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European Meetings Bring Mathematicians Together
*Historic "Firsts" in Cambridge and Paris*  page 689
Calendar of AMS Meetings and Conferences

This calendar lists all meetings and conferences approved prior to the date this issue went to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have been assigned. Programs of the meetings will appear in the issues indicated below. First and supplementary announcements of the meetings will have appeared in earlier issues. Abstracts of papers presented at a meeting of the Society are published in the journal Abstracts of papers presented to the American Mathematical Society in the issue corresponding to that of the Notices which contains the program of the meeting, insofar as is possible. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. The abstract deadlines listed below should be carefully reviewed since an abstract deadline may expire before publication of a first announcement. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of special sessions.

### Meetings

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* Please refer to page 760 for listing of Special Sessions.

### Conferences


### Deadlines

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* Please contact AMS Advertising Department for an Advertising Rate Card for display advertising deadlines.
** For material to appear in the Mathematical Sciences Meetings and Conferences section.
ARTICLES

This article pays tribute to the life and career of former AMS President Deane Montgomery, a distinguished topologist and longtime member of the Institute for Advanced Study.

688 Sloan Foundation Joins AMS to Aid Mathematics in the former Soviet Union
The Sloan Foundation has awarded the Society a $30,000 challenge grant to support the AMS program to assist mathematics in the former Soviet Union. Allyn Jackson describes the assistance program, and an accompanying announcement provides information on how to contribute to this important effort.

689 European Meetings Bring Mathematicians Together
A number of historic "firsts" took place in Europe this summer—the joint AMS meeting with the London Mathematical Society in Cambridge, England; the opening of the Isaac Newton Institute in Cambridge; and the first European Congress of Mathematics, held in Paris. Allyn Jackson reports on these events.

FEATURE COLUMNS

696 Computers and Mathematics Keith Devlin
Andrew Granville writes an expository article based on his paper There are infinitely many Carmichael numbers, cowritten with Red Alford and Carl Pomerance. Following Granville's piece, Barry Simon presents the results of a series of benchmark tests he has run on a number of computer mathematics systems.

711 Inside the AMS
Alice Schafer, Chair of the AMS Committee on Human Rights of Mathematicians, reports on the Committee's activities and accomplishments over the past two years.

712 Washington Outlook
Lisa Thompson discusses how the government allocates resources among the various elements of the scientific enterprise.
From the Executive Director . . .

RESOURCES FOR EXCELLENCE

There have been numerous national reports pointing out the need for the renewal of academic mathematical sciences departments. The reports call upon the departments to maintain the tradition of first-class research; reform mathematics education at all levels; revise the curriculum to introduce experimental classes, varied instructional approaches, and new technologies; become involved in teacher enhancement and preparation; engage in interdisciplinary activity and university service; increase the participation of underrepresented minorities and women; and contribute to economic competitiveness. This is only a partial list. Information is available, in varying degrees of detail and clarity, as to how to go about doing all these things.

These reports have been useful in providing a springboard for debate, in distributing important information, and in outlining means for change. However, it is time to move beyond the reports and into action, and mathematical sciences departments are the natural institutions to take actions to bring about substantial, long-term change within the community. There is general agreement on what needs to be done, and there are laudable examples of activities of individuals, groups, and departments that are doing exciting things. But, is the academic mathematical sciences community positioned to respond? Does this community have the resources (or the political sophistication to get them) necessary to meet these challenges and opportunities?

Mathematical sciences departments, on the whole, are not viewed as major players in acquiring academic resources. There is a history of little attention being paid to the political avenues by which mathematical sciences departments might position themselves more favorably. The current challenges and opportunities come at a time when there is a shortage of federal research funds and there is a depressed economy that is affecting academic finances. Indeed, department resources are vulnerable to serious cuts. Distressed departments cannot respond adequately to the new challenges confronting them. Faculty, staff (including technical assistance), appropriate space, computers and networking, libraries, instructional labs, and research and travel funds are just some of the resources necessary for departments to respond to the recommendations that are being made. How can we make the case for adequate academic resources for mathematics? How does a department determine what will work or, recognizing the limitations on its resources, what resources are needed to be successful in meeting the challenges? These are issues that the reports leave unanswered.

