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New Titles from the AMS

**Pioneers of Representation Theory: Frobenius, Burnside, Schur, and Brauer**

*Charles W. Curtis, University of Oregon, Eugene*

This book presents the early history of an active branch of mathematics. It includes enough detail to enable readers to learn the mathematics along with the history. The volume would be a suitable text for a course on representations of finite groups, particularly one emphasizing an historical point of view.

*History of Mathematics, Volume 15; 1999; approximately 319 pages; Hardcover; ISBN 0-8218-0002-6; List $45; All AMS members $35; Order code HMATH/15NT98*

**An Introduction to the Mathematical Theory of Waves**

*Roger A. Knobel, University of Texas-Pan American, Edinburg*

This book is based on an undergraduate course taught at the IAS/Park City Mathematics Institute, on linear and nonlinear waves. The intent of this book is to create a text suitable for independent study by undergraduate students in mathematics, engineering, and science. The content of the book is meant to be self-contained, requiring no special reference material. Access to computer software such as Mathematica®, MATLAB®, or Maple® is recommended, but not necessary. Scripts for MATLAB applications will be available via a Web site. Exercises are given within the text to allow further practice with selected topics.

*Wolfram Research, Inc., Champaign IL.

The Math Works, Inc., Natick, MA.

Waterloo Maple, Inc., Ontario, Canada.*

*Student Mathematical Library; 1999; approximately 200 pages; Softcover; ISBN 0-8218-2039-7; List $23; All AMS members $18; Order code STML/00CBELNT98*

**Lectures on Contemporary Probability**

*Gregory F. Lawler, Duke University, Durham, NC, and Lester N. Coyle, Loyola College, Baltimore, MD*

This volume is based on classes in probability for advanced undergraduates held at the IAS/Park City Mathematics Institute. It is derived from both lectures (Chapters 1–10) and computer simulations (Chapters 11–13) that were held during the program. The material is coordinated so that some of the major computer simulations relate to topics covered in the first ten chapters. The goal is to present topics that are accessible to advanced undergraduates, yet are areas of current research in probability.

*Student Mathematical Library, Volume 2; 1998; approximately 120 pages; Softcover; ISBN 0-8218-2029-X; List $17; All AMS members $14; Order code STML/02NCT98*

**Foundations of $p$-adic Teichmüller Theory**

*Shinichi Mochizuki, Research Institute for the Mathematical Sciences, Kyoto, Japan*

This book lays the foundation for a theory of uniformization of $p$-adic hyperbolic curves and their moduli. On one hand, this theory generalizes the Fuchsian and Bers uniformizations of complex hyperbolic curves and their moduli to nonarchimedean places. That is why in this book, the theory is referred to as $p$-adic Teichmüller theory, for short. On the other hand, the theory may be regarded as a fairly precise hyperbolic analog of the Serre-Tate theory of ordinary abelian varieties and their moduli.

*Student Mathematical Library; 1999; approximately 120 pages; Softcover; ISBN 0-8218-1647-0; List $17; All AMS members $14; Order code STML/12TBNT98*

**Miles of Tiles**

*Charles Radin, University of Texas, Austin*

In this book, we try to display the value (and joy!) of starting from a mathematically amorphous problem and combining ideas from diverse sources to produce new and significant mathematics—mathematics unforeseen from the motivating problem...

*from the Preface*

The common thread throughout this book is aperiodic tilings; the best-known example is the "kite and dart" tiling. This tiling has been widely discussed, particularly since 1984 when it was adopted to model quasicrystals. The presentation uses many different areas of mathematics and physics to analyze the new features of such tilings. Although many people are aware of the existence of aperiodic tilings, and maybe even their origin in a question in logic, not everyone is familiar with their subtleties and the underlying rich mathematical theory. For the interested reader, this book fills that gap.

*Student Mathematical Library, Volume 1; 1999; approximately 128 pages; Softcover; ISBN 0-8218-1933-X; List $16; All AMS members $13; Order code STML/01NT98*

**Prime Numbers and Their Distribution**

*Gérald Tenenbaum, Université Henri Poincaré, Nancy I, France, and Michel Mendès France, Université Bordeaux I, France*

From reviews for the French edition...

*This is a short introductory book on analytic number theory. The prerequisites are quite modest, but it still contains an impressive amount of information. A multitude of results is included, some of which were proved just recently... this book is very well written. It is fun to read and at the same time presents most of the fundamental concepts and ideas in analytic number theory.*

*Mathematical Reviews*

There are two ways in which the book is exceptional. First, some familiar topics are covered with refreshing insight and/or from new points of view. Second, interesting recent developments and ideas are presented that shed new light on the prime numbers and their distribution among the rest of the integers.

*This book is suitable for anyone who has had a little number theory and some advanced calculus involving estimates. Its engaging style and invigorating point of view will make refreshing reading for advanced undergraduates through research mathematicians. This book is the English translation of the French edition.*

*Student Mathematical Library; 1999; approximately 120 pages; Softcover; ISBN 0-8218-1647-0; List $17; All AMS members $14; Order code STML/12TBNT98*
Complex Variables

S.G. Krantz, Washington University, St. Louis, MO

This is a comprehensive and self-contained handbook for all the essential information and methods involving complex variables and analysis. The focus is on basic concepts and numerical tools for solving problems in applied mathematics, science, and engineering. The material has been carefully organized for quick and convenient reference. All the indispensable ideas are presented, as well as applications topics and a brief survey of available computer software.

Further valuable features include a comprehensive table of notation, an extensive glossary of key terms, a detailed subject index, a catalog of conformal maps, and tables and charts to summarize information for ease of use, i.e., conformal mappings, equivalent definitions and equivalent concepts. The book is generously illustrated with helpful figures and graphs, and presents carefully worked examples for all key concepts, and extensive examples for evaluating integrals using the calculus of residues.

$98.00 (tent.)

Geodesic Flows

G. P. Paternain, Centro de Matematica, Montevideo, Uruguay

Geodesic flows provide a unified arena in which one can explore numerous interplays among, for example, smooth ergodic theory, symplectic and Riemannian geometry, and algebraic topology. This book gives a concise introduction to the geodesic flow of a complete Riemannian manifold. It develops the relationship between the exponential growth rate of the average number of geodesic arcs between two points in the manifold and the topological entropy of the geodesic flow, and explores the link between the topological entropy of the geodesic flow and the homology of the loop space of a manifold. The presentation is self-contained and discusses a variety of methods and tools that to date are only scattered throughout the literature, and contains numerous exercises and examples.

Contents: Introduction to Geodesic Flows • The Geodesic Flow Acting on Lagrangian Subspaces • Geodesic Arcs, Counting Functions, and Topological Entropy • Mañé's Formula for Geodesic Flows and Convex Billiards • Topological Entropy and Loop Space Homology • Further Results and Problems on the Subject

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## Feature Articles

### Capillary Surface Interfaces

**Robert Finn**

Capillary action is governed by highly nonlinear equations. Some recently discovered formal consequences of these equations are at variance with predictions from formal expansions, and experiments on NASA and Mir flights were conducted to determine what actually occurs. This article sketches the history of the problems, some of the current theory, and relevant experimental results.

### Interview with Henri Cartan

**Allyn Jackson**

In a wide-ranging interview in his 95th year, Henri Cartan comments on his early mathematical memories, the beginnings of Bourbaki, his own mathematical interests, his teaching and his students, the Séminaire Cartan, and the defense of dissidents.

## Communications

Proofs from THE BOOK—a Book Review

Reviewed by Daniel H. Ullman

Walter Schachermayer Receives Wittgenstein Award

The “New” JPBM

## From the AMS

1998 Report of the Committee on Meetings and Conferences

Preliminary List of Candidates for 1999 AMS Election

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AMS in the Twentieth Century

The Bulletin and the Start of the Proceedings

This is the second in a series of columns about important figures and activities of the AMS during the past century. It is based on histories of the first and second fifty years of the AMS, written by Raymond Clare Archibald and Everett Pitcher, respectively. The first column in the series discussed Maxime Bôcher and the founding of the Transactions.

The Bulletin was the original publication of the Society, and the Proceedings grew out of it. Concerning the founding of the Bulletin in 1891, Archibald writes, "President McClintock reported... that the proposed bulletin should... contain, primarily, historical and critical articles, accounts of advances in different branches of mathematical science, reviews of important new publications, and general mathematical news and intelligence... The Bulletin started out with the title, Bulletin of the New York Mathematical Society. A Historical and Critical Review of Mathematical Science, and the only change in title during the next thirty years was the substitution of the word 'American' for 'New York', beginning with the fourth volume." This change occurred in 1894 at the time of the renaming of the Society, and the numbering of the volumes was started again from 1, the new volumes being called the second series. The subtitle was dropped in 1931.

Archibald writes about the early editors of the Bulletin and the quality of the articles: "For the 45 volumes of the Bulletin, 1891-1936, there were only three editors-in-chief: T. S. Fiske, the Society founder; F. N. Cole; and E. R. Hedrick; with Hedrick's resignation this term was changed to 'managing editor'." Archibald reports that the first seven years of the Bulletin included eight articles by M. Bôcher, six by E. Dickson, four by J. E. McClintock, fourteen by G. A. Miller, seven by E. H. Moore, four by W. F. Osgood, and one by F. Klein. As to Cole, he writes, "The minute care and wisdom exercised in... editing is noticeable in every volume." He continues, "During Hedrick's administration the standard for the acceptance of material became necessarily high, and the effective presentation of the complex contents notable. The Society's debt to Hedrick in this regard alone is great, calling as it did for an enormous amount of personal attention to details. By order of the Council the Bulletin, v. 44, 1938, was dedicated to him, and has his portrait as frontispiece."

Pitcher takes this volume as a typical one from the point of view of its content: "The volume 44 of 1938... contained reports of meetings, book reviews, notes on conferences, appointments and deaths, abstracts of contributed papers, and research papers. There was a list of contributed papers (i.e. abstracts) with bibliographic information on subsequent publication, and an index. Finally, the list of officers and members, the bylaws and the report of the treasurer were a part of the volume in a separate issue."

He continues, "In 1930, the journal had been separated into gray issues, consisting exclusively of short papers, and green issues, consisting of everything else, though the color differentiation of the cover did not appear until 1931. The supplement constituting the membership list was covered in a bright yellow. ...After World War II, the volume of material offered for publication increased and so did the backlog of the two journals [the Bulletin and the Transactions]. ...An Emergency Publication Committee... was appointed. ...With some modification [its 1949] report was adopted by the Council and the committee discharged. There were two sets of recommendations.

"First, the gray issues of the Bulletin were to be published beginning in 1950 as a separate journal known as the Proceedings of the American Mathematical Society. The green issues were to continue as the entire content of the Bulletin. ...Second, a new publication called the Memoirs of the American Mathematical Society was to be created."

These recommendations were approved and were implemented partly in 1949 and partly in 1950. Pitcher continues, "With the year 1950, the gray issues of the Bulletin assumed independent identity as the...Proceedings... Volume 55 from 1949 is the last volume of the Bulletin with the dual character. In 1950 the editors of the Proceedings reported that their backlog had been reduced but was still large and requested additional pages for the coming year. By the end of 1951, the Bulletin, the Proceedings, and the Transactions all stated that their backlogs were small."

—Anthony W. Knapp
Commentary

In My Opinion

The Triumph of Research

“Our new provost wants to require research for tenure and promotion. It’s okay for me because I do research anyway, although it’s unfair to some of the people who have been around for a while and away from research. They’re upset by it.” So said a new acquaintance, a recent Ph.D. I met at a conference in the spring of 1999, when asked what her department, a branch of a well-known southern state university, was like. I have heard variations of that statement for years. I could have made it myself twenty-five years ago. And like my colleague, I have no doubt that this change represents progress. In fact,

1) the conditions for university-based mathematics research in America are good;
2) there is a broad social consensus that mathematics research benefits people’s lives;
3) we do not always recognize (1) and (2), but we should.

In the last half century of American higher education, university transitions like the one above are so commonplace, and the assumptions and commitment behind them are so much a part of conventional wisdom, that the transition seems, if not inevitable, then at least unremarkable. It is neither. Things could have been different, and the American mathematics community and its range of research could have been far less robust.

Start with the assumptions: In addition to the basic belief that a better university results if faculty do research, there is the notion that the model for research is the individual investigator working on projects that he/she selects. The consensus for this model is so strong that alternatives sound like violations of academic freedom: imagine the department head calling you in to tell you that for the next quarter you are being taken off the four-manifolds project to be reassigned and you will be working on the large data sets in the Galois theory strategic initiative instead; you will be part of a team made up of Professors X, Y, and Z, with Professor W in charge; and you are to report your progress monthly. If this sounds too fantastic, remember that it is not unusual, at least in some components of one’s teaching assignment, to move from service course to service course by quarter or semester as department needs change, essentially at the discretion of the department’s course-scheduling officer, and for multisection courses to be part of a team of instructors that has been assembled in an ad hoc manner. In other words, it is at least conceivable that something other than the existing research arrangement could have been put into place.

And let us not forget the financial commitment the academic institutions are making to sustain this research environment. Assume that in the typical research department 40 percent of a faculty member’s effort is supposed to go to research. Now figure forty faculty in the average research mathematics department, and the collective financial commitment for salary alone for the research departments runs to hundreds of millions of dollars every year.

Any fair assessment of the assumptions and commitment to mathematics research in the American system of higher education has to judge it a triumph for mathematics. The mathematics community has not only benefited from the past half century of these developments, it has actively urged and supported them. However, I think it would be difficult to argue that we in any way caused them. Despite our Washington work, our public relations efforts, or our engagement with other science and education communities, valuable as these are, universities’ decisions to require research seem to be driven by deeper forces. For example, the colleague’s institution cited at the beginning of these comments definitely did not decide to require research because of any lobbying by the mathematics community.

I also find it remarkable that the conversions to research have been so resilient: one would expect at least a few instances where smaller departments, enjoying neither strong financial support nor selective student bodies, only recently beginning to require research, would abandon the enterprise. But even after a decade of hounding by the political enemies of tenure, academic freedom, and investigator-selected research, there seems to be no sign of even isolated reversions, much less a trend.

I want to acknowledge that the rosy picture being painted here has some shadows. Some of the impetus to support and emphasize university research in recent years stems from a desire by university administrators to collect the financial benefits of external funding. And while there is some evidence that one of the reasons universities earlier in the century chose to encourage faculty research was to improve the quality of instruction, the exact relation between research creativity and enhanced teaching of mathematics has not been completely sorted out.

The American mathematics community and our Society need to be (and are) attentive to the opportunities to tweak public opinion and academic policy in the best interests of mathematicians and mathematics. We also need to remember that we enjoy the fruits of (a not always explicitly articulated) public consensus on the value of research, on the individual investigator model, for an ever widening range of institutional contexts, a movement which, as my colleague’s story reminds me, is still going strong after at least half a century and which, in my opinion, suggests that American mathematics research still has a predictably solid base and secure future.

—Andy Magid
Associate Editor
Letters to the Editor

Change Terminology at the Turn of the Century
Recalling the day when the Swedes all took to the road and switched from driving on the left side to the right, I wonder if the scientific and mathematical communities would be interested in using the turn of the century as an occasion to change certain conventions that should have been different. An example that leaps to mind is the use of "covariant" and "contravariant" in differential geometry, which is backwards as seen from a modern viewpoint. Changing this usage would require the support of the physics community.

Perhaps a joint ad hoc committee could articulate proposed changes to be voted on by the membership of leading societies. For a few years, papers employing the new conventions would carry "warning labels" until the community adjusts to the new usage and the changes are relegated to footnotes in textbooks.

If this idea strikes a resonant chord and it is not too late, I call upon the AMS to be the vehicle to make it happen.

—R. Peter DeLong
Raytheon Systems Co.
(Received April 9, 1999)

Source of Pictures Like the March Cover
This is a response to the beautiful cover picture of the March 1999 issue of the Notices. For those who find such pictures worth looking at, I invite them to visit my gallery of algebraic surfaces at http://www.mathematik.uni-kl.de/~wwwagag/Galerie.html. In addition to some more nice pictures, there is background information which I hope is useful for nonexperts.

—Bruce Hunt
Max Planck Institute for Mathematics in the Sciences, Leipzig
(Received April 12, 1999)

Census, Sampling, and Politics
David S. Moore (Commentary, Notices, March 1999) argues that the public interest is damaged by those who make political, legal, or procedural objections to the proposed use of statistical sampling for the U.S. Census. He thinks that the census should be done by nonpartisan experts and should not be subject to political questioning.

If statisticians want to stay out of political and legal controversies, then they should avoid disguising political opinions as scientific ones. Everyone agrees that sampling has scientific merit, but whether it should be applied to apportionment is a political question, and whether it can be applied under current law is a legal question. When statisticians say that sampling is more accurate than the constitutionally mandated "actual enumeration", they are being as foolish as those who argue that polling a carefully selected sample is more accurate than having a regular election. There is a theoretical point of view under which the registered voters who vote are in a biased subset of the set of all eligible voters, but we have election procedures which are subject to political requirements, and people prefer counting ballots over estimating them.

For example, some people think it is unfair that all states get exactly two senators under the U.S. Constitution, regardless of the size of the state. No doubt statisticians could devise a fairer system. But anyone advocating a change has the nearly impossible burden of making the political case that a change is needed and that a new system would be politically successful.

Likewise, there is no consensus that sampling is needed for apportionment or that such sampling can be done in a way that is demonstrably free from partisan bias. Some people think that we should count only those people who are willing to be counted, just as we count votes only from those willing to vote.

Maybe some day statisticians will have such respect that the public will blindly let their formulas determine how votes are weighted. But as long as they claim that scientific accuracy dictates a change in our method of political apportionment, then critics will be justified in saying there is a "thumb on the scale".

—Roger Schlafly
Computer Sciences Department
University of California, Santa Cruz
(Received May 2, 1999)

Support Free Textbooks
I enjoyed reading Leonard Evens's letter, "Textbooks Could Be Free", Notices, May 1999. This is a big idea. All of us have to go all out for its realization.

—László Leindler
University of Szeged, Hungary
(Received May 12, 1999)

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.
Counterpoint

The Immigration Law of 1990 and Its Effects

Damon Scott

The dismal academic job market for mathematicians is now in its ninth consecutive year, judging from articles in the Notices. This year's choice quotation on the subject is by John Ewing, executive director of the AMS: "The problems young mathematicians face are deep, serious, and complex" [1].

Things might be looking up: in February 1999, the Notices reported a 3.1% unemployment rate for new Ph.D.'s in the profession, down from the double digits of only a few years previously [2, Table 3C]. All the data from that latest AMS Annual Survey appear to indicate a real and very welcome improvement in the job market. But no one knows what is causing the recent upturn or whether it will last, and other statistics, such as the number of applications per vacancy, are still very high and remain demoralizing for many applicants. We should not turn from the question of job markets because of an apparent recent upturn. Even if the malady is cured (which I doubt), the poor job markets of the 1990s still need to be examined in order to prevent a recurrence.

In December of 1997, Cora Sadosky wrote a Notices "Forum" in favor of open immigration in the profession. This essay is written as counterpoint.

The laws of supply and demand show that any job market is sure to suffer from high rates of immigration, and the only thing left to ponder is exactly how and in what form the suffering will occur. To bring lasting stability to the American job market and help American mathematicians in their careers, it is necessary to address the immigration issue plainly, forthrightly, and in a civil manner. The sides of the debate may generally be classified as those in favor of high immigration and those in favor of low. As a practical matter, the question on immigration boils down to this: What should be the level of scientific immigration into the United States in future years? And how many workers on temporary visas should we bring in as well?

The Immigration Law of 1990

In 1990 Congress passed a comprehensive immigration law [3] whose effects have been far reaching and profound. There are several useful commentaries on this law, for example [4], [5], [6], and [7]. As it pertains to the scientific and technical community, the law provides that 40,000 permanent visas per year, plus any unused visas from the priority worker category, be allotted to aliens with advanced degrees in professional fields or possessing exceptional abilities in the sciences, arts, or business [4, p. 3-7]. These are permanent visas; the temporary ones on the H-1B visa program currently allow 115,000 to be granted to technical workers annually [8]. Aliens may also be eligible by possessing a bachelor's degree in the field and five years' experience. Furthermore, in the words of [7], "while a petition in this category is normally filed by the employer seeking the services of the alien, the law permits the Attorney General to waive the requirement of a job offer for the alien's services in the sciences, arts, or business when it is deemed to be in the national interest." Also, as the same commentary put it, "It can be anticipated that the preference will not use all the visas assigned to it, assuring that visas will be available on a current basis for natives of most countries."

The term "exceptional ability" is not defined by the statute [4, p. 3-8], and its interpretation is left almost entirely to the discretion of the federal executive. Such an exemption can be legitimately granted to nearly everyone, to nearly no one, or anywhere in between. To determine what to make of this provision and the law as a whole, it may be advisable to look at the raw 40,000-immigrants-per-annum figure that is directly mentioned in the law. The terms of the law set forth truly massive immigration into the American scientific and technical professions.

Immigration and Its Effects

The effects of massive immigration are overwhelming. No number of interview facilities, employment projects, or requests for funding increases can possibly prevail against the tremendous market forces of a global supply of mathematicians being readily employed to meet a demand that is only domestic.

The 1998 Annual Survey [2] reports, via Table 3E, that only 58% of the 487 academic jobs in mathematics going to new Ph.D.'s in this country went to United States citizens. Among tenured and tenure-eligible hires in Ph.D-granting departments, the figure is 45%, approximately unchanged from 46% in 1992 [9]. And in 1997 a report by the Commission on Professionals in Science and Technology stated that those immigrants on temporary visas alone occupy over half the 25,000 postdoctoral positions in science in the country [10].

The large-scale use of "part-time" laborers at pitiful wages is but a symptom of this problem. Calling these people "part-timers" is a misnomer, since they often work as many hours as "full-time" professors as they try to cobble together a living from their miserable pay. A more appropriate term is "part-wagers", since their salary and benefits are a mere fraction of the otherwise prevailing
standard. Immigration is without doubt a substantial cause, for it is only by having access to a glutted supply at some level that colleges and universities are able to hire at this level with such wages and working conditions.

Sadosky's essay refers, via her reference 10, to a data brief released by the NSF [11]. According to this document, the number of scientists and engineers gaining permanent visas (called S&E's) was steady at about 12,000 annually during the 1980s, climbed dramatically starting in 1990, until it nearly doubled to 23,534 in 1993, and then declined 26% to 17,403 in 1994. Here the data stop, though the data brief was released in June of 1997. A November 1997 Notices account (p. 1333) of an NSF news release on the data brief says that “the latest data indicate that what observers thought was a major, long-term rise in skilled immigrants was only a temporary surge.” Obviously, the data indicate both a temporary surge—a huge one, in fact—and a long-term rise in annual immigration of S&E's on permanent visas for the years in question.

Unreported in all this is the use of “nonimmigrants” (as federal law distinctly calls them [12]) on temporary visas. These visas last for six years [13]. But however complicated (and currently not quite adequately reported) is the situation, one thing is clear: immigration (and even “nonimmigration”) is a very significant part of the overall employment picture and is able singlehandedly to affect the American job market dramatically.

Central Thesis versus Central Thesis

Let us turn now to the central thesis of the Sadosky essay, printed in italics in the original: It is imperative that the xenophobic “foreigners are getting all the jobs” does not become a rallying cry for inaction on the real causes of the problem.

First to be noticed is the use of the term “xenophobic” from psychiatry. Not only is the term extreme and inappropriate, it is also inaccurate. Never once have I met a mathematician who feared foreigners or who loathed foreigners, whatever his or her stand on immigration. Of course, no mathematician would ever say that “foreigners are getting all the jobs,” if only because mathematicians are habitually scrupulous on the use of the quantifier “all.” What is true is that persons of foreign citizenship are getting a large share of the mathematical jobs in this country, and by the laws of supply and demand this does affect the job market significantly and adversely.

The essay posits three other causes of the unemployment problem (paragraph 9): “declining overall Federal funding for basic research, declining states' funding for higher education, and university administrations applying corporate methods to handle the education boom ...”. Actually, the federal government has expanded expenditures for research, even with inflation taken into account. The annual appropriation from Congress to the NSF has risen from $1,737 million to $3,607 million from FY1988 to FY 1998 respectively [14, 15], an increase of about 50%. Since the Consumer Price Index has increased by about 37% in the same interval, the appropriation has actually increased in constant dollars. Furthermore, total scientific research (including the Institutes for Health, NASA, NSF, and other agencies, and specifically excluding any defense-related research) is packaged together in the United States budget under the title “Research Fund for America” and was $28,915 million in FY1998; there is a proposed 8% increase for the coming fiscal year [15]. As to total state support for higher education, what little information I could find on the subject indicated it was rising [16]. Incidentally, if these appropriations decline, it will be all the more reason, not all the less, for curtailing immigration in the profession. Finally, if anything plays into administrators' corporate methods, it is the high immigration rate, which, as explained above, gluts the job market and makes exploitive hiring practices possible.

Sadosky mentions another cause: declining enrollments in mathematics. Between 1990 and 1995 the enrollment in calculus declined 17% from 647,000 to 539,000 [17]. These figures represent a loss of well over 500 faculty positions, but more than that they show that Americans are simply retreating from the pursuit of mathematics, science, and engineering in general. (Calculus is, of course, the gateway course for all the technical professions.) The response of American government and industry to this news? Hardly a ripple. They know that the rest of the world is twenty times the size of the United States and can easily supply all the mathematics and science it could ever need now or in the future; all that is needed is to institute a policy of massive immigration. Many American students also have figured out how easily the country can do without their services in science and technology and are taking their careers and coursework elsewhere. The problem is well worthy of being addressed, but it will be solved only by restoring the job market, which itself will be accomplished, if at all, by better managing the one variable that can be set by statute, the immigration rate.

Since I see no evidence that government and industry are using less science and mathematics than in the past or employing fewer people to do it, the worsening of the total scientific job market appears to be due almost entirely to the immigration policies instituted in 1990. Despite various assertions to the contrary, high immigration rates do cause bad job markets, as is amply demonstrated by rudimentary considerations of economics, by the dynamics of salary and employment negotiations, and by common sense. No American job market can possibly be anything other than dismal in the face of massive immigration from the entire rest of the world—and this statement remains true whether the domestic demand is high or low, rising or falling. And no other industrialized country's job markets would be able to hold up under the strain of massive immigration either.

Special Immigration and Mass Immigration

As do nearly all proponents of open immigration, Sadosky cites some big names who immigrated to this country in times past: Sylvester, Noether, and, of course, Einstein. But the scientific and technical professions in this country have experienced tens of thousands of immigrants on permanent visas and hundreds of thousands of workers on temporary visas in this decade alone. Invocation of the great names of the past might, at best, justify the immi-
The immigration policies of those former ages, but it does nothing to justify the current immigration policy, which is completely different. If the United States wants the benefit of a few big names to come into this country, then that can be achieved with a rate of scientific immigration that is only a hundredth part—in fact, only a thousandth part—of the current immigration rate.

Conclusion

A news release printed in SIAM News in 1994 [18], commenting on the 62% increase in immigrant S&Es (on permanent visas) between the years 1991 and 1992, says that "such an abrupt increase after a decade of gradually rising immigration is the result of a 1990 change in the immigration law increasing quotas for highly skilled workers. It was a response to projections of a scientist shortage by NSF Director Erich Bloch." Even the quotas of the 1980s may have been too high: in 1989, mathematics departments were "being flooded with 500, 600, even 700 applications for a few positions" and "there is abundant anecdotal evidence about people having a surprisingly tough time finding jobs" [19]. After nine years of deteriorating job markets and employment conditions and in the face of growing collections of horror stories on the same [20], the provisions which Congress adopted in 1990 pertaining to scientific and technical immigration can be seen to be tremendous overkill, if not a move in the wrong direction entirely. The time is long overdue for these provisions of the Immigration Act of 1990 to be repealed. The United States simply does not have the capacity to provide a credible job market for everyone in the world, nor even to that fairly large subset of scientists of foreign citizenship who choose to pursue their graduate study in this country.

References

Capillary Surface Interfaces

Robert Finn

Anyone who has seen or felt a raindrop, or who has written with a pen, observed a spiderweb, dined by candlelight, or interacted in any of myriad other ways with the surrounding world, has encountered capillarity phenomena. Most such occurrences are so familiar as to escape special notice; others, such as the rise of liquid in a narrow tube, have dramatic impact and became scientific challenges. Recorded observations of liquid rise in thin tubes can be traced at least to medieval times; the phenomenon initially defied explanation and came to be described by the Latin word capillus, meaning hair.

It became clearly understood during recent centuries that many phenomena share a unifying feature of being something that happens whenever two materials are situated adjacent to each other and do not mix. We will use the term capillary surface to describe the free interface that occurs when one of the materials is a liquid and the other a liquid or gas. In physical configurations such as the capillary tube, interfaces occur also between these materials and rigid solids; these latter interfaces yield in many cases the dominant influence for determining the configuration.

In this article we describe a number of such phenomena, notably some that were discovered very recently as formal consequences of the highly nonlinear governing equations. These discoveries include discontinuous dependence on the boundary data, symmetry breaking, failure of existence under physical conditions, and failure of uniqueness under conditions for which solutions exist. The predicted behavior is in some cases in striking variance with predictions that come from linearizations and formal expansions, sufficiently so that it led to initial doubts as to the physical validity of the theory. In part for that reason, experiments were devised to determine what actually occurs. Some of the experiments required microgravity conditions and were conducted on NASA Space Shuttle flights and in the Russian Mir Space Station. In what follows we outline the history of the problems and describe some of the current theory and relevant experimental results.

