 1500 East Fairview Avenue, Montgomery, AL 36106-2148; phone 334-833-4476; fax: 334-283-5413; e-mail: jwimbish@huntingdon.edu; **Gary Davis**, Research & Graduate School of Education, University of Southampton.

This session invites papers that focus on topics related to proofs of current interest in undergraduate mathematics education. For example: Students'/Teachers' views on proof. How do students learn to prove theorems? How do students see "doing" proofs? How do they make the transition from strictly algorithmic activity to definition-theorem-proof?

Geometry in the Classroom in the Next Millennium, Thursday and Saturday mornings, **Colm Mulcahy** (*), Department of Mathematics, Spelman College, P.O. Box 373, Atlanta, GA 30314; phone: 404-223-7627; fax: 404-223-7662; e-mail: colm@spelman.edu; **David Henderson**, Cornell University; **Barry Schiller**, Rhode Island College.

Geometry, though one of mathematics' oldest branches, lives and has exciting new applications! This session welcomes papers on innovations in teaching college geometry at all levels, including courses for liberal arts, undergraduate majors (where students may be future researchers), and for preparing future and in-service K–12 teachers. We encourage presentations illustrating the evolving nature of geometry, its interaction with science and technology, its role in the curriculum, the incorporation of new results, pedagogical issues, and the use of technology.

Discrete Mathematics Revisited, Thursday and Saturday mornings, **Richard K. Molnar** (*), Department of Mathematics, Macalester College, St. Paul, MN 55105; phone: 612-696-6338; e-mail: molnar@macalester.edu; **Suzanne M. Molnar**, College of St. Catherine.

Before Calculus Reform, discrete mathematics was going to save undergraduate mathematics. This session will focus on ways in which discrete mathematics can serve as an entry into the curriculum, how it serves client disciplines such as biology and computer science, and how specific topics have influenced undergraduate research. Of special interest are constructive approaches to learning, discrete models, and the use of technology in the communication, doing, and teaching of discrete mathematics.

Projects That Work in Applied Mathematics Courses, Thursday and Saturday afternoons, **Alexandra Kurepa** (*), Department of Mathematics, North Carolina A&T State University, Greensboro, NC 27411; phone: 336-334-7822; fax: 336-334-7283; e-mail: kurepaa@ncat.edu; **Henry Warchall**, University of North Texas.

Typically a large number of students in the applied mathematics courses are nonmathematics majors. This session presents examples of interdisciplinary projects that link the students' major fields of study to applied mathematics. Applied problems drawn from such fields as engineering, physics, biology, chemistry, music, graphic design, and others that enliven the presentation of important mathematical concepts will be included. Projects that resulted from interdisciplinary research and team-teaching are particularly appropriate.

Innovative Use of Distance Learning Techniques to Teach Post-secondary Mathematics, Thursday and Saturday afternoons, **Brian E. Smith** (*), Department of Statistics, Faculty of Management, McGill University, 1001 Sherbrooke St. West, Montreal, QC, Canada H3A 1G5; phone: 514-398-4038; fax: 514-398-3876; e-mail: smithb@management.mcgill.ca; **Marcelle Bessman**, Jacksonville University.

The purpose of this session is to present teaching methods in mathematics using distance learning. Examples of existing distance education programs, as well as new and innovative techniques, are solicited. Of particular interest is a discussion of successful models of distance learning and also an analysis of concerns and difficulties experienced by educators who work in this medium. This session is organized on behalf of the MAA Committee on Computers in Mathematics Education.

Integrating Mathematics and Other Disciplines, Thursday and Saturday afternoons, **William McCallum** (*), Department of Mathematics, University of Arizona, Tucson, AZ 85721; phone: 621-520-6886; e-mail: wmc@math.arizona.edu; **Nicholas Losito** and **Yajun Yang**, SUNY Farmingdale.

Papers are invited describing (a) undergraduate courses or programs that are interdisciplinary in nature or (b) model examples of how applications of mathematics in other professions can be incorporated into undergraduate mathematics courses. Interdisciplinary courses should have a substantial mathematical component and a direct link to a discipline other than mathematics. Model examples of applications from other disciplines should show how the incorporation of these applications enhances mathematical understanding and increases the usefulness of the course to students not majoring in mathematics. These other disciplines might include the physical sciences, engineering, the social sciences, the arts, and the humanities. The session is organized on behalf of the CUPM Subcommittee on Calculus Reform and the First Two Years.

The Integral Role of the Two-Year College in the Preservice Preparation of Elementary School Teachers, Thursday and Saturday afternoons, **Mercedes McGowen** (*), Department of Mathematics, William Rainey Harper College, Palatine, IL 60067-7398; phone: 847-925-6526; fax: 847-925-6049; e-mail: mmcgowen@harper.cc.il.us; **Joanne Peeples**, El Paso Community College; **William E. Haver**, Virginia Collaborative for Excellence in the Preparation of Teachers.

Two-year colleges have an integral role in the preparation of elementary school teachers, given the many students who complete all of their mathematics content course requirements at a community college. This session invites presentations which describe innovative practices and activities that focus on the strengthening of undergraduate content courses, the recruitment of students into teacher preparation programs, and other implementation initiatives. We are particularly interested in reports of collaborative models developed in partnership by two-year colleges and four-year institutions, as well as other joint activities which have been beneficial to both parties.

Submission Procedures for MAA Contributed Papers

After you have selected a session to which you wish to contribute a paper, forward the name(s) and address(es) of the author(s) and a one-page summary of your paper directly to the organizer (indicated above with an (*)). The summary should enable the organizer(s) to evaluate the appropriateness of your paper for the selected session. Consequently, you should include as much detailed information as possible within the one-page limitation.

Your summary must reach the designated organizer by Friday, September 4, 1998. Submission of proposals via e-mail is preferred.

The organizer will acknowledge receipt of all summaries. If the organizer accepts your paper, you will receive in-

structions about preparing an abstract. Please submit completed abstracts to the AMS by Thursday, October 1, 1998. Abstracts received after the deadline will not be published in the booklet of abstracts available in the meetings registration area during the meetings in San Antonio.

Gainesville, Florida

University of Florida

March 12–13, 1999

Meeting #940

Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: June 11, 1998
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Alexander N. Dranishnikov, University of Florida, *Title to be announced.*

Gregory F. Lawler, Duke University, *Title to be announced.*

Michael P. Loss, Georgia Institute of Technology, *Title to be announced.*

John G. Thompson, University of Florida, *Title to be announced.*

Special Sessions

Analytical Problems in Mathematical Physics (Code: AMS SS M1), **Eric A. Carlen**, Georgia Institute of Technology, and **Laszlo Erdos**, New York University-Courant Institute.

Computability Theory (Code: AMS SS G1), **Douglas Cenzer**, University of Florida, **Geoffrey Louis LaForte**, University of West Florida, and **Rick L. Smith**, University of Florida.

Continuum Theory and Dynamical Systems (Code: AMS SS A1), **Philip Boyland** and **Beverly Brechner**, University of Florida, and **John Mayer**, University of Alabama at Birmingham.

Finite Groups and Their Representations (Code: AMS SS D1), **Alexandre Turull**, University of Florida.

Galois Theory (Code: AMS SS E1), **J. G. Thompson** and **H. Voelklein**, University of Florida.

Geometric Topology (Code: AMS SS H1), **James E. Keesling** and **Alexander N. Dranishnikov**, University of Florida.

Groups and Geometries (Code: AMS SS F1), **Chat Ho** and **Peter Sin**, University of Florida.

Linear Operator Theory (Code: AMS SS J1), **Leiba Rodman**, College of William & Mary, and **Scott A. McCullough**, University of Florida.

Markov Processes and Potential Theory (Code: AMS SS C1), **Joe Glover** and **Murali Rao**, University of Florida.

Partial Differential Equations and Applications (Code: AMS SS K1), **Gang Bao** and **Yun-mei Chen**, University of Florida.

Structure and Representation Theory of Lattice-Ordered Groups and f-Rings (Code: AMS SS L1), **Jorge Martinez**, University of Florida.

The Erdös Legacy and Connections to Florida (Code: AMS SS B1), **Krishnaswami Alladi** and **Jean Larson**, University of Florida.

Urbana, Illinois

University of Illinois, Urbana-Champaign

March 18–21, 1999

Meeting #941

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: June 18, 1998
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Alexander Beilinson, MIT, *Title to be announced.*

Alexandra Bellow, Northwestern University, *Title to be announced.*

Igor Krichever, Columbia University, *Title to be announced.*

Steven Rallis, Ohio State University, *Title to be announced.*

Trevor Wooley, University of Michigan, *Title to be announced.*

Special Sessions

Diophantine Equations, Inequalities and Related Arithmetic Problems (Code: AMS SS F1), **Michael Bennett**, University of Illinois-Urbana, and **Trevor Wooley**, University of Michigan.

Elementary and Analytic Number Theory (Code: AMS SS E1), **Harold G. Diamond** and **A. J. Hildebrand**, University of Illinois-Urbana.

Galois Representations (Code: AMS SS C1), **Nigel Boston**, University of Illinois-Urbana, and **Michael Larsen**, University of Missouri.

Graph Theory (Code: AMS SS G1), **Douglas B. West**, University of Illinois-Urbana.

Martingales and Analysis (Code: AMS SS D1), **Joseph Max Rosenblatt, Renming Song**, and **Richard B. Sowers**, University of Illinois-Urbana.

Nonstandard Analysis (Code: AMS SS B1), **C. Ward Henson** and **Peter Loeb**, University of Illinois-Urbana.

Recent Progress in Elementary Geometry (Code: AMS SS A1), **John E. Wetzel**, University of Illinois-Urbana, and **Clark Kimberling**, University of Evansville.

Las Vegas, Nevada

University of Nevada-Las Vegas

April 10–11, 1999

Meeting #942

Western Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: July 10, 1998
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Special Sessions

Analysis and Geometry (Code: AMS SS I1), **Peter Li** and **Song-Ying Li**, University of California, Irvine.

Combinatorial Theory (Code: AMS SS G1), **Kequan Ding**, University of Illinois-Urbana, **Peter Shiue**, University of Las Vegas, Nevada, and **Yeong-Nan Yeh**, Academia Sinica.

Control and Dynamics of Partial Differential Equations (Code: AMS SS A1), **Zhonghai Ding**, University of Nevada-Las Vegas.

Diophantine Problems (Code: AMS SS J1), **Arthur Baragar**, University of Nevada-Las Vegas, and **Michael Bennett**, University of Illinois.

Geometric Group Theory (Code: AMS SS H1), **Eric M. Freden**, Southern Utah University, and **Eric Lewis Swenson**, Brigham Young University.

Graph Theory (Code: AMS SS B1), **Hung-Lin Fu**, University of National Chiao-Tung University, Taiwan, **Chris A. Rodger**, Auburn University, and **Michelle Schultz**, University of Nevada-Las Vegas.

Nonlinear PDEs—Methods and Applications (Code: AMS SS C1), **David Costa**, University of Nevada-Las Vegas.

Number Theory (Code: AMS SS F1), **Gennady Bachman**, University of Nevada-Las Vegas, **Richard A. Mollin**, University of Calgary, and **Peter J. Shiue**, University of Nevada-Las Vegas.

Numerical Analysis and Computational Mathematics (Code: AMS SS E1), **Jun Zhang**, University of Minnesota and University of Kentucky, and **Jennifer Zhao**, University of Michigan, Dearborn.

Set Theory (Code: AMS SS D1), **Douglas Burke** and **Derrick BuBose**, University of Nevada-Las Vegas.

Buffalo, New York

State University of New York at Buffalo

April 24–25, 1999

Meeting #943

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: July 24, 1998
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Michele M. Audin, University of Louis Pasteur, *Title to be announced.*

Russel Caflisch, University of California, Los Angeles, *Title to be announced.*

Jeff Smith, Purdue University, *Title to be announced.*

Alexander Voronov, MIT, *Title to be announced.*

Gregg J. Zuckerman, Yale University, *Title to be announced.*

Special Sessions

Combinatorics and Graph Theory (Code: AMS SS C1), **Harris Kwong**, SUNY College at Fredonia.

Smooth Categories in Geometry and Mechanics (Code: AMS SS A1), **F. William Lawvere**, SUNY at Buffalo.

Thin Films: Solid and Liquid (Code: AMS SS B1), **E. Bruce Pitman**, SUNY at Buffalo, and **Brian Spencer**, State University of New York at Buffalo.

Melbourne, Australia

Melbourne, Australia

July 12–16, 1999

Meeting #944

Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced

For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Jennifer Tour Chayes, Microsoft, *Title to be announced.*

Michael Eastwood, University of Adelaide, *Title to be announced.*

Vaughan Jones, University of California, Berkeley, *Title to be announced.*

Hyam Rubinstein, Melbourne University, *Title to be announced.*

Richard M. Schoen, Stanford University, *Title to be announced.*

Neil Trudinger, Australian National University, *Title to be announced.*

Special Sessions

Fluid Dynamics (Code: AMS SS C1), **Susan Friedlander**, Northwestern University, and **Roger H. J. Grimshaw**, Monash University.

Geometric Themes in Group Theory (Code: AMS SS A1), **Gustav I. Lehrer**, University of Sydney, **Cheryl E. Praeger**, University of Western Australia, and **Stephen D. Smith**, University of Illinois at Chicago.

Low Dimensional Topology (Code: AMS SS D1), **William H. Jaco**, Oklahoma State University, and **Hyam Rubinstein**, Melbourne University.

Mathematical Physics-Quantum Field Theory (Code: AMS SS B1), **Alan L. Carey**, University of Adelaide, **Paul A. Pearce**, University of Melbourne, and **Mary Beth Ruskai**, University of Massachusetts, Lowell.

Probability Theory and Its Applications (Code: AMS SS E1), **Timothy Brown**, University of Melbourne, **Phil Pollett**, University of Queensland, and **Ruth J. Williams**, University of California, San Diego.

Providence, Rhode Island

Providence College

October 2–3, 1999

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: January 6, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Austin, Texas

University of Texas at Austin

October 8–10, 1999

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: January 6, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Mikhail Kapranov, Northwestern University, *Title to be announced.*

John Roe, Oxford University and Pennsylvania State University, *Title to be announced.*

Catherine Sulem, University of Toronto, *Title to be announced.*

Tatiana Toro, University of Washington, *Title to be announced.*

Washington, District of Columbia

Marriott Wardman Park Hotel and Omni Shoreham Hotel

January 19–22, 2000

Joint Mathematics Meetings, including the 106th Annual Meeting of the AMS, 83rd Meeting of the Mathematical Association of America (MAA), with minisymposia and other special events contributed by the Society for Industrial and Applied Mathematics (SIAM), and the annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM).
Associate secretary: Robert M. Fossum
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 20, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Lowell, Massachusetts

University of Massachusetts, Lowell

April 1–2, 2000

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: July 1, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Notre Dame, Indiana

University of Notre Dame

April 7–9, 2000

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: July 7, 1999
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Toronto, Ontario, Canada

University of Toronto

September 22–24, 2000

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

New Orleans, Louisiana

New Orleans Marriott and ITT Sheraton New Orleans Hotel

January 10–13, 2001

Joint Mathematics Meetings, including the 107th Annual Meeting of the AMS, 84th Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM).
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 11, 2000
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Columbia, South Carolina

University of South Carolina

March 16–18, 2001

Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: June 15, 2000
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Williamstown, Massachusetts

Williams College

October 13–14, 2001

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: January 11, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Diego, California

San Diego Convention Center

January 6–9, 2002

Joint Mathematics Meetings, including the 108th Annual Meeting of the AMS and 85th Meeting of the Mathematical Association of America (MAA).
Associate secretary: Robert J. Daverman
Announcement issue of *Notices*: To be announced
Program issue of *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 4, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Presenters of Papers

Manhattan, Kansas; March 27–28, 1998

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Program of the Sessions

Manhattan, Kansas, March 27–28, 1998

Friday, March 27

Meeting Registration

7:30 AM – 5:00 PM **Front Entrance Lobby, Cardwell Hall**

Special Session on Quantum Groups and Applications, I

8:00 AM – 10:55 AM **Room 129, Cardwell Hall**

Organizers: **Ya S. Soibelman**, Kansas State University
Volodymyr V. Lyubashenko, Kansas State University

8:00AM (1) *Decomposition numbers for Hecke algebras at roots of unity.*
Fred Goodman, University of Iowa (932-16-240)

8:45AM (2) *Lattice gauge field theory based on a quantum group and deformation quantization.*
Doug Bullock, Boise State University, **Charles Frohman***, The University of Iowa, and **Joanna Kania-Bartoszynska**, Boise State University (932-22-189)

9:30AM (3) *Cremmer-Gervais quantum groups.*
Timothy J. Hodges, University of Cincinnati (932-16-167)

10:15AM (4) *Invariants of links and three manifolds related with quantum and classical Lie superalgebra osp(1/2).* Preliminary report.
Arkady Vaintrob, New Mexico State University (932-57-185)

Special Session on Quantum Topology, I

8:00 AM – 10:55 AM **Room 130, Cardwell Hall**

Organizers: **David N. Yetter**, Kansas State University
Louis Crane, Kansas State University

8:00AM Discussion

8:45AM (5) *Kauffman bracket skein modules and the noncommutative torus.*
Razvan Gelca*, University of Michigan, and **Charles Frohman**, University of Iowa (932-57-106)

9:30AM (6) *Vassiliev's knot invariants and the lower central series of the pure braid groups.* Preliminary report.
Theodore B. Stanford, U.S. Naval Academy (932-57-194)

10:15AM (7) *The Kauffman bracket skein module at roots of unity, and reduced observables.*
Doug Bullock, Boise State University, **Charles Frohman***, The University of Iowa, and **Joanna Kania-Bartoszynska**, Boise State University (932-57-188)

Special Session on Integrable Systems and their Applications, I

8:00 AM – 10:55 AM **Room 143, Cardwell Hall**

Organizer: **Kirill L. Vaninsky**, Kansas State University

8:00AM ▸ (8) *KdV and inverse scattering; A nonlinear Fourier transform.* Preliminary report.
Bjorn Birnir, UC San Diego (932-82-96)

8:45AM ▸ (9) *Correlations between zeros of a random polynomial.* Preliminary report.
Pavel Bleher, Purdue U at Indianapolis (932-30-98)

9:30AM ▸ (10) *Integrability with tori of arbitrary dimension.*
Oleg I. Bogoyavlenskij, Mathematics, Queen's Univ., Kingston, Canada (932-34-32)

10:15AM (11) *Elliptic algebro-geometric solutions of the AKNS hierarchy.*
Friedrich Gesztesy*, University of Missouri-Columbia, and **Rudi Weikard**, University of Alabama at Birmingham (932-35-37)

AMS Exhibit and Book Sale

8:00 AM – 5:00 PM **Common Room, Cardwell Hall**

The time limit for each contributed paper in the sessions is ten minutes. In the Special Sessions the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.
For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.
Papers flagged with a solid triangle (▸) have been designated by the author as being of possible interest to undergraduate students.
Abstracts of papers presented in the sessions at this meeting will be found in Volume 19, Issue 2 of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings. The middle two digits, e.g., 897-**20**-1136, refer to the Mathematical Reviews subject classification assigned by the individual author. Groups of papers for each subject are listed chronologically in the *Abstracts*. The last one to four digits, e.g., 897-20-**1136**, refer to the receipt number of the abstract; abstracts are further sorted by the receipt number within each classification.

Special Session on Partial Differential Equations and Inverse Problems, I

8:30 AM - 10:30 AM **Room 122, Cardwell Hall**

Organizer: **Alexander G. Ramm**, Kansas State University

8:30AM (12) *The Pompeiu problem.*
Alexander G. Ramm, Kansas State University (932-35-29)

9:00AM (13) *A priori bounds and multiple solutions for superlinear indefinite elliptic problems.*
Julian Lopez-Gomez, Universidad Complutense de Madrid (932-35-38)

9:30AM (14) *On the existence of positive solutions for general sublinear cooperative elliptic systems.*
Marcela Molina-Meyer, Universidad Carlos III de Madrid (932-35-39)

10:00AM (15) *Uniqueness for inverse electromagnetic problems in the class of non-smooth domains .*
Dorina I. Mitrea and **Marius S. Mitrea***, University of Missouri (932-35-31)

Special Session on Pictorial Methods in Low Dimensional Topology, I

8:30 AM - 10:45 AM **Room 120, Ackert Hall**

Organizer: **David R. Auckly**, University of California Berkeley

8:30AM (16) *Totally linked positive braids realize the braid index.*
Charles I. Delman* and **Joseph Nolan**, Eastern Illinois University (932-57-192)

9:15AM (17) *Computing the Casson-Walker-Lescop invariant and an associated polynomial invariant of links.*
Jeff Johannes, Indiana University (932-57-75)

10:00AM (18) *Lefschetz fibrations and 3-fold branched covering spaces.*
Terry Fuller, University of California, Irvine (932-57-61)

Special Session on Representation Theory of Lie Algebras, Algebraic Groups and Quantum Groups, I

8:30 AM - 10:50 AM **Room 103, Cardwell Hall**

Organizers: **Zongzhu Lin**, Kansas State University
Daniel Ken Nakano, Utah State University

8:30AM (19) *Central extensions of Frobenius kernels and their representations.* Preliminary report.
Dmitriy A. Rumynin, University of Massachusetts at Amherst. (932-17-158)

9:00AM (20) *Simple nonrestricted modules for restricted Cartan-type Lie algebras.* Preliminary report.
Randall R. Holmes, Auburn University (932-17-132)

9:30AM (21) *Tame and representation-finite blocks of enveloping algebras.*
Rolf X. Farnsteiner, Universität Bielefeld, Bielefeld, Germany (932-16-65)

10:00AM (22) *Indecomposable modules over classical Lie algebras.*
Daniel K. Nakano, Utah St. University, and **David R. Pollack***, Queen's University (932-17-103)

10:30AM (23) *Nonrestricted representations of the Lie algebra of type G_2.* Preliminary report.
James E. Humphreys, University of Massachusetts at Amherst (932-17-79)

Special Session on Linear Operators and Holomorphic Function Spaces, I

8:30 AM - 10:50 AM **Room 120, Cardwell Hall**

Organizer: **V. V. Peller**, Kansas State University

8:30AM (24) *Applications of matrix-valued Herglotz functions.*
Eduard Tsekanovskii* and **Friedrich Gesztesy**, University of Missouri-Columbia (932-47-40)

9:00AM (25) *A uniqueness property for functions with sparse spectrum.*
Alexei B. Aleksandrov, Kansas State University (932-42-156)

9:30AM (26) *Analytic capacity and singular integral operators on nonhomogeneous spaces.*
Serguei Treil, Michigan State University (932-47-143)

10:00AM (27) *Approximation of Cauchy-type integrals in multiply-connected domains by rational functions with preassigned poles.*
Genrikh Ts. Tumarkin, Retired Professor (932-30-129)

10:30AM (28) *Approximation by analytic functions in the integral metric.* Preliminary report.
Fernando Perez-Gonzalez, Universidad de La Laguna, **Dmitry Khavinson***, University of Arkansas, and **Harold S. Shapiro**, Royal Institute of Technology (932-30-50)

Special Session on Groups and Geometry, I

8:30 AM - 10:50 AM **Room 146, Cardwell Hall**

Organizer: **Ernest E. Shult**, Kansas State University

8:30AM (29) *Towards a theory of flocks of cones.* Preliminary report.
William E. Cherowitzo, University of Colorado at Denver (932-51-47)

9:00AM (30) *Generalized quadrangles with parameters (q+1, q-1)* . Preliminary report.
M. A. Miller* and **Stan E. Payne**, Univ. Colo - Denver (932-51-42)

9:30AM (31) *On the ovoids in the orthogonal space of type $O_6^+(8)$.* Preliminary report.
Athula D. Gunawardena*, **John Fuelberth** and **David Shaffer**, Wayne State College (932-51-223)

10:00AM (32) *c-extensions of P-geometries.*
Corinna Wiedorn, Martin-Luther Universität, Halle, Germany (932-20-63)

10:30AM (33) *Higher order buildings as $\mathbb{Z} \times \mathbb{Z}$-buildings.* Preliminary report.
Curtis D. Bennett, Bowling Green State University (932-20-90)

Special Session on Mathematics Education and the Internet, I

9:00 AM - 11:00 AM **Room 102, Cardwell Hall**

Organizer: **Andrew G. Bennett**, Kansas State University

9:00AM ▸ (34) *Mathwright library: Interactive math workbooks on the Web.*
Ladnor Geissinger, Univ. of North Carolina, Chapel Hill (932-98-202)

9:30AM ▸ (35) *Interactive mathematical documents via the IBM techexplorer Hypermedia Browser.*
Robert S. Sutor* and **Samuel S. Dooley**, IBM T. J. Watson Research Center (932-98-199)

10:00AM ▸ (36) *What can be done to improve the learning of undergraduate mathematics students.*
J. J. Uhl, University of Illinois, Urbana-Champaign (932-98-154)

10:30AM *Teaching at a distance.*
▸ (37) **Deborah Hughes-Hallett**, Harvard University (932-98-153)

Special Session on Nonlinear Problems, I

9:00 AM – 11:00 AM **Room 131, Cardwell Hall**

Organizers: **Lev Kapitanski**, Kansas State University
Eugene Wayne, Pennsylvania State University

9:00AM (38) *Global existence and global nonexistence of solutions of the Cauchy problem for a nonlinearly damped wave equation.* Preliminary report. **Howard A. Levine***, Iowa State University, **S. R. Park**, Kiemung University, Teagu, Korea, and **James B. Serrin**, University of Minnesota (932-35-135)

9:30AM (39) *Nonlinearity versus linearity in ridge approximation.* Preliminary report. **Konstantin I. Oskolkov**, University of Southern California (932-41-163)

10:00AM (40) *Optimal heat kernel estimates for Schrödinger operators with magnetic fields in two dimensions.* **Michael P. Loss***, Georgia Tech, and **Bernd Thaller**, Institut fuer Mathematik, Universitaet Graz, Austria (932-81-89)

10:30AM Discussion

Special Session on Cohomology of Finite Groups, I

9:00 AM – 10:50 AM **Room 145, Cardwell Hall**

Organizers: **John S. Maginnis**, Kansas State University
Stephen F. Siegel, University of Massachusetts

9:00AM (41) *Connective complex k-cohomology rings of finite groups.* Preliminary report. **Robert R. Bruner**, Wayne State University (932-55-126)

9:30AM (42) *The lower algebraic K-theory of prime triangle groups in $PSL_2(R)$.* Preliminary report. **Ethan Berkove**, United States Military Academy, **Daniel Juan-Pineda**, Instituto De Mathemáticas-Unidad Morelia, and **Kimberly Pearson***, Valparaiso University (932-19-92)

10:00AM (43) *Periodicity in cohomology and free and proper actions on $R^{(n)} \times S^{(m)}$.* **Olympia Talelli**, Univ. of Athens (932-20-10)

10:30AM (44) *The p-completion of a classifying space.* Preliminary report. **Robert Lakatos*** and **John Martino**, Western Michigan University (932-55-94)

Special Session on Abstract Harmonic Analysis, I

9:00 AM – 10:50 AM **Room 106, Ackert Hall**

Organizer: **Sadahiro Saeki**, Kansas State University

9:00AM (45) *Random weighted Sidon sets for compact groups.* **Katherine M. Adams** and **David E. Grow***, Univ. of Missouri - Rolla (932-43-219)

9:30AM (46) *Transference of weak-type estimates for H^1.* Preliminary report. **Brian P. Kelly***, and **Annela R. Kelly**, Northeast Louisiana University (932-43-190)

10:00AM (47) *Jensen's inequality for vector-valued functions on a compact abelian group.* **Annela R. Kelly*** and **Brian P. Kelly**, Northeast Louisiana University (932-43-187)

10:30AM (48) *L^p-boundedness of a singular integral operator.* **Abdel Naser J. Al-Hasan*** and **Dashan Fan**, University of Wisconsin-Milwaukee (932-43-88)

Special Session on Lie Groups, Algebraic Groups: Their Arithmetic and Representation Theory, I

9:00 AM – 11:00 AM **Room 144, Cardwell Hall**

Organizer: **Gopal Prasad**, University of Michigan-Ann Arbor

9:00AM (49) *Algebraic K-theory of arithmetic groups with applications in geometric topology.* **Boris Goldfarb**, Stanford University (932-22-117)

9:30AM (50) *Compactifications of symmetric and locally symmetric spaces.* Preliminary report. **Armand Borel**, Institute for Advanced Study, Princeton, and **Lizhen Ji***, University of Michigan (932-22-102)

10:15AM (51) *Applications of the theory of types to harmonic analysis.* **Colin J. Bushnell**, Kings College, London, **Guy Henniart**, Univ. Paris Sud, and **Phil Kutzko***, Univ. of Iowa (932-22-213)

Special Session on Numerical Analysis and Computational Mathematics, I

10:00 AM – 10:50 AM **Room 116, Ackert Hall**

Organizers: **Qisu Zou**, Kansas State University
Huanan Yang, Kansas State University

10:00AM (52) *A local extrapolation method for ENO schemes.* **Huanan Yang**, Kansas State University (932-65-142)

10:30AM (53) *The use of conservative schemes for a numerical solution to Boltzmann equation.* Preliminary report. **Andrei V. Shcheprov**, Kansas State University (932-65-217)

Invited Address

11:00 AM – 11:50 AM **Room 101, Cardwell Hall**

(54) *Congruence subgroup problem: Computation of the metaplectic kernel.* **Gopal Prasad**, University of Michigan-Ann Arbor

Invited Address

1:30 PM – 2:20 PM **Room 101, Cardwell Hall**

(55) *Euler equations of fluid motion and wavelets.* **Mikhail Vishik**, University of Texas at Austin

Special Session on Pictorial Methods in Low Dimensional Topology, II

2:30 PM – 5:15 PM **Room 120, Ackert Hall**

Organizer: **David R. Auckly**, University of California Berkeley

2:30PM (56) *Dehn surgery with non-degenerate boundary slope rows.* **Xingru Zhang**, Oklahoma State University (932-57-118)

3:30PM (57) *Simple manifolds and Dehn fillings.* **Cameron McA. Gordon**, University of Texas at Austin, and **Ying-Qing Wu***, University of Iowa (932-57-105)

4:30PM (58) *Counting genus and tunnel number .* **Martin G. Scharlemann**, UCSB, and **Jennifer C. Schultens***, EMory University (932-57-23)

Special Session on Nonlinear Problems, II

2:30 PM – 6:00 PM **Room 131, Cardwell Hall**

Organizers: **Lev Kapitanski**, Kansas State University
Eugene Wayne, Pennsylvania State University

2:30PM (59) *Asymptotic structures in nonlinear wave equations.* Preliminary report.
Jerry L. Bona, University of Texas, Austin (932-35-232)

3:00PM (60) *Stability of traveling waves in birefringent fiber optics.*
Keith S Promislow*, Simon Fraer University, and **Yi A. Li**, U. of Minnesota (932-35-124)

3:30PM (61) *Evans function analysis in the essential spectrum.*
Robert A. Gardner, University of Massachusetts, Amherst (932-35-136)

4:00PM (62) *Geometry of singular solutions and self-replicating pulses in the 1-D Gray-Scott model.*
Tasso J. Kaper, Boston University (932-35-149)

4:30PM (63) *Long-time asymptotics for the Kuramoto-Sivashinsky equation in a circular domain.* Preliminary report.
Vladimir V. Varlamov, Universidad Nacional de Colombia (932-35-53)

5:00PM Discussion

Special Session on Representation Theory of Lie Algebras, Algebraic Groups and Quantum Groups, II

2:30 PM – 5:50 PM **Room 103, Cardwell Hall**

Organizers: **Zongzhu Lin**, Kansas State University
Daniel Ken Nakano, Utah State University

2:30PM (64) *Tensor categories arising from semisimple Lie algebras.* Preliminary report.
Jan Paradowski, University of Massachusetts, Amherst (932-20-115)

3:00PM (65) *Generic patterns for extensions of simple modules for finite Chevalley groups.*
Cornelius Pillen, University of South Alabama (932-20-172)

3:30PM (66) *Polynomial representations of Chevalley groups and quantized enveloping algebras.*
Stephen R. Doty, Loyola Univ. Chicago (932-20-216)

4:00PM (67) *Results related to the semi-simplicity of modules for finite Chevalley groups.*
George Joseph McNinch, University of Notre Dame (932-20-243)

4:30PM (68) *On tensor products of the irreducible representations of GL(n) in positive characteristic.* Preliminary report.
Alexander S. Kleshchev, University of Oregon (932-20-41)

5:00PM (69) *Generic representation theory.*
Ed Cline*, **Brian Parshall** and **Leonard Scott**, AMS (932-20-180)

5:30PM (70) *On the cohomology of finite general linear groups in non-describing characteristic.*
Brian J. Parshall, Department of Mathematics (932-20-211)

Special Session on Abstract Harmonic Analysis, II

2:30 PM – 3:20 PM **Room 106, Ackert Hall**

Organizer: **Sadahiro Saeki**, Kansas State University

2:30PM (71) *Bourgain algebras of inductive limit algebras.* Preliminary report.
Thomas V. Tonev, The University of Montana - Missoula (932-43-56)

3:00PM (72) *On the spectra of Hardy's operator on cones in R^n.* Preliminary report.
Kecheng Zhou, California State University at Sacramento (932-42-48)

Special Session on Groups and Geometry, II

2:30 PM – 5:20 PM **Room 146, Cardwell Hall**

Organizer: **Ernest E. Shult**, Kansas State University

2:30PM (73) *The permutation modules for $GL(n+1, \mathbb{F}_q)$ acting on $\mathbb{P}^n(\mathbb{F}_q)$ and $\mathbb{F}_q{}^{n+1}$.*
Matthew K. Bardoe, None, and **Peter K. Sin***, University of Florida (932-20-34)

3:00PM (74) *Restrictions of $\Omega_n^\epsilon(q)$-modules to alternating groups.* Preliminary report.
William J. Husen, Wayne State University (932-20-78)

3:30PM (75) *Irreducibility of alternating and symmetric squares.*
Kay Magaard*, Wayne State University, and **Gunter Malle**, Universitaet Heidelberg (932-20-74)

4:00PM (76) *Small modules for finite simple groups.* Preliminary report.
Gernot Stroth*, Universität Halle, and **Ulrich Meierfrankenfeld**, Michigan State University (932-20-64)

4:30PM (77) *Projective representations in cross characteristic for some classical groups.*
Corneliu G. Hoffman, Univ. of Southern California (932-20-44)

5:00PM ▸ (78) *Valentiner's group: The action on $\mathbf{CP}^2$ of the alternating group $\mathcal{A}_7$.*
Scott Crass, Buffalo State College (932-20-27)

Special Session on Quantum Groups and Applications, II

2:30 PM – 4:40 PM **Room 129, Cardwell Hall**

Organizers: **Ya S. Soibelman**, Kansas State University
Volodymyr V. Lyubashenko, Kansas State University

2:30PM (79) *Quantization of the Knizhnik-Zamolodchikov-Bernard equations.*
Aleksander Varchenko, University of North Carolina (932-81-234)

3:15PM (80) *Segal's conjecture and conformal field theory.*
Shrawan Kumar, University of North Carolina (932-17-238)

4:00PM (81) *Boson-Fermion identities for affine Lie algebra characters.*
Masato Okado, University of Osaka (932-17-241)

Special Session on Quantum Topology, II

2:30 PM – 5:25 PM **Room 130, Cardwell Hall**

Organizers: **David N. Yetter**, Kansas State University
Louis Crane, Kansas State University

2:30PM (82) *How to integrate a knot.*
Charles Frohman, University of Iowa, and **Joanna Kania-Bartoszynska***, Boise State University (932-57-191)

3:15PM (83) *Discrete physics and topological quantum field theory.*
Louis H. Kauffman, Univ of Illinois at Chicago (932-55-173)

4:00PM (84) *Diagrammatic moves associated to higher category structures.*
J. Scott Carter*, University of South Alabama, **Louis H. Kauffman**, University of Illinois, Chicago, and **Masahico Saito**, University of South Florida (932-57-134)

4:45PM (85) *State sums for triangulated 4-manifolds and their diagrammatics.* Preliminary report.
J. Scott Carter, University of South Alabama, **Louis H. Kauffman**, University of Illinois at Chicago, and **Masahico Saito***, University of South Florida (932-57-131)

Special Session on Lie Groups, Algebraic Groups: Their Arithmetic and Representation Theory, II

2:30 PM – 6:30 PM **Room 144, Cardwell Hall**

Organizer: **Gopal Prasad**, University of Michigan-Ann Arbor

2:30PM (86) *Cohomology of some arithmetic quotients of* $F_{4,1}$ Preliminary report.
Wee Teck Gan, Harvard University (932-22-197)

3:00PM (87) *Boundary values of forms on p-adic symmetric spaces.* Preliminary report.
Jeremy T. Teitelbaum, Univ. of Illinois at Chicago (932-11-179)

4:15PM (88) *Foliation-preserving maps between solvmanifolds.*
Holly Bernstein, Washington University, and **Dave Witte***, Oklahoma State University (932-22-186)

5:00PM (89) *On non-Riemannian homogeneous spaces with no compact quotients.*
Hee Oh, Oklahoma State University (932-22-214)

5:30PM (90) *A comparison of zeros of L-functions.*
Ravi Raghunathan, California Institute of Technology (932-11-201)

6:00PM (91) *Depth zero representations and theta dichotomy for finite reductive dual pairs.* Preliminary report.
Shu-Yen Pan, Cornell University (932-22-159)

Special Session on Partial Differential Equations and Inverse Problems, II

3:00 PM – 5:30 PM **Room 122, Cardwell Hall**

Organizer: **Alexander G. Ramm**, Kansas State University

3:00PM (92) *Integrable systems in differential geometry.*
Vladimir E. Zakharov, Landau Institute for Theoretical Physics (932-35-62)

3:30PM (93) *Initial-boundary value problems for the inelastic material behavior of metals.*
Hans-Dieter Alber, Technische Universität Darmstadt (932-35-35)

4:00PM (94) *Inverse spectral problems with partial knowledge of the potential.*
Fritz Gesztesy*, University of Missouri-Columbia, and **Barry Simon**, CALTECH (932-34-19)

4:30PM (95) *Two points blow-up for the nonlinear Schrödinger equation with quartic self-interacting potential on* $1+1$ *space-time.*
Hayato Nawa, Nagoya University (932-35-25)

5:00PM (96) *On new modifications of Newton method with the applications to inverse scattering problems.* Preliminary report.
Ruben G. Airapetyan, Kansas State University (932-35-26)

Special Session on Mathematics Education and the Internet, II

3:00 PM – 5:00 PM **Room 102, Cardwell Hall**

Organizer: **Andrew G. Bennett**, Kansas State University

3:00PM ▸ (97) *Interactive geometry on the Internet: Four "site visits".*
Thomas F. Banchoff, Brown University (932-51-68)

3:30PM ▸ (98) *Mathematics on the Web: Looking back and looking forward.*
Davide Cervone, Union College (932-98-169)

4:00PM ▸ (99) *Training teaching assistants with the help of the Internet.*
Judith Baxter, University of Illinois at Chicago (932-98-171)

4:30PM ▸ (100) *Effective design of computer-based instructional materials for mathematics.*
William J. Mueller, University of Arizona (932-98-43)