The original attempts to explain liquid rise in a capillary tube were based on the notion that the portion of the tube above the liquid was exerting a pull on the liquid surface. That, however, cannot be what is happening, as one sees simply by observing that the surface fails to recede (or to change in any way) if the tube is cut off just above the interface. Further, changing the thickness of the walls has no effect on the surface, thus suggesting that the forces giving rise to the phenomenon can be significant only at extremely small distances (more precise analysis indicates a large portion of these forces to be at most molecular in range). Thus, for a vertical tube the net attractive forces between liquid and wall must by symmetry be horizontal. It is this horizontal attraction that causes the vertical rise. Molecules being pulled toward the walls force other molecules aside in all directions, resulting in a spread along the walls that is only partly compensated by gravity. Liquid is forced upward along the walls, and cohesive forces

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carry the remaining liquid column with it. The lowered hydrostatic pressure at the top of the column is compensated by the curvature of the surface, in essentially the same manner as occurs with a soap bubble. This basic observation as to the nature of the acting forces appeared for the first time in the writings of John Leslie in 1802.

An early attempt to explain capillarity phenomena was made by Aristotle, who wrote circa 350 B.C. that A broad flat body, even of heavy material, will float on a water surface, but a long thin one such as a needle will always sink. Any reader with access to a needle and a glass of water will have little difficulty refuting the statement. On the other hand, Leonardo da Vinci wrote in 1490 on the mechanics of formation of liquid drops, using ideas very similar to current thinking. But in the absence of the calculus, the theory could not be made quantitative, and there was no convincing way to test it against experiments.

The achievements of the modern theory depend essentially on mathematical methods, and specifically on the calculus, on the calculus of variations, and on differential geometry. When one looks back on how that came about, one is struck by the irony that the initial mathematical insights were introduced by Thomas Young, a medical physician and natural philosopher who made no secret of his contempt for mathematics (and more specifically for particular mathematicians). But it was Young who in 1805 first introduced the mathematical concept of mean curvature \( H \) of a surface and who showed its importance for capillarity by relating it to the pressure change across the surface: \( \Delta p = 2\sigma H \), with \( \sigma \) equal to surface tension. Young also reasoned that if the liquid rests on a support surface \( W \), then the fluid surface \( S \) meets \( W \) in an angle \( \gamma \) (contact angle) that depends only on the materials and not on the gravity field, the shape of the surface, or the shape or thickness of \( W \); see Figure 1.

Young derived with these concepts and from the laws of hydrostatics the first correct approximation for the rise height at the center of a circular capillary tube of small radius \( a \) immersed vertically in a large liquid bath:

\[
(1) \quad u_0 \approx \frac{2 \cos \gamma}{Ka}, \quad \kappa = \frac{\rho g}{\sigma};
\]

where \( \rho \) is the density change across the free surface, \( g \) the magnitude of gravitational acceleration.

Young's chief competitor in these developments was Laplace, who relied heavily on mathematics. Laplace derived a formal mathematical expression for the mean curvature \( H \) of a surface \( u(x, y) \); he was led to

\[
(2) \quad 2H = \nabla \cdot T u, \quad T u = \frac{D u}{\sqrt{1 + \| Du \|^2}}
\]

for the mean curvature \( H \) of a surface \( u(x, y) \). See Figure 2.

Instead of a tube dipped into an infinite reservoir as considered by Young, one could imagine a vertical tube closed at the bottom and partially filled with a prescribed volume of liquid covering the base. In general in this case \( \lambda \neq 0 \), but addition of a constant to \( u \) converts (3) to (4). From uniqueness properties discussed below, it follows that in
yielding improved bounds was given by the partial asymptotic expansion in powers of \( B \); that result was obtained again independently by E. Miersemann in 1994.

In 1830 Gauss used the Principle of Virtual Work, formulated by Johann Bernoulli in 1717, to unify the achievements of Young and of Laplace, and he obtained both the differential equation and the boundary condition as consequences of the principle. In the Gauss formulation the constant \( \lambda \) in (3) appears as a Lagrange parameter arising from an eventual volume constraint.

Capillarity attracted the attention of many of the leading mathematicians of the nineteenth and early twentieth centuries, and some striking results were obtained; however, the topic then suffered a hiatus till the latter part of the present century. A great influence toward new discoveries was provided by the “BV theory”, developed originally for minimal surfaces by E. de Giorgi and his co-workers. In the context of this theory M. Emmer provided in 1973 the first existence theorem for the capillary tube of general section. For further references to these developments, see [1, 2]. Other directions were initiated by Almgren, Federer, Fleming, Simons, and others and led to results of different character; see, e.g., [10].

**The Wedge Phenomenon**

It is unlikely that anyone reading this article will be unfamiliar with the name of Brook Taylor, as the Taylor series figures prominently in every calculus sequence. It is less widely known that Taylor made capillarity experiments, almost one hundred years prior to the work of Young and of Laplace. He formed a vertical wedge of small angle \( 2\alpha \) between two glass plates and observed that a drop of water placed into the corner would rise up into the wedge, forming contact lines on the plates that tend upward in a manner “very near to the common hyperbola”. Taylor had no theory to explain the phenomenon, but in the course of the ensuing centuries a number of “proofs” of results leading to or at least suggesting a hyperbolic rise independent of opening angle appeared in the literature.

The actual behavior is quite different and varies dramatically depending on the contact angle and angle of opening. There is a discontinuous transition in behavior at the crossing point \( \alpha + \gamma = \pi/2 \). In the range \( \alpha + \gamma < \pi/2 \), Taylor’s observation is verified as a formal property that holds for any solution. Specifically, we consider a surface \( S \) given by \( u(x, y) \) over the intersection \( \Omega_0^\alpha \) of a wedge domain with a disk of radius \( \delta \) as in Figure 3. We obtain:

**Theorem 2.** Let \( u(x, y) \) satisfy (4) with \( \kappa > 0 \) in \( \Omega_0^\alpha \) and suppose \( S \) meets interior points of the bounding wedge walls in an angle \( \gamma \) such that \( \alpha + \gamma < \pi/2 \). Let \( k = \sin \alpha / \cos \gamma \). Then in terms of a polar coordinate system \((r, \theta)\) centered at the vertex \( \theta \), there holds...
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On the other hand, if \( \alpha + \gamma \geq \frac{\pi}{2} \), then \( u(x, y) \) is bounded, depending only on \( \kappa \) and on the size of the domain covered by \( \mathcal{S} \) near \( \partial \).

**Theorem 3.** If \( u(x, y) \) satisfies (4) with \( \kappa > 0 \) in \( \Omega^g \) and if \( \mathcal{S} \) meets the bounding wedge walls in an angle \( \gamma \) such that \( \alpha + \gamma > \pi/2 \), then

\[
|u| \leq \left( \frac{2}{\kappa \delta} \right) + \delta
\]

throughout \( \Omega^g \).

It is important to observe that the boundary is singular at \( \partial \) and the contact angle cannot be prescribed there. Despite this singularity, neither theorem requires any growth hypothesis on the solution near \( \partial \). Such a statement would not be possible, for example, for harmonic functions under classical conditions of prescribed values or normal derivatives on the boundary. It is also noteworthy that no hypothesis is introduced with regard to behavior on \( \Gamma \). The local behavior is completely controlled by the opening angle and by the contact angle over the wedge segments near \( \partial \) and is an essential consequence of the nonlinearity in the equation. (In another direction, it can be shown that if \( u(x, y) \) satisfies (4) in all space, then \( u \equiv 0 \).)

If in an initial configuration there holds \( \alpha + \gamma > \pi/2 \) and \( \alpha \) is then continuously decreased until equality is attained, (8) provides a uniform bound on height up to and including the crossing point. For any smaller \( \alpha \) the estimate (7) prevails, and the surface is unbounded at \( \partial \).

This behavior was tested in the Stanford University medical school in a "kitchen sink" experiment by T. Coburn, using two acrylic plastic plates and distilled water. Figure 4 shows the result of a change of about 2° in the angle between the plates, leading in the smaller \( \alpha \) case to a measured rise height over ten times the predicted maximum of Theorem 2. That result was confirmed under controlled laboratory conditions and for varying materials by M. Weislogel in 1992; it yields a contact angle of water with acrylic plastic of 80°, ±2°. (See the remarks in the next section.)

The relation (7) was extended by Miersemann (1993) to a complete asymptotic expansion at \( \partial \), in powers of \( B = \kappa r^2 \). It is remarkable that the coefficients are completely characterized by \( \alpha \) and \( \gamma \) and are otherwise independent of the data and domain of definition for the solution. Thus again the behavior is strikingly different from that arising in linear problems.

If gravity vanishes, the discontinuous dependence becomes still more striking. In this case (3) becomes

\[
\text{div} \, Tu = \lambda = 2H,
\]

so that the surface has constant mean curvature. We find:

**Theorem 4.** If \( u(x, y) \) satisfies (9) in \( \Omega^g \) and defines a surface \( \mathcal{S} \) that meets interior points of the wedge walls in the constant angle \( \gamma \), then \( \alpha + \gamma \geq \pi/2 \) and \( u(x, y) \) is bounded at \( \partial \).

Thus, the change is now from boundedness to nonexistence of a solution.

It may at first seem strange that this physical problem should fail to admit a solution; after all, fluid placed into a container has to go somewhere. Figure 5 shows the result of an experiment conducted by W. Masica in the 132-meter drop tower facility at NASA Glenn Research Center, which provides about five seconds of free fall. Two cylindrical containers of regular hexagonal section were dropped, both with acrylic plastic walls but with differing liquids, providing configurations on both sides of the critical value. In this case, when \( \alpha + \gamma \geq \pi/2 \), the exact solution is known as a lower spherical cap, and this surface is observed in the experiment. When \( \alpha + \gamma < \pi/2 \), the liquid fills out the edges and climbs to the top of the container, as indicated in Figure 6. Thus the physically observed surface folds back over itself and cannot be expressed as a graph over the prescribed domain. The physical surface thus exists as it has to, but not in the form of a solution to (9), (5). It should be noted that for regular polygonal sections, the change in character of the solution is discontinuous. That is clearly apparent, as (unique) solutions exist as lower spherical caps throughout the closed range \( \alpha + \gamma \geq \pi/2 \).
Existence and Nonexistence; the Canonical Proboscis

The just-described concurrence of experimental results with prediction from the formal theory provides a persuasive indication that the Young-Laplace-Gauss theory, beyond its aesthetic appeal, also correctly describes physical reality. The physical validity of that theory has been questioned on the basis of ambiguities that occur in attempts to measure contact angle. There are experimental procedures that give rise to reasonably repeatable measurements of what may be described as an “equilibrium angle”. However, if one partially fills a vertical circular cylinder with liquid (symmetrically) and then tries to move the liquid upward by a piston at the bottom, the contact line of liquid with solid does not immediately move, but instead an increase in the contact angle is observed. The maximum possible such angle before motion sets in is known as the “advancing angle”. Correspondingly, the smallest such angle obtainable before reverse motion occurs is the “receding angle”. The difference between advancing and receding angles is the “hysteresis range”, which presumably arises due to frictional resistance to motion at the interface, but could conceivably also reflect inadequacy of the theory. This range can be very large; for example, for the water and acrylic plastic interface in the Coburn experiment described above, it is over 20°. Such apparent anomalies of measurement have led to some questioning of “contact angle” as a physical concept. The experimental confirmation of discontinuous dependence on data at the critical opening in a wedge supports the view that contact angle does have intrinsic physical meaning; in addition it suggests a new method for measuring the angle in particular cases. One need only place a drop of the liquid into a wedge that is formed by vertical plates of the solid and has initial opening sufficiently large that Theorem 3 applies. The opening angle is then slowly decreased until the liquid jumps up in the corner to a height above the bound given by (8). The criteria of Theorems 2 and 3 then determine y.

For values of y close to π/2, remarkably good agreement has been obtained in this way with the “equilibrium angle” measured under terrestrial conditions. On the other hand, for values of y close to 0°, the physical changes occur in the immediate neighborhood of θ with an opening close to π, and measurements become subject to experimental error. We thus seek domains in which the discontinuous behavior is manifested over a larger set. We can do so in the context of a general theory of independent mathematical interest, applying to zero gravity configurations and determining criteria for existence and nonexistence of solutions of (9), (5) in tubes of general piecewise smooth section Ω.

Let Γ be a curve in Ω cutting off a subdomain Ω* ⊂ Ω and subarc Σ* ⊂ Σ = ∂Ω, as in Figure 7. From the zero gravity equations (9) and (5) we obtain, for the area |Ω*| and length |Σ*|,

\[ 2H|Ω*| = |Σ*| \cos y + \int_Γ v \cdot \nu \, ds. \]

The same procedure with Ω* = Ω yields

\[ 2H = \frac{|Σ| \cos y}{|Ω|}. \]

In (10) we observe that

\[ |v \cdot \nu| \leq \frac{|Du|}{\sqrt{1 + |Du|^2}} < 1 \]

for any differentiable function u(x, y). It follows that whenever there exists a solution to the problem, the functional Φ(Ω*, y) = |Γ| - |Σ*| \cos y + 2H|Ω*| satisfies

\[ Φ(Ω*, y) > 0 \]

for all strict nonnull subsets Ω* ⊂ Ω cut off by smooth curves Γ, when H is determined by (11). This inequality provides a necessary condition for existence of a solution.

To make the condition sufficient, we appeal to the properties of “Caccioppoli sets” in the BV...
theory. Roughly speaking, these are subsets of $\Omega$ whose boundaries within $\Omega$ can be assigned a finite length, in a variational sense. Details of general properties of these sets can be found in [1, 2]; reference [3] and references cited there give specific applications to capillarity. It was shown by Giusti in 1976 that if we rephrase (13) as a property of Caccioppoli sets, the condition also becomes sufficient; see also Theorem 7.10 of [3]. We obtain:

**Theorem 5.** A smooth solution $u(x, y)$ exists in $\Omega$ if and only if the functional $\Phi(\Omega^*; y)$ is positive for every Caccioppoli set $\Omega^* \subset \Omega$, with $\Omega^*$ not equal to $\emptyset$ or $\Omega$.

In order to use this result, one proves that if $\Omega$ is piecewise smooth, then $\Phi$ can be minimized among Caccioppoli sets, and the minimizing sets can be characterized geometrically. One obtains:

**Theorem 6.** For $\Omega$ piecewise smooth, there exists at least one minimizing set $\Omega_0$ for $\Phi$ in $\Omega$. Any such set is bounded by $\Omega$ by a finite number $N_0$ of nonintersecting subarcs of semicircles of radius $1/(2H)$, each of which either meets $\Sigma$ at a smooth point with angle $\gamma$ measured within $\Omega_0$ or meets $\Sigma$ at a corner point. The curvature vector of each subarc is directed exterior to $\Omega_0$.

Thus, the existence question is reduced to evaluation of particular configurations, which often can be determined explicitly by the geometrical requirements of prescribed radius and angle with $\Sigma$. In general, there will be a number $N \geq N_0$ of subarcs of semicircles satisfying those requirements. We refer to these arcs as *extremals*. If $N = 0$, then $\Phi$ vanishes on the null set, we find $\Phi(\Omega^*; \gamma) \geq 0$, all $\Omega^* \subset \Omega$ with $\Omega^* \neq \emptyset, \Omega$ and hence by Theorem 5 a smooth solution exists. That happens, for example, in a rectangle when $\gamma \geq \pi/4$. (If $\gamma < \pi/4$, then by Theorem 4 there is no solution for that problem.)

If $N$ is finite and positive, then a finite number of subdomains $\Omega^*$ appears for examination. If one or more of these sets yields $\Phi \leq 0$, then no solution of (9), (5) can exist in $\Omega$. If the value zero but no smaller value is achieved by $\Phi$ on the sets $\Omega^*$, then there exists a set $\Omega_0$ among them such that there will be a solution $u(x, y)$ in the set $\Omega \setminus \Omega_0$ and such that $u \rightarrow \infty$ as $\Omega_0$ is approached from within $\Omega \setminus \Omega_0$. If we then set $u = \infty$ in $\Omega_0$, we obtain a generalized solution in a sense introduced by M. Miranda in connection with minimal surfaces in 1977. This solution will have mean curvature determined by (11).

If a domain $\Omega^*$ exists with $\Phi(\Omega^*; \gamma) < 0$, then that inequality holds also for each minimizer. Again it can be shown [4] that there exists a solution $u(x, y)$ in a subdomain such that $u(x, y)$ tends to infinity on a finite number of circular subarcs of equal radius that intersect $\Sigma$ in angle $\gamma$. The mean curvature $H$ (and accordingly the radius of the arcs) will, however, no longer be determined by (11).

The case $N = N_0 = \infty$ can occur, and it is this case that provides the clue for obtaining domains in which there is abrupt transition in height of solutions over large sets at the critical angle separating existence from nonexistence. Following joint work by Bruce Fischer, by Tanya Leise, and by Jonathan Marek with the author, we look for a translational continuum of extremals, each of which yields $\Phi = 0$. We construct the domain $\Omega$ by finding the curves that meet a given translational family of circular arcs of common radius $R$ in a fixed angle $\gamma_0$; these curves can be written explicitly, in the form

$$x + c = \sqrt{R^2 - y^2} + R \sin \gamma_0 \ln \frac{\sqrt{R^2 - y^2} \cos \gamma_0 - y \sin \gamma_0}{R + y \cos \gamma_0 + \sqrt{R^2 - y^2} \sin \gamma_0}.$$

We choose upper and lower branches of the curves joining at a point on the x-axis as part of the boundary $\Sigma$, and then complete the domain by a circular “bubble” whose radius is adjusted so that the arcs become extremals with $\Phi = 0$, as indicated in Figure 8. We refer to such a domain as a canonical proboscis. It can be shown that when the contact angle exceeds $\gamma_0$, then a smooth solution of (9), (5) exists for that domain; however, for $\gamma = \gamma_0$ the surface becomes a generalized solution in the sense of Miranda, infinite in the entire region covered by the extremals.

Since the relative size of the portion of such a domain that is covered by extremals can be made as large as desired, the canonical proboscides can be used for determining small contact angles based on rapid changes of fluid height over large sets (see the initial paragraph of this section). The theory was tested by Fred W. Leslie in the Space Shuttle USML-2 using containers with two proboscides on.
opposite sides of a “bubble” corresponding to contact angles 30° and 34°. The fluid used had an equilibrium contact angle measured on Earth as 32°, with a hysteresis range of 25°. Effects of resistance of the contact line to motion (see beginning of this section) were observed in the experiment, but after the astronaut tapped the apparatus the successive configurations of Figure 9 (top row in cover montage) appeared. In an analogous container stored for some days, the fluid on the right climbed over the top and descended on the other side. Thus, although time is required (and perhaps also thermal and mechanical fluctuations), the resistance effects are overcome and a clearly determined contact angle is evidenced.

Differing Contact Angles; the \( \mathcal{D}^2 \) Domains, and Edge Blobs

We return to the discussion of wedges above and ask what happens when two distinct contact angles \( \gamma_1, \gamma_2 \) are prescribed on the two sides of a wedge. Again, new differences in possible behavior appear. Setting \( B_j = \cos \gamma_j \), one sees easily that a necessary condition for existence of any surface over a wedge domain \( \Omega^\alpha \) of opening \( 2\alpha \) and with normal vector continuous to \( \partial \) is that \( (B_1, B_2) \) lies in the closed ellipse

\[
\mathcal{E} : \quad B_1^2 + B_2^2 + 2B_1B_2 \cos 2\alpha \leq \sin^2 2\alpha.
\]

See Figure 10. For data in the indicated domains \( \mathcal{D}^+ \) bounded between the square and the ellipse, one can show the natural extension of Theorem 4 that solutions of (9), (5) are precluded without regard to growth hypotheses.

For data lying in \( \mathcal{D}^- \) the situation is very different. In this case solutions of (9), (5) have been shown to exist under general conditions, but their form must be very different from what occurs for data in \( \mathcal{E} \), in which case spherical surfaces yield particular solutions; that cannot happen in \( \mathcal{D}^- \), as the normal is discontinuous for such data. The classical Scherk minimal surface provides a particular example. But for data \( (B_1, B_2) \) that are not on the boundary of the square in Figure 10, the solution \( u(x, y) \) is bounded above and below. It has been conjectured by J.-T. Chen, E. Miersemann, and this author that \( u(x, y) \) is itself discontinuous at \( \partial \).

The conjecture was examined numerically, initially in special cases by Concus and Finn (1994), and later by Mittelmann and Zhu (1996) in a comprehensive survey of minimal surfaces achieving the data \( (B, -B) \) and \( (-B, B) \) on adjacent sides of a square. The calculations suggest that a discontinuity does indeed appear in \( \mathcal{D}^- \), although at points close to the boundary with \( \mathcal{E} \) it was so small as to create a numerical challenge to find it.

The local problem we have been discussing can be realized either by a global surface in a capillary tube, with prescribed contact angle along the walls, or alternatively by a drop of liquid sitting in a wedge with planar walls that meet in a line \( \mathcal{L} \) and extend to infinity. In the latter case, if data come from \( \mathcal{E} \), a solution can be given explicitly for any prescribed \( H > 0 \), as the outer spherical surface \( S \) of a portion of a ball of radius \( 1/H \) cut off by the wedge. This is effectively the only possible such surface. Specifically:

**Theorem 7.** If \( (B_1, B_2) \) lies interior to \( \mathcal{E} \) and if \( S \) is topologically a disk and locally a graph near its intersections with \( \mathcal{L} \), over a plane \( \Pi \) orthogonal to \( \mathcal{L} \), then \( S \) is metrically spherical, and is uniquely determined by its volume, up to rigid motion parallel to \( \mathcal{L} \).

Theorem 7 can be viewed as an extension of the H. Hopf theorem that characterizes genus zero immersions of closed constant \( H \) surfaces as metric spheres.

We now keep the volume of the drop constant and allow the data to approach the boundary of \( \mathcal{E} \). For simplicity we restrict attention to the two symmetry lines \( B_1 = B_2 \) joining the \( \mathcal{D}^+_1 \) regions, and \( B_1 = -B_2 \) joining the \( \mathcal{D}^-_2 \) regions. We find:
Theorem 8. As one increases $B_1 = B_2$ to move from the ellipse $E$ to the region in the parameter space $D^-_1$, the free surface of the drop changes in topological character from a disk to a cylinder. The surface becomes a metric sphere with two caps removed at the places where the drop contacts the two plates. Figure 11a depicts a value of the parameter shortly before the transition occurs. On approaching $D^+_1$ within $E$ on the same line, the radius of the drop grows unboundedly, with the drop covering very thinly a long segment of $E$; see Figure 11b. As either $D^-_2$ or $D^+_2$ are entered from $E$ on the line $B_1 = -B_2$, the drop becomes a spherical cap lying on a single plate and not contacting the other plate; see Figure 11c.

As already mentioned, for data in $D^-_1$ or in $D^+_1$, no drop in the wedge can exist even locally as a graph over a plane orthogonal to $E$. Theorem 8 suggests that the same result should hold for $D^-_2$ or $D^+_2$ data. The statement is here, however, less clear-cut; in fact, recent joint work of P. Concours, J. McCuan, and the author [6] shows that capillary surfaces with data in $D^-_2$ can exist locally as graphs. The matter may be related to the presence of vertices, in a sense introduced in [5]. There a blob of liquid topologically a ball was considered, resting on a system of planes, each of which it meets in a prescribed angle. Points at which intersection lines of the planes meet the surface of the blob are called vertices. This concept extends also to configurations in which the intersection point is not clearly defined, as can occur for data in $D^+_2$. The following results are proved, for a configuration with $N$ vertices, and for which all data on intersecting planes that it contacts lie in $E$:

Theorem 9. If $N \leq 2$, then either $N = 0$ and the blob consists either of a spherical ball or a spherical cap resting on a plane, or else $N = 2$ and the blob forms a spherical drop in a wedge. If $N = 3$, then the blob covers the corner point of a trihedral angle; under the supplementary orientation condition that the mean curvature vector is directed away from the vertex, the surface is spherical.

If $N > 3$, the surface need not be spherical. The surfaces described in the Appendix of [6] have four vertices. A spherical drop in a wedge has two vertices. We are led to:

Conjecture. There exists no blob in a wedge, with $N = 2$ vertices and data in $D^+_2$.

Stability of Liquid Bridges

A substantial literature has developed in recent years on stability criteria for liquid bridges joining two parallel plates separated by a distance $h$, in the absence of gravity. Earlier papers considered bridges joining prescribed circular rings, but more recently the problem was studied with contact angle conditions on the two plates. The initial contributions to this latter problem, due to M. Athanassenas and to T. I. Vogel, were for contact angles $\gamma_1 = \gamma_2 = \pi/2$ for which a bridge exists as a circular cylinder, and established that every stable configuration is a cylinder with volume $V \leq h^3/\pi$. A consequence is that instability occurs at half the value of $h$ that is indicated in classical work of Plateau and of Rayleigh on stability of liquid columns. The discrepancy arises because of the use here of a contact angle condition, rather than the Dirichlet condition employed by those authors. It was later shown by Vogel and this author that the same inequality holds regardless of contact angles. The most complete results on stability of such bridges are due to Lianmin Zhou in her 1996 Stanford University dissertation; Zhou established in the general case of equal contact angles $\gamma$ on the plates that regardless of $\gamma$ there is a unique stable bridge if the volume exceeds a critical $V_\gamma$. In 1997 Zhou also obtained the striking result that for unequal contact angles, the stability set in terms of a defining parameter can be disconnected.
With regard to interpretation of these and also of earlier results, see the editor's note following her 1997 paper and the later clarifying papers by Große-Brauckmann and by Vogel. The stability criteria just described should also be interpreted in the context of the comments directly following:

**Stability of Liquid Bridges II**

Stable liquid bridges joining parallel plates are rotationally symmetric but are in general not spherical. The meridional sections (profiles) of these surfaces were characterized by Delaunay in 1841 as the "roulades" of conic sections, and yield the sphere as a limiting case. We obtain, however, the result [6]: Every nonspherical tubular bridge joining parallel plates is unstable, in the sense that it changes discontinuously with infinitesimal tilting of either plate. In the earlier stability results, tilting of the plates was not contemplated.

From another point of view, there is the remarkable 1997 result of McCuan:

**Theorem 10.** If the data \((B_1, B_2)\) are not in \(D_1^-\), then there is no embedded tubular bridge joining intersecting plates.

It should be noted here that data in \(D_1^-\) are exactly those for which tubular bridges that are metrically spheres are possible (cf. Theorem 8 above). It is not known whether nonspherical embedded bridges can occur in that case. H. C. Wente gave an example of a nonspherical immersed bridge, with contact angle \(\pi/2\) on both plates (and thus with data in \(E\)).

**Exotic Containers; Symmetry Breaking**

For solutions of (3), (5) in a bounded domain \(\Omega\) with given \(K \geq 0\), uniqueness for prescribed fluid volume and contact angle can be established under much weaker conditions than are needed for linear equations. In fact, arbitrary changes of the data on any set of linear Hausdorff measure zero on \(\partial \Omega\) have no effect on the solution within \(\Omega\); this behavior holds without growth condition on the solutions considered. Finn and Hwang showed if \(K > 0\) (positive gravity) then the stated result can be extended to unbounded domains of any form, without conditions at infinity. In the case of equations (9), (5) (zero gravity), uniqueness can fail for unbounded domains.

A liquid blob resting on a planar support surface is also uniquely determined by its volume and contact angle, although the known proof proceeds along very different lines from the one for the statement above. We may ask whether uniqueness will persist during a continuous (convex) deformation of the plane to a tube. The negative answer can be seen from Figure 12. If the tube on the right is filled from the bottom until nearly the maximum height of the conical portion with a liquid making contact angle \(45^\circ\), then a horizontal surface will result. But if it is filled to a very large height, then a curved meniscus appears. Removal of liquid can then lead to two distinct surfaces with identical volumes and contact angles.

This line of thought can be carried further: Capillary surfaces are characterized as stationary configurations for the functional consisting of the sum of their mechanical (gravitational and surface) energies. In any gravity field and for any \(\gamma\), "exotic" containers can be constructed that yield an entire continuum of stationary interfaces for fluid configurations with the container as support surface, all with the same volume and the same mechanical energy. This can be done in a rotationally symmetric container, so that all the surface interfaces have the same rotational symmetry, that no other symmetric capillary interfaces exist, and in addition so that energy can be decreased by a smooth asymmetric deformation of one of the surfaces. Thus, none of the interfaces in the

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**Figure 12.** For given volume, uniqueness holds in cylindrical tube for any section \(\Omega\); also drop on plane is unique. But uniqueness fails in tube with curved bottom.
continuum can minimize the energy. Using a theorem due to Jean Taylor, we can prove that: A minimizer for energy will exist but is necessarily asymmetric.

Local minimizers for this "symmetry breaking" phenomenon were obtained computationally by Callahan, Concus, and Finn, and then sought experimentally, initially in drop tower experiments conducted by M. Weislogel. In the lower left of the cover montage are shown calculated meridian sections for the continuum of stationary symmetric nonminimizing surfaces, corresponding to a contact angle of 80° and zero gravity. The second row of the montage shows the planar initial interface in the earth's gravity field, and a "spoon" shaped configuration that appeared near the end of free fall in the 132-meter drop tower. The spoon surface has the general form of the global minimizer suggested by the calculations, which had also located two local minimizers of larger energy ("potato chip" and "lichen"). The time permitted by the drop tower was, however, insufficient to determine whether the spoon configuration was in equilibrium or whether it might continue to evolve to some distinct further form.

In view of the ambiguity in the drop tower results, space experiments were later undertaken in order to obtain a more extended low gravity environment. These were performed initially by Lawrence de Lucas on the NASA Space Shuttle USML-1 and then by Shannon Lucid in the Mir Space Station. Figure 13 (the lower right corner of the cover montage) shows comparison of the latter experiment. The upper row shows the calculated spoon and potato chip; the lower row shows experimental observation. The experiment thus confirms both the occurrence and the qualitative structure of global and also of local asymmetric minimizers, in a container for which an entire continuum of symmetric stationary surfaces appears.

Re-entrant Corners; Radial Limits

It was shown by Korevaar in 1980 that if the opening 2\(\alpha\) of a wedge domain exceeds \(\pi\), then even if \(B_1 = B_2\), solutions \(u(x, y)\) of (3) can exist that are discontinuous at the vertex \(\partial\), in the sense that the tangential limits along the two sides differ. Lancaster and Siegel (1996) showed that under general conditions radial limits at the vertex exist from every direction. Further, if \(u(x, y)\) is discontinuous, then there will exist "fans" of constant radial limit adjacent to each side. If \(2\alpha < \pi\) and if \((B_1, B_2) \in \mathbb{E}\), then the fans overlap, yielding continuity of \(u(x, y)\) up to \(\partial\). Earlier work, initially for the case \(B_1 = B_2\), due originally to L. Simon and later extended by Tam, by Lieberman, and by Mersemann, can be used to extend the result to the parts of \(\partial\mathbb{E}\) bordering \(D^\pm\), yielding continuity of the unit normal up to \(\partial\), and shows that for data in-

![Figure 14. Pendent liquid drop (Thomson, 1886).](image)

terior to \(\mathbb{E}, u(x, y)\) has first derivatives Hölder continuous to \(\partial\). Note that no growth condition is imposed in any of this work.

If \(2\alpha > \pi\) then it can occur that a central fan of opening \(\pi\) appears, in addition to the two fans at the sides.

Pendent Drops

We consider what happens when \(\kappa < 0\) in (3). That occurs when the heavier fluid lies above the interface. Examples are a liquid drop hanging from a "medicine dropper", or a drop pendent from a horizontal plate. The behavior of such solutions is very different from what occurs in the cases discussed above and, in general, instabilities must be expected. This "pendent drop equation" was much studied toward the end of the last century, and Kelvin calculated a remarkable particular solution of a parametric form of the equation; see Figure 14.

This surface is unstable; however its bottom tip could be observed as a stable drop hanging from a ceiling in a house with a leaking roof. The best stability criteria were obtained in 1980 by Wente, who showed that in the development of a drop by increasing volume, instability occurs after the initial appearance of an inflection in the profile, and prior to appearance of a second inflection. Wente showed existence of stable drops with both "neck"
and "bulge". An example is the drop of colored water in a bath of castor oil, shown in Figure 15.

Concus and Finn proved the existence of "Kelvin drops" that are formal solutions of the parametric equation, and which have an arbitrarily large number of bulges. In addition they proved existence of a rotationally symmetric singular solution \( U(r) = 1/k \) of (4); this solution was shown by M.-F. Bidaut-Veron to extend to a strict solution for all \( r > 0 \). (If \( k \geq 0 \) then any isolated singularity of a solution of (3) is removable.) It was shown by Finn that in the limit as the number of bulges increases unboundedly, the Kelvin solutions tend, uniformly in compacta, to such a singular solution. In a remarkable work now in preparation, R. Nickolov proves the uniqueness of that singular solution, among all rotationally symmetric surfaces with a nonremovable isolated singularity. The result holds without growth hypotheses.

**Gradient Bounds**

In addition to the height bounds indicated in Theorems 2, 3, and 4, gradient bounds can also be obtained. Again, some of these have an inimical character, reflecting the particular nonlinearity of the problems. We indicate two such results:

i) (Finn and Giusti, 1977). There exists \( R_0 = (0.5654064...)/H_0 \) and a decreasing function \( G(RH_0) \) with \( G(R_0H_0) = \infty \) and \( G(1) = 0 \), such that if \( u(x,y) \) satisfies (9) with \( H = H_0 \equiv \text{const.} > 0 \) in a disk \( B_R(0) \) and \( R > R_0 \), then \( |Du(0)| < G(RH_0) \). The condition \( R > R_0 \) is necessary. There is no solution of (9) in \( B_R(0) \) if \( RH_0 > 1 \).

ii) (Finn and Lu, 1998). Suppose \( H = H(u) \) with \( H'(u) \geq 0 \) and \( H(\infty) \neq H(\infty) \). Then there exists \( F(R) < \infty \) such that if \( u(x,y) \) satisfies (9) in \( B_R(0) \) then \( |Du(0)| < F(R) \).

From the case \( R < R_0 \) in (i) we see that the estimate of (ii) would be false if \( H \) is identically constant. We note that the hypotheses of (ii) are satisfied by the equation (4) for capillary surfaces in a gravity field when \( \kappa > 0 \).

**Past and Future**

I have described only some of the many new results that have appeared in recent years; choices had to be made as to what to cover, and they were based largely on the simple criterion of familiarity. Other directions of interest can be inferred from items in the bibliography. Let me close with the opening quotation from the 1851 Russian treatise on capillarity by A. Yu Davidov:

The outstanding contributions made by Poisson and by Laplace to the mathematical theory of capillary phenomena have completely exhausted the subject and brought it to such a level of perfection that there is hardly anything more to be gained by its further investigation.

For the later French and German translations of the book, Davidov changed the quotation to:

The outstanding contributions made by Poisson, by Laplace, and by Gauss to the mathematical theory of capillary phenomena have brought the subject to a high level of perfection.

The subject has advanced in significant ways since the time of Davidov, but may nevertheless still be in early stages. The material I have described should indicate the kind of behavior to be expected; some of it may serve as building blocks toward creation of a cohesive and structured theory.

**Acknowledgments**

The work described here was supported in part by grants from the NASA Microgravity Research Division and from the NSF Division of Mathematical Sciences. I am indebted to many colleagues and students for numerous conversations, extending over many years, that have deepened my knowledge and understanding. I wish to thank the editors of the Notices for careful reading of the manuscript and for perceptive comments from which the exposition has benefited greatly. The exposition has also profited from comments by Paul Concus and by Mark Weislogel.

—R. F.

**Skeletal Bibliography**


About the Cover
The top row exhibits “nearly discontinuous” dependence on data for fluid in a cylindrical “canonical proboscis” container in zero gravity; the container section has two noses with slightly different critical angles that encompass the one for the fluid. Following successive taps by the astronaut, the fluid remains bounded in height below a predicted maximum on one side, but rises well above that height on the other side.

The second row shows symmetry breaking for fluid in an “exotic container” designed for zero gravity, shown just prior to and near the end of free fall in a drop tower. The curves on the lower left are calculated meridional sections of a continuum of symmetric equilibrium surfaces bounding equal volumes in the container; all these surfaces are unstable. The fluid volume for the drop tower experiment is chosen so that the initial section in the earth’s gravity field can be identical to the horizontal section of the calculated zero gravity family.

The lower right shows comparison of calculation and experiment for surfaces yielding asymmetrical critical points for mechanical energy in an exotic container during an experiment on the Mir Space Station. The apparent global minimum (“spoon”) and a local minimum of larger energy (“potato chip”) are both observed by the astronaut.

The cover montage was prepared by Gary Nolan of the NASA Glenn Research Center.

—R. F.
Interview with Henri Cartan

Biographical Sketch
Henri Cartan is one of the first-rank mathematicians of the twentieth century. He has had a lasting impact through his research, which spans a wide variety of areas, as well as through his teaching, his students, and the famed Séminaire Cartan. He is one of the founding members of Bourbaki. His book Homological Algebra, written with Samuel Eilenberg and first published in 1956, is still in print and remains a standard reference.

The son of Elie Cartan, who is considered to be the founder of modern differential geometry, Henri Cartan was born on July 8, 1904, in Nancy, France. He attended the École Normale Supérieure and received his Docteur ès Sciences mathématiques in 1928. After holding positions in Lille and Strasbourg, he returned to Paris and taught at the École Normale from 1940 until 1965. Later he moved to the Université de Paris-Sud at Orsay, and he retired in 1975. Cartan is a member of the Académie des Sciences of Paris and of twelve other academies in Europe, the United States, and Japan. He has received honorary doctorates from several universities, and also the Wolf Prize in Mathematics in 1980.

Early Years

Notices: Let’s start at the beginning of your life. What are your earliest memories of mathematical interest?

Cartan: I have always been interested in mathematics. But I don’t think it was because my father was a mathematician. I had no doubt that I could become a mathematician. I had many teachers, good or not so good. I don’t think it was because of a particular teacher. Of course, I had some conversations with my father. I was quite surprised when he told me that Euclid’s Postulate was not a necessity.

Notices: How old were you when he told you that?

Cartan: I don’t know, perhaps 14.

Notices: Do you have other memories of mathematical discussions with your father?

Cartan: My father was a discreet man, you know. He never tried to influence me—it was always possible to ask him questions, but which questions I don’t know. Much later we worked together on some problems. For instance, he knew more than I did about Lie groups, and it was necessary to use this knowledge for the determination of all...

**Notices:** You were interested in music.

**Cartan:** Yes. I had a brother two years younger than myself, who became a composer. But he died at age 25 of tuberculosis. It was a great loss. Of course I played much music, but I can’t now because I can’t see.

**Notices:** What about your other siblings? Did you have other brothers?

**Cartan:** Yes, a younger brother who became a physicist. But he was killed during the war by the Germans, because he was in the Résistance. He was deported to Germany in February 1943, sentenced to death in August, and beheaded in December of the same year. From February 1943 right until the end of May 1945, we never heard about him. Under the circumstances, one could not expect to get any news. Some German colleagues were so good as to try to find out about him, but they didn’t succeed.

**Notices:** Who were the German colleagues?

**Cartan:** One of them was Heirich Behnke. Though a little older, Behnke was a friend of mine. My first invitation to go to Germany occurred in May 1931. Behnke was teaching in Münster-in-Westfalen, and he had a lot of students, about 40. I was invited because I had published a note in the *Comptes Rendus de l'Academie des Sciences* about circled domains ["Les transformations analytiques des domaines cercles les uns dans les autres", C. R. Acad. Sci. Paris 190 (1930), 718-720], where I had proved quite easily a theorem which had been proved earlier by Behnke, but under certain conditions, in a particular case. So I was invited to give several speeches in Münster. That was in 1931, and Behnke invited me again in 1937. It was the time of Hitler.

Before the war, since November 1931, I had been teaching at the University of Strasbourg. But in September 1939, the inhabitants of Strasbourg had to be evacuated. The university was displaced to Clermont-Ferrand, where I taught for a year before I was appointed professor at the Sorbonne in Paris, in November 1940 (in fact, I was to be in charge of the mathematics students at the École Normale).

Throughout the war I was not permitted to go to my apartment in Strasbourg. One day, Behnke

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Excerpts from the minutes by Jean Delsart of the first preparatory meeting of the group that was later to become Bourbaki. These excerpts are taken from the only extant original copy of the minutes, in the possession of Henri Cartan. The nine people listed in the top excerpt were the members of the group. The first meeting was January 14, 1935. Later Dubreil and Leray dropped out, and the seven others became Bourbaki. The second and third excerpts give André Weil's ideas concerning readership and style, and the fourth discusses assignments for the next meeting.
The first Bourbaki congress, at Besse-en-Chandesse, July 1935. Left to right, standing: Henri Cartan, René de Possel, Jean Dieudonné, André Weil, and a university laboratory technician; seated: Mirlès ("guinea pig"), Claude Chevalley, and Szolem Mandelbrojt. The "guinea pig" was a person being considered for membership in Bourbaki.

offered to try and retrieve some mathematical papers I had left there. He actually went to Strasbourg, but to no avail. He tried again and succeeded. He managed to get hold of some documents, which he left with the library of the University of Freiburg. In 1945, some members of the French Forces in Germany happened to find them there and returned them to me. Among those papers were the comptes rendus, minutes, of the first meetings of certain people who later became the Bourbaki group. That was the very beginning of Bourbaki's work. I don't think there exists another copy of these comptes rendus.

I returned to the University of Strasbourg after the war, at the end of 1945, for two years. In November 1946, I went to the Research Institute in Oberwolfach. It was very cold; there was snow and ice. I saw Professor Süss (the founder of Oberwolfach) and Frau Süss, and also Heinrich Behnke. I remember they asked me to play the piano. It was a beautiful piano—there were two pianos there. The old château at Oberwolfach doesn't exist anymore. I visited Oberwolfach several times after that. I was very grateful to my German colleagues for what they had done during the war.

Cartan: It is difficult to answer the question, because it depends. Of course, there were not so many mathematicians in France who were interested in analytic functions of several complex variables.

Notices: But there was a big tradition in France for function theory of one variable.

Cartan: Yes. It was perhaps the thing which was studied in France by most mathematicians—my father's work was an exception.

Notices: But you were the one who started to work on several variables in France.

Cartan: I believe it was André Weil who suggested that it could be interesting. He told me about the work of Carathéodory on circled domains. That was the beginning of my interest.

Behnke's assistant in 1931, namely Peter Thullen, was to become one of my best friends. We collaborated and wrote a paper together for the Mathematische Annalen ("Zur Theorie der Singularitäten der Funktionen mehrerer Komplexen Veränderlichen", Math. Ann. 106 (1932), 617–647). I always had a good relationship with Thullen. At the beginning of 1933 or 1934, he left Germany—not because he was Jewish, he was Catholic, a deeply convinced Catholic. Thanks to Courant, he got a position in Ecuador. Thullen founded the Social Security system in Ecuador, and later in Colombia. In 1951, I think, he came back to Europe. I was very glad he did. He went to Geneva to work with the Bureau International du Travail (B.I.T.), where he was in charge of Social Security systems in Latin America. When he retired from that position, he was appointed at the University of Zürich, thanks to Van der Waerden, and later he became professor of mathematics in Fribourg, Switzerland. I have always had a very good relationship with his eldest son, who worked with the United Nations in Geneva, and is now retired. He visits us every year.

Notices: When did you go to the United States for the first time?

Cartan: I went to the United States for the first time in 1948. In fact, during the war—I think it was in 1942—I was invited to the United States, because they wanted to protect French people from German aggression. But it was not possible for me to move there, because of my family, and because my father was getting old. I was invited by Harvard University to visit from the beginning of February till the end of May 1948. But prior to that I was invited to Chicago by André Weil in January. So before I left I had to learn some English, because in order to be able to give lectures in English, it was necessary for me to know some words! My first lectures I had to write out in English beforehand. Later I wrote only the résumés. When I arrived at the airport in New York in December 1947, I was met by Samuel Eilenberg. It was my first encounter...
Beginnings of Bourbaki

Notices: You first met André Weil when you were students together at the École Normale in Paris.

Cartan: Yes. We were there together, but he had been admitted the year before, at age 16.

Notices: You and Weil happened to be students at the École Normale together with such people as Jean Dieudonné, Claude Chevalley, Jean Delsarte, Jean Leray . . .

Cartan: Dieudonné of course came after me. I was no longer at the École Normale when Leray entered. He entered the same year as Chevalley.

Notices: These were some of the people who went on to form Bourbaki. Was there something at the École Normale, or in your common background, that later made you form Bourbaki?

Cartan: You see, after the First World War, there were not so many scientists, I mean good scientists, in France, because most of them had been killed. We were the first generation after the war. Before us there was a vacuum, and it was necessary to make everything new. Some of my friends went abroad, notably to Germany, and observed what was being done there. This was the beginning of a mathematical renouveau, renewal. It was due to such people as Weil, Chevalley, de Possel . . . The same people, responding to André Weil's initiative, came together to form the Bourbaki group. In Bourbaki I learned very much. Almost all I know in mathematics I learned from and with the Bourbaki group.

Notices: Leray was not in Bourbaki.

Cartan: Not quite. In fact, Leray was in the first group, at the beginning: a group which met from January to June, 1935. At that time we were considering writing a Traité d'Analyse. But two out of the group left before the summer; they didn't wish to continue. Leray was one of them. The final group was fixed in July 1935, in the so-called Congrès de Besse-en-Chandesse, and this group made decisions as to what they were going to treat.

Notices: It was the comptes rendus of these meetings in the first half of 1935 that were left in Strasbourg in your apartment?

Cartan: Yes.

Notices: Who wrote the comptes rendus?

Cartan: They were always written by Delsarte. Because of his position in the University of Nancy, he could have them typed by his secretary. Of course, typing was not so easy as it is now.

Notices: In those early meetings, was there a certain person who was dominant in the group?

Cartan: My answer is "André Weil", but you see, in Bourbaki most members had strong personalities. We often disagreed, we often had big arguments—but we remained good friends. For each subject, a "rédacteur" was appointed. Later, his ré-
daction was read aloud and thoroughly examined. The next "rédacteur" was given the appropriate instructions, and so on. For each chapter there could be up to nine rédactions. But in the end, everybody was fatigué—tired. And Dieudonné would say, "It is finished now. I shall write the last rédaction." Which he did. And eventually, although it seemed to be impossible to reach a complete agreement, there was an agreement. But it took time. It is perhaps not the best way in terms of teamwork, but that was the way we took.

Notices: Do you think that the Bourbaki style is dominant in France now?

Cartan: I don't think so. You see, it's a way of presenting some mathematical theories, but it does not claim to be the only way of doing mathematics. And each member of Bourbaki actually did things on his own and in his own way. When I wrote papers, I was not making rédactions for Bourbaki.

Notices: And yet, Bourbaki had an enormous influence on French mathematics.

Cartan: Not only in France. Outside France also, certain great mathematicians were influenced. For instance, Sir Michael Atiyah did some very beautiful mathematics, and being familiar with the Bourbaki way of thinking certainly helped him. Today, things are completely different. I don't think Bourbaki has a big influence on today's mathematicians. But it was certainly of great importance in the development of mathematics over several decades.

Notices: So you are saying the influence of Bourbaki now is not as strong as it used to be.

Cartan: What Bourbaki had to do is done now. Bourbaki is not eternal. But there still is the Séminaire Bourbaki, organized by some present members of Bourbaki. It is difficult for me to judge its influence, because I cannot have a good look at the mathematics of today.

Notices: Your work stretches over many parts of mathematics. It is quite unusual, because nowadays people are much more specialized. You seem...
to have covered most of pure mathematics, or touched upon all the areas.

Cartan: I can’t agree with this statement. I was interested in several fields, for instance, homological algebra, because of Eilenberg. We discovered together the generality of this notion. In fact, we had to find a title for our book, so we said: “It is algebra, but it is homological algebra. So we will call the book Homological Algebra.” What is surprising is that this book is still printed and sold today. I think it is quite remarkable, because it is now 43 years since the book first appeared. All of it was written by Sammy—I say “Sammy” because that’s the way everybody called him. Sammy wrote everything; I wrote nothing. Of course, we had discussions, but after that Sammy wrote. And I was in charge of correcting the spelling mistakes—in English! I don’t know much English, but I can spell. It was very easy and pleasant to work and discuss with Sammy.

Teaching at the École Normale and Learning There and Elsewhere

Notices: How did you choose problems to work on?

Cartan: They just came. Some people got me involved in some questions, for instance, Marcel Brelot. He was a great specialist in potential theory. He posed me some questions and problems, and I could solve them. It was during the war.

After the war, when I began to give my Séminaire at the École Normale, Jean-Pierre Serre asked me very many questions. He helped me discover many things by his questions. It was very important for me to know Serre and to hear his questions. When he prepared his thesis, he kept asking me questions, so I was forced to think about them. I learned a lot from my students at the École Normale. Many of them prepared theses under my direction—one normally says “direction”, but my “direction” consisted in understanding what they had in mind. So I learned very much. I was able to collaborate with Godement, for instance, who was one of my students at the École Normale. He entered the École Normale in 1940, when I began to teach there. In that promotion, there was Godement and there was Koszul, who later prepared his thesis “under my direction”. But he knew what he wanted to do. The students had to be helped of course, but they had their own ideas. Each one has his own personality, and you have to respect this personality, to help him find his own personality, and certainly not to impose somebody else’s ideas.

When I taught the first-year students, they had to solve some problems at home, and I corrected them. But they would also come to the blackboard, and I would help them discover various mathematical theories.

Notices: So this was a very individual teaching; you had students one on one.

Cartan: Yes, so it was possible to see what the students were able to understand. For the second year, I gave a regular course on a subject which changed every year. For the third year, there was the Agrégation. The students had to give lectures and to be criticized by the others—and by myself, of course. The fourth-year students had to choose a field of research. I had some discussions with each of them. In the first year, there were about twenty students. But in the second year, there were not so many, because some chose mathematics while others chose physics, so there were ten or twelve, and the same number for the third year.

Notices: Were there differences between the way you were taught as a student at the École Normale, and the way you taught when you were a professor there?

Cartan: Oh, yes. It was necessary to change that way of teaching. I did change it.

Notices: Was there one among your professors whose style you found particularly agreeable?

Cartan: I liked some professors, yes, of course. Gaston Julia for one, or my father, who gave some lessons at the École Normale, so I was his student. The students at the École Normale also had to attend general courses at the Sorbonne.

Notices: What about your Séminaire? How was that related to your teaching?

Cartan: I wanted to get several of my fourth-year students interested in some fields, notably in topology. Very soon Jean-Pierre Serre said, “But you must write down the exposés.” So, I wrote down the exposés, or I sometimes asked some of the others to write them down. At the beginning I had no precise long-term plans, but somehow this turned out
to be an irreversible process, hence the Séminaire. Every year more and more people kept coming—not only students, but also mathematicians from France and abroad. Of course, there was no other Séminaire at the time. I typed the exposés myself, but later on, the job was done by the secretary of the Institut Henri Poincaré. And then, one thing leading to another, it even happened that for some parts of the Séminaire, I didn’t do a thing—for instance, when Grothendieck spent half a year explaining and developing his ideas.

**Notices:** What are your memories of Grothendieck?

**Cartan:** He is an exceptional man, of course. He had a great influence on some parts of mathematics, notably algebraic geometry. His approach was something new—though not completely new, because at the beginning, for instance, he himself was influenced by Serre. Grothendieck is a very special man. Nobody knows where he is or what he is doing now.

**Notices:** Who is the mathematician you admire most?

**Cartan:** I admired quite a few when I could do and understand mathematics. Today ...!

**Notices:** When you could do it, who was the person you admired most?

**Cartan:** No, I don’t wish to answer the question. I admire many mathematicians, but I don’t wish to award prizes.

**Notices:** What do you consider your most important achievement in mathematics?

**Cartan:** For other people to say that.

**Notices:** But maybe there is something you particularly liked, or something that was especially satisfying.

**Cartan:** The connection between algebraic topology and analytic functions. I discovered general theorems which play a big role. But in this I was helped by Serre. By the way, this is one example of a mathematician for whom I have complete admiration: Serre.

**Notices:** You have always worked in pure mathematics, and today applied mathematics is very important. What do you think of this?

**Cartan:** You see, which parts of mathematics are applicable—not applied but applicable—it is very hard to tell in advance. When I was invited to Münster for the first time in 1931, they gave a big dinner at the end of my stay, and there was a big discussion. There was a philosopher who spoke about which parts of mathematics can be applied. "Anyway," somebody said, "not analytic functions of several complex variables! That can't be applied." But it was actually applied later. So it is difficult to tell in advance. And why mathematics can be applied to other things, to physics—that’s a mystery.

**Politics and Human Rights**

**Notices:** You have been active in politics. Can you say something about that?

**Cartan:** This is not mathematics!

**Notices:** It has no relationship to mathematics?

**Cartan:** Maybe it has .... You see, a mathematician thinks: "What is this question? What happens exactly? Why is it so, and not so? What is the reason? What is the logical consequence of all this?" I am applying this to politics. I have tried to analyze situations and to draw logical consequences. This was the way I became a European Federalist, because I understood that there is no other way. For me, what is going on now, today, proves the necessity of Federalism—if the word Federalism is correctly understood, that is. Some people misunderstand the word. In France, everything is decided at the top; nobody—except the Government—is responsible for anything. Look at what is going
on today in Kosovo. You hear people say, “Ah, Europe must have a common foreign policy.” Those are empty words: how can this ever be achieved without an authority that can make decisions and implement them and that can also be under democratic control? Nothing can ever be achieved unless a European constitution gives birth to a federal authority and makes it fully responsible for clearly defined areas of common interest. Of course, this federal authority would in no way encroach on the respective spheres of responsibility of either the states, regions, or townships.

All this I believe only because I am a mathematician who thinks about the situation and the logical consequences of this situation.

Notices: Would you agree that having lived in Strasbourg and gone through your experiences in the war may have influenced you in these views?

Cartan: Yes, but I was not a Federalist at the end of the Second World War. I became a Federalist a few years later.

Talking about the European elections—the first one was in 1979. It was very difficult to obtain these elections. The European Parliament did not have much power. After those elections I went to Stras-

Notices: You received an award from the New York Academy of Sciences, the Pagels Award. What was the award for?

Cartan: This was for assisting dissidents. I was involved in the defense of dissidents in the USSR and other countries, especially mathematicians. The so-called Comité des Mathématiciens was created to defend dissidents. I was very active in this defense process. The most famous dissident mathematician at the time was Leonid Plyushch. There was a big to-do! Plyushch was in a “special” psychiatric hospital. This was back in 1973, and our attention had been called on his case by Andrei Sakharov. We began to call upon the Soviet Embassy in Paris—it was possible at the time, but it soon became impossible. When the International Congress of Mathematicians was held in Vancouver in 1974, we tried to stir up the participants about the case of Plyushch. We asked people to sign an appeal, and gathered a thousand signatures asking for his liberation. I was asked to send a telegram to the Soviet authorities. As a consequence, when we returned to Paris, we organized this Comité des Mathématiciens, and we had several meetings at the seat of the Human Rights League in Paris. We held a big meeting in the Salle de Mutualité with several thousand people. Eventually, the Soviet authorities decided to free Plyushch in January 1976. It was a big success.

Later on, we worked for other people. The Uruguayan mathematician José Luis Massera, who was a Communist, was a victim of the military dictatorship there. The Comité des Mathématiciens— with such people as Laurent Schwartz—worked on his case. Today we have a very active Comité de Défense des Hommes de Science (CODHOS) within the French Académie des Sciences. Its president is François Jacob, a Nobel Prize laureate in medicine. Similar committees in France, Sweden, Great Britain, Italy, and the United States are now connected together and work hand in hand for similar purposes.
Proofs from THE BOOK
Reviewed by Daniel H. Ullman

"You don't have to believe in God, but you have to believe in The Book."—Paul Erdős

Is mathematics a religion? This question first occurred to me when I attended a session dedicated to the memory of Paul Erdős at the San Diego meetings in January 1998. There, many people spoke about the life of this man of legend, and this is what I heard: Erdős was a priest of mathematics, singularly devoted to this one passion. He traveled far and wide sharing his form of gospel. And he believed that his purpose on Earth was to "conjecture and prove." Many people in the outside world view this dedication as a peculiarity; they may admire the genius but cannot comprehend the mission. But we in the mathematics community share his faith in the meaningfulness of mathematics. We on the inside speak the same language, practice the same rituals, seek the same goals. We are therefore in a unique position to appreciate the greatness and the goodness of the man. We are in the fold. We are the believers.

Even while he was alive, the legend of Erdős was well established. The stories about his idiosyncrasies are by now part of the folk culture of mathematics. Erdős was fond of referring to The Book, where the perfect proofs of all theorems are written. "This one is from The Book", he would intone when seeing a particularly beautiful argument. And he lived his life on a crusade to reveal and enjoy as much of The Book as possible.

Proofs from THE BOOK is an effort by Martin Aigner and Günter Ziegler to reveal an approximation to a portion of The Book. (Let us denote by PFTB the book by Aigner and Ziegler, so as not to confuse The Book with "the book".) They had hoped to publish PFTB on the occasion of Erdős's eighty-fifth birthday in March 1998, with Erdős as a coauthor. But Erdős died in September 1997, and so Aigner and Ziegler wrote PFTB themselves and dedicated it to his memory. It is in large part a tribute to the mathematical legacy of Erdős.

It is an ambitious undertaking. I found the title at first to be somewhat off-putting, since it seems to suggest unashamedly that the contents are ideal, perfect, impossible to improve. The Book, Erdős would have said, is in the possession of the S. F. (the Supreme Fascist, Erdős's name for the Almighty). It is not for us in this lifetime to know

Daniel H. Ullman is associate professor of mathematics at George Washington University. His e-mail address is dullman@gwu.edu.
blocks can the edges of the complete graph representations is odd. The last published proof is thought to be Euler's. The partite graphs. The question here is into how few positions of a complete graph into complete bipo­rtite graphs. Theorem are so complicated that they can only be read with the assistance of computing machinery. Euler's formula and alternating chains and obtains result is a triumph of combinatorical reasoning, turning applied mathematics on its head to advance the cause of pure mathematics.

Carsten Thomassen's proof of the Five-Color Theorem. The only known proofs of the Four-Color Theorem are so complicated that they can only be read with the assistance of computing machinery. (We are still waiting for the Book proof.) The Five-Color Theorem, by contrast, has a relatively simple proof. In fact, the ideas in Alfred Kempe's 1879 famous false proof of the Four-Color Theorem, namely Euler's formula and alternating chains, serve easily to prove the five-color result. But the Book proof of the Five-Color Theorem must certainly be Thomassen's 1974 proof, a delicate example of "induction loading". Thomassen avoids Euler's formula and alternating chains and obtains a substantial generalization of the Five-Color Theorem in a mere three paragraphs.

3. Don Zagier's proof of the characterization of numbers expressible as the sum of two squares. This is another example of a recent proof of a classical result. Zagier's paper, which appeared in the American Mathematical Monthly in 1990 with the title "A one-sentence proof that every prime $p \equiv 1 \pmod{4}$ is a sum of two squares", proves the apparently stronger result that the number of such representations is odd. (In fact it is always 1.) While this result is sometimes attributed to Fermat, the first published proof is thought to be Euler's. The last published proof will no doubt be Zagier's.

4. H. Tverberg's proof of the optimal decomposition of a complete graph into complete bipartite graphs. The graph here is into how few blocks can the edges of the complete graph $K_n$ be partitioned if each block is the edge set of a complete bipartite graph? It is not difficult to find such a decomposition into $n - 1$ blocks, but the impossibility of decomposition into fewer than $n - 1$ blocks is more subtle. Ron Graham and Henry Pollak first proved this result using linear algebra in 1971. The proof of Tverberg appeared in 1982. No purely graph-theoretic proof is known.