Special Session on Cohomology of Finite Groups, II

3:00 PM – 5:20 PM **Room 145, Cardwell Hall**

Organizers: **John S. Maginnis**, Kansas State University
Stephen F. Siegel, University of Massachusetts

3:00PM ▸ (101) *Splitting classifying spaces of products: an algebraic perspective (preliminary report).* Preliminary report.
Jason G. Douma, Carthage College (932-20-77)

3:30PM (102) *On stably decomposing products of classifying spaces.*
Jason Douma, Northwestern University, **John Martino***, Western Michigan University, and **Stewart Priddy**, Northwestern University (932-55-17)

4:30PM (103) *The mod two cohomology of the smallest Suzuki group.* Preliminary report.
Deborah A. Sherman-Denvir, Truman State University (932-18-86)

5:00PM (104) *Local-subgroup structure conditions and homology approximations.* Preliminary report.
Stephen D. Smith, University of Illinois at Chicago (932-20-05)

Special Session on Linear Operators and Holomorphic Function Spaces, II

3:00 PM – 5:50 PM **Room 120, Cardwell Hall**

Organizer: **V. V. Peller**, Kansas State University

3:00PM (105) *Zero sets and invariant subspaces of Hilbert spaces of analytic functions.* Preliminary report.
Rick S. Chartrand, University of California at Berkeley (932-32-36)

3:30PM (106) *Operators on spaces of analytic functions in the Dixmier class.*
Mark C. Ho, National Sun Yat-Sen University (932-47-18)

4:00PM (107) *Carleson imbedding and Nehari-Aak theorems for Hankel operators in weighted spaces with two Szego weights.*
Cora Sadosky*, Howard University, and **Mischa Cotlar**, Universidad Central de Venezuela (932-47-228)

4:30PM (108) *Restoration of unimodular functions.*
Richard Rochberg, Washington University (932-46-168)

5:00PM (109) *Frame theory and functional analysis .*
David Larson, Texas A&M University (932-46-227)

5:30PM (110) *Composition operators and a certain pull-back measure formula.*
Valentin Matache, The University of Kansas (932-47-49)

Special Session on Numerical Analysis and Computational Mathematics, II

3:00 PM – 5:20 PM **Room 116, Ackert Hall**

Organizers: **Qisu Zou**, Kansas State University
Huanan Yang, Kansas State University

3:00PM (111) *Analytical solutions of lattice Boltzmann BGK model.*
Xiaoyi He, Los Alamos National Lab, **Qisu Zou***, Kansas State University, **Lishi Luo**, NASA Langley Research Center, and **Micah Dembo**, Boston University (932-65-151)

3:30PM ▸ (112) *A study of monitor functions for the variational approach of adaptive mesh generation.* Preliminary report.
Weizhang Huang, University of Kansas (932-65-12)

4:00PM ▸ (113) *Characterization of the natural measure by unstable periodic orbits in chaotic systems.*
Ying-Cheng Lai, The University of Kansas (932-58-14)

4:30PM (114) *Scale up in porous media.* Preliminary report.
Shuling Hou*, **Tim C. Wallstrom**, **David H. Sharp**, Los Alamos National Lab, **Mike A. Christie**, British Exploration Inc., and **Lou J. Durlofsky**, Chevron Petroleum Technology Co. (932-65-20)

5:00PM (115) *Approximation by analytic and harmonic functions,incompressible vector fields and temperature distributions.*
Sergey Lvin, University of Maine (932-41-07)

Special Session on Integrable Systems and their Applications, II

3:00 PM – 5:55 PM **Room 143, Cardwell Hall**

Organizer: **Kirill L. Vaninsky**, Kansas State University

3:00PM ▸ (116) *Determinant representations for quantum correlation functions of completely integrable models.* Preliminary report.
Vladimir Korepin, SUNY Stony Brook (932-81-107)

3:45PM ▸ (117) *Hamiltonian theory of 2D soliton equations and its applications.* Preliminary report.
Igor Krichever, Columbia University (932-14-108)

4:30PM ▸ (118) *On geometry of shallow water equation.* Preliminary report.
Henry McKean, Courant Institute (932-35-128)

5:15PM ▸ (119) *Laplace transformations and spectral theory. Differential and difference operators.* Preliminary report.
Sergey Novikov, U of Maryland (932-35-109)

Session on Session for Contributed Papers

3:00 PM – 4:10 PM **Room 105, Ackert Hall**

3:00PM (120) *Groups of analytical homeomorphisms of the low-dimensional manifolds are p-groups.* Preliminary report.
Boris S. Khots, Compressor Controls Corp. (932-22-82)

3:15PM (121) *The Jones-Witten invariant for non-simply-connected Lie groups.* Preliminary report.
Stephen F. Sawin, Fairfield University (932-81-93)

3:30PM ▸ (122) *Schroedinger equation and oscillatory Hilbert transforms of second degree.* Preliminary report.
Konstantin I. Oskolkov, University of Southern California (932-35-162)

3:45PM (123) *An inverse problem in elastodynamics.*
Lizabeth V. Rachele, Purdue University (932-35-222)

Special Session on Quantum Groups and Applications, III

7:00 PM – 9:10 PM **Room 129, Cardwell Hall**

Organizers: **Ya S. Soibelman**, Kansas State University
Volodymyr V. Lyubashenko, Kansas State University

7:00PM (124) *The analogue of Shafarevich's conjecture for odd dimensional Calabi-Yau manifolds.*
Andrey Todorov, University of California (932-57-239)

7:45PM (125) *Braided groups and quantum geometry.*
Shahn Majid, Research Fellow (932-20-160)

8:30PM (126) *Algebra and geometry over free associative algebras.*
Vladimir Retakh, University of Arkansas (932-16-60)

Saturday, March 28

Meeting Registration

7:30 AM – NOON **Front Entrance Lobby, Cardwell Hall**

AMS Exhibit and Book Sale

7:30 AM – NOON **Common Room, Cardwell Hall**

Special Session on Representation Theory of Lie Algebras, Algebraic Groups and Quantum Groups, III

8:00 AM – 10:50 AM **Room 103, Cardwell Hall**

Organizers: **Zongzhu Lin**, Kansas State University
Daniel Ken Nakano, Utah State University

8:00AM (127) *Irreducible weight modules over $gl(\infty)$.* Preliminary report.
Ivan Dimitrov* and **Ivan Penkov**, University of California, Riverside (932-17-157)

8:30AM (128) *Total positivity for flag varieties and canonical bases.*
Konstanze Rietsch, M.I.T. (932-20-81)

9:00AM (129) *Level one representations of the quantum affine algebra $U_q(G_2^{(1)})$.*
Naihuan Jing, North Carolina State University (932-17-138)

9:30AM (130) *Path realizations of crystals for Demazure modules.*
Kailash C. Misra, North Carolina State University (932-17-133)

10:00AM (131) *Representation theory and integral cohomology of real flag manifolds.*
Luis G. Casian* and **Robert J. Stanton**, The Ohio State University (932-22-145)

10:30AM (132) *Orbital varieties and standard domino tableaux for classical groups.*
William M. McGovern, University of Washington (932-22-16)

Special Session on Linear Operators and Holomorphic Function Spaces, III

8:00 AM – 10:50 AM **Room 120, Cardwell Hall**

Organizer: **V. V. Peller**, Kansas State University

8:00AM (133) *When is zero an eigenvalue for the self-commutator of a subnormal operator?*
Nathan S. Feldman, Michigan State University (932-47-140)

8:30AM (134) *Products of Hankel operators.*
Daoxing Xia and **Dechao Zheng***, Vanderbilt University (932-47-91)

9:00AM (135) *Visual information in a feedback loop.* Preliminary report.
Allen R. Tannenbaum, University of Minnesota (932-93-178)

9:30AM (136) *Hyperreflexivity and factorization properties.*
Hari Bercovici, Indiana University (932-47-101)

10:00AM (137) *From analytic function theorems to operator theorems to nonlinear operator theorems.* Preliminary report.
J. William Helton, Univ. Calif. San Diego (932-47-152)

10:30AM (138) *Linear operators and holomorphic function spaces.* Preliminary report.
Joseph A. Ball*, Virginia Tech, and **Victor Vinnikov**, Weizmann Institute of Science (932-32-148)

Special Session on Groups and Geometry, III

8:00 AM – 10:50 AM **Room 146, Cardwell Hall**

Organizer: **Ernest E. Shult**, Kansas State University

8:00AM (139) *Collineations of finite projective planes.* Preliminary report.
Chat-Yin Ho, Univ of Florida (932-51-174)

8:30AM (140) *The 2-transitive complex Hadamard matrices.* Preliminary report.
G. E. Moorhouse, Univ. of Wyoming (932-05-55)

9:00AM (141) *Antipodal distance transitive covers of complete graphs.*
Chris D. Godsil, Univeristy of Waterloo, **Robert A. Liebler***, Colorado State University, and **Cheryl Praeger, E.**, University of Western Australia (932-05-46)

9:30AM (142) *Flag-transitive hyperplane complements of classical generalized quadrangles.*
Antonio Pasini, University of Siena, Italy, and **Sergey Shpectorov***, Bowling Green State University (932-20-72)

10:00AM (143) *Characterization of P-geometries related to M_{22}.*
Jonathan I. Hall, Michigan State University (932-20-183)

10:30AM (144) *On the sphericity and simple connectivity of finite regular posets.* Preliminary report.
Chao Ku, California Institute of Technology (932-20-144)

Special Session on Quantum Groups and Applications, IV

8:00 AM – 10:55 AM **Room 129, Cardwell Hall**

Organizers: **Ya S. Soibelman**, Kansas State University
Volodymyr V. Lyubashenko, Kansas State University

8:00AM (145) *Duality in infinite dimensional Fock representations.*
Weiqiang Wang, Max-Planck-Institute, Bonn (932-81-233)

8:45AM (146) *$W_{1+\infty}$ as conformal algebra.*
Andrey Radul, Howard University (932-81-236)

9:30AM (147) *Decomposing representations of quantum affine algebras.*
Michael Kleber, U.C. Berkeley (932-17-15)

10:15AM (148) *Quantized conformal blocks.*
Evgeny Mukhin, University of North Carolina (932-81-231)

Special Session on Quantum Topology, III

8:00 AM – 10:55 AM **Room 130, Cardwell Hall**

Organizers: **David N. Yetter**, Kansas State University
Louis Crane, Kansas State University

8:00AM Discussion

8:45AM Discussion

9:30AM (149) *State sum models for quantum gravity.* Preliminary report.
John W. Barrett, University of Nottingham (932-83-209)

10:15AM (150) *State sum models, spin foam models, quantum gravity.*
Carlo Rovelli, Pittsburgh University (932-83-116)

Special Session on Partial Differential Equations and Inverse Problems, III

8:30 AM – 11:00 AM **Room 122, Cardwell Hall**

Organizer: **Alexander G. Ramm**, Kansas State University

8:30AM (151) *Multidimentional inverse scattering problem with non-reflecting boundary conditions.*
Semion Gutman, University of Oklahoma (932-35-30)

9:00AM (152) *Critical exponents for systems of equations.*
Keng Deng, University of Southwestern Louisiana (932-35-22)

9:30AM (153) *Transmission problems in nonsmooth domains.* Preliminary report.
Rodolfo H. Torres, University of Kansas (932-35-69)

10:00AM (154) *Semilinear subelliptic equations and CR Yamabe problem for prescribing curvatures on the Heisenberg and stratified groups.*
Guozhen Lu, Wright State University (932-35-100)

10:30AM ▸ (155) *Sources for inverting the Helmhotz equation on a cylindrical region.*
Frank Stenger, University of Utah (932-35-120)

Special Session on Pictorial Methods in Low Dimensional Topology, III

8:30 AM – 10:45 AM **Room 120, Ackert Hall**

Organizer: **David R. Auckly**, University of California Berkeley

8:30AM (156) *Generalized suspension laminations.* Preliminary report.
Rachel Roberts, Washington University, St Louis (932-57-193)

9:15AM (157) *Canonical genus, free genus, and volume.* Preliminary report.
Mark Brittenham, University of North Texas (932-57-141)

10:00AM (158) *Tight contact structures on lens spaces.*
John B. Etnyre, Stanford University (932-57-45)

Special Session on Integrable Systems and their Applications, III

8:30 AM – 10:40 AM **Room 143, Cardwell Hall**

Organizer: **Kirill L. Vaninsky**, Kansas State University

8:30AM ▸ (159) *Calogero-Moser systems in Seiberg-Witten theory.* Preliminary report. **D.H. Phong**, Columbia University (932-35-110)

9:15AM (160) *Weil's reciprocity and (differential) resultants.* Preliminary report. **Jean-Luc Brylinski**, Pennsylvania State University, and **Emma Previato***, Boston University (932-42-73)

10:00AM ▸ (161) *Involutive functionals, infinite dimensional tori and neighboring tori.* Preliminary report. **Marty Schwarz**, Northeastern University (932-35-111)

Special Session on Mathematics Education and the Internet, III

9:00 AM – 11:00 AM **Room 102, Cardwell Hall**

Organizer: **Andrew G. Bennett**, Kansas State University

9:00AM ▸ (162) *Web-based labs in elementary differential equations.* **Andrew G. Bennett**, Kansas State University (932-98-200)

9:30AM ▸ (163) *A colloquium on the mathematics of games.* **John W. Emert**, Ball State University (932-00-59)

10:00AM ▸ (164) *On line testing in mathematics courses.* **Mark Sapir**, Vanderbilt University (932-98-170)

10:30AM ▸ (165) *WeBWorK—Web based homework delivery.* Preliminary report. **Michael E. Gage*** and **Arnold K. Pizer**, University of Rochester (932-00-70)

Special Session on Cohomology of Finite Groups, III

9:00 AM – 10:50 AM **Room 145, Cardwell Hall**

Organizers: **John S. Maginnis**, Kansas State University
Stephen F. Siegel, University of Massachusetts

9:00AM (166) *Complexes and vanishing of cohomology for group schemes .* **Christopher P. Bendel***, University of Notre Dame, and **Daniel K. Nakano**, Utah State University (932-20-24)

9:30AM (167) *Extensions of modules over Schur algebras, symmetric groups and Hecke algebras .* **Stephen R. Doty**, Loyola University, **Karin Erdmann**, Oxford University, and **Daniel K. Nakano***, Utah St. University (932-20-76)

10:00AM ▸ (168) *Cohomology of restricted Lie algebras and finite groups .* Preliminary report. **Joerg Feldvoss**, University of Hamburg (932-20-84)

10:30AM (169) *Transfer maps and virtual projectivity.* **Jon F. Carlson**, University of Georgia, **Chuang Peng**, Morehouse College, and **Wayne W. Wheeler***, University of Georgia (932-20-80)

Special Session on Numerical Analysis and Computational Mathematics, III

9:00 AM – 10:50 AM **Room 116, Ackert Hall**

Organizers: **Qisu Zou**, Kansas State University
Huanan Yang, Kansas State University

9:00AM Discussion

9:30AM (170) *A discontinuous Galerkin finite element method for Hamilton-Jacobi equations.* **Changqing Hu** and **Chi-Wang Shu***, Brown University (932-65-121)

10:00AM (171) *A robust grid based front tracking method for fluid interface instabilities.* **Xiaolin Li**, Indiana University-Purdue University, Indianapolis (932-65-127)

10:30AM Discussion

Special Session on Lie Groups, Algebraic Groups: Their Arithmetic and Representation Theory, III

9:00 AM – 11:00 AM **Room 144, Cardwell Hall**

Organizer: **Gopal Prasad**, University of Michigan-Ann Arbor

9:00AM (172) *Hecke algebras and p-adic SL(N).* **Alan J. Roche**, Purdue University (932-22-204)

9:30AM (173) *Hecke algebras and parabolic induction.* Preliminary report. **Anne-Marie Aubert**, Ecole Normale Superieure, **Philip C. Kutzko**, University of Iowa, and **Lawrence Morris***, Clark University (932-22-206)

10:15AM (174) *Some applications of the SL(2,R) action on Teichmuller space.* Preliminary report. **Alex Eskin**, University of Chicago (932-22-196)

Special Session on Nonlinear Problems, III

9:30 AM – 11:00 AM **Room 131, Cardwell Hall**

Organizers: **Lev Kapitanski**, Kansas State University
Eugene Wayne, Pennsylvania State University

9:30AM Discussion

10:00AM (175) *Convergence of the vanishing viscosity approximation for superpositions of confined eddies.* **Milton C. Lopes**, Filho, **Helena J. Nussenzveig-Lopes**, IMECC-UNICAMP, and **Yuxi Zheng***, Indiana University (932-35-122)

10:30AM (176) *Cahn-Hilliard description of secondary flows of a viscous incompressible fluid in an unbounded domain.* **Guido Schneider**, University Hannover (932-35-123)

Invited Address

11:00 AM – 11:50 AM **Room 101, Cardwell Hall**

(177) *Invariant manifolds and the asymptotics of dissipative partial differential equations.* **Clarence Eugene Wayne**, Pennsylvania State University, University Park

Invited Address

1:30 PM – 2:20 PM **Room 101, Cardwell Hall**

(178) *Stability and bifurcations in dynamical systems.* **Zihong Jeff Xia**, Northwestern University

Special Session on Partial Differential Equations and Inverse Problems, IV

2:30 PM – 3:00 PM **Room 122, Cardwell Hall**

Organizer: **Alexander G. Ramm**, Kansas State University

2:30PM (179) *Homogenization of a minimization problem for Ginzburg -Landau functional and superconducting composites.*
Leonid V. Berlyand*, Penn State University, and **Eugene Ya. Khruslov**, Institute of Low Temperature and Engineering, Ukranian Academy (932-35-230)

Special Session on Pictorial Methods in Low Dimensional Topology, IV

2:30 PM – 5:15 PM **Room 120, Ackert Hall**

Organizer: **David R. Auckly**, University of California Berkeley

2:30PM (180) *The SU(3) Casson invariant via gauge theory I.*
Hans U. Boden*, Ohio State, and **Christopher M. Herald**, Swarthmore (932-57-221)

3:30PM (181) *The SU(3) Casson invariant via gauge theory.*
Hans U. Boden, Ohio State University Mansfield, and **Christopher M. Herald***, Swarthmore College (932-57-218)

4:30PM (182) *Hurwitz spaces and braid group representations.* Preliminary report.
Eric P. Klassen* and **Yaacov Kopeliovich**, Florida State University (932-30-205)

Special Session on Nonlinear Problems, IV

2:30 PM – 5:00 PM **Room 131, Cardwell Hall**

Organizers: **Lev Kapitanski**, Kansas State University
Eugene Wayne, Pennsylvania State University

2:30PM (183) *Index theorems and the Heisenberg caluclus.*
Charles L. Epstein, U. of Penn (932-58-150)

3:00PM (184) *On limits of rescaling.* Preliminary report.
Igor Y. Rodnianski, Kansas State University (932-35-198)

3:30PM (185) *Evolution semigroups for infinite dimensional cocycles.*
Yuri Latushkin, University of Missouri (932-34-119)

4:00PM (186) *Invariant Tori for periodically perturbed planar oscillators.* Preliminary report.
Carmen Chicone, University of Missouri (932-58-28)

4:30PM Discussion

Special Session on Representation Theory of Lie Algebras, Algebraic Groups and Quantum Groups, IV

2:30 PM – 5:50 PM **Room 103, Cardwell Hall**

Organizers: **Zongzhu Lin**, Kansas State University
Daniel Ken Nakano, Utah State University

2:30PM (187) *The indecomposable decomposition of the tensor representation of the classical Lie superalgebra* $\mathfrak{p}(n)$. Preliminary report.
Dongho Moon, University of Wisconsin-Madison (932-17-164)

3:00PM (188) *Representations for Lie superalgebra* $spo(2m,1)$.
Chanyoung Lee Shader, University of Wyoming (932-17-85)