In PFTB one can also find the best proof of Pick's Theorem, of the arithmetic mean-geometric mean inequality, and of the lemma of Littlewood and Offord. If you haven't seen it before, do not miss the beautiful solution to Sylvester's problem about finite sets in the plane. Or Erdős's proof of Bertrand's postulate, from his first publication. It goes on and on.

There are thirty short chapters organized into five general areas: number theory, geometry, analysis, combinatorics, and graph theory. Some of the chapters are organized around single theorems, such as Turán's Theorem, Borsuk's Conjecture, or Cayley's Formula. Others are essays on a collection of results, with titles such as "In praise of inequalities" or "Three famous theorems on finite sets". Throughout, the writing is polished, clean, simple, as such a book demands. I noted the influence of Erdős in over half of the chapters.

The authors intended to make their book "accessible to readers whose backgrounds include only a modest amount of technique from undergraduate mathematics." Yet the level of the exposition varies substantially. There is much here appropriate for the Olympiad-level high schooler or a talented undergraduate math major. But not many such students will have the sophistication to follow the arguments or the experience to appreciate their elegance. The margin of the first page contains a statement of Lagrange's Theorem on the size of a subgroup, together with a proof in four short sentences. The student who has never before seen Lagrange's Theorem is unlikely to follow this high-level proof and certainly will not be able to appreciate any of Chapter 5, entitled "Every finite division ring is a field". My guess is that this book will find the vast majority of its readers among professional mathematicians. Yet no such reader needs to have the notion of a bijection explained to them, as is done at some length in Chapter 16.

What qualifies a proof to be in The Book? What makes an argument beautiful? It isn't easy to explain to a nonmathematician. Perhaps it cannot be explained at all. One simply appreciates these things or one does not, and if one is the first type of person, one might want to be a mathematician. One cannot force a person to enjoy music or art. Neither can a person be made to feel anything when presented with a brilliant argument. In fact, numbness toward mathematics is more common among the general populace than numbness toward music or art. After all, while most people grow...
up hearing and seeing things, thus learning to combine sounds and sights (the elements of music and art), many people do not grow up with much experience in combining logical ideas. Such people are likely to develop a sort of tone deafness toward mathematics; they may possess an ability to listen to and perhaps even comprehend a mathematical argument, but no ability to appreciate one.

Even among mathematicians there will always be a debate about what is elegant, about what is clever, about what is beautiful. Aigner and Ziegler do not claim to have presented the definitive collection of great mathematics. In their brief introduction they write: "We have no definition or characterization of what constitutes a proof from The Book; all we offer is the examples that we have selected, hoping that our readers will share our enthusiasm about brilliant ideas, clever insights and wonderful observations." I do.

The only criterion I can discern from PFTB for what constitutes a brilliant or beautiful proof is that such a proof contains an unexpected combination of ideas. Erdős is perhaps best known for his invention of the probabilistic method in graph theory, introducing random variables to attack questions about nonrandom objects. The last chapter of PFTB is devoted to several gems stemming from this combination of ideas. The penultimate chapter is devoted to a proof of the so-called friendship theorem via linear algebra, where a purely graph-theoretic question is answered by analyzing eigenvalues. The first chapter contains a proof by Harry Furstenberg of the infinitude of primes using topology. This mixing of ideas is common to nearly every argument featured in PFTB. Music is not just notes; it is the way the notes are combined.

There are many reasons to do mathematics. Some mathematicians may labor to prove theorems for the betterment of humanity—to improve efficiency of business, say, or to yield new techniques for medical care. Some may seek only to build mathematics itself. Others may seek fame and fortune (misguided though they may be). Yet others explore mathematics just to be tickled by ideas. PFTB is for them. Although the book restricts itself to elementary mathematics, I doubt there are many mathematicians, no matter how seasoned, who will know all the proofs here. And for the rest of us, PFTB will reward our attention richly. In a mere 199 pages we can encounter many of the great theorems of elementary mathematics with their best-known proofs. And we’ll be the wiser for it.
Walter Schachermayer Receives Wittgenstein Award

Walter Schachermayer has received the 1998 Wittgenstein Award, Austria's highest honor for scientific achievement. The award carries a monetary prize of 15 million Austrian schillings (approximately $1.2 million).

Walter Schachermayer was born in 1950 in Linz, Austria. After studying computer science, economics, and mathematics in Vienna, he began his career in France and Mexico in 1974. In France he was working in the group of young functional analysts around Laurent Schwartz, which at that time included, among others, Bernard Maurey and Gilles Pisier. In 1978 Schachermayer became an assistant professor at the University of Linz, and in 1982 he began a two-year stint working in a private insurance company. After holding a position at the Institute of Statistics at the University of Vienna, he moved in the fall of 1998 to the Vienna University of Technology, where he holds the Chair for Actuarial and Financial Mathematics.

After working in the field of functional analysis, Schachermayer started in the early 1990s to apply techniques from that field to the area of mathematical finance. Among his achievements is the proof of the "Fundamental Theorem of Asset Pricing" in its general form, which was done in joint work with Freddy Delbaen.

One to three Wittgenstein Awards are presented each year by the Austrian Science Fund (Fonds zur Förderung der Wissenschaftlichen Forschung, or FWF). The awards may be presented to researchers in any area of science who are under the age of fifty. The awards are intended to guarantee maximum freedom and flexibility to the researchers in order to facilitate progress of their scientific performance. Nominations for the Wittgenstein Award may be submitted by officers of the FWF or past awardees. The Wittgenstein Award was presented for the first time in 1996, and Schachermayer is the first mathematician to receive it.

The FWF was founded in 1967 as an independent organization devoted to the advancement of basic research in Austria. Among other things, it funds scientific research projects by individuals and groups, supports young scholars, and works to stimulate scientific research cooperation within Europe.

Also receiving Wittgenstein Awards in 1998 were computer scientist Georg Gottlob and quantum physicist Peter Zoller.

—Allyn Jackson

NOTICES OF THE AMS VOLUME 46, NUMBER 7
The Joint Policy Board for Mathematics (JPBM) is an umbrella organization that facilitates collaborative projects of the three major U.S. organizations in the mathematical sciences: the AMS, the Mathematical Association of America (MAA), and the Society for Industrial and Applied Mathematics (SIAM). JPBM has traditionally worked on increasing public awareness of mathematics and on tracking developments in federal funding for research. With a new director and federal relations consultant in place, JPBM is working on new ways to promote the role of mathematics on the national agenda.

JPBM is funded by the three societies and has ten members: the JPBM director, the executive directors and presidents of the three societies, and one additional representative for each society. For SIAM, this additional representative is a SIAM vice-president, for the MAA it is the MAA secretary, and for the AMS it is an individual elected by the AMS Council. Established in 1984, JPBM was originally headed by Kenneth Hoffman of the Massachusetts Institute of Technology. More recently, Richard Herman, now provost of the University of Illinois, served as chair and director of JPBM from 1991 until mid-1997 while he was also dean at the University of Maryland. For a number of years JPBM retained the services of a public relations firm, and it also had on staff Lisa Thompson, who was the JPBM congressional liaison until last year. Thompson is perhaps best known in the mathematical sciences community for producing the JPBM electronic newsletter *Tidbits*, which contained news and information about federal support for research and education in the mathematical sciences.

In the fall of 1998 Daniel Goroff accepted the part-time position of director of JPBM while keeping his position as professor of the practice of mathematics at Harvard University. Prior to joining the Board, he worked at the White House Office of Science and Technology Policy, which is headed by the president's science advisor. Goroff also served part-time for a year on the staff of the National Research Council. Also joining JPBM as federal relations consultant is April Burke of Lewis-Burke Associates. With eight people on staff, Burke's organization specializes in monitoring and analyzing developments in Congress and the government that could have an impact on science and academia. An attorney by training, Burke brings much experience providing advice to universities, research consortia, and other scientific institutions concerning federal policy and budgeting decisions.

Goroff says that the main purpose of JPBM—to coordinate advocacy for the mathematical sciences on behalf of the three societies—has not changed. In addition, most of JPBM's traditional activities will remain. A new incarnation of *Tidbits*, renamed *The Washington Polymath*, will appear at least once a month. JPBM will continue to produce its annual overview of federal funding for the mathematical sciences across the government; this overview is published as a chapter in a

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1. To subscribe to *The Washington Polymath*, send an e-mail message to jpbm@math.umd.edu.
Number Theory

Computational Perspectives on Number Theory
Proceedings of a Conference in Honor of A. O. L. Atkin
D. A. Buell, Center for Computing Sciences, Bowie, MD, and
J. T. Teitelbaum, University of Illinois at Chicago, Editors

This volume contains papers presented at the conference “Computational Perspectives on Number Theory” held at the University of Illinois at Chicago in honor of the retirement of A. O. L. Atkin. In keeping with Atkin’s interests and work, the papers cover a range of topics, including algebraic number theory, $p$-adic modular forms and modular curves. Many of the papers reflect Atkin’s particular interest in computational and algorithmic questions.

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Volume 5, 1999 (year to date)

A. Calogero, Wavelets on general lattices, associated with general expanding maps of $\mathbb{R}^n$

Enrico Casadio Tarabusi, Joel M. Cohen, and Flavia Colonna, Characterization of the range of the Radon transform on homogeneous trees

Igor Rivin and Jean-Marc Schlenker, The Schlafli formula in Einstein manifolds with boundary

Huai-Dong Cao and Jian Zhou, On quantum de Rham cohomology theory

Frank Sottile, The special Schubert calculus is real

Marius Mitrea, On Bojarski's index formula for nonsmooth interfaces

Anton Petrunin, Metric minimizing surfaces

D. Novikov and S. Yakovenko, Tangential Hilbert problem for perturbations of hyperelliptic Hamiltonian systems

Gaven J. Martin, The Hilbert-Smith conjecture for quasiconformal actions

Steffen König and Changchang Xi, Cellular algebras and quasi-hereditary algebras—a comparison

Robert Brooks and Eran Makover, The first eigenvalue of a Riemann surface

Elon Lindenstrauss, Pointwise theorems for amenable groups

Brian Marcus and Selim Tuncel, Powers of positive polynomials and codings of Markov chains onto Bernoulli shifts

Harsh Pittie and Arun Ram, A Pieri-Chevalley formula in the K-theory of a $G/B$-bundle
The National Science Foundation (NSF) has awarded its Graduate Research Fellowships for fiscal year 1999. This program supports students pursuing doctoral study in all areas of science and engineering and provides a stipend of $15,000 per year for three years of full-time graduate study. This is the first year in which the Graduate and Minority Graduate Research Fellowship competitions have been combined in a single program.

Listed below are the names of the 1999 awardees in the mathematical sciences, followed by their undergraduate institutions (in parentheses) and the institutions where they plan to pursue graduate work.

JAMES M. BELK (State University of New York, Binghamton), Princeton University; ANDREW A. BELLINGER (Princeton University), Harvard University; JEFFREY P. BURDGEES (Georgia Institute of Technology), Princeton University; JASON M. BURNS (University of South Carolina, Columbia), University of South Carolina, Columbia; ELIZABETH A. BURROUGHS (University of North Carolina, Chapel Hill), University of New Mexico; FRANCESCO D. CALEGARI (Melbourne University), University of California, Berkeley; SAMIT DASGUPTA (Harvard University), Princeton University; WILLIAM M. DIRKS (Western Washington University), New York University; MARK C. DREW (Texas A&M University), Texas A&M University; DAVID A. DUMAS (Pennsylvania State University, University Park), Harvard University; Uri T. EDEN (California Institute of Technology), Harvard University/Massachusetts Institute of Technology Program in Health Sciences & Technology; TRAVIS W. FISHER (University of Nebraska, Lincoln), University of Maryland, College Park; CHRISTOPHER A. FRANCISCO (University of Illinois, Urbana-Champaign), Cornell University; MARCI J. GAMBRELL (University of Chicago), University of California, Berkeley; ANDREI C. GREPP (Harvard University), Massachusetts Institute of Technology; SARAH M. GROFF (Yale University), Massachusetts Institute of Technology; STEPHEN G. HARTKE (University of Dayton), Rutgers University; DAVID F. HELM (Harvard University), University of California, Berkeley; BRADEN K. HUNSAKER (Harvard University), Georgia Institute of Technology; ANDREW D. HUTCHINGS (Harvey Mudd College), Cornell University; KATHERINA J. KECHRISS (University of California, Los Angeles), University of California, Berkeley; CAROLINE J. KLIVANS (Cornell University), Massachusetts Institute of Technology; ELI B. LEBOW (Harvard University), University of California, Berkeley; PHILLIP D. LYNCH (University of Washington), University of Washington; PAUL T. MACKLIN (University of Nebraska, Lincoln), New York University; KIMBALL L. MARTIN (University of Maryland, Baltimore County), University of Chicago; KEVIN P. McBRIDE (University of Pittsburgh), Massachusetts Institute of Technology; SHARON K. MERRYMAN (Rice University), Harvard University; Vivek MOHTA (Massachusetts Institute of Technology), Massachusetts Institute of Technology; AMANDA R. MUELLER (University of Notre Dame), Stanford University; ROBERT W. NEEL (Stanford University), Massachusetts Institute of Technology; TING FAI NG (University of Pennsylvania), Princeton University; KATHERINE A. PAUR (Massachusetts Institute of Technology), Harvard University; JOSHUA B. PLOTKIN (Harvard University), University of California, Berkeley; JAN M. SKOTHEIM (Massachusetts Institute of Technology), Massachusetts Institute of Technology; ELIZABETH A. STUART (Smith
College), Cornell University; KATHRYN E. TEMPLE (University of Washington), Cornell University; THAO THANJI TH TRAN (University of Florida), Harvard University; JULIANA S. TOMCZEK (Harvard University), Princeton University; MARTIN H. WEISSMAN (Princeton University), Harvard University; STEPHEN M. WHALEN (University of Nebraska, Lincoln), University of Minnesota, Twin Cities; and STEPHANIE T.-F. YANG (Princeton University), University of California, Berkeley.

Editor's note: The institutions of graduate study listed here are from the students' original applications. In some cases students will have switched institutions by the time the fellowship tenure begins.

—From NSF announcement

CAREER Awards Made

The National Science Foundation (NSF) has honored 338 outstanding new science and engineering faculty members in fiscal year 1998 with Faculty Early Career Development (CAREER) awards totaling approximately $80 million. The NSF established the awards to support promising scientists, mathematicians, and engineers who are committed to the integration of research and education. The grants run from four to five years and range from $200,000 to $500,000 each.

The mathematicians who were awarded CAREER grants and the titles of their grant projects are: MICHAEL BRENNER, Massachusetts Institute of Technology: Mathematics of nonlinear partial differential equations in applying techniques of nonlinear dynamics to fluid dynamics, acoustics, and biophysics; MERILSE CLYDE, Duke University: Model uncertainty, model selection, and robustness with applications in environmental sciences; and ARLIE PETTERS, Princeton University: Gravitational lensing geometry and optics.

—From NSF announcement

National Academy of Sciences Elections

The National Academy of Sciences (NAS) has announced the election of sixty new members and fifteen foreign associates. Following are the names and affiliations of the mathematicians who are among the newly elected members: RICHARD A. ASKEY, University of Wisconsin, Madison; ELWIN R. BERLEKAMP, University of California, Berkeley; RICHARD S. HAMILTON, University of California, San Diego; VAUGHAN F. R. JONES, University of California, Berkeley; DUSA M. McDUFF, State University of New York, Stony Brook; and VLADIMIR ROKHLIN, Yale University. YAKOV G. SINAÍ of Princeton University was elected as foreign associate from Russia.

—From NAS announcement

Ferran Sunyer i Balaguer Prize Awarded

The Institut d'Estudis Catalans has awarded the seventh Ferran Sunyer i Balaguer Prize to PATRICK DEHORNOY of the Université de Caen for his monograph Braids and Self-Distributivity. The prize consists of 1,800,000 pesetas (approximately $12,400). According to the terms of the prize, the monograph will be published in the Birkhäuser series Progress in Mathematics. The Ferran Sunyer i Balaguer Prize is awarded each year to a mathematical monograph of an expository nature presenting the latest developments in an active area of mathematics research in which the author has made important contributions.

—From an Institut d'Estudis Catalans announcement
ONR Young Investigator Program

The Office of Naval Research (ONR) sponsors a Young Investigator Program to support academic scientists and engineers who have recently received the Ph.D. or equivalent degrees and who show exceptional promise for doing creative research.

During fiscal year 2000 it is expected that at least 18 awards will be made for proposals within an area of naval research interest. The basic award is $100,000 per year for three years, and additional funds may be provided based on need. The program is open to United States citizens, nationals (native residents of a U.S. possession), and permanent residents who hold tenure-track or permanent faculty positions at U.S. universities and who received their graduate degrees on or after December 1, 1994.

Proposals in mathematical, computer, and information sciences must be sent to the director of that division Andre M. Van Tilborg, Room 607, ONR 311 (FY00 YIP), 800 N. Quincy Street, Arlington, VA 22217-5660; telephone 703-696-4312; e-mail: vantila@onr.navy.mil. Proposals must be received by 4:00 p.m. on October 1, 1999. For further information and instructions for proposal preparation, see the ONR Web site, http://www.onr.navy.mil/sci_tech/information/mathematical/.

—From ONR announcement

Deadlines and Target Dates at the NSF

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) has a number of programs in support of mathematical sciences research and education. Listed below are the names of programs having deadlines or target dates coming up in the next several months.

July 19, 1999 (proposal deadline): Grants for Vertical Integration of Research and Education in the Mathematical Sciences (VIGRE)
July 22, 1999 (deadline): Faculty Early Career Development (CAREER) Program
September 7, 1999 (full proposal deadline): Integrative Graduate Education and Research Training (IGERT) Program
September 15, 1999 (deadline): Mid-Career Methodological Opportunities
September 15, 1999 (deadline): Research Experiences for Undergraduates Sites (send inquiries to: reu.dms@nsf.gov)
October 9, 1999 (target date): Algebra and Number Theory
October 9, 1999 (target date): Analysis
October 9, 1999 (target date): Foundations
October 16, 1999 (deadline): Mathematical Sciences Postdoctoral Research Fellowships (send inquiries to: msprf@nsf.gov)
November 4, 1999 (target date): Applied Mathematics (excluding Mathematical Biology)
November 4, 1999 (target date): Statistics and Probability
November 4, 1999 (target date): Geometric Analysis
November 4, 1999 (target date): Topology
November 13, 1999 (deadline): University-Industry Cooperative Research Programs in the Mathematical Sciences
November 25, 1999 (deadline): Interdisciplinary Grants in the Mathematical Sciences
December 4, 1999 (target date): Computational Mathematics
December 4, 1999 (target date): Mathematical Biology
December 9, 1999 (deadline): Professional Opportunities for Women in Research and Education (POWRE)

Proposals for conferences, workshops, and special years that are submitted to the Statistics and Probability program or to the Topology and Foundations program can be sent at any time. However, proposals for these activities submitted to all other DMS programs (Analysis, Algebra and Number Theory, Applied Mathematics, Computational Mathematics, and Geometric Analysis) must be submitted according to the target dates for those programs. Proposals for supplements for Research Experiences for Undergraduates may be submitted at any time. For further information consult the DMS Web site at http://www.nsf.gov/mps/dms/. The mailing address is Division of Mathematical Sciences, National Science Foundation, Room 1025, 4201 Wilson Boulevard, Arlington, VA 22230. The telephone number is 703-306-1870.

—From a DMS announcement

NAS Mathematics Award
Nominations Sought

The National Academy of Sciences Award in Mathematics, a $5,000 prize established in 1988 by the AMS in commemoration of its centennial, recognizes excellence in research in the mathematical sciences published within the last ten years. Previous recipients include Robert P. Langlands (1989), Robert D. Macpherson (1993), and Andrew J. Wiles (1996).

The award will be presented in the year 2000, and nominations will be accepted through September 1, 1999. To access a nomination form, visit the Academy's Web site at http://www.nas.edu/nas/awards/, or for more information contact: National Academy of Sciences, 2101 Constitution Avenue, NW, Awards Program, Room 185, Washington, DC 20418; phone: 202-334-1602; fax: 202-334-2153; e-mail: sgrodin@nas.edu; Web: http://www.nas.edu/nas/.

—National Academy of Sciences
NSF Keeps Two Existing Institutes and Funds a Third

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) has announced the results of the recompetition of the mathematics institutes it funds. The two existing institutes—the Mathematical Sciences Research Institute (MSRI) in Berkeley and the Institute for Mathematics and its Applications (IMA) at the University of Minnesota—will continue to be funded by the NSF. They will be joined by a new institute, the Institute for Pure and Applied Mathematics (IPAM) at the University of California, Los Angeles.

The National Science Board, the governing body of the NSF, approved the recommendation to renew the funding for MSRI for five years starting July 1, 2000. NSF director Rita Colwell approved the recommendations of the NSF’s Division of Mathematical Sciences to renew the funding for IMA and to establish IPAM. At the time of this writing, the actual awards had not been made but were scheduled to be made in the fall after Cooperative Agreements between the NSF and the institutes are drawn up.

MSRI and IMA were launched in the early 1980s and have received continuous funding from the DMS since then. NSF policy stipulated that such projects must be put up for recompetition after fifteen years of funding (this policy has now been changed to require recompetition after ten years). The DMS announced the recompetition in late 1996, and proposals were due in February 1998. The NSF received between ten and twenty proposals in the recompetition. Site visits were conducted during 1998, and the final decisions were made in spring 1999 by the National Science Board.

Institute for Pure and Applied Mathematics, UCLA

The main purpose of IPAM is to encourage cross-fertilization between mathematics and other scientific disciplines and to broaden the range of mathematical techniques used in science. There will be three programs per year, each of which will have a mathematical stream and a complementary stream drawing on one or more scientific areas. Two examples of areas in which programs are being planned are functional genomics (statistics, mathematical biology, computational techniques, etc.) and geometrically based motions (geometric PDEs, threshold dynamics, computer vision, computer-aided design, materials, etc.). The plan is to have present on a long-term basis four senior researchers and about ten researchers in the early stages of their careers (including but not limited to postdoctoral researchers), as well as about twenty other visitors at any one time. The participants will be split approximately equally between the two streams. Each program will end with a culminating conference at the UCLA conference center in the mountains at Lake Arrowhead. In order to encourage the formation of groups that continue to work together, each IPAM program will have two 1-week reunion conferences, held one year and two years after the program ends. IPAM will also have an educational component that will include an undergraduate program modeled on the mathematical modeling “clinic” at Harvey Mudd College. Formally an institute of UCLA, IPAM is independent of the mathematics department and has its own scientific board and board of directors. IPAM will occupy a 13,000-square-foot building on the UCLA campus, adjacent to the mathematics department. It will hold its first programs in the year 2000-01.
Institute for Mathematics and its Applications, University of Minnesota

IMA and MSRI will each maintain its traditional structure and purpose but will make some changes. IMA's purpose is to identify areas of mathematical research related to problems in science and engineering and to provide settings in which work on such problems can fruitfully take place. Each year IMA focuses on a single theme; upcoming themes are Mathematics in Multimedia (2000-01) and Mathematics in the Geosciences (2001-02). About 1,200 people participate annually in IMA programs. IMA has also become well known for its strong interactions with industry, through activities such as the Industrial Problems Seminar, in which industrial scientists present problems from industry that have mathematical content, and through the IMA Industrial Postdoc program, in which young researchers come to the IMA for two years and spend half their time working with a company and half in IMA's general program. Two changes have been made in the regular IMA postdoctoral program: the program will now support researchers for two years and will also provide opportunities for teaching and/or industrial experience in the second year. IMA is exploring the establishment of Industrial Consortia, in which teams of mathematicians will focus on problems arising in a single industry; companies from that industry will provide the financial support. IMA and the Joint Alliance for Minorities in Mathematics will enter into a long-term relationship aimed at increasing involvement of underrepresented groups in IMA programs and in industrial mathematics. Through support from the University of Minnesota, the physical space for IMA activities has nearly doubled.

Mathematical Sciences Research Institute, Berkeley

The basic mode of operation of MSRI is each year to run two to four research programs of varying lengths, each of which is centered on a specific area of the mathematical sciences. For example, MSRI will have three programs spanning the 1999-2000 year: Noncommutative Algebra, Galois Groups and Fundamental Groups, and Numerical and Applied Mathematics. Workshops are held in each program area, as well as on topics outside of the programs. More than 1,000 mathematicians visit MSRI each year for varying periods, and there is a postdoctoral program that brings in 20-30 young researchers each year. MSRI will continue to run programs in both core and applied mathematics topics, as it has from its beginning. MSRI has strengthened its ties to other sciences and to industry through, for example, its Corporate Affiliates program and the establishment of a professorship funded by Hewlett-Packard. Its outreach programs have expanded to include the MSRI Journalist-in-Residence program and sponsorship of the Bay Area Mathematical Olympiad, a mathematical contest for local high school students. The MSRI building is owned by the University of California, Berkeley, but MSRI is not formally a part of the university. UCB has substantially strengthened its commitment to MSRI: MSRI will no longer pay rent for its building, and UCB will provide support for the equivalent of about 2.75 full-time senior faculty at MSRI.

According to NSF budget documents, the DMS budget request for fiscal year 2000 for the three institutes is $8.1 million; this amount, which includes an increase to fund the third institute, had not been appropriated at the time of this writing and could change. The steady-state annual NSF funding for the institutes is projected to be $2.5 million for IPAM, $2.2 million for IMA, and $3.4 million for MSRI. When non-NSF funding is included, the total annual budget for IMA is about $3.5 million and for MSRI is about $4.5 million. The IPAM directors say they are actively pursuing additional funding for the institute and have secured support from IPAM affiliates in academia, industry, and national laboratories.

What follows is contact information for the three institutes.

Institute for Mathematics and its Applications
Director: Willard Miller
University of Minnesota
400 Lind Hall
207 Church Street, SE
Minneapolis, MN 55455
Telephone: 612-624-6066
Fax: 612-626-7370
e-mail: ima-staff@ima.umn.edu
World Wide Web: http://www.ima.umn.edu/

Institute for Pure and Applied Mathematics
Co-directors: Mark Green and Eitan Tadmor
Department of Mathematics
University of California, Los Angeles
Los Angeles, CA 90095
e-mail: ipam@math.ucla.edu
World Wide Web: http://www.ipam.org/

Mathematical Sciences Research Institute
Director: David Eisenbud
1000 Centennial Drive, #5070
Berkeley, CA 94720-5070
Telephone: 510-642-0143
Fax: 510-642-8609
e-mail: inquiries@msri.org
World Wide Web: http://www.msri.org/

—Allyn Jackson

Joint Testimony by Society Presidents

On April 28, 1999, AMS president Felix Browder, together with three other scientific organization presidents, gave testimony before the subcommittee of the House Appropriations Committee, which oversees the budget of the National Science Foundation (NSF). The testimony called for increased funding for the NSF across all the disciplines the foundation supports.
The testimony was presented before the Subcommittee on Veterans Affairs, Housing and Urban Development, and Independent Agencies. Joining Browder in the presentation were William Brinkley, president of the Federation of American Societies for Experimental Biology; Jerome Friedman, president of the American Physical Society; and Edel Wasserman, president of the American Chemical Society. Brinkley began the testimony by explaining that the four organizations had banded together to present joint testimony—for the second year in a row—in order to stress the interdependence of the scientific disciplines. He also introduced the group; and then Wasserman, Browder, and Brinkley spoke, in that order.

In his part of the testimony, Wasserman pointed out that since the NSF was created fifty years ago, the U.S. has become the world leader in science, technology, and engineering. He also pointed to estimates by economists that, in recent years, 70 percent of the economic growth of the U.S. has come from technology and scientific innovation.

Browder’s portion of the testimony was as follows: “Among federal agencies, the National Science Foundation is unique, because its portfolio spans all the disciplines: the physical and life sciences, mathematics, engineering, and the social sciences. The activities it supports are key to R&D [research and development] performed and underwritten by all other federal agencies. While the Foundation’s share of the FY 1999 federal budget amounts to a little more than 0.2 percent, the agency has had a powerful impact on U.S. science since its inception in 1950. An impressive percentage of American Nobel laureates have been recipients of NSF support: about 50 percent of all laureates in chemistry and physics, 60 percent in economics, and 30 percent in medicine and physiology. NSF has also supported approximately 45 percent of worldwide recipients of the Fields Medal, the mathematical equivalent of the Nobel Prize. Beyond this, the agency has played a major role in the development of the Internet, which generated revenues of about $7 billion in 1998, with an increase to $40 billion expected by 2002.”

In concluding the testimony, Brinkley emphasized that increased funding is needed not just for the biomedical sciences but also for the other major scientific disciplines. He said that to maximize returns on the nation’s investment in biomedical sciences there must also be “robust support for fundamental research in physics, chemistry, mathematics, and engineering.”

—Allyn Jackson

Scholarships Funded from H-1B Visa Fees

The National Science Board approved plans by the National Science Foundation (NSF) to provide some $21 million to fund 8,000 one-year scholarships of up to $2,500 each to low-income students who pursue degrees in computer science, engineering, or mathematics. These Computer Science, Engineering, and Mathematics Scholarships (CSEMS) are authorized by the American Competitiveness and Workforce Improvement Act of 1998.

The $21 million education fund created during the first year of the program (FY 1999) is derived from a $500 fee that U.S. employers pay to the federal government for each high technology immigrant employee they employ under terms of an H-1B visa application. Additional funds will be provided in FY 2000 and FY 2001.

Among the eligible institutions to receive and administer the scholarship awards are two-year community colleges, undergraduate and graduate institutions. One hundred institutions will receive the two-year scholarship fund grants in the first year of the program. Each will be able to award a total of eighty scholarships (i.e., forty during each of the two years of the grant).

The program will be managed by NSF’s Directorate for Education and Human Resources, and the program awards will be made to institutions that in turn will award scholarships to economically disadvantaged students, as determined by Department of Education criteria used for Pell Grants or Graduate Assistance in Areas of National Need. The first scholarships are expected to be made in January 2000.