3:30PM (189) *Maximal subalgebras of the simple modular Lie algebras.*
Gaik M. Melikian, UW-Milwaukee (932-17-208)

4:00PM (190) *Imaginary Verma modules for quantum affine Lie algebras.* Preliminary report.
Viatcheslav M. Futorny*, **Alexander N. Grishkov**, Universidade de Sao Paulo, and **Duncan J. Melville**, St. Lawrence University (932-17-165)

4:30PM (191) *Quantum deformations of α-stratified modules.*
Viatcheslav M. Futorny, U. de Sao Paulo, and **Duncan J. Melville***, St. Lawrence University (932-17-139)

5:00PM (192) *Modular representation theory for affine Hecke algebras.* Preliminary report.
Arun Ram*, Princeton University, and **Jacqui Ramagge**, University of Newcastle (932-16-182)

5:30PM (193) *A quantum octonion algebra.*
Georgia Benkart* and **José M. Perez-Izquierdo**, University of Wisconsin, Madison (932-17-87)

Special Session on Groups and Geometry, IV

2:30 PM – 5:20 PM **Room 146, Cardwell Hall**

Organizer: **Ernest E. Shult**, Kansas State University

2:30PM (194) *A lemma on quasithin groups.* Preliminary report.
Michael Aschbacher, Caltech (932-20-104)

3:00PM (195) *Geometrical considerations in the classification of quasithin groups.* Preliminary report.
Stephen D. Smith, University of Illinois at Chicago (932-20-08)

3:30PM (196) *Framed vertex operator algebras and rank one lattice type VOAs.*
Robert L. Griess Jr., University of Michigan (932-20-207)

4:00PM (197) *$Sz(8)$ embeds in $E_8(C)$.* Preliminary report.
Alexander J. Ryba, University of Michigan (932-20-212)

4:30PM (198) *SL(2,7) and PSL(2,7) Subgroups of the Lie Group E8(C).*
Michael J. Kantor, Knox College (932-20-175)

5:00PM (199) *Classical groups as monodromy composition factors.*
Daniel E. Frohardt* and **Kay Magaard**, Wayne State University (932-20-181)

Special Session on Quantum Groups and Applications, V

2:30 PM – 4:40 PM **Room 129, Cardwell Hall**

Organizers: **Ya S. Soibelman**, Kansas State University
Volodymyr V. Lyubashenko, Kansas State University

2:30PM (200) *Some problems in deformation quantization.*
Boris Tsygan, Penn State University (932-16-237)

3:15PM (201) *Noncommutative geometry based on commutator expansions.*
Michail Kapranov, Northwestern University (932-14-235)

4:00PM (202) *Quantum field theory on algebraic curves.* Preliminary report.
Leon A. Takhtajan, SUNY at Stony Brook (932-81-229)

Special Session on Quantum Topology, IV

2:30 PM – 4:40 PM **Room 130, Cardwell Hall**

Organizers: **David N. Yetter**, Kansas State University
Louis Crane, Kansas State University

2:30PM (203) *Cabling HOMFLY-Vassiliev knot invariants.*
Sergei Chmutov, Program System Institute, Pereslavl-Zalessky, Russia, **Oliver T. Dasbach**, Columbia University, and **Arkady Vaintrob***, New Mexico State University (932-57-184)

3:15PM (204) $S_{2,\infty}(H_n \# H_m; Z[A^{\pm 1}], A)$. Preliminary report.
Józef H. Przytycki, George Washington University (932-57-210)

4:00PM (205) *Lattice gauge field theory.*
Doug Bullock*, George Washington Univ., **Charles Frohman**, University of Iowa, and **Joanna Kania-Bartoszynska**, Boise State University (932-57-125)

Special Session on Lie Groups, Algebraic Groups: Their Arithmetic and Representation Theory, IV

2:30 PM – 6:00 PM **Room 144, Cardwell Hall**

Organizer: **Gopal Prasad**, University of Michigan-Ann Arbor

2:30PM (206) *Moy-Prasad filtrations and harmonic analysis on G.* Preliminary report.
Stephen DeBacker, The University of Chicago (932-22-83)

3:00PM (207) *The tempered spectrum of classical p-adic groups via twisted endoscopy.*
David Goldberg*, Purdue Universty, and **Freydoon Shahidi**, Purdue University (932-22-215)

4:15PM (208) *Symmetric cube L-functions for GL_2 are entire.*
Henry H. Kim*, Southern Illinois University, and **Freydoon Shahidi**, Purdue University (932-11-146)

5:00PM (209) *The moment mapping on spherical nilpotent orbits.* Preliminary report.
Donald R. King, Northeastern University (932-20-51)

5:30PM (210) *On the DPW method for general Lie groups.* Preliminary report.
Josef F. Dorfmeister, University of Kansas, and **Vladimir D. Balan***, University of Kansas / Politehnica University of Bucharest (932-22-52)

Special Session on Mathematics Education and the Internet,IV

3:00 PM – 5:00 PM **Room 102, Cardwell Hall**

Organizer: **Andrew G. Bennett**, Kansas State University

3:00PM ▸ (211) *Using the Internet for teaching and learning mathematics outside the traditional course structure.* Preliminary report.
Eugene A. Klotz, Math Forum/Swarthmore College (932-98-71)

3:30PM ▸ (212) *Student evaluation of the quality of history of mathematics Web pages.* Preliminary report.
V. Frederick Rickey, Bowling Green State University (932-01-203)

4:00PM Discussion

Special Session on Cohomology of Finite Groups, IV

3:00 PM – 4:50 PM **Room 145, Cardwell Hall**

Organizers: **John S. Maginnis**, Kansas State University
Stephen F. Siegel, University of Massachusetts

3:00PM (213) *Phantom maps and purity in modular representation theory (Part 1).* Preliminary report.
David J. Benson and **Gilles Ph. Gnacadja***, University of Georgia (932-20-57)

3:30PM (214) *Phantom maps and purity in modular representation theory (Part 2).* Preliminary report.
David J. Benson* and **Gilles Ph. Gnacadja**, University of Georgia (932-20-58)

4:00PM (215) *Stable endomorphism rings of idempotent E-modules.*
Peteris Daugulis, University of Georgia (932-15-67)

4:30PM (216) *Self-equivalences of stable module categories.*
Jon F. Carlson*, University of Georgia, and **Raphaël Rouquier**, Université Denis Diderot (932-20-66)

Special Session on Linear Operators and Holomorphic Function Spaces, IV

3:00 PM – 5:50 PM **Room 120, Cardwell Hall**

Organizer: **V. V. Peller**, Kansas State University

3:00PM (217) *Carleson measures and multipliers for Dirichlet spaces.*
Zhijian Wu, University of Alabama (932-47-166)

3:30PM (218) *C* algebras generated by a subnormal operator.*
Kit C. Chan*, Bowling Green State University, and **Zeljko Cuckovic**, The University of Toledo (932-47-137)

4:00PM (219) *Cyclic subnormal operators without disjoint invariant subspaces.*
Robert F. Olin, Virginia Tech (932-47-130)

4:30PM (220) *Analytic BMO on the d-torus.* Preliminary report.
Sarah H. Ferguson*, Purdue University, and **Cora Sadosky**, Howard University (932-47-176)

5:00PM (221) *Spin geometry techniques in multivariable operator theory.*
Mircea Martin, Baker University (932-47-161)

5:30PM (222) *Reproducing kernel Hilbert spaces and Robertson conjecture.*
Subhajit Ghosechowdhury, Purdue University (932-47-220)

Special Session on Numerical Analysis and Computational Mathematics, IV

3:00 PM – 4:20 PM **Room 116, Ackert Hall**

Organizers: **Qisu Zou**, Kansas State University
Huanan Yang, Kansas State University

3:00PM ▸ (223) *Lattice Boltzmann method on curvilinear grid.*
Xiaoyi He, Los Alamos National Lab. (932-65-21)

3:30PM (224) *Mathematical and numerical analysis for two-phase flow in porous media.*
Zhangxin Chen, Southern Methodist University (932-65-11)

4:00PM (225) *Solutions for new equations of two phase flow and an open problem.*
James Glimm*, **David Saltz**, SUNY at Stony Brook, and **David Sharp**, Los Alamos National Lab (932-65-13)

Special Session on Integrable Systems and their Applications, IV

3:00 PM – 5:55 PM **Room 143, Cardwell Hall**

Organizer: **Kirill L. Vaninsky**, Kansas State University

3:00PM ▸ (226) *The Kadomtsev-Petviashvili equation with quasiperiodic initial data.* Preliminary report.
Harvey Segur, U of Colorado, Boulder (932-35-112)

3:45PM ▸ (227) *On asymptotic localization and ratio of two symplectic volumes.* Preliminary report.
Kirill L. Vaninsky, Kansas State University (932-82-95)

4:30PM ▸ (228) *Asymptotic calculation of Selberg type integrals.* Preliminary report.
Stephanos Venakides, Duke University (932-35-113)

5:15PM ▸ (229) *Rigorous perturbation theory for near-integrable systems.* Preliminary report.
Xin Zhou, Duke University (932-35-114)

Special Session on Quantum Groups and Applications, VI

7:00 PM - 9:10 PM **Room 129, Cardwell Hall**

Organizers: **Ya S. Soibelman**, Kansas State University
Volodymyr V. Lyubashenko, Kansas State University

7:00PM (230) *The Borel-Weil-Bott Theorem at a root of unity.*
Alexander A. Voronov, M.I.T. (932-17-33)

7:45PM (231) *Vertex representations of Kac-Moody algebras.*
Naihuan Jing, North Carolina State University (932-17-177)

8:30PM (232) *Quantum groupoids and deformation quantization.* Preliminary report.
Ping Xu, Penn State University (932-81-06)

Susan J. Friedlander
Associate Secretary
Chicago, Illinois

Presenters of Papers

Philadelphia, Pennsylvania; April 4–6, 1998

Numbers following the name indicate the speaker's position on the program.
• AMS Invited Lecturer, ∗ Special Session Speaker, ▸ Graduate Student

Presenters

Program of the Sessions

Philadelphia, Pennsylvania, April 4–6, 1998

Saturday, April 4

Meeting Registration

8:00 AM – 4:00 PM **Ground Level, 1616 Walnut Street, TUCC**

AMS Book Sale

8:00 AM – 4:00 PM **Ground Level, 1616 Walnut Street, TUCC**

Special Session on Topology of Manifolds and Varieties, I

8:25 AM – 10:50 AM **Room 305, TUCC**

Organizers: **Sylvain E. Cappell**, New York University-Courant Institute
Georgia Triantafillou, Temple University

8:25AM (1) *Homology manifold bordism.*
Heather M. Johnston*, Rutgers University, and **Andrew A. Ranicki**, University of Edinburgh (933-57-230)

9:05AM (2) *Analytic torsion for bundles with the covering space of a compact manifold as typical fiber.*
Mel Rothenberg, University of Chicago (933-57-251)

9:45AM (3) *A bivariant Riemann-Roch theorem for geometric topology.*
Bruce Williams, U. of Notre Dame (933-57-247)

10:20AM (4) *Holomorphic K-theory, algebraic co-cycles and Loop groups.* Preliminary report.
Ralph L. Cohen, Stanford University (933-55-206)

Special Session on Modular Identities and Q-Series in Number Theory, I

8:30 AM – 10:50 AM **Room 8B, TUCC**

Organizers: **Marvin I. Knopp**, Temple University
Boris Datskovsky, Temple University

8:30AM (5) *Distribution of parity of the partition function on arithmetic progressions.*
Scott D. Ahlgren, Penn State University (933-11-73)

9:00AM (6) *Septic theta function identities in Ramanujan's Lost Notebook.*
Seung H. Son, University of Illinois at Urbana-Champaign (933-11-42)

9:30AM (7) *Modular equations of degree 5 found in Ramanujan's Lost Notebook.*
Soon-Yi Kang, University of Illinois at Urbana-Champaign (933-11-46)

10:00AM (8) *Incomplete Elliptic Integrals in Ramanujan's Lost Notebook.* Preliminary report.
Bruce C. Berndt, University of Illinois at Urbana-Champaign (933-11-81)

10:30AM (9) *Rational Landen transformations: the sixth degree case.*
Victor H. Moll* and **George Boros**, Tulane University (933-33-250)

Special Session on Mathematical Pedagogy, I

8:30 AM – 10:50 AM **Room 5B, TUCC**

Organizer: **Orin N. Chein**, Temple University

8:30AM ▸ (10) *Calculus using Maple and Scientific Notebook.*
Philip B. Yasskin, Texas A&M University (933-98-149)

9:00AM ▸ (11) *Connecting nursing research to nursing statistics with a Web-based dataset archive.* Preliminary report.
Thomas H. Short* and **Marilyn S. Fetter**, Villanova University (933-62-196)

9:30AM ▸ (12) *Using Maple to create calculus laboratory activities.*
Shari Prevost, Gainesville College (933-98-141)

10:00AM ▸ (13) *The "new" differential equations and the "old" numerical analysis.*
James P. Fink, Gettysburg College (933-98-12)

10:30AM (14) *Collaborative learning: What works, what doesn't, and why.*
Raymond F. Coughlin, Temple University (933-98-197)

The time limit for each contributed paper in the sessions is ten minutes. In the Special Sessions the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

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

Papers flagged with a solid triangle (▸) have been designated by the author as being of possible interest to undergraduate students.

Abstracts of papers presented in the sessions at this meeting will be found in Volume 19, Issue 2 of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings. The middle two digits, e.g., 897-**20**-1136, refer to the Mathematical Reviews subject classification assigned by the individual author. Groups of papers for each subject are listed chronologically in the *Abstracts*. The last one to four digits, e.g., 897-20-**1136**, refer to the receipt number of the abstract; abstracts are further sorted by the receipt number within each classification.

Special Session on Differential Geometric Methods in Hydrodynamics, I

8:30 AM – 10:50 AM **Room 2B, TUCC**

Organizer: **Gerard K. Misiolek**, University of Notre Dame and California Institute of Technology

8:30AM (15) *Geometric and topological aspects of vortex knot dynamics.*
Renzo L. Ricca, University College London, UK (933-58-97)

9:00AM (16) *Embedding Hamiltonian systems into geodesic systems on Lie groups.* Preliminary report.
Toshihiko Ono, Yukawa Institute for Theoretical Physics (933-70-228)

9:30AM (17) *Lagrangian formalism on complex manifolds: Leray residue vs. Stokes formula.*
Boris A. Khesin, University of Toronto/IAS (933-58-191)

10:00AM ▸ (18) *Jacobi fields in hydrodynamics and some integrable systems.*
Tsutomu Kambe, University of Tokyo (933-76-140)

10:30AM (19) *Algebraic-geometric n-orthogonal curvilinear coordinate systems.*
Igor Krichever, Columbia University (933-14-102)

Special Session on PDEs in Several Complex Variables, I

8:50 AM – 10:50 AM **Room 306, TUCC**

Organizers: **Shiferaw Berhanu**, Temple University
Gerardo Mendoza, Temple University

8:50AM (20) *Analytic regularity of the Bergman kernel.* Preliminary report.
Gabor Francsics*, Columbia University, and **Nicholas Hanges**, Lehman College/CUNY (933-35-186)

9:20AM (21) *Boundary behavior of the Bergman kernel .* Preliminary report.
Gabor Francsics, Columbia University, and **Nicholas Hanges***, Lehman College/CUNY (933-32-187)

9:55AM (22) *Using the Szegő Projection to solve classical boundary value problems on non-smooth domains in the plane.*
Loredana Lanzani, The University of Arkansas at Fayetteville (933-31-53)

10:30AM Discussion

(23) *A trace theorem for function spaces defined by vector fields.*
Shif Berhanu and **Isaac Pesenson***, Temple University (933-00-161)

Special Session on Radon Transforms and Tomography, I

9:00 AM – 10:50 AM **Room 302, TUCC**

Organizers: **Eric L. Grinberg**, Temple University
Eric Todd Quinto, Tufts University

9:00AM (24) *Two radius support theorems for the sphere transform.* Preliminary report.
Yiying Zhou, Tufts University (933-44-75)

9:30AM (25) *Sampling and the three squares theorem.* Preliminary report.
David F. Walnut, George Mason University (933-44-157)

10:00AM (26) *Anti-self-dual symplectic forms and integral geometry.*
Juan Carlos Alvarez Paiva*, Universite Catholique de Louvain, and **Izrail M. Gelfand**, Rutgers University (933-44-153)

10:30AM (27) *$SL(2,\mathbb{R})$ and complex horosphers.* Preliminary report.
Simon Gindikin, Rutgers University (933-44-212)

Special Session on The History of American Mathematics, I

9:00 AM – 10:50 AM **Room 10B, TUCC**

Organizers: **David E. Zitarelli**, Temple University
Karen H. Parshall, University of Virginia

9:00AM ▸ (28) *The Declaration of American Independence and other mathematical texts of the eighteenth century.*
John G. Fauvel, The Open University, England (933-01-91)

9:30AM ▸ (29) *From so obscure a beginning: The analyst of Joel E. Hendricks.*
Joe Albree, Auburn U. at Montgomery (933-01-101)

10:00AM ▸ (30) *W. W. Johnson and Newton's calculus.* Preliminary report.
George M. Rosenstein, Franklin & Marshall College (933-01-104)

10:30AM ▸ (31) *Mathematics curriculum at West Point during the nineteenth century: Courses, textbooks, content, faculty, students, and influences.*
David C. Arney, United States Military Academy (933-01-32)

Special Session on Rings and Representations, I

9:00 AM – 10:50 AM **Room 9B, TUCC**

Organizers: **Maria E. Lorenz**, Ursinus College
Martin Lorenz, Temple University

9:00AM ▸ (32) *On the Donald-Flanigan Conjecture.* Preliminary report.
Murray Gerstenhaber, University of Pennsylvania (933-16-233)

9:30AM (33) *Aspects of the Donald-Flanigan Conjecture.* Preliminary report.
Tony Giaquinto, Texas A&M University (933-16-229)

10:00AM (34) *Branching rules for finite unitary groups.*
Thomas R. Hagedorn, The College of New Jersey (933-20-18)

10:30AM (35) *A practical algorithm for finding matrix representations for polycyclic groups.*
Eddie H. Lo, National Security Agency, and **Gretchen Ostheimer***, Tufts University (933-20-174)

Special Session on Harmonic Analysis and Its Applications to PDEs, I

9:00 AM – 10:50 AM **Room 303, TUCC**

Organizers: **Cristian E. Gutierrez**, Temple University
Guozhen Lu, Wright State University

9:00AM (36) *Two weight norm estimates for potential and maximal operators on spaces of homogeneous type.* Preliminary report.
Carlos Pérez, Universidad Autónoma de Madrid, and **Richard L. Wheeden***, Rutgers University (933-35-47)

9:30AM (37) *Lebesgue space estimates for operators associated with the Neumann problem for the wave equation on an exterior domain.* Preliminary report.
Michael Beals, Rutgers University (933-35-172)

10:00AM (38) *Stable solutions of semi-linear elliptic equations in convex domains.*
Sagun Chanillo, Rutgers Univ., New Brunswick. (933-35-37)

10:30AM (39) *Self-improving properties of Poincaré inequalities in metric spaces.*
Bruno Franchi, University of Bologna (933-46-118)

Special Session on Heat Kernel Analysis on Lie Groups, I

9:00 AM – 10:50 AM **Room 3B, TUCC**

Organizers: **Leonard Gross**, Cornell University
Omar Hijab, Temple University

9:00AM (40) *Analysis and geometry on the pseudogroup of univalent functions.*
Paul Malliavin, Jussieu (933-58-116)

9:25AM (41) *Brownian motion on large unitary groups.*
Philippe Biane, Ecole Normal Superieure (933-58-115)