Students must be pursuing an accredited associate, bachelor’s, or graduate degree in computer science, engineering, mathematics, computer technology, or engineering technology. Students may be supported for up to two years but must recompete annually. Scholarship recipients must be U.S. citizens, U.S. nationals, refugee aliens, or permanent resident aliens.

For further information on this program, contact:
Marilyn J. Suiter
Program Director, Education and Human Resources
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230
Telephone: 703-306-1625
e-mail: msuiter@nsf.gov

—From NSF news release

Correction to AWM Article

The January 1999 issue of the Notices carried our article about the Association for Women in Mathematics (AWM), entitled “AWM in the 1990s”. Please note the following correction to the sidebar that appeared on page 34. The Hay Award and the Schafer Prize were indeed first awarded when Jill Mesirov was AWM president, but they were established when Rhonda Hughes was AWM president (1987–89). Also Betty Ance Case and Anne Leggett have served AWM as meetings coordinator and newsletter editor for nineteen and twenty-two years respectively, rather than the figures given in the article. Finally, the number of members reported was overestimated because over 500 institutionally-nominated student members from the prior year had not been purged from the database.

—Jean Taylor and Sylvia Wieand
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


July 22, 1999: Deadline for proposals for the NSF CAREER/PECASE awards. For more information, see the CAREER/PECASE Web site at http://www.nsf.gov/home/crssprgm/career/guide.htm or contact the National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230, telephone 703-306-1870 (Division of Mathematical Sciences, NSF).

July 30, 1999: Deadline for submission of proposals for Long-Term Project Development grants from the Office of International Affairs of the National Research Council. For more information, contact the Office of International Affairs, National Research Council, 2101 Constitution Avenue, NW (FO 2060), Washington, DC 20418; telephone 202-334-3680; fax 202-334-2614; e-mail: ucee@nas.edu; World Wide Web http://www2.nas.edu/oia/22da.html.


September 1, 1999: Deadline for nominations for National Academy of Sciences Mathematics Award. For more information, see "Mathematics Opportunities" in this issue.

September 1, 1999: Deadline for receipt of applications for the AWM Mathematical Sciences Education Board and Staff

May 1998, p. 632, February 1999, p. 244

Mathematics Research Institutes contact information

May 1999, p. 580, August 1999, p. 804

National Science Board

March 1999, p. 361

NSF Mathematical and Physical Sciences Advisory Committee

March 1999, p. 362

Officers of the Society 1998 and 1999 (Council, Executive Committee, Publications Committees, Board of Trustees)

May 1999, p. 583

Program officers for federal funding agencies (DoD, DoE, NSF)

October 1998, pp. 1182-1184; February 1999, p. 244
workshop for women graduate students and postdocs. For more information, contact the Workshop Selection Committee, Association for Women in Mathematics, 4114 Computer & Space Sciences Building, University of Maryland, College Park, MD 20742-2461; telephone 301-405-7892; e-mail: awm@math.umd.edu.

October 1, 1999: Deadline for receipt of proposals for the Office of Naval Research Young Investigator Program. For more information, see "Mathematics Opportunities" in this issue.

October 1, 1999: Deadline for receipt of nominations for the AWM Louise Hay Award. For more information, call the AWM at 301-405-7892 or send e-mail to awm@math.umd.edu.

October 1, 1999: Deadline for receipt of nominations for the AWM Alice T. Schafer Mathematics Prize. For more information, contact the Alice T. Schafer Award Selection Committee, Association for Women in Mathematics, 4114 Computer & Space Sciences Building, University of Maryland, College Park, MD 20742-2461; telephone 301-405-7892; e-mail: awm@math.umd.edu.

November 1, 1999: Deadline for applications for NSF/AWM Travel Grants for Women. For more information, see the AWM Web site, http://www.awm-math.org/travelgrants.html; or telephone 301-405-7892 or send e-mail to awm@math.umd.edu.


Contact Information for Mathematics Institutes

This list supplements the list of institute contact information that appeared in the May 1999 issue of the Notices, pp. 580–581.

Stefan Banach International Mathematical Center
00-950 Warszawa ul Mokotowska 25, Poland
Telephone: +48-22-628-01-92
Fax: +48-22-622-57-50
e-mail: banach@impan.gov.pl

Centre for Mathematical Physics and Stochastics (MaPhySto)
Department of Mathematical Sciences
University of Aarhus
Ny Munkegade, DK-8000 Aarhus C,
Denmark
Telephone: +45-8942-3532
Fax: +45-8613-1769
e-mail: maaphysto@maaphysto.dk
World Wide Web: http://www.maaphysto.dk/

Centre de Recerca Matemàtica (CRM)
Institut d'Estudis Catalans
Apartat 50
E-08193 Bellaterra, Spain
Telephone: +34-93-581-1081
Fax: +34-93-581-2202
e-mail: crm@crm.es
World Wide Web: http://crm.es/

Centro de Investigacion en Matematicas (CIMAT)
A. P. 402, Guanajuato, Gto.
C.P. 36000, Mexico
Telephone: +52-473-271-55
Fax: +52-473-257-49
e-mail: cimat@cimat.mx
World Wide Web: http://www.cimat.mx/

Forschungsinstitut für Mathematik (FIM)
Eidgenössische Technische Hochschule Zürich
8092 Zürich, Switzerland
Telephone: +41-1-632-3475
Fax: +41-1-632-1085
e-mail: scherbel@math.ethz.ch
World Wide Web: http://www.fim.math.ethz.ch/

Institute for Pure and Applied Mathematics (IPAM)
Mathematics Department
University of California, Los Angeles
6363 Math Sciences
405 Hilgard Avenue
Box 951555
Los Angeles, California 90095-1555
Telephone: 310-825-4701
Fax: 310-206-6673
e-mail: ipam@math.ucla.edu
World Wide Web: http://www.ipam.org/

Istituto Nazionale di Alta Matematica “F. Severi”
Città Universitaria
P.le Aldo Moro 5
00185 Rome, Italy
Telephone: +39-06490320
Fax: +39-06462293
e-mail: indam@mat.uniroma1.it
World Wide Web: http://indam.mat.uniroma1.it/

Korea Institute for Advanced Study (KIAS)
207-43 Cheongryangri-dong
Dongdaemun-gu
Seoul 130-012, Korea
Telephone: +82-2-958-3701
Fax: +82-2-958-3770
only books published within the last two years, though exceptions may be made in cases where current events (e.g., the death of a prominent mathematician, coverage of a certain piece of mathematics in the news) warrant drawing readers' attention to older books. Suggestions for books to include on the list may be sent to the Managing Editor, e-mail: notices@ams.org.


# Visiting Mathematicians

## American and Canadian Mathematicians Visiting Abroad

<table>
<thead>
<tr>
<th>Name and Home Country</th>
<th>Host Institution</th>
<th>Field of Special Interest</th>
<th>Period of Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archdeacon, Dan (U.S.A.)</td>
<td>University of Auckland, New Zealand</td>
<td>Graph Theory</td>
<td>9/99 - 12/99</td>
</tr>
<tr>
<td>Booth, Peter (Canada)</td>
<td>University of Wales, Bangor</td>
<td>Homotopy Theory</td>
<td>5/00 - 8/00</td>
</tr>
<tr>
<td>Fehribach, Joseph D. (U.S.A.)</td>
<td>Technische Universiteit Delft, The Netherlands</td>
<td>Computational PDE/Modeling</td>
<td>8/99 - 8/00</td>
</tr>
<tr>
<td>Golden, Kenneth (U.S.A.)</td>
<td>Australian National University</td>
<td>Mathematical Physics</td>
<td>2/00 - 4/00</td>
</tr>
<tr>
<td>Nowakowski, R. J. (Canada)</td>
<td>Otego University, New Zealand</td>
<td>Graph Theory</td>
<td>1/00 - 5/00</td>
</tr>
<tr>
<td>Oh, Yong-Geun (U.S.A.)</td>
<td>Kyoto University, Japan; Korean Institute for Advanced Study</td>
<td>Symplectic Geometry and Topology</td>
<td>8/99 - 12/99</td>
</tr>
<tr>
<td>Sehgal, Sudarshan (Canada)</td>
<td>Institut D'estudis Catalans, Spain; RWTH, Aachen, Germany</td>
<td>Algebra</td>
<td>1/00 - 6/00</td>
</tr>
<tr>
<td>Turner, Robert E. L. (U.S.A.)</td>
<td>University of Pisa, Italy</td>
<td>Differential Equations, Neuroscience</td>
<td>2/00 - 3/00</td>
</tr>
</tbody>
</table>

## Visiting Foreign Mathematicians

<table>
<thead>
<tr>
<th>Name and Home Country</th>
<th>Host Institution</th>
<th>Field of Special Interest</th>
<th>Period of Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andre, Nelly (France)</td>
<td>Purdue University</td>
<td>Nonlinear Analysis</td>
<td>8/99 - 1/00</td>
</tr>
<tr>
<td>Angelert-Hugel, Lidia (Germany)</td>
<td>Université de Sherbrooke</td>
<td>Théorie des représentations</td>
<td>10/99 - 11/99</td>
</tr>
<tr>
<td>Archeva, Svatoslav (Russia)</td>
<td>Purdue University</td>
<td>Algebraic Geometry</td>
<td>8/99 - 5/02</td>
</tr>
<tr>
<td>Ban, Dubravka (Croatia)</td>
<td>Purdue University</td>
<td>Representation Theory</td>
<td>8/99 - 5/01</td>
</tr>
<tr>
<td>Bardos, Claude (France)</td>
<td>Brown University</td>
<td>Partial Differential Equations</td>
<td>1/00 - 6/00</td>
</tr>
<tr>
<td>Berry, Daniel (Israel)</td>
<td>University of Waterloo</td>
<td>Programming Language Design</td>
<td>9/98 - 8/99</td>
</tr>
<tr>
<td>Bojanov, Borislav (Bulgaria)</td>
<td>Texas A&amp;M University</td>
<td>Numerical Analysis</td>
<td>9/99 - 5/00</td>
</tr>
<tr>
<td>Bonk, Mario (Germany)</td>
<td>Purdue University</td>
<td>Analysis</td>
<td>1/99 - 12/99</td>
</tr>
<tr>
<td>Charatonik, Wlodzimierz (Poland)</td>
<td>University of Missouri-Rolla</td>
<td>Topology, Continuum Theory</td>
<td>8/99 - 6/00</td>
</tr>
<tr>
<td>Coelho, Flavio Ulhoa (Brazil)</td>
<td>Université de Sherbrooke</td>
<td>Théorie des représentations</td>
<td>10/99 - 11/99</td>
</tr>
<tr>
<td>Dajani, Karma (The Netherlands)</td>
<td>George Washington University</td>
<td>Ergodic Theory</td>
<td>9/99 - 12/99</td>
</tr>
<tr>
<td>Danileyan, Arthur (Armenia)</td>
<td>University of South Florida</td>
<td>Complex Approximation Theory</td>
<td>8/98 - 5/00</td>
</tr>
<tr>
<td>de Alba, Enrique (Mexico)</td>
<td>University of Waterloo</td>
<td>Actuarial Science</td>
<td>8/99 - 3/00</td>
</tr>
<tr>
<td>Deng, Yuefan (People's Republic of China)</td>
<td>SUNY at Stony Brook</td>
<td>Simulation of Materials</td>
<td>7/99 - 6/99</td>
</tr>
<tr>
<td>Downey, Rodney (New Zealand)</td>
<td>University of Wisconsin-Madison</td>
<td>Logic</td>
<td>9/99</td>
</tr>
<tr>
<td>Drazin, Philip (United Kingdom)</td>
<td>University of California, Los Angeles</td>
<td>Hydrodynamic Stability</td>
<td>4/00 - 6/00</td>
</tr>
<tr>
<td>Foth, Tatjana (Russia)</td>
<td>University of Arizona</td>
<td>Analysis</td>
<td>8/99 - 3/00</td>
</tr>
<tr>
<td>Fujiwara, Kazuhiro (Japan)</td>
<td>University of California, Los Angeles</td>
<td>Number Theory</td>
<td>1/00 - 3/00</td>
</tr>
<tr>
<td>Funaro, Daniele (Italy)</td>
<td>University of California, Los Angeles</td>
<td>Numerical Analysis</td>
<td>1/00 - 3/00</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name and Home Country</th>
<th>Host Institution</th>
<th>Field of Special Interest</th>
<th>Period of Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goetze, Friedrich (Germany)</td>
<td>University of Connecticut</td>
<td>Probability</td>
<td>7/99</td>
</tr>
<tr>
<td>Grina Cintas, Pedro (Spain)</td>
<td>University of Waterloo</td>
<td>Statistical Methods, Quality Control and Improvements</td>
<td>5/99 - 8/99</td>
</tr>
<tr>
<td>Gronau, Hans-Dietrich (Germany)</td>
<td>Florida Atlantic University</td>
<td>Mathematical Science</td>
<td>8/99 - 5/00</td>
</tr>
<tr>
<td>Hayman, Walter (United Kingdom)</td>
<td>Purdue University</td>
<td>Analysis</td>
<td>8/99 - 9/99</td>
</tr>
<tr>
<td>Hernandez, Julio (Brazil)</td>
<td>University of Waterloo</td>
<td>Calculus, Linear Algebra, Numerical Analysis and Differential Equations</td>
<td>9/98 - 8/99</td>
</tr>
<tr>
<td>Huan, Zhongdan (People's Republic of China)</td>
<td>Worcester Polytechnic Institute</td>
<td>Partial Differential Equations, Computational Modeling</td>
<td>8/99 - 6/00</td>
</tr>
<tr>
<td>Huh, Jib (Korea)</td>
<td>University of Alberta</td>
<td>Kernel Smoothing Method of Density Estimation</td>
<td>1/99 - 1/00</td>
</tr>
<tr>
<td>Iannelli, Mimmo (Italy)</td>
<td>Purdue University</td>
<td>Applied Mathematics</td>
<td>8/99 - 5/00</td>
</tr>
<tr>
<td>Jiang, Qingtang (Singapore)</td>
<td>University of Alberta</td>
<td>Analysis</td>
<td>7/99 - 6/00</td>
</tr>
<tr>
<td>Joshi, Kirti (India)</td>
<td>University of Arizona</td>
<td>Algebra and Number Theory</td>
<td>8/99 - 5/00</td>
</tr>
<tr>
<td>Juhasz, Istvan (Hungary)</td>
<td>University of Wisconsin-Madison</td>
<td>Logic and Set Theory</td>
<td>10/99</td>
</tr>
<tr>
<td>Kerswell, Richard (United Kingdom)</td>
<td>University of California, Los Angeles</td>
<td>Fluid Mechanics</td>
<td>10/99 - 3/00</td>
</tr>
<tr>
<td>Kim, Honggie (Korea)</td>
<td>University of South Carolina</td>
<td>Statistics</td>
<td>12/98 - 12/99</td>
</tr>
<tr>
<td>Kurt, Vasyl (Ukraine)</td>
<td>University of South Florida</td>
<td>Differential Equations</td>
<td>8/98 - 5/00</td>
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<tr>
<td>Lei, Li (People's Republic of China)</td>
<td>SUNY at Stony Brook</td>
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<td>Ohio State University</td>
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<td>Liow, Yishiang (Singapore)</td>
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<tr>
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<tr>
<td>Matthes, Daniel (Germany)</td>
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<tr>
<td>Mihaiulescu, Eugen (Romania)</td>
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<td>Moricz, Ferenc (Hungary)</td>
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<td>Functional Analysis/Fourier Analysis</td>
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<td>University of Arizona</td>
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<td>Machine Translation</td>
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<td>Niknam, Assad (Iran)</td>
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<td>Functional Analysis</td>
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<td>Ria, Bindhyachal (India)</td>
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<td>Roitman, Moshe (Israel)</td>
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<tr>
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<td>Host Institution</td>
<td>Field of Special Interest</td>
<td>Period of Visit</td>
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<td>Zentchouk, Alexandre (Brazil)</td>
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<td>Group Representations, Probability and Special Functions, Applied Statistics</td>
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<td>Zhang, Tusheng (China)</td>
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From the AMS

1998 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:

1. To provide advice to the leadership of the Society and to make recommendations as to Society policy.
2. To be responsible for taking a long-range view in their areas.
3. To conduct an annual high-level review of activities and structure within their areas and evaluate progress towards Society goals.
4. To report regularly to the membership, both in writing and by presentations at meetings.
5. To maintain communications with the membership and to keep aware of their views.
6. 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 (4), reporting regularly to the membership in writing. Here is the first of the 1998 reports of the AMS policy committees.

Committee on Meetings and Conferences (COMC)
Joel H. Spencer, Chair

There was in general a very positive feeling about meetings and conferences. This area speaks to the heart of what we do. Both the professional staff in Providence and the Secretariat are running well. Issues always arise, but in all cases it seems the critical point is as it should be: what can be done to make it easier for mathematicians to prove and conjecture.

1. International Meetings
Secretary Robert Fossum spoke about our ongoing program of international meetings. We have a biennial meeting with the Sociedad Matematica Mexicana (SMM). Otherwise we have roughly one such meeting a year: 1996 in Belgium, 1997 in South Africa, an upcoming 1999 meeting in Australia, and two 2000 meetings—one in Denmark and one (tentative) in Hong Kong.

There was a unanimous and very positive feeling toward these meetings. There was discussion over the frequency of such meetings, but, as they are still evolving and each one is in many ways a special event, no particular goal was given.

The joint meetings with the SMM were discussed at length. This year, for the first time, we will have the joint meeting in the United States—in Denton, Texas. There was a strong feeling that we should reciprocate the hospitality shown us in previous meetings. Further, there was a sense that as Mexico is our neighbor, it was right and proper to view these meetings somewhat separately from our other international meetings, even while administratively they were being handled the same. COMC voted unanimously for the following statement of support:

COMC views the relationship with the Sociedad Matematica Mexicana as being special and endorses the Secretariat’s efforts to financially support these meetings.

2. Special Lectures
Karen Vogtmann presented the report of the Subcommittee to Review Special Lecture Series and Special Projects. The Colloquium and Gibbs lectures are both running very well and have a particularly important role at our national
meetings. There was discussion about possible resurrection of the Progress in Mathematics Lectures. The Erdős Lecture will first be given at Denton and then should be given annually at an AMS meeting. Details on this remain to be worked out.

3. Summer Conference Program

The AMS-IMS-SIAM Joint Summer Research Conferences consist of 5 to 7 one-week conferences held in the same place (on different topics) during the summer. There is also a three-week Summer Research Institute.

The mathematical content of these conferences is not an issue. All who have attended and/or organized such meetings report enthusiastically. Further, the efforts of our Providence office have made organizing relatively easy. Essentially, an organizer needs to determine only two things: the scientific program and the amount of support for participants. The AMS conference coordinator handles all other aspects concerning logistics and administration of a conference.

These conferences are very much in flux, and their future is by no means assured. The current funding runs through summer 1999. In February 1998 the AMS joined with SIAM in submitting a proposal for future funding of the AMS-IMS-SIAM Joint Summer Research Conferences to the Division of Mathematical Sciences’ institutes recompition. This was done at the direction of DMS in spite of the fact that this conference activity did not appear to fit very well into the format of a fixed-site institute. Opportunities for future funding of the conferences appeared to hinge on submitting to this competition. In July DMS notified AMS and SIAM that our proposal was being dropped from further consideration within the institutes recompition, but we were informed that DMS would consider a suitably revised proposal within its infrastructure program, the traditional home for conference proposals from the various societies. John Ewing and Jim Crowley followed up by visiting with Don Lewis and Infrastructure Program officers in early September. With further clarification from this meeting, plans have been put in place to revise the proposal and resubmit it in November. The proposal will request funding for conference activity from 2000 through 2004.

Money is not the only problem here. In the past there has been a lack of proposals for these conferences. We noted, however, that this was reversed in the last go-around, which was taken as a very good sign. There are difficulties here, but also great opportunities. What is needed is a revitalization of this program.

NOTE: The AMS has recently received word that NSF will be funding the Joint AMS-IMS-SIAM Summer Conference Program.

4. Abstracts: Paper and Electronic

Abstracts for the scientific program for sectional meetings are now being handled electronically. Abstracts are available on the AMS Web site as soon as the program is posted. In an effort to move the deadlines for the submission of abstracts closer to the meetings themselves, effective this year the paper publication of the meeting program in the Notices has been appearing after the meeting itself has taken place. (This does not affect participants at the meeting, as a current copy of the program with abstracts is given to all registered participants at the start of the meeting.) This is a necessary consequence given the current (shortened) deadline for submission and the current frequency of Notices publication. In this instance the advantages of the shortened deadline outweigh the paper publication of the schedule. It was noted that all other information about the meetings, including titles of Special Sessions, will still appear in the Notices. Further, information about the Web site address for the meetings is clearly given in the Notices.

A motion was made and seconded. All were in favor of COMC endorsing the efforts of the Secretariat to halt paper production of the scientific program for sectional meetings in the Notices and to designate the Web version of these programs as the official program.

John Ewing noted that designation of the Web version as the official program will require special archival efforts. It was appreciated that implementation of the above motion will first require resolution of these technical issues.

5. Summer 2000 Meeting

Felix Browder reported on the current status of the August 2000 Mathematical Challenges of the 21st Century meeting, to be held at UCLA on August 7-10, 2000.

6. Sectional Meetings

It was noted that the registration fee for sectional meetings has remained static at $30 for several years. There was discussion about the possibility of simultaneously increasing the registration fee by a modest amount and upgrading the services offered. No firm conclusions were reached.

7. Future Projects

A modification was made in our schedule of reviews. In view of the uncertainty surrounding the summer conference program, we have put off review of that program until 2002, by which time it is hoped that it will be on sound footing. For this coming year a subcommittee will examine the scientific program at the national meeting. This will include the writing of a mission statement for the meeting. The committee will consist of Michael Starbird (chair), Karen Parshall, and Lesley Sibner representing the Secretariat.

8. Next Meeting

COMC agreed to hold its next meeting in Providence at AMS headquarters. This confirmed an agreement in principle from last year’s meeting. The thought was that occasional meetings at the Providence office would be very beneficial in giving committee members a sense of the professional staff organization.

9. Future Meetings

COMC agreed in principle to move its meetings to the spring, beginning in spring 2000.
Preliminary List of Candidates for 1999 AMS Election

President Elect
Hyman Bass
Daniel W. Stroock

Vice President
David Eisenbud
Thomas G. Kurtz

Trustee
Eric M. Friedlander
Donald E. McClure

Member at Large of the Council
Patricia E. Bauman
William Fulton
Susan C. Geller
Martin Golubitsky
Ellen Kirkman
Jonathan M. Rosenberg
Claude M. Schochet
Ronald J. Stern
Lisa M. Traynor
William Yslas Velez
NEW JOURNALS FROM KLUWER

ALGEBRAS AND REPRESENTATION THEORY

Editors-in-Chief:
A. Verschoren,
University of Antwerp, RUCA, Belgium;
Y.A. Drozd,
Kiev Taras Shevchenko University, Ukraine

Algebras and Representation Theory plays a unifying role in this, presenting to its reader both up-to-date information about progress within the field of rings, algebras and their representations, as well as clarifying relationships with other fields.

This journal publishes high level, significant and original research papers, as well as expository survey papers written by specialists, wishing to present the 'state-of-the-art' of well-defined subjects or subdomains.

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Volume 2, Issue 1, March 1999
• Strong Exceptional Sequences Provided by Quivers; Klaus Altmann, Lutz Hille.
• Generic Splitting Fields of Central Simple Algebras: Galois Cohomology and Nonexistence; Oleg T. Izhboldin, Nikita A. Karpenko.
• Discrete Series Characters for GL(n, q); James A. Green.
• Galois Theory for Multiplier Hopf Algebras with Integrals; A. Van Daele, Y. H. Zhang.

Subscription Information:
1999, Volume 2 (4 issues), ISSN 1386-923X
http://www.wkap.nl/journals/algebras

POSITIVITY

AN INTERNATIONAL JOURNAL DEVOTED TO THE THEORY AND APPLICATIONS OF POSITIVITY IN ANALYSIS

Editor: A.W. Wickstead, Queen's University of Belfast, N. Ireland

Positivity publishes papers on analysis having a clear link to the general theme of positivity as well as papers covering applications of such mathematics to other disciplines. Positivity, mathematical topics will include but not be restricted to:

• Ordered topological vector spaces and operators on them. • Banach spaces, their geometry, unconditional structure and asymptotic theory. • C* and other operator algebras, especially non-commutative order theory.
• Partial differential equations and positive semigroup theory. • Measure theory, Boolean algebras and stochastic processes.
• Potential theory, harmonic analysis, positive harmonic functions and diffusion. • Variational analysis and variational inequalities. • Optimization and optimal control theory. • Convex functions and convex analysis.
• Non-standard analysis and Boolean valued models.

Applications will be areas including economics, engineering, life sciences, physics and statistical decision theory; no subject area is excluded a priori.
Mathematics Calendar

August 1999

9-13 Colloquium on Quantum Groups and Hopf Algebras, La Faldia, Córdoba, Argentina.


September 1999

5-8 Conference Moshe Flato-Advances and Prospects in Physical Mathematics, Université de Bourgogne, Dijon, France.


October 1999

2 49th Algebra Day, Carleton University, Ottawa, Canada.

November 1999

7-10 OR/MS and the Quality of Life, Philadelphia, Pennsylvania.


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/ (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.

The most comprehensive and up-to-date Mathematics Calendar information is available on e-MATH at http://www.ams.org/mathcal/.
December 1999

*11–13 CMS Winter 1999 Meeting, Hôtel du Parc, Montreal (Quebec), Canada.

Meeting Committee: Meeting Director: M. Deleur (Montréal), Local Organizing Committee Chair: V. Hussin (Montréal).

Program: The meeting follows an expanded format with a program encompassing many symposia, various meetings, and plenary talks including the Coxeter-James Lecture and the CMS Doctoral Prize. In addition there will be a Graduate Seminar and a Contributed Papers Session. The meeting will be preceded by the 30th anniversary of the CRM on December 10 at the Université de Montréal and followed by the First CMS “Job Fair” on December 14 at the Hôtel du Parc.

Plenary Speakers: A. Dress (Univ. of Bielefeld, Germany), A. Garsia (UCSD), D. Lay (Univ. of Maryland), E. H. Lieb (Princeton), P. Nevzor (USC), Z. Xia (Northwestern and Georgia Tech).

Prize Lectures: The Coxeter-James Lecture will be given by M. Zwozski, Univ. of California at Berkeley. The CMS Doctoral Prize is to be announced.

Public Lecture: J. Chayes (Microsoft Research, Redmond).

Symposia: Confirmed conference titles: Algebra and geometric methods in differential equations: The 20th century in celestial mechanics and one century of work on Hilbert’s 16th problem (CMS-CRM); Applied Logic; Combinatorial algebra, group representations and Macdonald polynomials; Computing and mathematical modelling (CMS-NCM); General history of mathematics; Graduate student seminar (CMS-ISM); Mathematical Physics: I. Probability methods and applications and II. Group theory methods and applications (CMS-PFS); Mathematical genetics and genomics (CMS-Field); Orders, lattices and universal algebra; Teaching of linear algebra.

Contributed Papers: Contributed papers of 30 minutes duration are invited and graduate students are particularly urged to participate. Abstracts must be received before September 30, 1999. The abstract must be accompanied by its contributor’s registration form and full payment of appropriate fees.

Related Activities: 30th Anniversary of the CRM: December 10, 1999, Centre de recherches mathématiques, Université de Montréal. For information, please contact L. Pelletier (30eCRM@Umunet). First CMS “Job Fair”: December 14, 1999, Hôtel du Parc. For more information, please contact C. Rousseau (rousseau@CRM.UMontreal.CA).

Information: Canadian Mathematical Society, 577 King Edward, Suite 103, P.O. Box 450, Station A, Ottawa, Ontario, Canada K1N 6NS; tel: 613-562-5702; fax: 613-565-1539; e-mail: meetings@cms.math.ca; http://www.camel.math.ca/CMS/Events/ winter99/.

January 2000

*10-14 San Diego Symposium on Asymptotics and Applied Analysis, San Diego State University, San Diego, California.

Focus: This symposium will emphasize recent advances in asymptotic analysis, especially as applied to problems involving difference equations, differential equations, and functions defined by integrals.

Topics: The topics will include representations for solutions of ordinary differential equations in large sectors of complex plane, large parameter expansions, and asymptotic methods involving special functions. Included also will be new results related to exponentially improved asymptotics and hyperasymptotics, summation of divergent solutions, connection problems, and error analysis of asymptotic approximations. Related physical applications involving asymptotic analysis will also be covered under the scope of the symposium—for example, new results in wave physics and tunneling in quantum mechanics.


Invited Speakers: R. Askey (Wisconsin), W. Balser (Ulm, Germany), C. Bender (St. Louis), M. Berry (Bristol, UK), B. Braaksma (Groningen), F. W. J. Olver (Maryland), P. F. Pamm (Nice, France), R. Schaefer (Strasbourg, France), Y. Sibuya (Minneapolis), N. Temme (Netherlands), and R. Wong (Hong Kong).

Contributed Talks: There will be opportunities for contributed talks of 30 minutes in the three areas listed above. Those participants wishing to give talks should indicate this to the organizers, providing a title and abstract.

Deadline: The deadline for the title and abstract of contributed talks is Nov. 1, 1999.

Support: Postdoctoral and graduate students, and especially those from underrepresented groups in mathematics, are encouraged to attend; there will be some limited NSF support available to cover the local expenses for such participants. Those interested should contact the organizers for more details.

Information: For further information and updates on the program, as well as information regarding travel and accommodations, see the Web site: http://www.math.ucsd.edu/math_cs/asymptotics2000/ or contact the organizers via e-mail: dunster@math.ucsd.edu or lutz@math.ucsd.edu.