9:45AM Break

10:05AM (42) *Characterizing Yang-Mills fields by stochastic parallel transport.*
Robert O. Bauer, Institute for Advanced Study (933-60-25)

10:30AM (43) *Short time behavior of logarithmic derivatives of the heat kernel.*
James Turetsky, Harvard University (933-58-239)

Special Session on Nonlinear Partial Differential Equations, I

9:00 AM – 10:50 AM **Room 6B, TUCC**

Organizer: **Yanyan Li**, Rutgers University

9:00AM (44) *Boundary value problems at infinity for surfaces of constant mean curvature in Hyperbolic space.* Preliminary report.
Joel Spruck, Johns Hopkins University (933-35-105)

9:30AM (45) *Function theory and minimal surfaces.*
William P. Minicozzi, II*, Johns Hopkins University, and **Tobias H. Colding**, NYU (933-53-122)

10:00AM (46) *Extremal Hermitian metrics in Riemann surface and generalization of the uniformization theorem to surface with boundary.*
xiuxiong Chen, Stanford University (933-58-190)

10:30AM (47) *Harmonic maps on complete manifolds.*
Wenxiong Chen*, Southwest Missouri State University, and **Congming Li**, University of Colorado (933-35-110)

Special Session on Sparse Elimination Methods in Polynomial System Solving, I

9:30 AM – 10:50 AM **Room 7B, TUCC**

Organizers: **Ioannis Z. Emiris**, INRIA, Sophia-Antipolis, France
J. Maurice Rojas, Massachusetts Institute of Technology

9:30AM (48) *On multivariate Descartes rule.* Preliminary report.
Tien-Yien Li*, Michigan State University, and **Xiaoshen Wang**, University of Central Arkansas (933-65-124)

10:00AM (49) *Integral points on sparse algebraic curves.*
J. Maurice Rojas, City University of Hong Kong (933-14-185)

10:30AM (50) *The expected number of roots of a multihomogeneous systems of polynomial equations.*
Andrew M. McLennan, University of Minnesota (933-14-23)

Invited Address

11:00 AM – 11:50 AM **Room 5B, TUCC**

(51) *Manifolds with Ricci curvature bounds.*
Tobias H. Colding, Courant Institute - New York University

Invited Address

1:30 PM – 2:20 PM **Room 5B, TUCC**

(52) *Why foundations are important.*
Martin Davis, University of California, Berkeley

Special Session on Modular Identities and Q-Series in Number Theory, II

2:30 PM – 5:20 PM **Room 8B, TUCC**

Organizers: **Marvin I. Knopp**, Temple University
Boris Datskovsky, Temple University

2:30PM ▸ (53) *Universal deformation rings of representations of finite groups.* Preliminary report.
Frauke M. Bleher and **Ted C. Chinburg***, Univ. of Penn. (933-11-120)

3:00PM (54) *The hyperbolic geometry of the Crisp-Moran conjecture.*
Thomas A. Schmidt, Oregon State University, and **Mark Sheingorn***, CUNY - Baruch College and Graduate Center (933-11-54)

3:30PM ▸ (55) *Divisibility of class numbers and orders of Tate-Shafarevich groups.*
Ken Ono, Penn State University (933-11-40)

4:00PM (56) *Character sums and automorphic forms.* Preliminary report.
Ching-Li Chai, University of Pennsylvania, and **Wen-Ching Winnie Li***, Pennsylvania State University (933-11-78)

4:30PM (57) *Nonanalytic automorphic integrals.*
Paul C. Pasles, Saint Joseph's University (933-11-139)

5:00PM ▸ (58) *Log-polynomial period functions for Hecke groups.*
Abdulkadir Hassen, Rowan University (933-11-60)

Special Session on Radon Transforms and Tomography, II

2:30 PM – 4:50 PM **Room 302, TUCC**

Organizers: **Eric L. Grinberg**, Temple University
Eric Todd Quinto, Tufts University

2:30PM (59) *Radon transform on direct limit groups.* Preliminary report.
Elinor Velasquez, U.C. Berkeley (933-44-181)

3:00PM (60) *Morera theorems on C^n and manifolds.*
Eric L. Grinberg, Temple University, and **Eric Todd Quinto***, Tufts University (933-44-26)

3:30PM (61) *L^p estimates for restricted X-ray transforms and integrals over curves in R^4.* Preliminary report.
Allan Greenleaf*, University of Rochester and **Andreas Seeger**, University of Wisconsin (933-44-39)

4:00PM (62) *Uniqueness and non-uniqueness for overdetermined X-ray transforms.* Preliminary report.
Jan Boman, Stockholm University (933-44-129)

4:30PM (63) *New range theorems for the Radon transform and its dual.*
Alexander Katsevich, University of Central Florida (933-44-57)

Special Session on The History of American Mathematics, II

2:30 PM – 4:20 PM **Room 10B, TUCC**

Organizers: **David E. Zitarelli**, Temple University
Karen H. Parshall, University of Virginia

2:30PM (64) *"Moulding the Mathematical Education of 55 Million" Americans: Sylvester at Hopkins (1876–1883).*
Karen V.H. Parshall, University of Virginia (933-01-83)

3:00PM ▸ (65) *C. S. Peirce as a mathematician.* preliminary report.
Albert C. Lewis, Indiana University (933-01-243)

3:30PM ▸ (66) *The remarkable Charlotte Scott.* Preliminary report.
James J. Tattersall, Providence College (933-01-14)

4:00PM ▸ (67) *The early history of the Cornell University mathematics department.*
Gary G. Cochell, Culver-Stockton College (933-01-35)

Special Session on Mathematical Pedagogy, II

2:30 PM – 5:20 PM **Room 5B, TUCC**

Organizer: **Orin N. Chein**, Temple University

2:30PM (68) *From algorithm to exploration.*
Peter G. Jessup, Ursinus College (933-98-133)

3:00PM ▸ (69) *The Calculus Consortium based at Harvard turns 10: Reflections on lessons learned.*
Jeff Tecosky-Feldman, Haverford College (933-98-137)

3:30PM ▸ (70) *Using history to teach undergraduate real analysis.*
David M. Bressoud, Macalester College (933-28-09)

4:00PM ▸ (71) *Involving prospective teachers in the design of Maple laboratory assignments.*
Louise M. Berard, Wilkes University (933-98-20)

4:30PM ▸ (72) *Beyond testing – ways to assess student learning.* Preliminary report.
Alice A. Deanin, Villanova University (933-98-193)

5:00PM ▸ (73) *Does cognitive psychology support standards based reform?* Preliminary report.
Malcolm J. Sherman, State University of New York at Albany (933-97-225)

Special Session on Differential Geometric Methods in Hydrodynamics, II

2:30 PM – 4:50 PM **Room 2B, TUCC**

Organizer: **Gerard K. Misiolek**, University of Notre Dame and California Institute of Technology

2:30PM (74) *Instablity of geodesics on the group of area-preserving diffeomorphisms (motions of fluid) of 2-sphere.*
Kyo Yoshida, University of Tokyo (933-76-150)

3:00PM (75) *Hamiltonian hydrodynamic type systems and Riemannian geometry.*
Sergey P. Novikov, University of Maryland at College Park and Landau Institute for Theoretical Physics, Moscow (933-58-119)

3:30PM (76) *Flows on diffeomorphisms of the circle, grassmannians and the geometry of the periodic KdV equation.*
Maria E. Schonbek, **Andrey N. Todorov***, University of California at Santa Cruz, and **Jorge P. Zubelli**, IMPA, Brazil (933-58-93)

4:00PM (77) *Stability and instability criteria for magnetohydrodynamics.*
Susan Friedlander*, University of Illinois, Chicago, and **Misha Vishik**, University of Texas, Austin (933-35-100)

4:30PM (78) *Solutions to the Euler equations with unbounded vorticity.*
Misha Vishik, University of Texas at Austin (933-35-103)

Special Session on Nonlinear Partial Differential Equations, II

2:30 PM – 4:50 PM **Room 6B, TUCC**

Organizer: **Yanyan Li**, Rutgers University

2:30PM (79) *Prescribing scalar curvature on n-spheres.*
Congming Li, Univ. of Colorado (933-35-144)

3:00PM (80) *Asymptotic behavior for positive solutions to* $\Delta_g u = u^q + Su$ *with prescribed singularities.*
David L. Finn, Merrimack College (933-35-10)

3:30PM (81) *Double vortex-condensates in the Chern-Simons-Higgs theory.* Preliminary report.
Gabriella Tarantello, Universitá di Roma "Tor Vergata" (933-35-79)

4:00PM (82) *Applications of a minmax principle.*
Alfonso Castro, University of North Texas (933-35-62)

4:30PM (83) *Diffusion vs. cross-diffusion: an elliptic approach.* Preliminary report.
Yuan Lou*, University of Chicago, and **Wei-Ming Ni**, University of Minnesota (933-35-109)

Special Session on Sparse Elimination Methods in Polynomial System Solving, II

2:30 PM – 5:20 PM **Room 7B, TUCC**

Organizers: **Ioannis Z. Emiris**, INRIA, Sophia-Antipolis, France
J. Maurice Rojas, Massachusetts Institute of Technology

2:30PM (84) *Groebner bases and invariants.* Preliminary report.
Karin Gatermann, FU Berlin / ZIB (933-68-184)

3:00PM (85) *Degrees of Groebner bases of toric ideals.*
Serkan Hosten, George Mason University (933-14-182)

3:30PM (86) *Computing the state polytope of a toric ideal.* Preliminary report.
Rekha Rachel Thomas* and **Birkett Huber**, Texas A&M University (933-14-178)

4:00PM (87) *Certificates for deficient sparse polynomial systems.*
Birkett Huber*, Texas A&M University, and **Jan Verschelde**, Michagan State University (933-14-171)

4:30PM Discussion

Session on Session for Contributed Papers

2:30 PM – 4:40 PM **Room 1B, TUCC**

2:30PM (88) *Additive isometries of continuoius functions.* Preliminary report.
Edward Beckenstein, Temple University (933-46-19)

2:45PM *Krylov-subspace solvers for emission tomograph.*
▸ (89) **Tuan Cao-Huu**, Harvard University and Massachusetts General Hospital (933-15-22)

3:00PM *Eta-equivalent solutions of nonlinear PDE-problems.*
(90) Preliminary report.
Efim Galperin, University of Quebec at Montreal (933-35-67)

3:15PM *Illuminating points with tangent lines.*
▸ (91) **Alan L. Horwitz**, Penn State University (933-26-215)

3:30PM *An a-priori estimate establishing regularity for the*
(92) *viscosity solution of an HJB equation with large discount factor.* Preliminary report.
Clifford A. Johnston, West Chester University (933-35-07)

3:45PM *Attenuated Radon transform and high-frequency*
(93) *scattering theory.* Preliminary report.
Alexander Panchenko, University of Delaware (933-44-201)

4:00PM *A numerical procedure for estimating model*
(94) *parameters.* Preliminary report.
Yixum Shi, Bloomsburg University (933-65-70)

4:15PM *A cumulant spectral density for a two-valued*
(95) *random field with summable ρ^*-mixing coefficients.*
Curtis P. Miller, Southeast Missouri State University (933-60-11)

4:30PM *Inequalities and stability for a linear scalar*
(96) *functional differential equation.*
Tingxiu Wang, Oakton Community College (933-34-44)

Special Session on Topology of Manifolds and Varieties, II

2:35 PM – 5:05 PM **Room 305, TUCC**

Organizers: **Sylvain E. Cappell**, New York University-Courant Institute
Georgia Triantafillou, Temple University

2:35PM *Torelli group action on the homology of*
(97) *representation variety.*
Ronnie Lee, Yale University (933-55-235)

3:15PM *Analytic compactifications of character varieties.*
(98) **Georgios Daskalopoulos**, Brown University, **Stamatis Dostoglou***, University of Missouri, and **Richard Wentworth**, U.C. Irvine (933-53-134)

3:55PM *The geography problem for symplectic 4-manifolds.*
(99) **Zoltan Szabo**, Princeton University (933-57-203)

4:35PM *Braid groups and Lagrangian spheres.*
(100) **Paul Seidel**, IAS, Princeton (933-57-170)

Special Session on Rings and Representations, II

2:40 PM – 5:30 PM **Room 9B, TUCC**

Organizers: **Maria E. Lorenz**, Ursinus College
Martin Lorenz, Temple University

2:40PM *Grading and derivations.* Preliminary report.
(101) **Christof Geiss**, UNAM, **Edward L. Green***, Virginia Tech, and **Eduardo N. Marcos**, Univ. of Sao Paulo (933-16-211)

3:10PM *The homology of string algebras.* Preliminary report.
(102) **Birge Huisgen-Zimmermann***, University of California, and **Sverre O. Smalø**, Norwegian University for Science and Technology (933-16-213)

3:40PM *Groebner-Shirshov bases for relations of a Lie*
(103) *algebra and its enveloping algebra.*
Leonid Bokut', Institute of Mathematics, Novosibirsk, and **Peter Malcolmson***, Wayne State University (933-17-232)

4:10PM *Ideals of the enveloping algebra $U(sl_3)$.*
(104) **Stefan Catoiu**, Temple University (933-16-50)

4:40PM *Symmetric pairs for quantized enveloping algebras.*
(105) **Gail Letzter**, Virginia Tech (933-17-152)

5:10PM *Poisson polynomial identities, coadjoint orbits, and*
(106) *Krull dimension.*
Daniel R. Farkas, Virginia Tech. (933-16-63)

Special Session on Heat Kernel Analysis on Lie Groups, II

2:40 PM – 4:55 PM **Room 3B, TUCC**

Organizers: **Leonard Gross**, Cornell University
Omar Hijab, Temple University

2:40PM *Some variational problems in quantum*
(107) *communication theory.* Preliminary report.
Eric A. Carlen, Georgia Tech (933-46-237)

3:05PM *Heat kernel measures and cohomology.*
(108) **Edward L. Bueler**, Mathematical Sciences Research Institute (933-58-88)

3:25PM Break

3:45PM *Complexifications of symmetric spaces and*
(109) *associated Bargmann transforms.*
Bent Ørsted, Odense University (933-58-113)

4:10PM *Unitary representations with reflection symmetry.*
(110) **Gestur Olafsson**, Louisiana State University (933-57-114)

4:35PM *Unitary representations of Lie groups with*
▸ (111) *reflection symmetry.*
Palle E.T. Jorgensen, University of Iowa (933-46-131)

Special Session on PDEs in Several Complex Variables, II

2:45 PM – 5:05 PM **Room 306, TUCC**

Organizers: **Shiferaw Berhanu**, Temple University
Gerardo Mendoza, Temple University

2:45PM *Pseudoconvex Mizohata structures on compact*
(112) *manifolds.*
Abdelhamid Meziani, Florida International University (933-32-106)

3:20PM *CR circle bundles and Mizohata structures.*
(113) **Anbo Le**, Ohio State University (933-32-58)

4:05PM *Homogeneous CR submanifolds in $\mathbb{C}^n$.*
(114) **Nancy K. Stanton**, University of Notre Dame (933-32-95)

4:40PM *On a linearity problem of CR mappings between*
(115) *spheres of different dimensions.*
Xiaojun Huang, Rutgers University (933-00-199)

Special Session on Harmonic Analysis and Its Applications to PDEs, II

2:45 PM – 5:05 PM **Room 303, TUCC**

Organizers: **Cristian E. Gutierrez**, Temple University
Guozhen Lu, Wright State University

2:45PM *Estimates for bilinear cone operators.* Preliminary
(116) report.
Andrea R. Nahmod*, Institute for Advanced Study, and **John Gilbert**, University of Texas at Austin (933-42-189)

3:15PM *L^p boundedness of singular integrals with rough*
(117) *kernels.* Preliminary report.
Yibiao Pan, University of Pittsburgh (933-42-128)

3:45PM (118) *Oscillatory integrals with nonhomogeneous phase functions related to Schrödinger equations.*
Lawrence A. Kolasa, Ryerson Polytechnic University (933-42-30)

4:15PM (119) *Harnack inequality for the linearized parabolic Monge-Ampère equation.*
Qingbo Huang, Temple University, Philadelphia, PA 19122 (933-35-72)

4:45PM (120) *Weighted inequalities on John domains.*
Seng-Kee Chua, National University of Singapore (933-46-204)

Sunday, April 5

Meeting Registration

8:00 AM – NOON **Ground Level, 1616 Walnut Street, TUCC**

AMS Book Sale

8:00 AM – NOON **Ground Level, 1616 Walnut Street, TUCC**

Special Session on Sparse Matrix Computations, I

8:20 AM – 10:10 AM **Room 1B, TUCC**

Organizers: **Jesse Barlow**, Pennsylvania State University
Daniel B. Szyld, Temple University

8:20AM (121) *Low rank matrix approximation using the Lanczos bidiagonalization process with applications.*
Hongyuan Zha, Penn State Univ. (933-65-65)

8:50AM (122) *Performance of greedy ordering heuristics for sparse Cholesky factorization.*
Esmond G. Ng, Oak Ridge National Laboratory, and **Padma Raghavan***, University of Tennessee (933-68-136)

9:20AM (123) *The effect of mesh quality on the solution of associated sparse linear systems.*
Paul E. Plassmann, The Pennsylvania State University (933-65-198)

9:50AM ▸ (124) *Multigrid methods for sparse matrices arising from PDE discretizations.*
Jinchao Xu, Pennsylvania State University (933-65-13)

Special Session on Topology of Manifolds and Varieties, III

8:25 AM – 10:50 AM **Room 305, TUCC**

Organizers: **Sylvain E. Cappell**, New York University-Courant Institute
Georgia Triantafillou, Temple University

8:25AM (125) *The naturality of Kirwan's decomposition.*
Ching-Li Chai, University of Pennsylvania, and **Amnon Neeman***, University of Virginia (933-55-06)

9:05AM (126) *A holomorphic Casson invariant for Calabi-Yau threefolds.*
Richard P. Thomas, Institute for Advanced Study, Princeton (933-14-164)

9:45AM (127) *Parametrized Seiberg-Witten theory.*
Tian-Jun Li*, IAS, and **Aiko Liu**, MIT (933-58-179)

10:20AM (128) *The minimal genus problem for a symplectic 4-manifold.*
Peter S. Ozsvath*, IAS, and **Zoltan Szabo**, Princeton University (933-57-240)

Special Session on Modular Identities and Q-Series in Number Theory, I

8:30 AM – 10:50 AM **Room 8B, TUCC**

Organizers: **Marvin I. Knopp**, Temple University
Boris Datskovsky, Temple University

8:30AM (129) *On a partition theorem of Göllnitz and quartic transformations.*
Krishnaswami Alladi, University of Florida (933-11-24)

9:00AM (130) *WZ-forms, q-series accelerations, irrationality proofs.*
Tewodros Amdeberhan*, DeVry Institute of Technology, and **Doron Zeilberger**, Temple University (933-11-43)

9:30AM (131) *Extending theorems of Gollnitz, a new family of partition identities.* Preliminary report.
Jose Plinio O. Santos*, UNICAMP, Campinas-Brasil, and **Paulo Mondek**, UFMS-Campo Grande - Brasil (933-11-45)

10:00AM ▸ (132) *Some q-expansions of modular forms.* Preliminary report.
David W. Farmer, Bucknell University (933-11-159)

10:30AM (133) *New algorithms in public-key cryptography.*
Daniel B. Lieman, University of Missouri (933-11-217)

Special Session on Mathematical Pedagogy, III

8:30 AM – 10:50 AM **Room 404, TUCC**

Organizer: **Orin N. Chein**, Temple University

8:30AM ▸ (134) *How to grade 80 mathematical essays and survive to tell the tale.*
Annalisa Crannell, Franklin & Marshall College (933-98-34)

9:00AM ▸ (135) *Calculus on the Web (COW).*
Dan Reich* and **Gerardo A. Mendoza**, Temple University (933-98-31)

9:30AM (136) *Cooperative learning for mathematics majors.*
Nancy L. Hagelgans, Ursinus College (933-98-56)

10:00AM ▸ (137) *Bad writing before good.* Preliminary report.
Stephen B. Maurer, Swarthmore College (933-98-17)

10:30AM ▸ (138) *Using the print media to enhance the learning of statistical concepts in a core mathematics course.* Preliminary report.
Eli Passow, Temple University (933-98-96)

Special Session on Differential Geometric Methods in Hydrodynamics, III

8:30 AM – 10:50 AM **Room 2B, TUCC**

Organizer: **Gerard K. Misiolek**, University of Notre Dame and California Institute of Technology

8:30AM (139) *Stability of stationary flows of an ideal incompressible fluid of piecewise constant density.*
Yu. K. Kashaev, Rostov University, **Vasiliy I. Sedenko***, Department of Fundamental and Applied Mathematics, and **Victor I. Yudovich**, Department of Mathematics and Mechanics (933-76-99)

9:00AM (140) *On the Riemannian curvature of an ideal continuum medium with constraints.*
Victor Yudovich, Department of Mathematics and Mechanics (933-58-94)

9:30AM (141) *Motion of incompressible inviscid fluids with free boundary and surface tension.*
David G. Ebin, State University of New York at Stony Brook (933-35-108)

10:00AM (142) *Riemannian geometry of the motion of a thin vortex filament and instability analysis.*
Suzuki Katsuhiro, Tokyo University of Agriculture and Technology (933-76-183)

10:30AM (143) *Topological Euler equations and diffeomorphisms groups.*
Rudolf Schmid, Emory University (933-58-205)

Special Session on PDEs in Several Complex Variables, III

8:50 AM – 10:50 AM **Room 306, TUCC**

Organizers: **Shiferaw Berhanu**, Temple University
Gerardo Mendoza, Temple University

8:50AM ▸ (144) *Germs of blow downs.*
Charles L. Epstein, U. of Penn. (933-32-156)

9:20AM (145) *Resolvents and functions of the Kohn Laplacian on the Heisenberg group.*
Daryl Geller, SUNY at Stony Brook (933-32-180)

9:55AM (146) *Compactness of the $\bar{\partial}$-Neumann problem on convex domains.*
Siqi Fu and **Emil J Straube***, Texas A&M University (933-32-29)

10:30AM (147) *On strictly pseudoconvex domains with Kahler-Einstein Bergman metrics.*
Siqi Fu*, Texas A & M University, and **Bun Wong**, University of Calfornia, Riverside (933-32-71)

Special Session on Radon Transforms and Tomography, III

9:00 AM – 10:50 AM **Room 302, TUCC**

Organizers: **Eric L. Grinberg**, Temple University
Eric Todd Quinto, Tufts University

9:00AM ▸ (148) *Exponential Radon transform and John equation.* Preliminary report.
Leon Ehrenpreis, Temple University, **Peter Kuchment***, Wichita State University, and **Alex Panchenko**, University of Delaware (933-44-173)

9:30AM (149) *An inverse problem in elastodynamics.*
Lizabeth V. Rachele, Purdue University (933-35-85)

10:00AM ▸ (150) *Tomography in electron microscopy: The state of the art.*
Gabor T. Herman*, **Roberto Marabini**, University of Pennsylvania, Philadelphia, and **Jose M. Carazo**, Universidad Atonoma de Madrid, Spain (933-92-59)

10:30AM (151) *Fast functional magnetic resonance imaging and wavelets.*
Larry Shepp* and **Cun Hui Zhang**, Rutgers University (933-92-28)

Special Session on The History of American Mathematics, III

9:00 AM – 10:50 AM **Room 10B, TUCC**

Organizers: **David E. Zitarelli**, Temple University
Karen H. Parshall, University of Virginia

9:00AM ▸ (152) *Leonard Dickson and the University of Chicago: The consolidation and growth of an algebraic research tradition.*
Della D. Fenster, University of Richmond (933-01-90)

9:30AM ▸ (153) *The founding of the MAA.*
Florence D. Fasanelli, MAA (933-01-160)

10:00AM ▸ (154) *E. H. Moore's failed attempt to involve the American Mathematical Society in pedagogy, 1902–1915.* Preliminary report.
David L. Roberts, University of Maryland (933-01-61)

10:30AM ▸ (155) *Women at Cornell: The pre-1940 Ph.D.s.* Preliminary report.
Judy Green*, Marymount University, Arlington, VA, and **Jeanne LaDuke**, DePaul University (933-01-222)

Special Session on Rings and Representations, III

9:00 AM – 10:50 AM **Room 9B, TUCC**

Organizers: **Maria E. Lorenz**, Ursinus College
Martin Lorenz, Temple University

9:00AM (156) *Associative envelopes of Lie superalgebras satisfying a polynomial identity.*
M. Susan Montgomery, University of Southern California (933-16-38)

9:30AM (157) *Kaplansky's 6th conjecture holds for quasitriangular Hopf algebras.*
Shlomo Gelaki* and **Pavel Etingof**, Harvard University (933-16-107)

10:00AM (158) *Quantum function algebras, at roots of unity, not finite over their centers.* Preliminary report.
Edward S. Letzter, Texas A&M University (933-16-188)

10:30AM (159) *Quantum determinantal ideals.*
Kenneth R Goodearl*, University of California, and **Thomas H Lenagan**, University of Edinburgh (933-16-143)

Special Session on Harmonic Analysis and Its Applications to PDEs, III

9:00 AM – 10:50 AM **Room 303, TUCC**

Organizers: **Cristian E. Gutierrez**, Temple University
Guozhen Lu, Wright State University

9:00AM (160) *The initial-Dirichlet problem for higher order parabolic equations in Lipschitz cylinders.*
Russell M. Brown*, University of Kentucky, and **Wei Hu**, Houghton College (933-35-168)

9:30AM ▸ (161) *Local minima in $W^{1,p}$ versus local mimina in $C^{1,\alpha}$.* Preliminary report.
Jesús García-Azorero, Universidad Autónoma de Madrid, **Juan J. Manfredi***, University of Pittsburgh, and **Ireneo Peral**, Universidad Autónoma de Madrid (933-35-98)

10:00AM (162) *The characterizatio of wavelets and related functions.*
Guido L. Weiss, Washington University (933-42-64)

10:30AM (163) *On the Grushin operator and hyperbolic symmetry.* Preliminary report.
William Beckner, University of Texas at Austin (933-58-27)

Special Session on Heat Kernel Analysis on Lie Groups, III

9:00 AM – 10:50 AM **Room 3B, TUCC**

Organizers: **Leonard Gross**, Cornell University
Omar Hijab, Temple University

9:00AM (164) *Yang-Mills theory and the Segal-Bargmann transform.* Preliminary report.
Bruce K. Driver and **Brian C. Hall***, UC San Diego (933-81-169)

9:25AM (165) *Asymptotic expansions of Hermite functions on groups.* Preliminary report.
Jeffrey J. Mitchell, Cornell University (933-22-132)

9:45AM Break

10:05AM (166) *The S-transform and low dimensional gauge theories.*
Ambar N. Sengupta, Louisiana State University (933-81-69)

10:30AM (167) *The heat kernel measure and Driver-Gross isometry on infinite dimensional groups.*
Maria Gordina, Cornell University (933-46-192)

Special Session on Nonlinear Partial Differential Equations, III

9:00 AM – 10:50 AM **Room 6B, TUCC**

Organizer: **Yanyan Li**, Rutgers University

9:00AM (168) *Optimal transportation of manifolds and shape recognition.* Preliminary report.
Wilfrid Gangbo, Georgia Institute of Technology, and **Robert J. McCann***, Brown University (933-49-112)

9:30AM (169) *A singularly perturbed elliptic partial differential equation with an almost periodic term.*
Greg S. Spradlin, U. California-Davis (933-35-200)

10:00AM (170) *Spike-layered solutions of singularly perturbed elliptic problems in a degenerate setting.*
Manuel del Pino and **Patricio Felmer***, Universidad de Chile (933-35-92)

10:30AM (171) *Nonradial solutions of semilinear elliptic equations in* $\mathbf{R}^N$. Preliminary report.
Joseph A. Iaia, University of North Texas (933-35-51)

Special Session on Sparse Elimination Methods in Polynomial System Solving, III

9:30 AM – 10:50 AM **Room 7B, TUCC**

Organizers: **Ioannis Z. Emiris**, INRIA, Sophia-Antipolis, France
J. Maurice Rojas, Massachusetts Institute of Technology

9:30AM (172) *Symbolic and numeric methods for exploiting structure in constructing resultant matrices.* Preliminary report.
Victor Y. Pan*, Lehman College, City University of New York, and **Ioannis Z. Emiris**, INRIA (933-68-147)

10:00AM ▸ (173) *Sparsity in Dixon resultants.*
Deepak Kapur, State University of New York at Albany (933-13-148)

10:30AM (174) *Structured matrices and polynomial system solving.*
Bernard Mourrain, INRIA (933-15-218)

Invited Address

11:00 AM – 11:50 AM **Room 5B, TUCC**

(175) *The Yamabe problem on manifolds with boundaries: existence and compactness results.*
Yanyan Li, Rutgers University

Invited Address

1:30 PM – 2:20 PM **Room 5B, TUCC**

(176) *Gromov-Witten invariants in higher genus: A survey.*
Ezra Getzler, Northwestern University

Special Session on Modular Identities and Q-Series in Number Theory, IV

2:30 PM – 5:50 PM **Room 8B, TUCC**

Organizers: **Marvin I. Knopp**, Temple University
Boris Datskovsky, Temple University

2:30PM (177) *Rereading L. J. Rogers.* Preliminary report.
Richard A. Askey, University of Wisconsin (933-33-21)

3:00PM (178) *Some octahedral congruences for η-products.*
Basil Gordon, UCLA (933-11-248)

3:30PM (179) *On p-adic families of Jacobi forms.*
Pavel I. Guerzhoy, Temple University (933-11-52)

4:00PM (180) *Function theoretic derivations of Ramanujan partition identities.* Preliminary report.
Hershel M. Farkas, The Hebrew University of Jerusalem, and **Irwin Kra***, State University of New York at Stony Brook (933-30-68)

4:30PM (181) *The symmetric square L-function and it's derivative at 1.* Preliminary report.
Brian Conrey, American Institute of Mathematics and Oklahoma State University (933-11-86)

5:00PM (182) *Density theorems related to the non-vanishing of L-series of modular forms.*
Kevin L. James, Penn. State University (933-11-76)

5:30PM (183) *Weyl's Law with error estimate for Sl(3,Z) .* Preliminary report.
Sultan Catto, **Jonathan M. Huntley**, Baruch College, CUNY, **Nam-Jong Moh**, Graduate Center, CUNY, and **David E. Tepper***, Baruch College, CUNY (933-11-16)

Special Session on Radon Transforms and Tomography, IV

2:30 PM – 4:50 PM **Room 302, TUCC**

Organizers: **Eric L. Grinberg**, Temple University
Eric Todd Quinto, Tufts University

2:30PM (184) *Morera type problems in quaternionic analysis.* Preliminary report.
Emilio Marmolejo Olea, University of Maryland at College Park. (933-44-127)

3:00PM (185) *Some injectivity problems for the Radon transform on real quadrics.* Preliminary report.
Mark L. Agranovsky, Bar-Ilan University, Ramat-Gan, Israel (933-44-77)

3:30PM (186) *The spectral representations for multitemporal wave equations.*
Sigurdur Helgason, MIT (933-22-66)

4:00PM (187) *Grassmannian transforms: An inversion formula.* Preliminary report.
Fulton B. Gonzalez, Tufts University (933-44-84)

4:30PM (188) *Radon transform and wave front sets.* Preliminary report.
Leon Ehrenpreis, Temple University (933-44-145)

Special Session on The History of American Mathematics, IV

2:30 PM – 4:20 PM **Room 10B, TUCC**

Organizers: **David E. Zitarelli**, Temple University
Karen H. Parshall, University of Virginia

2:30PM ▸ (189) *The structures of computation.*
Michael S. Mahoney, Princeton University (933-01-151)

3:00PM (190) *Origins of spectral sequences.*
John H. McCleary, Vassar College (933-01-234)

3:30PM *Elbert F. Cox: An early pioneer.*
▸ (191) **James A. Donaldson**, Howard University, and **Richard J. Fleming***, Central Michigan University (933-01-163)

4:00PM *Historical reflections on the 25th anniversary of*
▸ (192) *Historia Mathematica* . Preliminary report.
Joseph W. Dauben, CUNY (933-01-130)

Special Session on Mathematical Pedagogy, IV

2:30 PM – 5:20 PM **Room 404, TUCC**

Organizer: **Orin N. Chein**, Temple University

2:30PM (193) *Using course portfolios to document teaching.* **Orin N. Chein**, Temple University (933-98-121)

3:00PM ▸ (194) *The World Wide Web as a tool for teaching mathematics.* Preliminary report. **Eugene A. Klotz**, Math Forum/Swarthmore College (933-98-33)

3:30PM ▸ (195) *Cartographiometry: an interdisciplinary approach to mathematics and cartography.* **Elaine F. Bosowski** and **Timothy G. Feeman***, Villanova University (933-00-41)

4:00PM ▸ (196) *A learning styles and reasoning approach to mathematics.* Preliminary report. **Seymour W. Pustilnik**, New York City Technical College (933-98-175)

4:30PM ▸ (197) *Mathematics in modern and medieval literature.* Preliminary report. **Phyllis L. Pustilnik**, Union Institute (933-01-176)

5:00PM ▸ (198) *Integrating technology into the mathematics classroom.* **Anthony Hughes**, Temple University (933-98-236)

Special Session on Differential Geometric Methods in Hydrodynamics, IV

2:30 PM – 3:50 PM **Room 2B, TUCC**

Organizer: **Gerard K. Misiolek**, University of Notre Dame and California Institute of Technology

2:30PM (199) *The spectral geometry of Writhe and Helicity.* **Jason Cantarella***, **Dennis DeTurck** and **Herman Gluck**, University of Pennsylvania (933-53-135)

3:00PM (200) *$\mathcal{D}^s_\mu(M)$ with weak H^1 metric.* **Steve Shkoller**, Caltech (933-58-165)

3:30PM (201) *On minimal geodesics on groups of volume-preserving maps and the hydrostatic limit of the Euler equations.* **Yann Brenier**, Universite Paris 6 (933-76-252)

Special Session on Nonlinear Partial Differential Equations, IV

2:30 PM – 4:20 PM **Room 6B, TUCC**

Organizer: **Yanyan Li**, Rutgers University

2:30PM (202) *A new topological invariant in abelian gauge theory.* Preliminary report. **Lesley M. Sibner***, Polyrechnic University, **Robert J. Sibner**, CUNY,Brooklyn College, and **Yisong Yang**, Polytechnic University (933-53-48)

3:00PM (203) *Existence results of conformal metrics with constant scalar curvature and constant boundary mean curvature.* **Zheng-Chao Han*** and **YanYan Li**, Rutgers University (933-53-226)

3:30PM (204) *Decay estimates for porous medium systems.* Preliminary report. **Zhengfang Zhou***, Michigan State University, and **Hongjun Yuan**, Jilin University, China (933-35-214)

4:00PM (205) *Symmetry of solutions of relativistic Thomas-Fermi equations.* **Michael K-H. Kiessling**, Rutgers U. (933-35-209)

Special Session on Sparse Elimination Methods in Polynomial System Solving, IV

2:30 PM – 4:50 PM **Room 7B, TUCC**

Organizers: **Ioannis Z. Emiris**, INRIA, Sophia-Antipolis, France
J. Maurice Rojas, Massachusetts Institute of Technology

2:30PM (206) *Balancing the lifting values to improve the numerical stability of polyhedral homotopy continuation methods.* Preliminary report. **Tangan Gao**, **T. Y. Li**, **Jan Verschelde*** and **Mengnien Wu**, Michigan State University (933-65-89)

3:00PM (207) *On the geometry of Graeffe iteration.* **Gregorio Malajovich***, Departamento de Matematica Aplicada, UFRJ., and **Jorge Passamani Zubelli**, IMPA, CNPq (933-65-55)

3:30PM (208) *Applications of various methods in elimination theory to a problem in computer vision.* Preliminary report. **Peter F. Stiller**, Texas A&M Univeristy (933-14-194)

4:00PM (209) *Applications of elimination methods in exact-arithmetic based geometric programs.* **John C. Keyser***, **Dinesh Manocha**, University of North Carolina at Chapel Hill, **Shankar Krishnan**, AT&T Research Labs, and **Tim Culver**, University of North Carolina at Chapel Hill (933-14-238)

4:30PM Discussion

Special Session on Sparse Matrix Computations, II

2:30 PM – 3:50 PM **Room 1B, TUCC**

Organizers: **Jesse Barlow**, Pennsylvania State University
Daniel B. Szyld, Temple University

2:30PM (210) *Symmetric reduction redux: Incomplete factor preconditioners.* **Alex Pothen***, Old Dominion University and ICASE, and **David Hysom**, Old Dominion University (933-68-162)

3:00PM (211) *Orderings for incomplete factorization preconditioning of sparse nonsymmetric linear systems.* **Michele Benzi**, Los Alamos National Lab, **Daniel B. Szyld***, Temple University, and **Arno van Duin**, Leiden University (933-65-167)

3:30PM (212) *Developing an efficient hybrid ICCG solver.* **John G. Gilbert**, Xerox PARC, **Esmond G. Ng***, **Barry W. Peyton**, Oak Ridge National Laboratory, and **Padma Raghavan**, The Univ. of Tennessee (933-65-177)

Special Session on Topology of Manifolds and Varieties, IV

2:35 PM – 5:05 PM **Room 305, TUCC**

Organizers: **Sylvain E. Cappell**, New York University-Courant Institute
Georgia Triantafillou, Temple University

2:35PM (213) *Topology of complements of plane curves.* Preliminary report. **Ludmil V. Katzarkov**, UC Irvine, and **Tony G. Pantev***, University of Pennsylvania (933-14-207)

3:15PM (214) *Equivariant K-theory and Casson's invariant.* Preliminary report.
Jonathan L. Block, University of Pennsylvania (933-58-246)

3:55PM (215) *Geometry of closed geodesics.* Preliminary report.
Joseph A. Datskovsky, State University of Rio de Janeiro, Brazil (933-53-249)

4:35PM (216) *The isotopy classification of real affine quartic curves.* Preliminary report.
Anatoly Korchagin and **David Weinberg***, Texas Tech University (933-14-166)

Special Session on Rings and Representations, IV

2:40 PM – 5:30 PM **Room 9B, TUCC**

Organizers: **Maria E. Lorenz**, Ursinus College
Martin Lorenz, Temple University

2:40PM (217) *Schemes of line modules.* Preliminary report.
Brad Shelton and **Michaela Vancliff***, University of Oregon (933-16-49)

3:10PM (218) *Noncommutative projective planes of weight (1,1,n).* Preliminary report.
Darin R. Stephenson, Hope College (933-16-202)

3:40PM (219) *Noncommutative symmetric algebras of two-sided vector spaces.*
David Patrick, University of Washington (933-16-123)

4:10PM (220) *Existence of critical modules of GK-dimension 2 over elliptic algebras.*
Kaushal Ajitabh, Florida International University (933-16-210)

4:40PM (221) *Von Neumann algebras and linear independence of translates.*
Peter A. Linnell, Virginia Tech (933-46-74)

5:10PM (222) *On locally nilpotent derivations and AK invariant.*
Leonid Makar-Limanov, Bar-Ilan University, 52900 Ramat-Gan, Israel and Wayne State University, Detroit MI, 48202 USA. (933-16-138)