May 2000

*24-26 Advances in Fluid Mechanics, Montreal, Canada.

Organizer: Wessex Institute of Technology, Southampton, UK.

Sponsor: Dalhousie Univ., Halifax, Canada.

Objectives: The conference covers a wide range of topics, with emphasis on new applications and research currently in progress. The basic mathematical formulations of fluid mechanics and their computer modeling will be discussed, as well as the relationship between experimental and analytical results.

Information: Conference Secretariat, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, SO4 7AA, UK; tel: 44-0-23-80-392323; fax: 44-0-23-80-292853; e-mail: wii@wessex.ac.uk.

June 2000


Topics: Operator theory and related topics of mathematics and its applications (differential operators, reproducing kernel spaces, Hankel and Toeplitz operators, harmonic analysis, control theory, system theory, and signal processing).


Organizing Committee: L. Baratchart (Sophia-Antipolis), A. Borichev (Bordeaux), G. Cassier (Lyon), J. Escher (Bordeaux), N. Nikolski, chairman (Bordeaux and St. Petersburg), V.-H. Vassiliev (Lille). President of the steering committee of IWOTA: I. Gohberg (Tel Aviv).

Information: Further information, including deadlines, registration information, etc., will be available from the conference Web site: http://www.math.u-bordeaux.fr/~iwota/.

www.camel.math.ca/CMS/Events/winter99/.
New Publications Offered by the AMS

Algebra and Algebraic Geometry

**Differential Topology, Infinite-Dimensional Lie Algebras, and Applications**

D. B. Fuchs' 60th Anniversary Collection

Alexander Astashkevich, Renaissance Technologies, East Setauket, NY, and Serge Tabachnikov, University of Arkansas, Fayetteville, Editors

This volume presents contributions by leading experts in the field. The articles are dedicated to D. B. Fuchs on the occasion of his 60th birthday. Contributors to the book were directly influenced by Professor Fuchs and include his students, friends, and professional colleagues. In addition to their research, they offer personal reminiscences about Professor Fuchs, giving insight into the history of Russian mathematics.

The main topics addressed in this unique work are infinite-dimensional Lie algebras with applications (vertex operator algebras, conformal field theory, quantum integrable systems, etc.) and differential topology. The volume provides an excellent introduction to current research in the field.

This item will also be of interest to those working in geometry and topology.

**Contents:** V. I. Arnold, First steps of local symplectic algebra; P. Etingof, Whittaker functions on quantum groups and q-deformed Toda operators; B. Feigin and E. Frenkel, Integrable hierarchies and Wakimoto modules; B. Feigin and S. Loktev, On generalized Kostka polynomials and the quantum Verlinde rule; M. Finkelberg and I. Mirkovic, Semi-infinite flags. I. Case of global curve \( p \); B. Feigin, M. Finkelberg, A. Kuznetsov, and I. Mirkovic, Semi-infinite Flags. II. Local and global intersection cohomology of quasimaps' spaces; F. Malikov and V. Schechtman, Chiral de Rham complex. II; E. Mukhin and A. Varchenko, On algebraic equations satisfied by hypergeometric solutions of the qKZ equation; V. Ovsienko and C. Roger, Deforming the Lie algebra of vector fields on \( S^1 \);

inside the Lie algebra of pseudodifferential symbols on \( S^1 \);

A. Postnikov, B. Shapiro, and M. Shapiro, Algebras of curvature forms on homogeneous manifolds; V. Retakh, C. Reutenauer, and A. Vaintrob, Noncommutative rational functions and Farber's invariants of boundary links; S. Tabachnikov, Remarks on the geometry of exact transverse line fields; B. Tsygan, Formality conjectures for chains; V. A. Vassiliev, On finite order invariants of triple point free plane curves; A. Schwarz, A. Susslin, C. Roger, B. Feigin, S. Tabachnikov, and A. Astashkevich, Appendix. Personal notes.

American Mathematical Society Translations—Series 2 (Advances in the Mathematical Sciences), Volume 194


**Local Tame Lifting for GL(n) II: Wildly Ramified Supercuspidals**

Colin J. Bushnell, King's College, London, UK, and Guy Henniart, Université de Paris-Sud, Orsay, France

A publication of Société Mathématique de France.

In this work, the authors discuss the following problem: Let \( F \) be a finite extension of the field of \( p \)-adic numbers. The Langlands Conjectures relate the representations of the absolute Galois group of \( F \) with the representations of general linear groups over \( F \). These conjectures have recently been proved, via global geometric methods, by Harris-Taylor and Henniart.

The approach given here uses no global or geometric methods. In the crucial case where the dimension is a power of \( p \), they construct a correspondence exhibiting almost all of the desired properties. This very explicit approach is based on the theory of Bushnell-Kutzko and their behavior under base change with respect to tame extensions of \( F \).

Distributed by the AMS in the United States, Canada, and Mexico.

Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France.

Members of the SMF receive a 30% discount from list.
Contents: Introduction; Notation and Preliminaries; Algebraic tame lifting; Correspondence with Galois representations; Central types; Base field extension for central types; Construction of the tame lift; Automorphic local constants; Gauss sums mod roots of unity; Gauss sum relations; Calculation of the commutator Gauss sum; Comparison with base change; Appendix: Representations of finite groups; Bibliography.

Astérisque, Number 254
April 1999, 105 pages, Softcover, 1991 Mathematics Subject Classification: 22E50, 11F70, 11R69, Individual member $30, List $33, Order code AST/254N

Admissible Invariant Distributions on Reductive $p$-adic Groups
Harish-Chandra †, Notes by Stephen DeBacker and Paul J. Sally, Jr., University of Chicago, IL

Harish-Chandra presented these lectures on admissible invariant distributions for $p$-adic groups at the Institute for Advanced Study in the early 1970s. He published a short sketch of this material as his famous "Queen's Notes". This book, which was prepared and edited by DeBacker and Sally, presents a faithful rendering of Harish-Chandra's original lecture notes.

The main purpose of Harish-Chandra's lectures was to show that the character of an irreducible admissible representation of a connected reductive $p$-adic group $G$ is represented by a locally summable function on $G$. A key ingredient in this proof is the study of the Fourier transforms of distributions on $\mathfrak{g}$, the Lie algebra of $G$. In particular, Harish-Chandra shows that if the support of a $G$-invariant distribution on $\mathfrak{g}$ is compactly generated, then its Fourier transform has an asymptotic expansion about any semisimple point of $\mathfrak{g}$.

Harish-Chandra's remarkable theorem on the local summability of characters for $p$-adic groups was a major result in representation theory that spawned many other significant results. This book presents, for the first time in print, a complete account of Harish-Chandra's original lectures on this subject, including his extension and proof of Howe's Theorem.

In addition to the original Harish-Chandra notes, DeBacker and Sally provide a nice summary of developments in this area of mathematics since the lectures were originally delivered. In particular, they discuss quantitative results related to the local character expansion.

Contents: Introduction; Fourier transforms on the Lie algebra; An extension and proof of Howe's Theorem; Theory on the group; Bibliography; List of symbols; Index.

University Lecture Series, Volume 16

A Classic

Foundations of Twisted Endoscopy
Robert E. Kottwitz, University of Chicago, IL, and Diana Shelstad, Rutgers University, Newark, NJ

A publication of Société Mathématique de France.

This book develops the foundations of a general theory of twisted endoscopy by discussing the following: the definition of endoscopic groups, the study of the correspondence between twisted conjugacy classes and conjugacy classes in endoscopic groups, the definition of transfer factors, and finally the stabilization of the elliptic part of the twisted trace formula. The book also develops a theory of duality and Tamagawa numbers for the hypercohomology of complexes $T - U$ of tori.

Distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Automorphism and L-groups; Endoscopy; Norm mappings; Relative transfer factors; The notion of transfer; Beginning of the stabilization; End of the stabilization; Hypercohomology of complexes of tori over local fields; Inner twists of a group plus automorphism; Hypercohomology of complexes of tori over number fields; Duality for tori over number fields; Tamagawa numbers for complexes of tori; Bibliography.

Astérisque, Number 255
May 1999, 190 pages, Softcover, 1991 Mathematics Subject Classification: 11F72, 11R34, 22E50, 22E55, Individual member $50, List $55, Order code AST/255N

A1 Subgroups of Exceptional Algebraic Groups
R. Lawther, Lancaster University, England, and D. M. Testerman, University of Warwick, Coventry, England

Contents: Introduction; Labelled diagrams; Essential embeddings; Unipotent classes; Centralizers; Results; (AutG)-conjugacy; Tables of $A_1$ subgroups; References.

Memoirs of the American Mathematical Society, Volume 141, Number 674
Involution Complexes et Vecteurs Sphériques Associés pour les Groupes de Lie Nilpotents Réels

Bernard Magneron, Université Paris-Nord, Villetaneuse, France

A publication of Société Mathématique de France.

Monomial representations of a nilpotent Lie group $G$ have been studied successfully during the last few years by several people, including Grélaud, Corwin and Greenleaf, Fujikura and Lipsman. They are constructed by induction, starting from a unitary character of a $G$-subgroup.

Starting from a subalgebra $\mathfrak{t}$ of the complexification $\mathfrak{g}_\mathbb{C}$ of the Lie algebra $\mathfrak{g}$ of $G$, and from a form $f$ or $g^*$ such that $f([t,t]) = \{0,1\}$, one can construct the associated holomorphically induced representation. This gives another way to obtain unitary representations for $G$, which generalizes the standard method.

This construction was used by Auslander and Kostant in 1971, assuming that $\mathfrak{t}$ is a so-called positive polarization. Their goal was to study irreducible unitary representations of general solvable groups. Since then, no attempts seem to have been made to use this method to consider non-irreducible unitary representations.

This work is a first attempt to fill in this gap. Benoist’s study of the monomial representation associated to the trivial character of the fixed points subgroup for an involution of $G$, which was carried out in 1985, showed it was a good starting example for studying more general monomial representations.

In the same way, Magneron studies here the holomorphically induced representation $(\rho, \mathcal{H})$ associated to the trivial functional on the fixed points for an involution of $\mathfrak{g}$, giving some insight of what might happen in more general instances. Text is in French.

Distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: Introduction. Contexte de notre étude; Résumé des résultats; Conventions, notations et rappels complémentaires; Les fonctions $\kappa^\mathfrak{t}$ et les vecteurs sphériques associés; Géométrie des objets associés à la paire symétrique $(\mathfrak{g}, \sigma)$; Calcul des fonctions $\kappa^\mathfrak{t}_\mathfrak{g}$ dans certains cas. Conséquences; Récurrences et vecteurs sphériques; Propriétés du cône $\Theta_\mathfrak{t}$; Propriétés du cône $\Theta_\mathfrak{g}$; Synthèse et résultats principaux; Non nullité de la représentation $\rho$; Quelques exemples; Appendice; Bibliographie; Index; Liste des notations.

Astérisque, Number 253


Iwahori-Hecke Algebras and Schur Algebras of the Symmetric Group

Andrew Mathas, University of Sydney, NSW, Australia

This volume presents a fully self-contained introduction to the modular representation theory of the Iwahori-Hecke algebras of the symmetric groups and of the $q$-Schur algebras. The study of these algebras was pioneered by Dipper and James in a series of landmark papers. The primary goal of the book is to classify the blocks and the simple modules of both algebras. The final chapter contains a survey of recent advances and open problems.

The main results are proved by showing that the Iwahori-Hecke algebras and $q$-Schur algebras are cellular algebras (in the sense of Graham and Lehrer). This is proved by exhibiting natural bases of both algebras which are indexed by pairs of standard and semistandard tableaux respectively. Using the machinery of cellular algebras, which is developed in chapter 2, this results in a clean and elegant classification of the irreducible representations of both algebras. The block theory is approached by first proving an analogue of the Jantzen sum formula for the $q$-Schur algebras.

This book is the first of its kind covering the topic. It offers a substantially simplified treatment of the original proofs. The book is a solid reference source for experts. It will also serve as a good introduction to students and beginning researchers since each chapter contains exercises and there is an appendix containing a quick development of the representation theory of algebras. A second appendix gives tables of decomposition numbers.

Contents: The Iwahori-Hecke algebra of the symmetric group; Cellular algebras; The modular representation theory of $\mathcal{H}$; The $q$-Schur algebra; The Jantzen sum formula and the blocks of $\mathcal{H}$; Branching rules, canonical bases and decomposition matrices; Finite dimensional algebras over a field; Decomposition matrices; Elementary divisors of integral Specht modules; Index of notation; References; Index.

University Lecture Series, Volume 15

Théorie Homotopique des Schémas
Fabien Morel, Université Paris, France

A publication of Société Mathématique de France.

In this text, the author proposes a general framework to apply the standard methods from homotopy theory to the category of smooth schemes over a reasonable base scheme. It is shown that some expected properties are satisfied, for example, concerning algebraic $K$-theory of those schemes. The text is in French.

This item will also be of interest to those working in geometry and topology.

Distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.


Astérisque, Number 251

Quasi-Abelian Categories and Sheaves
Jean-Pierre Schneiders, Université Paris 13, Villetaneuse, France

A publication of Société Mathématique de France.

This memoir is divided in three parts. In the first, Schneiders introduces the notion of quasi-abelian categories and links the homological algebra of these categories to that of their abelian envelopes. Quasi-abelian categories form a special class of non-abelian additive categories that contain in particular the category of locally convex topological vector spaces and the category of filtered abelian groups.

In the second part, what is meant by an elementary quasi-abelian category is defined, and it is shown that sheaves with values in such a category can be manipulated almost as easily as sheaves of abelian groups. In particular, Schneiders establishes that Poincaré-Verdier duality and the projection formula hold in this context.

The third part of the volume is devoted to an application of the results obtained to the cases of filtered and topological sheaves.

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Contents: Introduction; Quasi-abelian categories; Sheaves with values in quasi-abelian categories; Applications; Bibliography.

Mémoires de la Société Mathématique de France, Number 76
The main theme of the book is the study of uniformly continuous functions on unit spheres of infinite dimension and its related problems. In that time, a huge number of papers discussing the conjecture and its related problems were inspired. Finally in 1984, de Branges completed the solution.

In 1989, Professor Gong wrote and published a short book in Chinese, *The Bieberbach Conjecture*, outlining the history of the related problems and de Branges' proof. The present volume is the English translation of that Chinese edition with modifications by the author. In particular, he includes results related to several complex variables. Open problems and a large number of new mathematical results motivated by the Bieberbach conjecture are included.

Completion of a standard one-year graduate complex analysis course will prepare the reader for understanding the book. It would make a nice supplementary text for a topics course at the advanced undergraduate or graduate level.

Titles in this series are co-published with International Press, Cambridge, MA.

Contents: Introduction; Löwner theory; Grunsky inequality; De Branges theorem; Several complex variable cases; References; List of symbols; Index.

AMS/IP Studies in Advanced Mathematics, Volume 12

**Differential Equations**

**Evolution Semigroups in Dynamical Systems and Differential Equations**

Carmen Chicone and
Yuri Latushkin, University of Missouri, Columbia

The main theme of the book is the spectral theory for evolution operators and evolution semigroups, a subject tracing its origins to the classical results of J. Mather on hyperbolic dynamical systems and J. Howland on nonautonomous Cauchy problems. The authors use a wide range of methods and offer a unique presentation.

The authors give a unifying approach for a study of infinite-dimensional nonautonomous problems, which is based on the
consistent use of evolution semigroups. This unifying idea connects various questions in stability of semigroups, infinite-dimensional hyperbolic linear skew-product flows, translation Banach algebras, transfer operators, stability radii in control theory, Lyapunov exponents, magneto-dynamics and hydro-dynamics. Thus the book is much broader in scope than existing books on asymptotic behavior of semigroups.

Included is a solid collection of examples from different areas of analysis, PDEs, and dynamical systems. This is the first monograph where the spectral theory of infinite dimensional linear skew-product flows is described together with its connection to the multiplicative ergodic theorem; the same technique is used to study evolution semigroups, kinematic dynamos, and Ruelle operators; the theory of stability radii, an important concept in control theory, is also presented. Examples are included and non-traditional applications are provided.

Contents: Introduction; Semigroups on Banach spaces and evolution semigroups; Evolution families and Howland semigroups; Characterizations of dichotomy for evolution families; Two applications of evolution semigroups; Linear skew-product flows and Mather evolution semigroups; Characterizations of dichotomy for linear skew-product flows; Evolution operators and exact Lyapunov exponents; Bibliography; List of notations; Index.

Mathematical Surveys and Monographs, Volume 70

General and Interdisciplinary

Proceedings of the St. Petersburg Mathematical Society Volume V
N. N. Uraltseva, St. Petersburg State University, Russia, Editor

This volume contains 10 papers with new results on problems in mathematical physics, differential equations, and probability. Included also is an article on the dramatic history of mathematics in Leningrad in the 1930s.


American Mathematical Society Translations—Series 2, Volume 193

Assistantships and Graduate Fellowships in the Mathematical Sciences, 1999-2000

Review of the previous annual edition: What makes this directory unusual is the additional information provided about the department. The AMS has provided for each department the number of tenured faculty that have published within the last three years and a breakdown of the financial support available to graduate students as well as the kind of work required to obtain support. From a student's point of view, these additional data are vital in the selection process. The American Mathematical Society has provided a valuable aid to students in the mathematical sciences. This guide is highly recommended for any academic institution with an undergraduate mathematics major.

—American Reference Books Annual

This publication is an indispensable source of information for students seeking support for graduate study in the mathematical sciences. Providing data from a broad range of academic institutions, it is also a valuable resource for mathematical sciences departments and faculty.

Assistantships and Graduate Fellowships brings together a wealth of information about resources available for graduate study in mathematical sciences departments in the U.S. and Canada. Information on the number of faculty, graduate students, and degrees awarded (bachelor's, master's, and doctoral) is listed for each department when available. Stipend amounts and the number of awards available are given, as well as information about foreign language requirements. Numerous display advertisements from mathematical sciences departments throughout the country provide additional information.

Also listed are sources of support for graduate study and travel, summer internships, and graduate study in the U.S. for foreign nationals. Finally, a list of reference publications for fellowship information makes Assistantships and Graduate Fellowships a centralized and comprehensive resource.

Combined Membership List 1999-2000

The Combined Membership List (CML) is a comprehensive directory of the membership of the American Mathematical Society, the American Mathematical Association of Two-Year Colleges, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

There are two lists of individual members. The first is a complete alphabetical list of all members in all four organizations. For each member, the CML provides his or her address, title, department, institution, telephone number (if available), and electronic address (if indicated), and also indicates membership in the four participating societies. The second is a list of individual members according to their geographic locations. In addition, the CML lists academic, institutional, and corporate members of the four participating societies, providing addresses and telephone numbers of mathematical sciences departments.

The CML is distributed on request to AMS members in even-numbered years. MAA members can request the CML in odd-numbered years from the MAA. The CML is an invaluable reference for keeping in touch with colleagues and for making connections in the mathematical sciences community in the United States and abroad.


Séminaire Bourbaki, Volume 1997/98, Exposés 835-849

A publication of Société Mathématique de France.

The talks at Bourbaki seminars are devoted to the most important topics of current research interest. This volume contains 15 lectures (given in 1997/98) on the subjects: differential Galois theory; Riemannian geometry; symplectic geometry; Hecke algebras; quasi-crystals; quantumization of Poisson manifolds; integrable systems and quantum field theory; sieve methods; loop spaces of compact Lie groups; Lie algebras; eigenvalues of Hermitian matrices; quantum cohomology of projective hypersurfaces; fundamental groups of curves in algebraic geometry; the K-theory of \( C^* \)-algebras; and zeta functions.

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Complex Geometry of Groups

Angel Carocca, Pontificia Universidad Católica de Chile, Santiago, Chile, Víctor González-Aguilera, Universidad Técnica Federico Santa María, Valparaíso, Chile, and Rubi E. Rodríguez, Pontificia Universidad Católica de Chile, Santiago, Editors

This volume presents the proceedings of the Iberoamerican Congress on Geometry: Cruz del Sur held in Olmué, Chile. The main topic was "The Geometry of Groups: Curves, Abelian Varieties, Theoretical and Computational Aspects". Participants came from all over the world.

The volume gathers the expanded contributions from most of the participants in the Congress. Articles reflect the topic in its diversity and unity, and in particular, the work done on the subject by Iberoamerican mathematicians. Original results and surveys are included on the following areas: curves and Riemann surfaces, abelian varieties, and complex dynamics. The approaches are varied, including Kleinian groups, quasiconformal mappings and Teichmüller spaces, function theory, moduli spaces, automorphism groups, algebraic geometry, and more.

Contents: R. E. Rodríguez, Complex geometry in Chile: Panorama and perspectives; W. Abikoff, Quasiconformal conjugation of Möbius transformations; R. Bamón, A family of n-dimensional differential equations with Lorenz-like attractors; C. Birkenhake, H. Lange, and V. González-Aguilera, Automorphisms of 3-dimensional abelian varieties; L. Brambila-Paz, L. Hidalgo-Solis, and J. Mucino-Raymundo, On restrictions of the Picard bundle;
New Publications Offered by the AMS

A. M. Castro, Representations of triangle groups in the Heisenberg group; M. Chuaqui and B. Osgood, Recent progress on the geometry of univalence criteria; A. F. Costa and A. M. Porto, On anticonformal automorphisms of order > 2 of Riemann; C. J. Earle, F. P. Gardiner, and N. Lakic, Isomorphisms between generalized Teichmüller spaces; H. M. Farkas and I. Kra, Ramanujan partition identities; H. M. Farkas and I. Kra, A function theoretic approach to the Ramanujan partition identities with applications to combinatorial number theory; C. M. Fernández-Pacheco and J. J. Giraldo, Elliptic and Lefschetz fibrations; J. Earle, F. P. Gardiner, and N. Lakic, Isomorphisms between Fuchsian groups of signature (0; e1, e2, e3, e4) with 2 ≤ e1 ≤ e2 ≤ e3 e4 = ∞; J. R. Quine, Geometric and holomorphic moduli of extremal Riemann surfaces.

Contemporary Mathematics, Volume 240


Recommended Text

4-Manifolds and Kirby Calculus

Robert E. Gompf, University of Texas, Austin, and András I. Stipsicz, ELTE, TTK, Budapest, Hungary

The past two decades have brought explosive growth in 4-manifold theory. Many books are currently appearing that approach the topic from view-}

points such as gauge theory or algebraic geometry. This volume, however, offers an exposition from a topological point of view. It bridges the gap to other disciplines and presents classical but important topological techniques that have not previously appeared in the literature.

Part I of the text presents the basics of the theory at the second-year graduate level and offers an overview of current research. Part II is devoted to an exposition of Kirby calculus, or handlebody theory on 4-manifolds. It is both elementary and comprehensive. Part III offers in depth a broad range of topics from current 4-manifold research. Topics include branched coverings and the geography of complex surfaces, elliptic and Lefschetz fibrations, h-cobordisms, symplectic 4-manifolds, and Stein surfaces.

Applications are featured, and there are over 300 illustrations and numerous exercises with solutions in the book.

Contents: 4-manifolds; Introduction; Surfaces in 4-manifolds; Complex surfaces; Kirby calculus; Handlebodies and Kirby diagrams; Kirby calculus; More examples; Applications: Branched covers and resolutions; Elliptic and Lefschetz fibrations; Cobordisms, h-cobordisms and exotic S^4; Symplectic manifolds; Stein surfaces; Appendices: Solutions; Notation; Important figures; Bibliography; Index.

Graduate Studies in Mathematics, Volume 20


Periodic Hamiltonian Flows on Four Dimensional Manifolds

Yael Karshon, Hebrew University of Jerusalem, Israel

Contents: Introduction; Graphs; Metrics; Uniqueness: Graph determines space; Isolated fixed points implies toric variety; Blowing-up; Completing the classification; our spaces are Kähler; Appendices; References.

Memoirs of the American Mathematical Society, Volume 141, Number 672


Diffeomorphisms and Noncommutative Analytic Torsion

John Lott, University of Michigan, Ann Arbor

Contents: Introduction; Noncommutative bundle theory; Groups and covering spaces; R-hermitian metrics and characteristic classes; Noncommutative superconnections; Fiber bundles; Diffeomorphism groups;

References.

Memoirs of the American Mathematical Society, Volume 141, Number 673

Homotopy Invariant Algebraic Structures

A Conference in Honor of J. Michael Boardman
Jean-Pierre Meyer, Jack Morava, and W. Stephen Wilson, Johns Hopkins University, Baltimore, MD, Editors

This volume presents the proceedings of the conference held in honor of J. Michael Boardman's 60th birthday. It brings into print his classic work on conditionally convergent spectral sequences.

Over the past 30 years, it has become evident that some of the deepest questions in algebra are best understood against the background of homotopy theory. Boardman and Vogt's theory of homotopy-theoretic algebraic structures and the theory of spectra, for example, were two benchmark breakthroughs underlying the development of algebraic K-theory and the recent advances in the theory of motives.

The volume begins with short notes by Mac Lane, May, Stasheff, and others on the early and recent history of the subject. But the bulk of the volume consists of research papers on topics that have been strongly influenced by Boardman's work. Articles give readers a vivid sense of the current state of the theory of "homotopy-invariant algebraic structures". Also included are two major foundational papers by Goerss and Strickland on applications of methods of algebra (i.e., Dieudonné modules and formal schemes) to problems of topology.

Boardman is known for the depth and wit of his ideas. This volume is intended to reflect and to celebrate those fine characteristics.

Contents: Some history: R. Thom, Note; S. Mac Lane, Higher homotopies, pacts, and the bar construction; J. P. May, The hare and the tortoise; J. Morava, Cobordism of involutions revisited, revisited; J. Stasheff, Graffiti Boardman's cherry trees to quantum field theory; R. M. Vogt, My time as Mike Boardman's student and our work on infinite loop spaces; Research papers: T. P. Bisson, D. J. Pengelley, and F. Williams, Stabilizing the lower operations for mod two cohomology; J. M. Boardman, Conditionally convergent spectral sequences; A. K. Bousfield, On $K(n)$-equivalences of spaces; S. L. Devadoss, Tesselations of moduli spaces and the mosaic operad; P. G. Goerss, Hopf rings, Dieudonné modules, and $E_2$-Tate cohomology; P. Hovey and J. H. Palmieri, The structure of the Bousfield lattice; P. Hu, Transfinite spectral sequences; I. Kriz, The $Z/p$-equivariant complex cobordism ring; K. Morisugi, Hopf constructions, Samelson products, and suspension maps; D. Randall, Embedding homotopy spheres and the Kervaire invariant; R. Schwanzl, R. M. Vogt, and F. Waldhausen, Adjoining roots of unity to $E_0$-ring spectra in good cases—A remark; B. Steer and A. Wren, Grothendieck topology and the Picard group of a complex orbifold; N. P. Strickland, Formal schemes and formal groups; J. M. Turner, Simplicial commutative $F_2$-algebras through the looking-glass of $F_2$-local spaces; A. A. Voronov, The Swiss-cheese operad; W. S. Wilson, $K(n+1)$-equivalence implies $K(n)$-equivalence.

Contemporary Mathematics


Logic and Foundations

Norms on Possibilities I: Forcing with Trees and Creatures

Andrzej Roslanowski, Boise State University, ID, and Saharon Shelah, Hebrew University of Jerusalem, Israel

Contents: Introduction; Basic definitions; Preperness and the reading of names; More properties; Omitory with Halving; Around not adding Cohen reals; Playing with ultrafilters; Friends and relatives of PP; List of definitions; Bibliography.

Memoirs of the American Mathematical Society, Volume 141, Number 671

Model Theory and Applications

This volume is a collection of papers on model theory and its applications. The longest paper, "Model Theory of Unitriangular Groups" by O. V. Belegradek, forms a subtle general theory behind Mal'tsev's famous correspondence between rings and groups. This is the first published paper on the topic. Given the present model-theoretic interest in algebra groups, Belegradek's work is of particular interest to logicians and algebraists.

The rest of the collection consists of papers on various questions of model theory, mainly on stability theory. Contributors are leading Russian researchers in the field.

Contents: O. V. Belegradek, Model theory of unitriangular groups; O. V. Belegradek, Model theory of locally free algebras; A. A. Voronkov, Model theory based on the notion of truth in the constructive sense; B. I. Zil'ber, Hereditarily transitive groups and quasi-Urbanik structures; K. Zh. Kudaibergenov, The number of homogeneous models of a complete theory; T. G. Mustafin, The stability theory of polynomials; E. A. Palyutin and S. S. Starchenko, Horn theories with nonmaximal spectrum; A. N. Ryasik, The number of models of complete theories of unars; M. G. Peretyat'kin, Finitely axiomatizable theories and similarity relations.

American Mathematical Society Translations—Series 2, Volume 195

Mathematical Physics

Trends in Mathematical Physics
Vasilios Alexiades and George Siopsis, University of Tennessee, Knoxville, Editors

This volume presents the proceedings of the conference on "Trends in Mathematical Physics" held at the University of Tennessee. The conference drew international experts from mathematical and computational physics. The following topics were addressed: superstrings and quantum gravity, pattern formation, and crystallographic topology. The cutting-edge research reflected in the extensive surveys in the book are written for a diverse audience.

Titles in this series are co-published with International Press, Cambridge, MA.


Number Theory

Spectral Problems in Geometry and Arithmetic
Thomas Branson, University of Iowa, Iowa City, Editor

These are the proceedings of the NSF-CBMS Conference on "Spectral Problems in Geometry and Arithmetic" held at the University of Iowa. The principal speaker was Peter Sarnak, who has been a central contributor to developments in this field. The volume approaches the topic from the geometric, physical, and number theoretic points of view. The remarkable new connections among seemingly disparate mathematical and scientific disciplines have surprised even veterans of the physical mathematics renaissance forged by gauge theory in the 1970s.

Numerical experiments show that the local spacing between zeros of the Riemann zeta function is modelled by spectral phenomena: the eigenvalue distributions of random matrix theory; in particular the Gaussian unitary ensemble (GUE). Related phenomena are from the point of view of differential geometry and global harmonic analysis. Elliptic operators on manifolds have (through zeta function regularization) functional determinants, which are related to functional integrals in quantum theory. The search for critical points of this determinant brings about extremely subtle and delicate sharp inequalities of exponential type. This indicates that zeta functions are spectral objects—and even physical objects. This volume demonstrates that zeta functions are also dynamic, chaotic, and more.

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

Contents: E. L. Basor, Connections between random matrices and Szegö limit theorems; S.-Y. A. Chang and P. C. Yang, On a fourth order curvature invariant; R. Gornet and J. McGowan, Small eigenvalues of the Hodge Laplacian for three-manifolds with pinched negative curvature; C. M. Judge, Heating and stretching Riemannian manifolds; J. C. Lagarias, Number theory zeta functions and dynamical zeta functions; M. L. Lapidus and M. van Frankenhuyzen, Complex dimensions of fractal strings and oscillatory phenomena in fractal geometry and arithmetic; K. Okikiolu, High frequency cut-offs, trace formulas and geometry; P. Perry, Meromorphic continua.
Previously Announced Publications

Geometric Models for Noncommutative Algebras
Ana Cannas da Silva and Alan Weinstein, University of California, Berkeley

The volume is based on a course, "Geometric Models for Noncommutative Algebras" taught by Professor Weinstein at Berkeley. Noncommutative geometry is the study of noncommutative algebras as if they were algebras of functions on spaces, for example, the commutative algebras associated to affine algebraic varieties, differentiable manifolds, topological spaces, and measure spaces. In this work, the authors discuss several types of geometric objects (in the usual sense of sets with structure) that are closely related to noncommutative algebras.

Central to the discussion are symplectic and Poisson manifolds, which arise when noncommutative algebras are obtained by deforming commutative algebras. The authors also give a detailed study of groupoids (whose role in noncommutative geometry has been stressed by Connes) as well as of Lie algebroids, the infinitesimal approximations to differentiable groupoids.

Featured are many interesting examples, applications, and exercises. The book starts with basic definitions and builds to (still) open questions. It is suitable for use as a graduate text. An extensive bibliography and index are included.

Berkeley Mathematical Lecture Notes, Volume 10

The Classification of the Finite Simple Groups, Number 4
Part II, Chapters 1–4: Uniqueness Theorems
Daniel Gorenstein†, Richard Lyons, Rutgers University, New Brunswick, NJ, and Ronald Solomon, Ohio State University, Columbus

After three introductory volumes on the classification of the finite simple groups, (Mathematical Surveys and Monographs, Volumes 40.1, 40.2, and 40.3), the authors now start the proof of the classification theorem: They begin the analysis of a minimal counterexample $G$ to the theorem.

Two fundamental and powerful theorems in finite group theory are examined: the Bender–Suzuki theorem on strongly embedded subgroups (for which the non-character-theoretic part of the proof is provided) and Aschbacher's Component theorem. Included are new generalizations of Aschbacher's theorem which treat components of centralizers of involutions and $p$-components of centralizers of elements of order $p$ for arbitrary primes $p$.

This book, with background from sections of the previous volumes, presents in an approachable manner critical aspects of the classification of finite simple groups.
A Survey of the Hodge Conjecture
Second Edition
James D. Lewis, University of Alberta, Edmonton, Canada

This book provides an introduction to a topic of central interest in transcendental algebraic geometry: the Hodge conjecture. Consisting of 15 lectures plus addenda and appendices, the volume is based on a series of lectures delivered by Professor Lewis at the Centre de Recherches Mathematiques (CRM).

The book is a self-contained presentation, completely devoted to the Hodge conjecture and related topics. It includes many examples, and most results are completely proven or sketched. The motivation behind many of the results and background material is provided. This comprehensive approach to the book gives it a "user-friendly" style. Readers need not search elsewhere for various results. The book is suitable for use as a text for a topics course in algebraic geometry; includes an appendix by B. Brent Gordon.

CRM Monograph Series, Volume 10

Characters of Connected Lie Groups
Lajos Pukanszky

This book adds to the great body of research that extends back to A. Wiel and E. P. Wigner on the unitary representations of locally compact groups and their characters, i.e. the interplay between classical group theory and modern analysis. The groups studied here are the connected Lie groups of general type (not necessarily nilpotent or semisimple).

Final results reflect Kirillov’s orbit method; in the case of groups that may be non-algebraic or non-type I, the method requires considerable sophistication. Methods used range from deep functional analysis (the theory of $C^*$-algebras, factors from F. J. Murray and J. von Neumann, and measure theory) to differential geometry (Lie groups and Hamiltonian actions).

This book presents for the first time a systematic and concise compilation of proofs previously dispersed throughout the literature. The result is an impressive example of the deepness of Pukanszky’s work.

Mathematical Surveys and Monographs

Algebraic Geometry 1
From Algebraic Varieties to Schemes
Kenji Ueno, Kyoto University, Japan

This is the first of three volumes on algebraic geometry.

Early in the 20th century, algebraic geometry underwent a significant overhaul, as mathematicians, notably Zariski, introduced a much stronger emphasis on algebra and rigor into the subject. This was followed by another fundamental change in the 1960s with Grothendieck’s introduction of schemes. Today, most algebraic geometers are well-versed in the language of schemes, but many newcomers are still initially hesitant about them. Ueno’s book provides an inviting introduction to the theory, which should overcome any such impediment to learning this rich subject.

The book begins with a description of the standard theory of algebraic varieties. Then, sheaves are introduced and studied, using as few prerequisites as possible. Once sheaf theory has been well understood, the next step is to see that an affine scheme can be defined in terms of a sheaf over the prime spectrum of a ring. By studying algebraic varieties over a field, Ueno demonstrates how the notion of schemes is necessary in algebraic geometry.

This first volume gives a definition of schemes and describes some of their elementary properties. It is then possible, with only a little additional work, to discover their usefulness. Further properties of schemes will be discussed in the second volume.

Ueno’s book is a self-contained introduction to this important circle of ideas, assuming only a knowledge of basic notions from abstract algebra (such as prime ideals). It is suitable as a text for an introductory course on algebraic geometry.

Translations of Mathematical Monographs (Iwanami Series in Modern Mathematics), Volume 185

Invariant Measures
John von Neumann

In 1940-1941 von Neumann lectured on invariant measures at the Institute for Advanced Study at Princeton. This book is essentially a written version of those lectures.

The lectures began with general measure theory and went on to Haar measure and some of its generalizations. Shizuo Kakutani was at the Institute that year, and he and von Neumann had many conversations on the subject. The conversations revealed facts and produced proofs. Quite a bit of the content of the course, especially toward the end, was discovered a few weeks before it appeared on the blackboard. The original version of these notes was prepared by Paul Halmos, von Neumann’s assistant that year. Von Neumann read the handwritten version before it went to the typist and sometimes scribbled comments on the margins; he rewrote most of Chapter 6. This book is the first published version of the original notes.

Bestselling Titles in Algebraic Geometry and Applications

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B. Greene, Cornell University, Ithaca, NY, and S.-T. Yau, Harvard University, Cambridge, MA, Editors

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Rick Miranda, Colorado State University, Ft. Collins

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One of my students said that this is one of a very few books in algebraic geometry that he can read and understand. The price of the book is very affordable.

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**Mirror Symmetry I**
Shing-Tung Yau, Harvard University, Cambridge, MA, Editor

From a review for the first edition...

This volume is a requisit for those working in the area of CY 3-folds, as well as those interested in mathematical implications of contemporary physics.

—Mathematical Reviews

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Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name and above body copy, unless additional headline copy is specified by the advertiser. Headlines will be centered in boldface at no extra charge. Ads will appear in the language in which they are submitted.

There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified advertising.


U.S. laws prohibit discrimination in employment on the basis of color, age, sex, race, religion, or national origin. "Positions Available" advertisements from institutions outside the U.S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U.S. laws. Details and specific wording may be found on page 1373 (vol. 44).

Submission: Promotions Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940, or via fax, 401-331-3842, or send e-mail to clasaads@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02904. Advertisers will be billed upon publication.
Margaret A. Darrin
Distinguished
Professor in
Applied Mathematics

The Department of Mathematical Sciences at Rensselaer invites nominations and applications for the Margaret A. Darrin endowed chair in applied mathematics at the rank of Full Professor. The previous holder of the chair was Julian Cole.

An exceptional record of research in applied mathematics is essential. It is expected that the holder of the chair will build a strong research program within the department, and be an academic and scientific leader, both at Rensselaer and in the applied mathematics community.

Nominations and inquiries should be sent to Mark Holmes either at the address below or via email at Holmes@rpi.edu.

Applications should send a letter of interest, curriculum vitae, and names and addresses of three references to: Mark Holmes, Department of Mathematical Sciences, Rensselaer Polytechnic Institute, Troy, NY 12180. Applications will be reviewed starting September 1, 1999, and the process will continue until the position is filled.

The University of Western Ontario
Department of Mathematics

The Department of Mathematics is seeking a candidate to nominate for an NSERC University Faculty Award in the fall 1999 competition.

The University Faculty Award was created by NSERC to encourage Canadian universities to appoint very promising women researchers to tenure-track positions in science and engineering. Further information on the program can be found on the Web page http://www.nserc.ca/programs/ot/ufa_e.htm.

The nominee from our department will have an outstanding record of research and publication in a field related to one of the existing areas of strengths of the department; these include homotopy theory, algebraic K-theory, cyclic homology, algebraic groups, complex analysis, and analytic geometry. The candidate will also have a commitment to and aptitude for teaching undergraduate and graduate students and will be expected to supervise graduate students.

The appointment is scheduled to begin on July 1, 2000.

Those interested in being nominated for this award should send a curriculum vitae and the names of at least three referees to:

Professor J. F. Jardine, Chair Department of Mathematics
The University of Western Ontario
London, Ontario N6A 5B7, Canada
We also welcome email inquiries and submissions, to be sent to the address: mathpost@uwo.ca. Application materials should arrive no later than August 31, 1999. This position is subject to budgetary approval and to the success of the application to NSERC.

In accordance with Canadian immigration requirements, this advertisement is directed to Canadian citizens and permanent residents of Canada. The University of Western Ontario is committed to employment equity, welcomes diversity in the workplace, and encourages applications from all qualified individuals, including women, members of visible minorities, aboriginal persons, and persons with disabilities.

The Faculty of Sciences of the University of Fribourg, Switzerland, invites applications for the position of a full professor in analysis and a full professor in geometry (algebra) at the Institute of Mathematics, opening October 1, 2000.

We are seeking high-profile researchers with proven teaching abilities. In addition to their own research, the successful candidates will be expected to contribute to the teaching program for students at all levels and assume administrative responsibilities. The University of Fribourg is a bilingual institution; teaching language is either French or German, and the new professors will be expected to attain a reasonable proficiency in the second language within a short time.

For the position in analysis, we are seeking a professor with broad interest in PDE and functional analysis in order to complement our current research interests.

In geometry/algebra, preference will be given to applicants whose research interests complement our current research in differential geometry.

Letters of application (with the mention of analysis or geometry (algebra)), including a curriculum vita; a list of publications, including copies of the three most important ones; a short outline of current and planned research; as well as the names of three references, should be sent by August 31, 1999, to the Dean of the Faculty of Sciences, University of Fribourg, P. O. Box 1700 Fribourg, Switzerland.

For additional information, please contact Web site http://www.unifr.ch/math/ or Prof. Ernst Ruh (ernst.ruh@unifr.ch).

PUBLICATIONS OFFERED

FREE TEXTBOOK ONLINE

Textbooks are too long and too expensive. Elements of Abstract and Linear Algebra by E. H. Connell is 140 pages. Nearly. This "in your face" algebra text breaks the mold and makes the subject easier to teach and easier to learn. There should be no difficulties except those inherent in the material itself. You may view or download at http://www.math.lamar.edu/~ec/book/.

PUBLICATIONS WANTED

MATHEMATICS BOOKS PURCHASED

Pure & appl. adv. & research level, any age, usable cond. Reprints OK. One box to whole libraries sought. Contact: Collier Brown or Kirsten Berg @ Powell's Technical Bks., Portland, OR. Call 800-225-6911, fax 503-228-0505, or e-mail kirsten@technical.powells.com.
Members of the Society who move or change positions are urged to notify the Providence Office as soon as possible.

Journal mailing lists must be printed four to six weeks before the issue date. Therefore, in order to avoid disruption of service, members are requested to provide the required notice well in advance.

Besides mailing addresses for members, the Society's records contain information about members' positions and their employers (for publication in the Combined Membership List). In addition, the AMS maintains records of members' honors, awards, and information on Society service.

When changing their addresses, members are urged to cooperate by supplying the requested information. The Society's records are of value only to the extent that they are current and accurate.

If your address has changed or will change within the next two or three months, please fill out this form, supply any other information appropriate for the AMS records, and mail it to:

Customer Services
AMS
P.O. Box 6248
Providence, RI 02940

or send the information on the form by e-mail to:

amsmem@math.ams.org or cust-serv@math.ams.org

New position ____________________________

If mailing address is not that of your employer, please supply the following informations:

New employer ____________________________

Location of employer (city, state, zip code, country) ____________________________

Telephone number ____________________________

e-mail ____________________________

Recent honors and awards ____________________________
GEOMETRIC GROUP THEORY DOWN UNDER

Proceedings of a Special Year in Geometric Group Theory, Canberra, Australia, 1996

Editors: John Cossey • Charles F. Miller III
Walter D. Neumann • Michael Shapiro

ISBN 3-11-016366-7

CONTENTS

NUMBER THEORY IN PROGRESS

Proceedings of the International Conference on Number Theory organized by the Stefan Banach International Mathematical Center in Honor of the 60th Birthday of Andrzej Schinzel, Zakopane, Poland, June 30 – July 9, 1997

Editors: Kálmán Győry • Henryk Iwaniec • Jerzy Urbanowicz

Volume 1: Diophantine Problems and Polynomials
Volume 2: Elementary and Analytic Number Theory

1999. xvi, vi + 1,185 pages. 2 volumes. Hardcover $229.95.
ISBN 3-11-015715-2

These Proceedings, containing 71 selected and refereed contributions on number theory, are dedicated to Professor Andrzej Schinzel, editor-in-chief for over 29 years of Acta Arithmetica - the first international journal devoted exclusively to number theory.

The material is divided into two volumes: Diophantine Problems and Polynomials, and Elementary and Analytic Number Theory. The first volume covers diophantine equations, diophantine approximation, transcendental number theory and polynomials. The second volume contains papers on sieve methods, automorphic forms, Hecke operators, estimates on exponential and character sums, L-functions and other topics.

The two-volume work, containing articles from leading experts in the world, encompasses an account of the state of research in a wide variety of topics. It will prove invaluable to anyone working in number theory.

Prices are subject to change.
CMS Winter 1999 Meeting
Renaissance-Hôtel du Parc, Montréal, Québec, December 11–13, 1999

On behalf of the Université de Montréal, the Département de Mathématiques et de Statistique extends a warm welcome to all participants in the 1999 Winter Meeting of the CMS. All scientific activities will take place from December 11 to 13, 1999, at the Conference Center of the Renaissance-Hôtel du Parc (3625, Avenue du Parc, Montréal (Québec) Canada H2X 3P8, Tel: 514-288-6666 or 800-363-0735, Fax: 514-288-2469, Web page http://www.duparc.com).

PLenary Speakers: Andreas Dress (University of Bielefeld, Germany), Adriano Garsia (UCSD), David Lay (University of Maryland), Elliott H. Lieb (Princeton), Pavel Pevzner (USC), Zhihong Xia (Northwestern and Georgia Tech).

Prize Lectures: The Coxeter-James Lecture will be given by Maciej Zworski, University of California at Berkeley. The CMS Doctoral Prize is to be announced.

Public Lecture: Jennifer Chayes, Microsoft Research, Redmond.

Symposia:
Algebraic and geometric methods in differential equations: The 20th century in celestial mechanics and one century of work on Hilbert's 16th problem (CMS-CRM)
(Org: Angelo Mingarelli, Carleton University and Christiane Rousseau, Université de Montréal).

Applied Logic
(Org: Wendy MacCaull, St. Francis Xavier University, Phil Scott, University of Ottawa, and Prakash Panangaden, McGill University).

Combinatorial algebra, group representations and Macdonald polynomials
(Org: François Bergeron, UQAM, and Nantel Bergeron, York University).

Computing and mathematical modelling (CMS – NCMz)
(Org: Pierre Hansen, École des HEC, Montréal, and Gilbert Laporte, CRT, Université de Montréal).

General history of mathematics
(Org: Richard O'Lan­der and Ronald Sklar, St. John's University, USA).

Graduate student seminar (CMS–ISM)
(Org: Paul Libbrecht, UQAM, Thomas Mattman, McGill, and Simon Thomas, McGill): A seminar is being organized by and for graduate students. Anyone interested in participating in this seminar should contact the Meeting Director, at the following address: md-w99@cms.math.ca

Mathematical physics: I. Probability methods and applications and II. Group theory methods and applications (CMS-Plms)
(Org: George Bluman, UBC, Michel Grondland, UQTR, and Gordon Slade, McMaster University).

Mathematical genetics and genomics (CMS-Fields)
(Org: Sabin Lessard and David Sankoff, Université de Montréal).

Orders, lattices and universal algebra
(Org: Benoît Larose, Collège régional Champlain, Longueuil, Lucien Haddad, Royal Military College, Kingston, and Ivo Rosenberg, Université de Montréal).

Teaching of linear algebra
(Org: Joel Hillel, Concordia University, and Jacqueline Klasa, Vanier College, Montréal).

Contributed Papers: Contributed papers of 15-minute duration are invited and graduate students are particularly urged to participate. Abstracts for CMS contributed papers should be prepared as specified below. For an abstract to be eligible, the abstract must be received before September 30, 1999. The abstract must be accompanied by its contributor's registration form and appropriate fees.

Related Activities: Celebration of the 30th anniversary of the CRM on December 10, 1999, at the Centre de recherches mathématiques, Université de Montréal. For information, please contact Louis Pelletier (30e@CRM.UMontreal. CA)

The first CMS “Job Fair” on December 14, 1999, at the Hôtel du Parc. For information, please contact Christiane Rousseau (rousseaus@dms.UMontreal. CA)

Submission of Abstracts: Titles for Plenary Speakers, Prize Lecturers, and Invited Speakers for the scientific and education programme will appear in the November issue of the CMS Notes. Titles for Contributed Papers will appear in the November issue of the CMS Notes. All abstracts will be published in the meeting programme and will also be available on the Canadian Mathematical Electronics Services (Camel) http://camel.math.ca/CMS/Events/winter99.

Speakers should send their titles to their organizers before August 1.

Plenary Speakers, Prize Lecturers, and Invited Speakers for the scientific and education programme: These speakers are asked to submit their abstracts to the CMS as instructed by their organizers.

Abstracts may be sent electronically, following instructions given below. Abstracts may also be prepared on the standard CMS form available from the session organizer or the CMS office in Ottawa. Abstracts should be sent to the Abstracts Coordinator, CMS Winter Meeting 1999, CMS Executive Office, 577 King Edward, Suite 109, Ottawa, Ontario, Canada K1N 6N5 by September 1, 1999.
Contributed Papers: Those submitting contributed papers may submit their abstracts electronically, following instructions given below, or by using the standard CMS form available from the CMS office in Ottawa, and in the September issue of the CMS Notes, or at the CMS Web site. Abstracts should be sent to the Abstracts Coordinator, CMS Winter Meeting 1999, CMS Executive Office, 577 King Edward, Suite 109, Ottawa, Ontario, Canada K1N 6N5 by September 30, 1999.

Electronic submission of abstracts: Files including the speaker's name, affiliation, complete address, title of talk, and abstracts may be sent to: http://abstracts@cms.math.ca (speakers) or http://abstracts-cp@cms.math.ca (contributed papers).

Please note the above deadlines for the submission of your abstract.

SOCIAL EVENTS: The welcoming reception will be held during registration on Friday evening, December 10, from 7:00 p.m. to 9:00 p.m. at the Renaissance-Hôtel du Parc. A cash bar will be available. A delegates' luncheon and a banquet will be held at the Renaissance-Hôtel du Parc. Coffee and juice will be available during the scheduled breaks.

REGISTRATION: Registration fee information and forms are available from the CMS Executive Office, 577 King Edward, Suite 109, P.O. Box 450, Station A, Ottawa, Ontario, Canada K1N 6N5 Tel: 613-562-5702, Fax: 613-565-1539, e-mail: meetings@cms.math.ca, Web: http://camel.math.ca/CMS/Events/winter99.

Electronic pre-registration is available on our Camel site at http://camel.math.ca/CMS/Events/winter99. This site also has the latest information on the meetings.

ACCOMMODATION: It is recommended that those attending the conference book early to avoid disappointment. Blocks of rooms have been reserved at three different facilities and will be held until November 8, 1999. Reservations not in by that date will be on a space available basis. Rates quoted are in Canadian dollars.

For all hotels, reservations will be held until 6 p.m. on the arrival day only, unless you provide a deposit for one night or the reservation is guaranteed by a major credit card.

Renaissance-Hôtel du Parc
3625, Avenue du Parc, Montréal (Québec) H2X 3P8
Check-in: 3 p.m.; Check-out: 12:00 noon
Reservation Deadline: November 8, 1999
Rates: $109, single/double occupancy, regular room
$129, single/double occupancy, Club excellence
(An additional charge of $15/room for additional person)
Applicable taxes: GST (7%), PST (7.5%), Municipal hotel tax ($2 per room)
Phone: 514-288-6666
Fax: 514-288-2499
Toll-free reservations (Canada & U.S.): 1-800-363-0735

Quality Hotel
3440, Avenue du Parc, Montréal (Québec) H2X 2H5
Check-in: 3 p.m.; Check-out: 12:00 noon
Reservation Deadline: November 8, 1999
Rates: $59, queensize bed or two double beds - s/d/t/q occupancy
$78, kingsize bed - single/double occupancy
Applicable taxes: GST (7%), PST (7.5%), Municipal hotel tax ($2 per room)

Phone: 514-849-1413
Fax: 514-849-6564
Toll-free reservations (Canada & U.S.): 1-800-228-5151

Hôtel de Paris
901, rue Sherbrooke est, Montréal (Québec) H2L 1L3
This is a bed and breakfast style accommodation. Please call the number below for more details on accommodation and services provided.
Check-in: 12:00 noon; Check-out: 12:00 noon
Reservation Deadline: November 8, 1999
Rates: $52 per person
Applicable taxes: GST (7%), PST (7.5%), Municipal hotel tax ($2 per room)
Phone: 514-522-6861
Fax: 514-522-1387
Toll-free reservations (Canada & U.S.): 1-800-567-7217

CHILD CARE: Child care can be arranged by the Renaissance-Hôtel du Parc by calling the front desk. Advance notice of 24 hours is required.

TRAVEL: Autocar Connaisseur/Gray Line offers an Express Airport Service between Dorval and the Center-town Terminal (777, de la Gauchetiere) or the Voyageur Bus Terminal (Berri-UQAM subway station). Fees are $9.25 one-way and $16.75 return.

Gray Line provides transportation directly to the hôtel du Parc every half hour between 5:10 a.m. and 11:10 p.m. The cost is $9.25 one-way. Please call ahead to organize transport.

To reach the Quality Hotel from the Voyageur terminal, take the subway (green line) to Place des Arts and then take the Bleeur exit. Avenue du Parc extends Bleeur Street to the North and the hotel is only a few blocks away.

To reach the Hôtel de Paris from the Voyageur terminal, walk north on Berri and then turn right on Sherbrooke.

For more information, please consult the Dorval Airport Web site at http://www.admt1.com/dorval1/.

ACKNOWLEDGEMENTS: The support of the following organizations is gratefully acknowledged: Centre de recherches mathématiques, Institut des sciences mathématiques, Network for Computing and Mathematical Modelling, Fields Institute for Research in the Mathematical Sciences, The Pacific Institute for the Mathematical Sciences. The CMS wishes to acknowledge the contribution of the members of the Meeting Committee in organizing this meeting and presenting these exciting scientific, education, and social programmes.

MEETING COMMITTEE: Meeting Director: Michel Delfour (Montréal). Local Organizing Committee Chair: Véronique Hussin (Montréal). François Bergeron, Nathel Bergeron, George Bluman, Monique Bouchard (CMS ex-officio), Martin Goldstein, Michel Grundland, Lucien Haddad, Pierre Hansen, Joel Hillel, Jacques Hurtubise (CMS ex-officio), Jacqueline Klasa, Christiane Rousseau, David Sankoff, Phil Scott, Ronald Sklar, Gordon Slade, Simon Thomas, Graham Wright (CMS ex-officio).
IMPORTANT NEW PROGRAM INFORMATION: 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. As a result, Sectional Meeting programs have been appearing in the Notices *after* the meeting takes place. The Secretariat of the AMS has observed that this arrangement does not provide an adequate service to the reader. So, beginning with the Gainesville meeting (March 12-13, 1999), AMS Sectional Meeting programs will no longer appear in the print version of the Notices. However, prior to the meeting date, comprehensive and continually updated meeting and program information with links to the abstract for each talk can be found on e-MATH. See http://www.ams.org/meetings/. Programs and abstracts will continue to be displayed on e-MATH in the Meetings and Conferences section until about three weeks after the meeting is over. Final programs for Sectional Meetings will be archived on e-MATH in the next electronic issue of the Notices which follows the meeting. See the entry "Program issue of electronic Notices" listed below for each meeting to identify the specific issue.

Salt Lake City, Utah
University of Utah
September 25–26, 1999
Meeting #946
Western Section
Associate secretary: Bernard Russo
Announcement issue of Notices: June 1999
Program first available on eMATH: August 19, 1999
Program issue of electronic Notices: December 1999
Issue of Abstracts: Volume 20, Issue 4

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: August 3, 1999

Invited Addresses
Robert Burton, Oregon State University, *Title to be announced.*
Michael Kapovich, University of Utah, *Title to be announced.*
Richard Wentworth, University of California, Irvine, *Title to be announced.*
Maciej Zworski, University of California, Berkeley, *Title to be announced.*

Special Sessions
Arithmetical Algebraic Geometry (Code: AMS SS B1), Minhyong Kim, University of Arizona, and Wieslawa Niziol, University of Utah.
Commutative Algebra (Code: AMS SS C1), Paul Roberts, University of Utah, and Roger Wiegand, University of Nebraska.
Complex Variables and Operator Theory (Code: AMS SS A1), Siqi Fu, Farhad Jafari, and Peter Polyakov, University of Wyoming.
Ergodic Theory of Stochastic Processes (Code: AMS SS D1), Stewart N. Ethier and Davar Khoshnevisan, University of Utah.
Ergodic and Number Theory (Code: AMS SS G1), Robert Burton and Thomas Schmidt, Oregon State University.
Microlocal Analysis and Applications (Code: AMS SS E1), Gunther Uhlmann, University of Washington, and Maciej Zworski, University of California, Berkeley.
Numerical Methods for Partial Differential Equations (Code: AMS SS F1), Benito Chen and Junping Wang, Institute for Scientific Study, University of Wyoming.
Providence, Rhode Island
Providence College
October 2-3, 1999

Meeting #947
Eastern Section
Announcement issue of Notices: August 1999
Program available on eMATH: August 25, 1999
Program issue of electronic Notices: December 1999
Issue of Abstracts: Volume 20, Issue 4

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: August 11, 1999

Invited Addresses
Dan M. Barbasch, Cornell University, Unipotent representations and unitarity.
Henri Berestycki, Université Paris VI and École Normale Supérieure, Title to be announced.
David Mumford, Brown University, What is the right mathematical/statistical model for natural images?
Guoliang Yu, University of Colorado, The Novikov conjecture and geometry of groups.

Special Sessions
Algebraic and Geometric Combinatorics (Code: AMS SS A1), Vesselin N. Gasharov, Cornell University, and Ira M. Gessel, Brandeis University.
Difference Equations and Applications (Code: AMS SS E1), Gerasimos Ladas, University of Rhode Island, and Jeffrey T. Hoag, Providence College.
Geometric Properties of Nonlinear Elliptic PDEs (Code: AMS SS K1), Henri Berestycki, Université Paris VI and École Normale Supérieure, and Yanyan Li, Rutgers University.
Geometry and Representation Theory of Algebraic Groups (Code: AMS SS C1), James E. Humphreys and Ivan Mirkovic, University of Massachusetts.
Number Theory (Code: AMS SS J1), Michael I. Rosen and Siman Wong, Brown University.
Operator K-Theory and its Applications to Geometry and Topology (Code: AMS SS D1), Guoliang Yu, Carla E. Farsi, and Jeffrey S. Fox, University of Colorado, Boulder.

Representation Theory of Reductive Groups (Code: AMS SS B1), Dan M. Barbasch and Birgit Speh, Cornell University.
The History of Mathematics (Code: AMS SS F1), Daniel Otero, Xavier University, and C. Edward Sandifer, Western Connecticut State University.

Accommodations
Participants should make their own arrangements directly with a hotel of their choice. Special rates have been negotiated for reservations. Rates quoted do not include sales tax of 12%. When making a reservation, participants should state they are attending the AMS Eastern Sectional Meeting. Providence is a popular destination in the fall, so participants should make reservations as soon as possible. Many hotels will be fully booked during the meeting weekend.

N.B. Please note that no hotel is within walking distance of the meeting. Participants may want to consider sharing the cost of a rental car.

Days Hotel, 220 India St., 401-272-5577 (same number for fax); $89/single or double, $99/triple, $109/quad.
Deadline for reservations is September 4, 1999. Directions from I-95 north or south: Take exit 20 onto I-195 East; take exit 3 off I-195; turn left at the end of the ramp onto Gano St.; follow Gano for two blocks to the parking lot on the right.