Special Session on Heat Kernel Analysis on Lie Groups, IV

2:40 PM – 4:30 PM **Room 3B, TUCC**

Organizers: **Leonard Gross**, Cornell University
Omar Hijab, Temple University

2:40PM (223) *Spectral theory of differential operators.*
Thomas P. Branson, University of Iowa (933-58-154)

3:05PM (224) *Inversion of the F.B.I. transform on certain infinite radius tubes.* Preliminary report.
Matthew B. Stenzel, Ohio State University, Newark Campus (933-43-208)

3:25PM Break

3:45PM (225) *Perturbation theorems for supercontractive semigroups.*
Wicharn Lewkeeratiyutkul, Cornell University (933-58-125)

4:10PM (226) *Hypercontractivity over complex manifolds.*
Leonard Gross, Cornell University (933-46-111)

Special Session on PDEs in Several Complex Variables, IV

2:45 PM – 5:05 PM **Room 306, TUCC**

Organizers: **Shiferaw Berhanu**, Temple University
Gerardo Mendoza, Temple University

2:45PM (227) *Analytic and Gevrey regularity for solutions of PDEs arising in several complex variables.*
David S. Tartakoff, U. of IL at Chicago (933-35-146)

3:30PM (228) *The Bergman projection and a complex variables version of Hilbert's 17th problem.*
John P. D'Angelo, University of Illinois (933-32-253)

4:05PM (229) *The Cauchy problem for a shallow water type equation.*
Alex A. Himonas* and **Gerard Misiołek**, Univ. of Notre Dame (933-35-158)

4:40PM (230) *On the solvability of linear partial differential equations in spaces of hyperfunctions .*
Paulo D. Cordaro*, University of S. Paulo - Brazil, and **Jean-Marie Tre'preau**, Universite' Paris VI, France (933-35-219)

Special Session on Harmonic Analysis and Its Applications to PDEs, IV

2:45 PM – 5:05 PM **Room 303, TUCC**

Organizers: **Cristian E. Gutierrez**, Temple University
Guozhen Lu, Wright State University

2:45PM (231) *Regularity of strong solutions to Dirichlet problem for elliptic equations with discontinuous coefficients.*
Giuseppe Di Fazio, Catania University - Italy (933-35-142)

3:15PM (232) *Estimates near the boundary for solutions of second order parabolic equations.*
Mikhail V. Safonov, University of Minnesota (933-35-244)

3:45PM (233) *A generalization of Hall's lemma to bounded domains in R^n.* Preliminary report.
Peter M. Knopf, Pace University (933-31-87)

4:15PM (234) *The Dirichlet problem for sub-Laplacians.* Preliminary report.
Luca Capogna*, New York University, **Nicola Garofalo**, Purdue University, and **Duy-Minh Nhieu**, Academia Sinica (933-35-82)

4:45PM (235) *Integral equation methods for global boundary problems in Riemannian manifolds.*
Marius S. Mitrea, University of Missouri (933-35-08)

Monday, April 6

Ehrenpreis Conference

8:50 AM – 11:30 AM **Walk Auditorium, Ritter Hall, Main Campus**

Invited Address

11:30 AM – 12:20 PM **Walk Auditorium, Ritter Hall, Main Campus**

(236) *Singular Radon transforms: continuous and discrete.*
Elias M. Stein, Princeton University

Ehrenpreis Conference

2:00 PM – 4:30 PM **Walk Auditorium, Ritter Hall, Main Campus**

Lesley M. Sibner
Associate Secretary
Brooklyn, New York

Presenters of Papers

Davis, California; April 25–26, 1998

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Program of the Sessions

Davis, California, April 25–26, 1998

Saturday, April 25

Meetings Registration

7:30 AM – 5:00 PM **Lounge, Wellman Hall**

AMS Exhibit and Book Sale

7:30 AM – 5:00 PM **Lounge, Wellman Hall**

Special Session on C-algebras and Dynamics, I*

9:00 AM – 10:50 AM **Room 202, Wellman Hall**

Organizers: **Jerry Kaminker**, Indiana University-Purdue University at Indianapolis
Ian Fraser Putnam, University of Victoria
Jack Spielberg, Arizona State University

9:00AM (1) *Dynamics of tilings.*
Charles Radin* and **Lorenzo Sadun**, University of Texas (934-52-70)

9:30AM (2) *Topological invariants for tilings.* Preliminary report.
Alan H. Forrest, IMF, **John Hunton**, University of Leicester, and **Johannes Kellendonk***, Technische Universitaet Berlin (934-20-82)

10:00AM (3) *Minimal homeomorphisms with the same real coboundaries.* Preliminary report.
Nicholas S. Ormes, University of Texas (934-58-108)

10:30AM (4) *Endomorphisms and Cuntz-Krieger algebras.* Preliminary report.
Berndt A. Brenken, University of Calgary (934-46-136)

Special Session on Differential Equations with Applications, I

9:00 AM – 10:55 AM **Room 115, Wellman Hall**

Organizers: **Sally Sailai Shao**, Cleveland State University
Tatsuhiko J. Tabara, Golden Gate University

9:00AM (5) *To the asymptotic behavior of the general fourth Painleve transcendent.*
Alisher S. Abdullayev, National University (934-34-38)

9:30AM (6) *Homotopy classes for stable patterns in a class of fourth-order Hamiltonian systems.*
William D. Kalies*, California Polytechnic State University, **Jarek Kwapisz**, Michigan State University, **Jan-Bouwe VandenBerg**, University of Leiden, and **Robert VanderVorst**, Georgia Institute of Technology (934-34-109)

10:00AM (7) *Reduction of a network of voltage gated conductance equations to a one-dimensional map.*
Thomas LoFaro, Washington State University (934-34-32)

10:30AM (8) *Determining 3-D surfaces from 2-D radar data.*
Daniel Ostrov, Santa Clara University (934-35-35)

Special Session on Dualities in Mathematics and Physics, I

9:00 AM – 10:55 AM **Room 216, Wellman Hall**

Organizers: **Edward Frenkel**, University of California, Berkeley
Nicolai Reshetikhin, University of California, Berkeley

9:00AM (9) *Calogero-Moser systems in Seiberg-Witten Theory.*
Eric D'Hoker*, UCLA, and **D. H. Phong**, Columbia University (934-51-53)

9:40AM (10) *Field theory and intersecting branes.*
Jan de Boer, UC Berkeley (934-81-64)

10:20AM (11) *Heat kernel and localization.*
Kefeng Liu, Stanford University (934-53-92)

The time limit for each contributed paper in the sessions is ten minutes. In the Special Sessions the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

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

Papers flagged with a solid triangle (►) have been designated by the author as being of possible interest to undergraduate students.

Abstracts of papers presented in the sessions at this meeting will be found in Volume 19, Issue 2 of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings. The middle two digits, e.g., 897-**20**-1136, refer to the Mathematical Reviews subject classification assigned by the individual author. Groups of papers for each subject are listed chronologically in the *Abstracts*. The last one to four digits, e.g., 897-20-**1136**, refer to the receipt number of the abstract; abstracts are further sorted by the receipt number within each classification.

Special Session on Dynamical Systems and Mathematical Physics, I

9:00 AM – 10:45 AM **Room 226, Wellman Hall**

Organizers: **Motohico Mulase**, University of California, Davis
Bruno L Nachtergaele, University of California, Davis

9:00AM (12) *Statistical mechanics and super-Brownian motion.* **Gordon Slade**, McMaster University (934-82-60)

9:45AM ▸ (13) *A stability property of the quenched state in mean field spin glass models.* **Michael Aizenman** and **Pierluigi Contucci***, Princeton University (934-82-89)

10:10AM ▸ (14) *Ground states of the Falicov-Kimball model: A lattice Laplacian plus binary potential.* Preliminary report. **Karl Haller** and **Tom G. Kennedy***, University of Arizona (934-82-110)

Special Session on Geometric Analysis, I

9:00 AM – 10:50 AM **Room 119, Wellman Hall**

Organizers: **Chikako Mese**, University of Southern California
Richard M. Schoen, Stanford University

9:00AM (15) *New examples of self-shrinking mean curvature flow.* Preliminary report. **Claire C. Chan**, University of Utah (934-51-117)

9:30AM (16) *Asymptotic behavior of cosmological solutions of Einstein's equations.* Preliminary report. **James A. Isenberg**, University of Oregon (934-83-103)

10:00AM (17) *Regularity results of some 4th order PDE.* **Sun-Yung Alice Chang**, UCLA (934-58-139)

10:30AM (18) *Polyhedra in hyperbolic 3-space.* Preliminary report. **Xiliang Bao** and **Francis Bonahon***, University of Southern California (934-51-112)

Special Session on The Geometry and Topology of 3-manifolds, I

9:00 AM – 10:50 AM **Room 1, Wellman Hall**

Organizers: **Dmitry Fuchs**, University of California, Davis
Joel Hass, University of California, Davis
Ramin Naimi, University of California, Davis
William Thurston, University of California, Davis

9:00AM (19) *Genuine laminations and group negative curvature.* **David Gabai**, Caltech, and **William H. Kazez***, University of Georgia (934-57-97)

9:30AM (20) *Foliations with good geometry.* Preliminary report. **Sergio R. Fenley**, Washington University (934-57-72)

10:00AM (21) *Perturbing finite depth foliations.* Preliminary report. **Rachel Roberts**, Washington University (934-57-111)

10:30AM (22) *The orbifold theorem.* Preliminary report. **Daryl Cooper**, University of California, Santa Barbara, **Craig D. Hodgson**, University of Melbourne, and **Steven P. Kerckhoff***, Stanford University (934-57-105)

Special Session on Graph Theory, I

9:00 AM – 10:50 AM **Room 233, Wellman Hall**

Organizer: **David Barnette**, University of California, Davis

9:00AM (23) *On the total coloring of graphs embeddable in surfaces.* **Yue Zhao**, Benedict College (934-05-22)

9:30AM ▸ (24) *Constructing infinite 3-connected graphs.* Preliminary report. **David Barnette**, U. of California, **María José Chávez**, U. de Sevilla, **Luis M. Fernández**, U. de Sevilla, **Alberto Márquez**, U. de Sevilla, **Antonio Quintero** and **María Trinidad Villar***, U. de Sevilla (934-05-51)

10:00AM (25) *Regular honest graphs, isoperimetric numbers, and bisection of weighted graphs.* **Noga Alon**, Tel Aviv University, and Institute for Advanced Study, **Peter Hamburger***, Indiana-Purdue University Fort Wayne, and **Alexandr V. Kostochka**, Institute of Mathematics Novosibirsk (934-05-24)

10:30AM ▸ (26) *Matrices and graphs.* Preliminary report. **Moshe Rosenfeld**, Pacific Lutheran University (934-05-59)

Special Session on Nonlinear Analysis, I

9:00 AM – 10:20 AM **Room 6, Wellman Hall**

Organizers: **John K. Hunter**, University of California, Davis
Blake Temple, University of California, Davis

9:00AM ▸ (27) *Shock-waves, black holes and cosmology.* **Blake Temple**, University of California, Davis (934-83-159)

9:30AM (28) *The gap lemma and geometric criteria for the instability of viscous shock profiles.* **Robert A. Gardner***, University of Massachusetts, Amherst, and **Kevin A. Zumbrun**, Indiana University (934-35-158)

10:00AM (29) *Riemann problems for multidimensional conservation laws.* Preliminary report. **Suncica Canic**, Iowa State University, and **Barbara Lee Keyfitz***, University of Houston (934-35-07)

Special Session on Nonlinear Analysis, II

9:00 AM – 11:00 AM **Room 26, Wellman Hall**

Organizers: **John K. Hunter**, University of California, Davis
Blake Temple, University of California, Davis

9:00AM (30) *Description of singularities via the Fuchsian algorithm.* **Satyanad Kichenassamy**, Max-Planck-Institut, Leipzig (934-35-13)

9:30AM Discussion

(31) *Navier and Stokes meet the wavelet.* **Paul Federbush**, University of Michigan (934-76-157)

10:00AM (32) *An a priori bound for co-dimension one isometric embeddings.* **Yanyan Li**, Rutgers University, and **Gilbert Weinstein***, UAB (934-58-29)

10:30AM (33) *On the nature of the generic cosmological singularity.* **Beverly K. Berger**, Oakland University (934-83-15)

Invited Address

11:10 AM – NOON **Room 1100, Social Sciences Building**

(34) *Recent progress in geometric langlands correspondence.*
Edward V. Frenkel, University of California, Berkeley (934-20-94)

Invited Address

1:50 PM – 2:40 PM **Room 1100, Social Sciences Building**

(35) *C*-algebras and dynamics.*
Ian F. Putnam, University of Victoria (934-47-107)

Special Session on C-algebras and Dynamics, II*

3:00 PM – 5:20 PM **Room 202, Wellman Hall**

Organizers: **Jerry Kaminker**, Indiana Univ-Purdue Univ at Indianapolis
Ian Fraser Putnam, University of Victoria
Jack Spielberg, Arizona State University

3:00PM (36) *Self-similarities of Poisson structures on tori.*
Kentaro Mikami, Akita University, and **Alan Weinstein***, University of California, Berkeley (934-58-100)

3:30PM (37) *Amenable groupoids.*
C. Anantharaman-Delaroche* and **J. Renault**, Universite d'Orleans (934-46-41)

4:00PM (38) *Analysis on or off fractals and aspects of noncommutative geometry.* Preliminary report.
Michel L. Lapidus, University of California, Riverside (934-58-124)

4:30PM (39) *Continuous graphs and C*-algebras.*
Valentin Deaconu, University of Nevada, Reno (934-46-95)

5:00PM (40) *C*-algebras of directed graphs and group actions.*
Alex Kumjian*, University of Nevada, Reno, and **David Pask**, University of Newcastle, Australia (934-46-62)

Special Session on Differential Equations with Applications, II

3:00 PM – 5:55 PM **Room 115, Wellman Hall**

Organizers: **Sally Sailai Shao**, Cleveland State University
Tatsuhiko J. Tabara, Golden Gate University

3:00PM (41) *Mathematical analysis for a system of PDE arises from the phase field theory.*
W Xie, California State Polytechnic University at Pomona (934-35-135)

3:30PM ▸ (42) *Periodic solution of a Lotka-Volterra system.*
Shagi-Di Shih, University of Wyoming (934-34-146)

4:00PM ▸ (43) *Attractivity and time lags for linear periodic delay-differntial equations.* Preliminary report.
Rinko Miyazaki, Shizuoka University, Japan (934-34-79)

4:30PM (44) *On the asymptotic behavior of a delay Fibonacci equation.*
Yoshihiro Hamaya, Okayama University of Science (934-34-88)

5:00PM (45) *A dynamical systems result in asymptotic integration of linear differential systems.* Preliminary report.
Sigrun I. Bodine, University of Southern California, Los Angeles (934-34-137)

5:30PM (46) *Stokes multipliers of a second order differential equation with a large parameter.*
Tatsuhiko J. Tabara, Golden Gate University (934-34-129)

Special Session on Dualities in Mathematics and Physics, II

3:00 PM – 5:35 PM **Room 216, Wellman Hall**

Organizers: **Edward Frenkel**, University of California, Berkeley
Nicolai Reshetikhin, University of California, Berkeley

3:00PM (47) *Noncommutative geometry and M(atrix) theory.*
Albert Schwarz, University of California at Davis (934-81-81)

3:40PM (48) *Duality in the fractional quantum Hall effect.* Preliminary report.
Hubert M. Saleur, University of Southern California (934-82-56)

4:20PM (49) *Complex counterpart of abelian Chern-Simons theory.*
Igor B. Frenkel, Yale University, **Boris Khesin**, University of Toronto, and **Andrey N. Todorov***, UCSC (934-51-63)

5:00PM (50) *Bispectral duality: Higher rank and higher dimensional examples.*
Alex Kasman, Concordia University and CRM (934-35-50)

Special Session on Dynamical Systems and Mathematical Physics, II

3:00 PM – 5:15 PM **Room 226, Wellman Hall**

Organizers: **Motohico Mulase**, University of California, Davis
Bruno L Nachtergaele, University of California, Davis

3:00PM (51) *Asymptotics of a class of Fredholm determinants.*
Craig A. Tracy, University of California, Davis, and **Harold Widom***, University of California, Santa Cruz (934-46-37)

3:45PM (52) *Asymptotic formulas for the determinant of a sum of finite Toeplitz and Hankel matrices.* Preliminary report.
Estelle L. Basor, California Polytechnic State University (934-47-68)

4:10PM (53) *Integrable operators and the asymptotics of quantum correlation functions.*
Alexander R. Its, Indiana University-Purdue University, Indianapolis (934-81-125)

4:55PM (54) *Deformation quantization for polynomial Poisson algebras.*
Michael Penkava, University of Wisconsin, and **Pol Vanhaecke***, UC Davis (934-16-106)

Special Session on Finite Groups and Representations, I

3:00 PM – 3:50 PM **Room 7, Wellman Hall**

Organizer: **Kenechukwu Kenneth Nwabueze**, University of Brunei Darussalam

3:00PM ▸ (55) *On the satisfied models.* Preliminary report.
Gun-Won Lee, Seoul National University (934-03-05)

3:30PM (56) *The Grothendieck ring of permutation representations of finite groups.*
Kenneth K. Nwabueze, University of Brunei Darussalam (934-20-55)

Special Session on Geometric Analysis, II

3:00 PM – 5:20 PM **Room 119, Wellman Hall**

Organizers: **Chikako Mese**, University of Southern California
Richard M. Schoen, Stanford University

3:00PM (57) *Embedded minimal ends asymptotic to the helicoid.* **David Hoffman*** and **John McCuan**, MSRI (934-53-145)

3:30PM ▸ (58) *The concavity question for H-graphs.* Preliminary report. **John E. McCuan**, MSRI (934-53-133)

4:00PM (59) *Some morse theoretic properties of Ginzburg-Landau vortices.* Preliminary report. **Jie Qing**, UCSC (934-35-119)

4:30PM (60) *Snowballs and Reifenberg flat metric spaces.* Preliminary report. **Guy David**, Universite Paris Sud, and **Tatiana Toro***, University of Washington (934-51-91)

5:00PM (61) *Analytic torsions on manifolds with boundary.* Preliminary report. **Xianzhe Dai***, USC and UCSB, and **Hao Fang**, UCLA (934-58-101)

Special Session on The Geometry and Topology of 3-manifolds, II

3:00 PM – 5:20 PM **Room 1, Wellman Hall**

Organizers: **Dmitry Fuchs**, University of California, Davis
Joel Hass, University of California, Davis
Ramin Naimi, University of California, Davis
William Thurston, University of California, Davis

3:00PM (62) *Tilings.* **Alberto Candel**, Caltech (934-51-147)

3:30PM (63) *Kleinian length functions and the complex of curves.* **Yair N. Minsky**, SUNY at Stony Brook (934-57-80)

4:00PM (64) *Canonical genus, free genus, and volume.* Preliminary report. **Mark Brittenham**, University of North Texas (934-57-69)

4:30PM (65) *Foliation cones.* Preliminary report. **John Cantwell***, Saint Louis University, and **Lawrence Conlon**, Washington University (934-57-06)

5:00PM (66) *Harmonic measures on hyperbolic laminations .* Preliminary report. **Vadim Kaimanovich**, Universite de Rennes, and **Mikhail Lyubich***, SUNY at Stony Brook (934-51-99)

Special Session on Graph Theory, II

3:00 PM – 4:50 PM **Room 233, Wellman Hall**

Organizer: **David Barnette**, University of California, Davis

3:00PM (67) *Vizing's planar graph conjecture.* **Daniel P. Sanders***, Princeton University, and **Yue Zhao**, Benedict College (934-05-114)

3:30PM ▸ (68) *Edge coloring chordal graphs with distance restrictions.* **Jennifer J. Quinn**, Occidental College, Los Angeles, CA 90041 (934-05-52)

4:00PM ▸ (69) *Decomposing complete graphs into cycles of fixed length.* **Brian Alspach***, Burnaby, British Columbia, and **Heather Gavlas**, Grand Valley, Michigan (934-05-39)

4:30PM ▸ (70) *Diagonal flips in planar triangulations.* **Jason Z. Gao**, Carleton University (934-05-75)

Special Session on Nonlinear Analysis, III

3:00 PM – 5:00 PM **Room 6, Wellman Hall**

Organizers: **John K. Hunter**, University of California, Davis
Blake Temple, University of California, Davis

3:00PM ▸ (71) *The Wulff shape as the asymptotic limit of a growing crystallin interface.* Preliminary report. **Stanley Joel Osher*** and **Barry Lynn Merriman**, UCLA (934-73-21)

3:40PM ▸ (72) *On the hyperbolic approximations to first order partial differential equations.* Preliminary report. **Zhouping Xin**, Courant Institute, New York University (934-35-155)

4:10PM (73) *An algorithm for the computation of shear bands in granular materials.* **Xabier Garaizar***, Lawrence Livermore National Laboratory, and **John Trangenstein**, Duke University (934-39-28)

4:40PM (74) *Renormalization of the Chapman Enskog expansion.* Preliminary report. **Marshall Slemrod**, Center for Math. Sci., UW Madison (934-76-14)

Special Session on Nonlinear Analysis, IV

3:00 PM – 5:30 PM **Room 26, Wellman Hall**

Organizers: **John K. Hunter**, University of California, Davis
Blake Temple, University of California, Davis

3:00PM (75) *The Alexandrov-Bakelman-Pucci inequality.* **Joseph G. Conlon***, U. of Michigan, and **Renming Song**, U. of Illinois (934-35-18)

3:40PM (76) *Singularly perturbed Hodgkin Huxley systems.* **William E. Fitzgibbon***, University of Houston, **Mary E. Parrott** and **You Youcheng**, University of South Florida (934-35-08)

4:10PM (77) *Degenerate systems of conservation laws.* **Robin C. Young**, U. Mass. (934-35-27)

4:40PM (78) *On the full Toda flows.* **Anthony M. Bloch***, University of Michigan, **Peter E. Crouch**, Arizona State University, and **Michael W. Gekhtman**, William and Mary College (934-70-31)

5:10PM ▸ (79) *Bounds for heat transport in a porous layer.* **Charles R. Doering**, University of Michigan (934-76-12)

Session for Contributed Papers

3:00 PM – 4:40 PM **Room 101, Wellman Hall**

3:00PM ▸ (80) *Three Newton polynomials.* **D. G. Mead**, University of California at Davis, and **S. K. Stein***, Univeristy of California at Davis (934-12-54)

3:15PM ▸ (81) *A note on odd perfect numbers.* **Susil Kumar Jena**, Brahma Kumaries (934-11-121)

3:45PM (82) *Weak sharpness and continuity of the isotonic uniform projection.* Preliminary report.
Salem Sahab*, King Abdulaziz University, and **Robert Huotari**, KFUPM (934-93-25)

4:00PM ▸ (83) *The matrix Riccati equations and the acceleration of thoroughbreds.*
Rod A. Freed, California State University at Dominguez Hills (934-00-143)

4:15PM ▸ (84) *SnapPea PC for Windows 95/NT: Program for 3-dimensional hyperbolic manifolds.*
A. C. Manoharan, California State University, Stanislaus (934-51-90)

4:30PM ▸ (85) *Reflecting on Magid: Undergraduate education in mathematics.* Preliminary report.
Danielle Mihram, University of Southern California, and **G. Arthur Mihram***, Princeton (934-98-126)

Sunday, April 26

Meetings Registration

8:00 AM – 11:00 AM **Lounge, Wellman Hall**

AMS Exhibit and Book Sale

8:00 AM – 11:00 AM **Lounge, Wellman Hall**

Special Session on Dynamical Systems and Mathematical Physics, III

8:30 AM – 10:45 AM **Room 226, Wellman Hall**

Organizers: **Motohico Mulase**, University of California, Davis
Bruno L. Nachtergaele, University of California, Davis

8:30AM (86) *Stochastic Ising models at zero temperature.* Preliminary report.
Charles M. Newman, New York University (934-82-65)

9:15AM (87) *On the temperature zero limit in many-fermion systems.*
Joel Feldman, UBC, Vancouver, **Horst Knörrer**, **Manfred Salmhofer*** and **Eugene Trubowitz**, ETH Zurich (934-82-98)

9:40AM (88) *Internal DLA and the Stefan problem.*
Janko Gravner, University of California, Davis, and **Jeremy Quastel***, University of Toronto (934-60-86)

10:25AM (89) *Magnetic isoperimetric inequality and Lifschitz tail.*
Laszlo Erdos, Courant Institute, NYU (934-58-76)

Special Session on The Geometry and Topology of 3-manifolds, III

8:30 AM – 10:50 AM **Room 1, Wellman Hall**

Organizers: **Dmitry Fuchs**, University of California, Davis
Joel Hass, University of California, Davis
Ramin Naimi, University of California, Davis
William Thurston, University of California, Davis

8:30AM (90) *Geometric knot spaces and minimal stick numbers .* Preliminary report.
Jorge Alberto Calvo, UCSB (934-57-116)

9:00AM (91) *Essential laminations and Kneser normal form.* Preliminary report.
David Gabai, Caltech (934-57-118)

9:30AM (92) *Algorithms in the Dehn surgery space.* Preliminary report.
William Jaco and **Eric Sedgwick***, Oklahoma State University (934-57-104)

10:00AM (93) *Some surface subgroups survive surgery.* Preliminary report.
Daryl Cooper* and **Darren Long**, UCSB (934-57-23)

10:30AM (94) *Orientations in contact homology.* Preliminary report.
Yakov Eliashberg, Stanford University (934-57-115)

Special Session on C-algebras and Dynamics, III*

9:00 AM – 10:50 AM **Room 202, Wellman Hall**

Organizers: **Jerry Kaminker**, Indiana University-Purdue University at Indianapolis
Ian Fraser Putnam, University of Victoria
Jack Spielberg, Arizona State University

9:00AM (95) *Amenable C*-algebras.*
George A. Elliott, University of Toronto, University of Copenhagen, Fields Institute (934-47-144)

9:30AM (96) *Duality for an expansive automorphism of a compact connected abelian group.* Preliminary report.
Jerry Kaminker, IUPUI, **Ian Putnam**, U. Victoria, and **Jack Spielberg***, Arizona State U. (934-46-149)

10:00AM (97) *Transverse groupoids.* Preliminary report.
Jerome Kaminker*, IUPUI, and **Ian Putnam**, University of Victoria (934-46-150)

10:30AM (98) *Order on the K-theory of C*-algebras of minimal homeomorphisms.* Preliminary report.
N. Christopher Phillips, University of Oregon and Purdue University (934-46-122)

Special Session on Dualities in Mathematics and Physics, III

9:00 AM – 10:55 AM **Room 216, Wellman Hall**

Organizers: **Edward Frenkel**, University of California, Berkeley
Nicolai Reshetikhin, University of California, Berkeley

9:00AM (99) *Nonlinear Serre duality.*
Alexander B. Givental, UC Berkeley (934-14-58)

9:40AM (100) *Modular forms and the enumerative geometry of K3 and Abelian surfaces.*
Jim A. Bryan*, Univ. of Cal., Berkeley, and **Conan Leung**, Univ. of Minnesota (934-14-33)

10:20AM (101) *Homological mirror conjecture for elliptic curves.* Preliminary report.
Alexander Polishchuk* and **Eric Zaslow**, Harvard University (934-14-10)

Special Session on Geometric Analysis, III

9:00 AM – 10:50 AM **Room 119, Wellman Hall**

Organizers: **Chikako Mese**, University of Southern California
Richard M. Schoen, Stanford University

9:00AM ▸ (102) *Mathematical aspects of soap films.*
Brian White*, Stanford University, and **Jordan Drachman**, Stanford University (934-53-131)

9:30AM (103) *Conformally invariant fourth order equations.*
Paul Yang, Univ. of Southern California (934-58-123)

10:00AM (104) *Manifolds of nonpositive curvature and their ideal boundaries.*
Bruce Kleiner, Univ. of Utah (934-51-138)

10:30AM (105) *Reduction from instantons to holomorphic curves.*
Jingyi Chen, UBC (934-53-132)

Special Session on Mathematical Biology, I

9:00 AM – 10:50 AM **Room 115, Wellman Hall**

Organizer: **Alexander Isaak Mogilner**, University of California, Davis

8:50AM Discussion - Introduction

9:00AM (106) *Energy transduction in ATP synthase.*
Hong Yun Wang, University of California (934-92-61)

9:30AM (107) *Modeling celf-centering activity of cytoplasm.*
Alex Mogilner, University of California (934-92-42)

10:00AM (108) *Pattern formation induced by attractive diffusing and nondiffusing media.*
Angela Stevens, Stanford University (934-92-44)

10:30AM (109) *Urn models, replicator processes and genetic drift*
Sebastian Schreiber, Western Washington Univ. (934-92-43)

Special Session on Nonlinear Analysis, V

9:00 AM – 11:00 AM **Room 6, Wellman Hall**

Organizers: **John K. Hunter**, University of California, Davis
Blake Temple, University of California, Davis

9:00AM (110) *The zero-Mach limit of compressible Navier-Stokes flows.*
David C. Hoff, Indiana University (934-76-83)

9:30AM (111) *Particle-like solutions of the Einstein-Dirac equations.*
Felix Finster*, Harvard University, **Joel Smoller**, University of Michigan, and **Shing-Tung Yau**, Harvard University (934-83-36)

10:00AM (112) *Solutions of the Einstein Yang Mills equations.* Preliminary report.
Arthur G. Wasserman, U. of Michigan (934-83-84)

10:30AM (113) *Fluid flows in nonsmooth domains.*
Michael E. Taylor, Univ. of North Carolina (934-35-20)

Special Session on Nonlinear Analysis, VI

9:00 AM – 11:00 AM **Room 26, Wellman Hall**

Organizers: **John K. Hunter**, University of California, Davis
Blake Temple, University of California, Davis

9:00AM (114) *Bubbly flows, globally coupled oscillators, and Landau damping.*
Peter Smereka, University of Michigan (934-70-16)

9:30AM (115) *Time-independent bounds on spherically symmetric solutions of the relativistic Euler equations on non-flat spacetimes.*
Jeffrey M. Groah, La Sierra University (934-35-154)

10:00AM (116) *Beyond Painlevé equations: Darboux-Halphen systems.*
Mark J. Ablowitz, University of Colorado, **Sarbarish Chakravarty**, University of New South Wales, and **Rodney G. Halburd***, University of Colorado (934-34-120)

10:30AM (117) *The onset of chaos in vortex sheet roll-up.*
Robert Krasny*, University of Michigan, and **Monika Nitsche**, Tufts University (934-76-30)

Special Session on Random Fields and Stochastic Partial Differential Equations, I

9:00 AM – 10:50 AM **Room 233, Wellman Hall**

Organizers: **Arthur J. Krener**, University of California, Davis
Boris Rozovsky, University of Southern California

9:00AM (118) *Reciprocal diffusions in flat space.*
Arthur J. Krener, University of California, Davis (934-60-142)

9:30AM (119) *Exponential stability for Zakai's SPDE.* Preliminary report.
Ofer Zeitouni, Technion (934-60-140)

10:00AM (120) *Processes reciprocal in space and Markov in time.* Preliminary report.
Ram Vendatham, University of North Carolina at Wilmington (934-60-141)

10:30AM (121) *Representations for functionals of Hilbert space valued.*
Amarjit Budhiraja, Brown University (934-60-151)

Invited Address

11:10 AM – NOON **Room 1100, Social Sciences Building**

(122) *Wiener chaos and stochastic PDEs.*
Boris Rozovsky, University of Southern California (934-60-03)

Invited Address

1:50 PM – 2:00 PM **Room 1100, Social Sciences Building**

(123) *Three-manifolds, foliations and circles.*
William Thurston, University of California, Davis

Special Session on Dualities in Mathematics and Physics, IV

3:00 PM – 5:35 PM **Room 216, Wellman Hall**

Organizers: **Edward Frenkel**, University of California, Berkeley
Nicolai Reshetikhin, University of California, Berkeley

3:00PM (124) *A geometric approach to equations of KdV type.*
David Ben-Zvi*, Harvard University, and **Edward Frenkel**, U.C. Berkeley (934-22-57)

3:40PM (125) *Meromorphic tensor categories.*
Yan Soibelman, Kansas State University (934-22-34)

4:20PM (126) *Non-commutative analogue of Nahm transform.*
Alexander Astashkevich*, University of California at Davis, **Nikita Nekrasov**, Harvard University, and **Albert Schwarz**, University of California at Davis (934-81-148)

5:00PM (127) *Semi-infinite cohomology and superconformal algebras.*
Elena Poletaeva, Univetsity of Lund (934-17-66)

Special Session on Dynamical Systems and Mathematical Physics, IV

3:00 PM – 4:50 PM **Room 226, Wellman Hall**

Organizers: **Motohico Mulase**, University of California, Davis
Bruno L Nachtergaele, University of California, Davis

3:00PM (128) *Fourier duality for twisted D-modules.* Preliminary report.
Alexander Polishchuk*, Harvard University, and **Mitchell Rothstein**, University of Georgia, Athens (934-14-09)

3:30PM (129) *On axiomatics of asymmetric superconformal field theories.*
Anatoly V. Konechny, University of California, Davis (934-81-96)

4:00PM (130) *Infinite Grassmannian and Toda lattices.* Preliminary report.
Maarten J. Bergvelt, UIUC (934-58-87)

4:30PM (131) *The ubiquitous Dirac monopole.*
Gregory L. Naber, California State Univ (934-99-77)

Special Session on Geometric Analysis, IV

3:00 PM – 4:50 PM **Room 119, Wellman Hall**

Organizers: **Chikako Mese**, University of Southern California
Richard M. Schoen, Stanford University

3:00PM (132) *A general gluing construction for constant mean curvature surfaces.*
Rafe Mazzeo, Stanford University, **Frank Pacard**, Unversité Paris X11, and **Daniel Pollack***, University of Washington (934-53-102)

3:30PM (133) *Existence of covariant pseudo-differential operators.* Preliminary report.
Edith A. Mooers, UCLA (934-58-93)

4:00PM (134) *Christoffel's problem revisited.* Preliminary report.
George I. Kamberov, Washington University (934-53-11)

4:30PM (135) *Harmonic close-to-convex mappings.*
Jay M. Jahangiri*, Kent State University, and **Herb Silverman**, College of Charleston (934-30-26)

Special Session on The Geometry and Topology of 3-manifolds, IV

3:00 PM – 5:20 PM **Room 1, Wellman Hall**

Organizers: **Dmitry Fuchs**, University of California, Davis
Joel Hass, University of California, Davis
Ramin Naimi, University of California, Davis
William Thurston, University of California, Davis

3:00PM (136) *Intrinsically chiral graphs.*
Erica L. Flapan, Pomona College (934-57-67)

3:30PM (137) *Heegaard splittings of solvmanifolds.*
Daryl Cooper and **Martin Scharlemann***, U. C. Santa Barbara (934-57-74)

4:00PM (138) *Multi-variable Alexander polynomial and solvable Lie algebras.*
Arkady Vaintrob, New Mexico State University (934-57-130)

4:30PM ▸ (139) *Bounds for Thurston-Bennequin numbers of Legendrian links from state models for knot polynomials.*
Sergei Tabachnikov, University of Arkansas (934-57-128)

5:00PM (140) *The geodesic core of a subgroup.*
Rita Gitik, MSRI (934-20-85)

Special Session on Mathematical Biology, II

3:00 PM – 5:00 PM **Room 115, Wellman Hall**

Organizer: **Alexander Isaak Mogilner**, University of California, Davis

3:00PM Discusssion - Introduction

3:10PM (141) *The viscous nonlinear dynamics of twist and writhe.*
Raymond Goldstein, University of Arizona (934-92-49)

3:40PM (142) *The timing of life histories, viewed from an ultimate perspective and a proximate perspective.*
Marc Mangel, University of California (934-92-48)

4:10PM (143) *On the asymptotic speed of a stochastic invasion.*
Mark Lewis, University of Utah (934-92-47)

4:40PM (144) *The role of transient dynamics in population and community ecology.*
Alan Hastings, University of California (934-92-45)

Special Session on Nonlinear Analysis, VII

3:00 PM – 4:30 PM **Room 6, Wellman Hall**

Organizers: **John K. Hunter**, University of California, Davis
Blake Temple, University of California, Davis

3:00PM (145) *Some bifurcation problems of Rayleigh-Benard heat convection.* Preliminary report.
Takaaki Nishida* and **Hideaki Yoshihara**, Kyoto University (934-35-71)

3:40PM (146) *Global entropy solutions for exothermically reacting Euler equations.* Preliminary report.
David H. Wagner*, University of Houston, and **Gui-Qiang Chen**, Northwestern University (934-35-40)

4:10PM ▸ (147) *Solutions of spherically symmetric Einstein Yang Mills equations with cosmological constant.*
Alexander N. Linden, University of Michigan (934-83-113)

Special Session on Nonlinear Analysis, VIII

3:00 PM – 4:00 PM **Room 26, Wellman Hall**

Organizers: **John K. Hunter**, University of California, Davis
Blake Temple, University of California, Davis

3:00PM (148) *The basic attractor of jet engine flow.*
Bjorn Birnir* and **Hoskuldur Ari Hauksson**, Univ. of California, Santa Barbara. (934-35-19)

3:40PM (149) *Euler-Poisson-Darboux equations and nonlinear conservation laws.*
Gui-Qiang Chen, Northwestern University (934-35-156)

Special Session on Random Fields and Stochastic Partial Differential Equations, II

3:00 PM – 3:50 PM **Room 233, Wellman Hall**

Organizers: **Arthur J. Krener**, University of California, Davis
Boris Rozovsky, University of Southern California

3:00PM (150) *On the existence and the uniqueness of weak solutions to stochastic differential equation in a Hilbert space.*
V. Mandricar and **Anatoly V. Skorokhod***, Michigan State University (934-60-152)

3:30PM (151) *Transport by time dependent stationary flow.* **Leonid B. Koralov**, SUNY at Stony Brook (934-60-153)

Robert J. Daverman
Associate Secretary
Knoxville, Tennessee

Meetings and Conferences of the AMS

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The Meetings and Conferences section of the *Notices* gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. Up-to-date meeting and conference information is available on the World Wide Web at www.ams.org/meetings/.

Meetings:

Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 150 in the January 1998 issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

Abstracts

Several options are available for speakers submitting abstracts, including an easy-to-use interactive Web form. No knowledge of TeX is necessary to submit an electronic form, although those who use plain TeX, AMS-TeX, LaTeX, or AMS-LaTeX may submit abstracts with TeX coding. To see descriptions of the forms available, visit http://www.ams.org/abstracts/instructions.html or send mail to abs-submit@ams.org, typing help as the subject line, and descriptions and instructions on how to get the template of your choice will be e-mailed to you.

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Paper abstract forms may be sent to Meetings & Conferences Department, AMS, P.O. Box 6887, Providence, RI 02940. Note that all abstract deadlines are strictly enforced. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

Conferences: (See http://www.ams.org/meetings/ for the most up-to-date information on these conferences.)

1998:

June 21–July 23: Joint Summer Research Conferences in the Mathematical Sciences, South Hadley, MA. See pp. 1412–1416 (November 1997) and pp. 148–149 (January 1998) for details.

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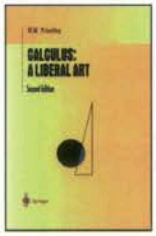

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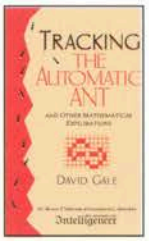

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