Food Service and Local Information
On campus Raymond Cafeteria will serve brunch ($5.00) and dinner ($5.75) on Saturday and Sunday. Newport Creamery on Smith Street is about a 15-minute walk; Gravity's on Admiral is about a 5-minute walk.
Please see the Web site maintained by Providence College at http://www.providence.edu/.

Other Activities
AMS Book Sale: Examine the newest titles from the 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
Parking on campus is complimentary. Enter campus through the main gate on Easton Street and a guard will direct you to parking.

Registration and Meeting Information
Registration will take place in the lounge in Slavin Center from 7:30 a.m. to 4:00 p.m. on Saturday, and 8:00 a.m. to noon on Sunday. Invited Addresses will take place in '64 Hall, Slavin Center; other sessions will be held in Slavin Center, Harkins Hall, Feinstein Center, and Moore Hall.
Registration fees (payable on-site only) are $30/AMS or CMS members; $45/nonmembers; $10/emeritus members, students, or unemployed mathematicians. Fees are payable by cash, check, VISA, MasterCard, Discover, or American Express.
Meetings & Conferences

The nearest airport is the T. F. Greene Airport, about a 15- to 20-minute ride from campus.

Delta Air Lines has been selected as the official airline for this meeting. The following specially negotiated rates are available exclusively to mathematicians and their families for the period September 29-October 5, 1999, on Delta Air Lines:

- 5% discount off published round-trip fares within the continental U.S., Hawaii, Alaska, Canada, Mexico, Bermuda, San Juan, Nassau, and the U.S. Virgin Islands. Some restrictions apply and seats are limited (no discounts apply on Delta Express). By purchasing your ticket 60 days or more prior to departure, you can receive an additional 5% bonus discount.
- 10% discount on Delta's domestic system for travel based on the published unrestricted round-trip coach (Y06) rates. No advance reservations or ticketing is required; however, by purchasing your ticket 60 days or more prior to departure, you can receive an additional 5% bonus discount. (No discounts on Delta Express.)

Special guaranteed round-trip Zone Fares to all cities served by Delta and Delta Express in the continental U.S., Hawaii, Alaska, Canada, Mexico, Bermuda, San Juan, Nassau, and the U.S. Virgin Islands for savings on midweek travel: two-day minimum stay, no Saturday night stay required, seven days advanced reservations and ticketing. Fares are fully refundable, less administrative service fee. Zone Fares are not valid for destinations served only by a Delta Connection carrier. For reservations call (or have your travel agent call) Delta Meeting Network Reservations at 800-241-6760 weekdays between 7:30 a.m. and 11:00 p.m. (8:30 a.m.-11:00 p.m. on weekends) Eastern Standard Time.

Refer to file number 117809A. These discounts are available only through Delta Meeting Network Reservation toll-free number.

Taxi fare from the airport to campus or the hotel is about $23.

Driving Directions

If driving from the airport or points south of Providence, take I-95 North to Rhode Island Exit 23 (State Offices). Bear right onto Orms Street. Proceed .3 miles along Orms Street to second traffic light at Smith Street (Route 44). Turn right onto Smith Street and proceed 1 mile along Smith Street to the third light at River Avenue. Turn right onto River Avenue and proceed .2 miles to the light at Eaton Street. The gate of the campus will be on your right.

From the North: Follow I-95 South to Rhode Island Exit 23 (Charles Street). Proceed right onto Charles Street and go .2 miles to the first light at Admiral Street. Take a left onto Admiral Street and proceed approximately 1.2 miles to the third light at River Avenue. Take a left onto River Avenue to the next light (.4 miles) at Eaton Street. The gate of the campus will be on your left.

From Albany and Western Massachusetts using I-90: Take I-90 East to Exit 10A which will lead you to Route 146 South (Providence). For almost an hour, follow Route 146 South into Providence to the Admiral Street exit. Take a right onto Admiral Street and proceed approximately 1.1 miles to the second light at River Avenue. Take a left onto River Avenue and continue as above.

From Hartford and Central Connecticut: Take I-84 to Route 2 East. Follow Route 2 East to Norwich, CT and then take I-395 North. Proceed along I-395 North to Route 6 East. Take Route 6 East into Johnston, RI. Proceed along Route 6 East to Route 10 North to the Dean Street/Atwells Avenue exit. At the top of exit ramp, turn left onto Dean Street and proceed approximately .7 miles to the sixth traffic light at Smith Street (Route 44). Dean Street's name will change into Raymond Street and then to Oakland Avenue. Turn left onto Smith Street and proceed along Smith Street for .6 miles to the first set of traffic lights at River Avenue. Turn right onto River Avenue and proceed .2 miles to the light at Eaton Street. The gate of the campus will be on your right.

Weather

Average high temperatures can be in the 60° range but the evenings can be chilly. A sweater and/or light coat is recommended. Rain is possible but snow is not expected in October.

Austin, Texas

University of Texas-Austin

October 8-10, 1999

Meeting #948

Central Section

Associate secretary: Susan J. Friedlander
Meetings & Conferences

Announcement issue of Notices: June 1999
Program first available on eMATH: August 25, 1999
Program issue of electronic Notices: December 1999
Issue of Abstracts: Volume 20, Issue 4

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: August 11, 1999

Invited Addresses
Mikhail Kapranov, Northwestern University, Title to be announced.
John Roe, Oxford and Pennsylvania State University, Large scale geometric invariants of elliptic operators.
Catherine Sulem, University of Toronto, The nonlinear Schroedinger equation: Self-focusing and wave collapse.
Tatiana Toro, University of Washington, Characterization of non-smooth domains via potential theory.

Special Sessions
Aperiodic Tiling (Code: AMS SS D1), Charles Radin and Lorenzo Sadun, University of Texas, Austin.
Banach and Operator Spaces: Isomorphic and Geometric Structure (Code: AMS SS E1), Edward Odell and Haskell P. Rosenthal, University of Texas, Austin.
DNA Topology (Code: AMS SS J1), Isabel K. Darcy, University of Texas, Austin, and Makkuni Jayaram, University of Texas, Austin.
Dehn Surgery and Kleinian Groups (Code: AMS SS L1), John Luecke and Alan Reid, University of Texas, Austin.
Dynamical Systems (Code: AMS SS S1), David Delatte, Daniel Mauldin, Mariusz Urbanski, and Luca Quardo Zamboni, University of North Texas.
Free Surface Interfaces and PDEs (Code: AMS SS K1), Kirk Lancaster, Wichita State University, and Thomas Vogel, Texas A&M University.
Harmonic Analysis and PDEs (Code: AMS SS C1), William Beckner and Luis A. Caffarelli, University of Texas at Austin, Toti Daskalopoulos, University of California, Irvine, and Tatiana Toro, University of Washington.
Interconnections Among Diophantine Geometry, Algebraic Geometry, and Value Distribution Theory (Code: AMS SS Q1), William Cherry, University of North Texas, Min Ru, University of Houston, and Felipe Voloch, University of Texas, Austin.
Mathematical Problems in Transport Phenomena (Code: AMS SS M1), Jose Antonio Carrillo and Irene M. Gamba, University of Texas, Austin.
Mathematical and Computational Finance (Code: AMS SS H1), Stathis Tompaidis, University of Texas, Austin.
Nonlinear Dynamics (Code: AMS SS G1), Robert J. McCann and Catherine Sulem, University of Toronto.
Recent Developments in Index Theory (Code: AMS SS F1), Daniel S. Freed, University of Texas, Austin, and John Roe, Pennsylvania State University.
The Development of Topology in the Americas (Code: AMS SS A1), Cameron Gordon, University of Texas, Austin, and Ioan Mackenzie James, University of Oxford.
The Diverse Mathematical Legacy of Jean Leray (Code: AMS SS N1), Eric M. Friedlander, Northwestern University, and Susan J. Friedlander, University of Illinois, Chicago.
Theoretical, Computational and Experimental Aspects of Mechanics (Code: AMS SS P1), Jerry Bona, Steven Levandosky, and Jiahong Wu, University of Texas, Austin.
Topology of Continua (Code: AMS SS R1), Wayne Lewis and Carl Seager, Texas Tech University.
Wavelets and Approximation Theory (Code: AMS SS B1), Don Hong, Eastern Tennessee State University, and Michael Prophet, Murray State University.

Charlotte, North Carolina
University of North Carolina, Charlotte

October 15-17, 1999

Meeting #949
Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of Notices: August 1999
Program first available on eMATH: September 1, 1999
Program issue of electronic Notices: December 1999
Issue of Abstracts: Volume 20, Issue 4

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: August 18, 1999

Invited Addresses
Valery Alexeev, University of Georgia, Title to be announced.
Béla Bollobás, University of Memphis and Cambridge University, Title to be announced.
Konstantin M. Mischenko, Georgia Institute of Technology, Title to be announced.
Yakov Sinai, Princeton University, Title to be announced.

Special Sessions
Algebraic Geometry (Code: AMS SS K1), Valery Alexeev, William Graham, Roy C. Smith, and Robert Varley, University of Georgia.
Applied Probabilistic Combinatorics (Code: AMS SS N1), Béla Bollobás, University of Memphis, and Gregory Sorkin, IBM T. J. Watson Research Center.
Meetings & Conferences

Cohomological Aspects of Algebraic Groups (AMS SS A1), José A. de la Peña, University of North Carolina at Chapel Hill.

Contemporary Methods in Dynamics and Differential Equations (Code: AMS SS J1), Robert W. Ghrist and Konstantin M. Mischaikow, Georgia Institute of Technology.


Geometric Function Theory (Code: AMS SS H1), David A. Herron, University of Cincinnati, and Shanshuang Yang, Emory University.


Operator Theory, including Applications in Operator Algebras and Wavelets (Code: AMS SS F1), Alan L. Lambert and Xingde Dai, University of North Carolina at Charlotte.

Optimal Control and Computational Optimization (Code: AMS SS D1), Mohammed A. Kazemi, University of North Carolina at Charlotte, and Gamal N. ElNagar, University of South Carolina Spartanburg.

Set-Theoretic Topology (Code: AMS SS G1), Ronald F. Levy.


Stochastic PDES and Turbulence (Code: AMS SS E1), Weinan E, Courant Institute, New York University.

Stochastic Processes and Control (Code: AMS SS M1), Volker Wihstutz and Alexander A. Yushkevich, University of North Carolina at Charlotte.

Accommodations

Participants should make their own arrangements directly with a hotel of their choice. Special rates have been negotiated at the hotels listed below. All rates quoted do not include sales tax of 12.5%. When making a reservation, participants should state they are attending the American Mathematics meeting on the UNC campus, and cite any special codes below. N.B. This is a popular tourist destination in the fall, so participants should make reservations as soon as possible. Many of these and other hotels will be fully booked during the meeting weekend.

Please note that none of the hotels is within easy walking distance of the meeting, and all are within the same general area. While the UNC Department of Mathematics will operate limited van service between the hotels and the meeting site, participants are encouraged to consider sharing the cost of a rental car.

Drury Inn & Suites, 415 West W.T. Harris Blvd., 704-593-0700; $59.95/double or queen, $66.95/king deluxe, 2.4 miles from the meeting. Deadline for reservations is September 30, 1999.

Hampton Inn, 8419 N. Tryon St., 704-548-0905; $72/single/double/king deluxe, includes continental breakfast, 2.2 miles from the meeting. Please cite reservation code AMS; deadline for reservations is September 13, 1999.

University of North Carolina at Charlotte

Holiday Inn, 8520 University Executive Park Drive, 704-547-0999; $79/single and $89/double, 2.4 miles from the meeting. Deadline for reservations is September 13, 1999.

Food Service and Local Information

Limited dining facilities are available on campus on Friday and Saturday. There are many restaurants within walking distance of the hotels and within a short drive of the campus. Further details about dining and other conference details will be available at the registration desk and at the department's Web site at http://www.math.uncc.edu/.

Parking

The visitors' parking deck will be open throughout the meeting. The cost is $3.00 on Friday; parking is free on Saturday and Sunday. The lot is accessed via Mary Alexander Road from NC Highway 49 (bear right after entering the campus).

Registration and Meeting Information

Registration will take place in the atrium on the first floor of Fretwell Building on Friday, 12:30 p.m. to 6:00 p.m., and Saturday, 8:00 a.m. to 5:00 p.m. The Invited Addresses and Special Sessions will take place in Denny and Fretwell Buildings.

Registration fees: (payable on-site only) $30/AMS or CMS members; $45 nonmembers; $10 emeritus members, students, or unemployed mathematicians. Fees are payable by cash, check, VISA, MasterCard, Discover, or American Express.
Travel
Charlotte/Douglas International Airport is the nearest airport. Taxi fare from the airport to the campus is about $28. There is also a limousine service which charges $16 for one person. Because of the high cost of commercial transportation and the lack of hotels within easy walking distance, participants are encouraged to consider sharing the cost of a rental car.

Delta Air Lines has been selected as the official airline for this meeting. The following specially negotiated rates are available exclusively to mathematicians and their families for the period October 12–20, 1999, on Delta Air Lines:

- 5% discount off published round-trip fares within the continental U.S., Hawaii, Alaska, Canada, Mexico, Bermuda, San Juan, Nassau, and the U.S. Virgin Islands. Some restrictions apply and seats are limited (no discounts apply on Delta Express). By purchasing your ticket 60 days or more prior to departure, you can receive an additional 5% bonus discount.
- 10% discount on Delta’s domestic system for travel based on the published unrestricted round-trip coach (Y06) rates. No advance reservations or ticketing is required; however, by purchasing your ticket 60 days or more prior to departure, you can receive an additional 5% bonus discount. (No discounts on Delta Express)

Special guaranteed round-trip Zone Fares to all cities served by Delta and Delta Express in the continental U.S., Hawaii, Alaska, Canada, Mexico, Bermuda, San Juan, Nassau, and the U.S. Virgin Islands for savings on midweek travel: two-day minimum stay, no Saturday night stay required, seven days advanced reservations and ticketing. Fares are fully refundable, less administrative service fee. Zone Fares are not valid for destinations served only by a Delta Connection carrier. For reservations call (or have your travel agent call) Delta Meeting Network Reservations at 800-241-6760 weekdays between 7:30 a.m. and 11:00 p.m. (8:30 a.m.-11:00 p.m. on weekends) Eastern Standard Time. Refer to file number 117809A. These discounts are available only through Delta Meeting Network Reservation toll-free number.

Driving directions: From the airport, follow the signs to I-85 North. From I-85 take the Harris Blvd. exit. The hotels are a short distance east of this exit. To reach the campus, proceed east on Harris and exit onto Hwy. 49. Turn left on 49, and proceed to the main entrance of the campus.

Weather
Typically, Charlotte weather in October is mild and dry. Highs and lows average 72 and 51 degrees, respectively.

Washington, District of Columbia

Marriott Wardman Park Hotel and Omni Shoreham Hotel

January 19–22, 2000

Note: This is a World Math Year 2000 (WMY2000) event.

Meeting #950
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: Bernard Russo

Announcement issue of Notices: October 1999
Program first available on eMATH: November 1, 1999
Program issue of electronic Notices: January 2000
Issue of Abstracts: Volume 21, Issue 1

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: August 10, 1999
For abstracts: October 5, 1999
For summaries of papers to MAA organizers: September 9, 1999

Joint Invited Addresses
Brian Greene, Columbia University, Title to be announced.
George C. Papanicolaou, Stanford University, Title to be announced.
Alexander R. Its, Indiana University-Purdue University, Indianapolis, Title to be announced.

Joint Special Sessions
Innovative Development Programs for Teaching Assistants and Part-Time Instructors (Code: AMS SS D1), Suzanne M. Lenhart, University of Tennessee.
Linear Algebra and Optimization (Code: AMS SS C1), Dianne P. O’Leary, University of Maryland, College Park, and Margaret H. Wright, Bell Laboratories.
Mathematics and Education Reform (Code: AMS SS P1),
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.

The History of Mathematics (Code: AMS SS E1), Karen H. Parshall, University of Virginia, and David E. Zitarelli, Temple University.

AMS Invited Addresses
Sun-Yung Alice Chang, University of California, Los Angeles, Title to be announced.
Thomas C. Hales, University of Michigan, Ann Arbor, Title to be announced.
Alexander R. Its, Indiana University-Purdue University, Indianapolis, Title to be announced.
Arthur M. Jaffe, Harvard University, Title to be announced (AMS Retiring Presidential Address).
M. Lyubich, SUNY at Stony Brook, Title to be announced.
Curtis T. McMullen, Harvard University, Title to be announced (AMS Colloquium Lectures).
Roger Penrose, Oxford University, Title to be announced (AMS Josiah Willard Gibbs Lecture).

AMS Special Sessions
Beautiful Graph Theory (Code: AMS SS J1), Gary Chartrand, Western Michigan University, and Frank Harary, New Mexico State University.
Complex Hyperbolic Geometry and Conformal Geometry of the Heisenberg Group (Code: AMS SS K1), William M. Goldman, University of Maryland, and Hanna M. Sandler, American University.
Difference Equations and Their Applications in Social and Natural Sciences (Code: AMS SS V1), Hassan Sedaghat, Virginia Commonwealth University, Abdul Aziz Yakubu, Howard University, Gerry Ladas, University of Rhode Island, and Saber Elaydi, Trinity University.
Ergodic Theory and Topological Dynamics of $Z^d$ and $R^d$ Actions (Code: AMS SS R1), E. Arthur Robinson, George Washington University, and Ayşe A. Şahin, North Dakota State University.
Geometric Analysis (Code: AMS SS G1), Paul C. Yang, University of Southern California, and Matthew J. Gursky, Indiana University.

Homotopy Theory (Code: AMS SS Q1), W. Stephen Wilson and Jack Morava, Johns Hopkins University.

Integral Equations and Applications (Code: AMS SS U1), Constantin Coste, University of Texas at Arlington, and Mehran Mahdavi, Bowie State University.


Mathematical Aspects of Consensus Theory (Code: AMS SS B1), Melvin F. Janowitz, University of Massachusetts, Amherst.

Mathematical Reviews (Code: AMS SS F1), Jane E. Kister, Mathematical Reviews.

Mistaken Philosophies in Mathematics Education (Code: AMS SS Z1), Seymour Lipschutz, Temple University.

Nonlinear Eigenvalue Problems and Applications (Code: AMS SS N1), Alfonso Castro, University of Texas at San Antonio, and Maya Chhetri and Ratnamahine Shivaji, Mississippi State University.

Operator Algebras (Code: AMS SS X1), May M. Nilsen, University of Nebraska, Lincoln, and Texas A&M University, and David R. Pitts, University of Nebraska, Lincoln.

Operator Theory, Systems Theory, and Interpolation in Several Complex Variables (Code: AMS SS H1), Joseph A. Ball, Virginia Polytech Institute & State University, and Cora S. Sadosky, Howard University.


Singularities in Algebraic and Analytic Geometry (Code: AMS SS S1), Ruth I. Michler, University of North Texas, and Caroline Melles, U.S. Naval Academy.

The Feynman Integral and Applications (Code: AMS SS A1), Michel L. Lapidus, University of California, Riverside, and Gerald W. Johnson, University of Nebraska.

The History of Topology (in honor of Ralph Krause) (Code: AMS SS T1), Jack Morava, Johns Hopkins University.

Santa Barbara, California
University of California, Santa Barbara

March 11-12, 2000

Meeting #951
Western Section
Associate secretary: Bernard Russo
Announcement issue of Notices: January 2000
Program first available on eMATH: February 3, 2000
Program issue of electronic Notices: May 2000
Issue of Abstracts: Volume 21, Issue 2

Deadlines
For organizers: August 11, 1999
For consideration of contributed papers in Special Sessions: November 23, 1999
For abstracts: January 18, 2000
Lowell, Massachusetts  
University of Massachusetts, Lowell  
April 1-2, 2000

Meeting #952  
Eastern Section  
Associate secretary: Lesley M. Sibner  
Announcement issue of Notices: February 2000  
Program first available on eMATH: February 24, 2000  
Program issue of electronic Notices: June/July 2000  
Issue of Abstracts: Volume 21, Issue 2  

Deadlines  
For organizers: September 1, 1999  
For consideration of contributed papers in Special Sessions: December 14, 1999  
For abstracts: February 8, 2000  

Invited Addresses  
Walter Craig, Brown University, Title to be announced  
Erwin Lutwak,Polytechnic University, Title to be announced  
Alexander Nabutovsky, Courant Institute of Mathematical Sciences, NYU, Title to be announced  
Mary Beth Ruskai, University of Massachusetts, Lowell, Title to be announced  

Special Sessions  
Combustion Theory (Code: AMS SS D1), James Graham-Eagle, University of Massachusetts, Lowell, and Daniel A. Schult, Colgate University  
Ergodic Theory and Dynamical Systems (Code: AMS SS C1), Stanley J. Eigen, Northeastern University, and Vidiha S. Prasad, University of Massachusetts, Lowell  
Invariance in Convex Geometry (Code: AMS SS A1), Daniel A. Klain, Georgia Institute of Technology, and Elisabeth Werner, Case Western Reserve University  
Quantum Information Theory (Code: AMS SS B1), Mary Beth Ruskai, University of Massachusetts, Lowell, and Christopher K. King, Northeastern University  
Syzgies (Code: AMS SS E1), Irena Peeva, Cornell University  

Lafayette, Louisiana  
University of Southwestern Louisiana  
April 14-16, 2000

Meeting #954  
Southeastern Section  
Associate secretary: John L. Bryant  
Announcement issue of Notices: February 2000  
Program first available on eMATH: March 2, 2000  
Program issue of electronic Notices: June/July 2000  
Issue of Abstracts: Volume 21, Issue 2  

Deadlines  
For organizers: September 14, 1999
Meetings & Conferences

For consideration of contributed papers in Special Sessions: December 28, 1999
For abstracts: February 22, 2000

Special Sessions

Mathematical Models in the Biological and Physical Sciences (Code: AMS SS B1), Lan Ke, Robert D. Sidman, and Azmy Smaan Ackleh, University of Southwestern Louisiana.
Nonlinear Differential Equations and Their Applications (Code: AMS SS C1), C. Y. Chan, Keng Deng, and A. S. Vatsala, University of Southwestern Louisiana.
Rings and Their Generalizations (Code: AMS SS A1), Gary F. Birkenmeier and Henry E. Heatherly, University of Southwestern Louisiana.
Scientific Computing (Code: AMS SS D1), R. Baker Kearfott, Qin Sheng, and Christo Christov, University of Southwestern Louisiana.

Odense, Denmark

Odense University

June 13–16, 2000

Meeting #955
First AMS-Scandinavian International Mathematics Meeting.
Sponsored by the AMS, Dansk Matematisk Forening, Suomen matemaattinen yhdistys, Icelandic Mathematical Society, Norsk Matematisk Forening, and Svenska matematiker-samfundet.
Associate secretary: Robert M. Fossum
Announcement issue of Notices: To be announced
Program first available on eMATH: N/A
Program issue of electronic Notices: N/A
Issue of Abstracts: N/A

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses
Tobias Colding, Courant Institute, New York University, Title to be announced.
Nigel J. Hitchin, University of Oxford, Title to be announced.
Pertti Mattila, University of Jyväskylä, Title to be announced.
Curtis T. McMullen, Harvard University, Title to be announced.
Alexei N. Rudakov, Norwegian University of Science & Technology, Title to be announced.
Dan Voiculescu, University of California, Berkeley, Title to be announced.

Los Angeles, California

University of California-Los Angeles

August 7–12, 2000

Note: This is a World Math Year 2000 (WMY2000) event.

Meeting #956
Associate secretary: Robert J. Daverman
Announcement issue of Notices: May 2000
Program first available on eMATH: May 24, 2000
Program issue of electronic Notices: October 2000
Issue of Abstracts: Volume 21, Issue 3

Deadlines
For organizers: N/A
For consideration of contributed papers in Special Sessions: N/A
For abstracts: May 10, 2000

Invited Addresses
James G. Arthur, University of Toronto, will speak on automorphic forms and the Langlands program.
Michael V. Berry, H. H. Wills Physics Laboratory, will speak on waves, geometry, and arithmetic.

Haim Brezis, University of Paris XI and Rutgers University, Title to be announced.

Alain Connes, Institut des Hautes Études Scientifiques, Title to be announced.

David L. Donoho, Stanford University, Title to be announced.

Charles L. Fefferman, Princeton University, Title to be announced.

Ronald L. Graham, AT&T Labs, Title to be announced (AMS-MAA President’s Lecture).

Helmut H. W. Hofer, New York University-Courant Institute, will speak on symplectic geometry/dynamical systems.

Richard M. Karp, University of Washington, will speak on computational molecular biology.

Sergiu Klainerman, Princeton University, Title to be announced.

Peter D. Lax, New York University-Courant Institute, will speak on mathematics and computing.

László Lovász, Yale University, will speak on discrete mathematics and algorithms.

David Mumford, Brown University, will speak on models of perception and inference.

Peter Sarnak, Princeton University, Title to be announced.

Surkov, Princeton University, will speak on dynamical systems.

Richard Stanley, Massachusetts Institute of Technology, Title to be announced.

Karen Uhlenbeck, University of Texas at Austin, Title to be announced.

S.R.S. Varadhan, Courant Institute-New York University, Title to be announced.

Edward Witten, Institute for Advanced Study, will speak on the mathematical impact of quantum fields and strings.

Shing-Tung Yau, Harvard University, will speak on geometry and its relation to physics.

San Francisco, California
San Francisco State University
October 21–22, 2000

Meeting #958
Western Section
Associate secretary: Bernard Russo
Announcement issue of Notices: August 2000
Program first available on eMATH: To be announced
Program issue of electronic Notices: To be announced
Issue of Abstracts: Volume 21, Issue 4

Deadlines
For organizers: March 21, 2000
For consideration of contributed papers in Special Sessions: June 21, 2000
For abstracts: August 29, 2000

New York, New York
Columbia University
November 3–5, 2000

Meeting #959
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: September 2000
Program first available on eMATH: September 28, 2000
Program issue of electronic Notices: To be announced
Issue of Abstracts: Volume 21, Issue 4

Deadlines
For organizers: April 3, 2000
For consideration of contributed papers in Special Sessions: July 18, 2000
For abstracts: September 12, 2000

Invited Addresses
Paula Cohen, Université des Sciences et Technologies de Lille, France, will speak on geometry and its relation to physics.

Alexander I. Suciu, Northeastern University, Title to be announced.
Birmingham, Alabama
University of Alabama-Birmingham
November 10-12, 2000
Meeting #960
Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of Notices: September 2000
Program first available on eMATH: October 5, 2000
Program issue of electronic Notices: To be announced
Issue of Abstracts: Volume 21, Issue 4
Deadlines
For organizers: April 10, 2000
For consideration of contributed papers in Special Sessions: July 25, 2000
For abstracts: September 19, 2000

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: October 2000
Program first available on eMATH: To be announced
Program issue of electronic Notices: To be announced
Issue of Abstracts: Volume 22, Issue 1
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: John L. Bryant
Announcement issue of Notices: To be announced
Program first available on eMATH: To be announced
Program issue of electronic Notices: To be announced
Issue of Abstracts: To be announced
Deadlines
For organizers: August 15, 2000
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Lawrence, Kansas
University of Kansas
March 30-31, 2001
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: To be announced
Program first available on eMATH: To be announced
Program issue of electronic Notices: To be announced
Issue of Abstracts: To be announced
Deadlines
For organizers: June 28, 2000
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Hoboken, New Jersey
Stevens Institute of Technology
April 28-29, 2001
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program first available on eMATH: To be announced
Program issue of electronic Notices: To be announced
Issue of Abstracts: To be announced
Deadlines
For organizers: September 28, 2000
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
Lyons, France
July 17–20, 2001
*First Joint International Meeting between the AMS and the Société Mathématique de France.*
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program first available on eMATH: To be announced
Program issue of electronic Notices: To be announced
Issue of Abstracts: To be announced

### Deadlines
For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Williamstown, Massachusetts
*Williams College*
October 13–14, 2001
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program first available on eMATH: To be announced
Program issue of electronic Notices: To be announced
Issue of Abstracts: To be announced

### Deadlines
For organizers: March 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 the 85th Meeting of the Mathematical Association of America (MAA).*
Associate secretary: John L. Bryant
Announcement issue of Notices: To be announced
Program first available on eMATH: To be announced
Program issue of electronic 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
Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: Bernard Russo, Department of Mathematics, University of California, Irvine, CA 92697; e-mail: brusso@math.uci.edu; telephone: 949-824-5505.

Central Section: Susan J. Friedlander, Department of Mathematics, University of Illinois at Chicago, 851 S. Morgan (M/C 249), Chicago, IL 60607-7045; e-mail: susan@math.nwu.edu; telephone: 312-996-3041.

Eastern Section: Lesley M. Sibner, Department of Mathematics, Polytechnic University, Brooklyn, NY 11201-2990; e-mail: lsibner@magnus.poly.edu; telephone: 718-260-3505.

Southeastern Section: John L. Bryant, Department of Mathematics, Florida State University, Tallahassee, FL 32306-4510; e-mail: bryant@math.fsu.edu; telephone: 850-644-5805.

The Meetings and Conferences section of the Notices gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. Information in this issue may be dated. Updated meeting and conference information is available on the World Wide Web at www.ams.org/meetings/.

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Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 106 in the January 1999 issue of the Notices for general information regarding participation in AMS meetings and conferences.

Abstracts

Several options are available for speakers submitting abstracts, including an easy-to-use interactive Web form. No knowledge of LaTeX is necessary to submit an electronic form, although those who use LaTeX or AMS-LaTeX may submit abstracts with such 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 emailed to you.

Completed abstracts should be sent to abs-submit@ams.org, typing submission as the subject line. Questions about abstracts may be sent to abs-info@ams.org.

Paper abstract forms may be sent to Meetings & Conferences Department, AMS, P.O. Box 6887, Providence, RI 02940. There is a $20.00 processing fee for each paper abstract. There is no charge for electronic abstracts. Note that all abstract deadlines are strictly enforced. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

Conferences: (See http://www.ams.org/meetings/ for the most up-to-date information on these conferences.)

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