The mathematical sciences are generally seen as important to education, research, and the mission of the university. In addition, there is widespread concern over low student retention in entry-level mathematics courses because it affects not only science and engineering career paths, but also overall retention at the university. However, these points will not suffice to make the case for improving resources for mathematical sciences departments. We need solid evidence with data and arguments about what works and what does not work. We need to set forth measurable expectations and articulate the case that changes will result from increased resources.

The Society is engaged in an intense examination of how it might be able to help the academic mathematical sciences community confront these issues. Can we provide information and assistance to academic departments in planning and in articulating the case for necessary resources?

An AMS Task Force is being formed to address these questions and to try to provide academic departments with a description of what activities are finding success and what resources are necessary to meet the challenges departments face. It is expected that usable data will be part of the outcome of this work. The Task Force will be working with other organizations in order to coordinate related activities. Continued coverage of the work of the Task Force will be in the Notices. The community’s advice and comments are needed and welcome.

William Jaco
Shafarevich Responds to Open Letter

Editor’s Note: The following is a response to the Open Letter to I. R. Shafarevich which appeared in the advertisements section of the March 1992 issue of the Notices. Both the Open Letter and the response below refer to Shafarevich’s work Russophobia [published by the Russischer Nationaler Verein, München, Germany, 1989; the latest version was published by Sovietskii Pisatel, Moscow, 1991]

Dear Colleagues,

I was deeply upset by your letter. In the years of our dissident struggle in the USSR, many of us looked at the U.S. as a kind of “Existenzbeweis”—a proof of existence of solution of the problem we aimed to solve: to establish a society where speech and thought are free. Unfortunately this letter of yours reminds me of numerous letters addressed in our country to Solzhenitzin, Pasternak, and Sakharov at that time. Not that I compare myself with one of those people, but the whole spirit of the letter is the same.

For instance you allude to “antisemitic” sentiment in my paper. In this paper I tried to show that “antisemitism” is an empty political slogan left deliberately vague just as the accusation in “anti-sovietism” so familiar to me. Still you do not try to make your accusations precise. Change “antisemitism” to “anti-sovietism” and your letter will become one of those hatred-letters in our country 20 years ago.

You predict the effect of my paper on my interactions with other mathematicians. Are you authorized by them to express their feelings? In those letters in our country the authors also usually used to speak on behalf of “Progressive mankind” or at least “All soviet scientists”

Without burdening yourself with arguments, you demand my public disclaimer of my views (which you call “anti-semitic polemic”)—that is the procedure that was so common during the purges under the communist regime in the USSR.

You attribute to me the “conspiratorial theory” which I certainly do not share (if only you do not broaden the notion of “conspiracy” in such a way as to consider e.g., the annihilation of North American Indians to be a conspiracy of English settlers). You certainly could see it from my paper, should you read it. But I have serious doubts about many of you having read it. I know personally many of those signed the letter who do not read Russian. While there is only a pirate English translation of the paper—without my authorization and supervision, I leave it to you to decide about the legal and moral character of such edition and about references to it.

Again it is very much like the letters to Sakharov in USSR; “I have not read this slander but I despise it…”

My last question is to the people who signed the letter and whom I knew 15 or 20 years ago as soviet mathematicians. Living in USSR they witnessed the deportation of Solzhenitzin, exile of Sakharov, persecution of religion, detention of sane persons in psychiatric hospitals for political reasons. We haven’t heard their protests against it then. Do they really believe that my paper is more dangerous?

Respectfully yours,

I. R. Shafarevich
Mathematical Institute of the Russian Academy of Sciences
(Received July 20, 1992)
Deane Montgomery was born on September 2, 1909, in Weaver, Minnesota. He received a B.A. from Hamline University in 1929, a M.S. in 1930 and a Ph.D. in 1933 from the University of Iowa.

After having held various fellowships at Harvard University, Princeton University, and the Institute for Advanced Study, he went to Smith College, where he was successively assistant professor (1935–1938), associate professor (1938–1941), and professor (1941–1946). During that period, he was also a Guggenheim fellow at the Institute and a visiting associate professor at Princeton University. After two years at Yale University as an associate professor (1946–1948), he came to the Institute, where he was a permanent member from 1948 to 1951 and a professor from 1951 to 1980, at which time he became emeritus.

His thesis adviser had been E. W. Chittenden, and he had a solid background in real analysis and point set topology. His initial research interests focused on the latter, to which he devoted his first four papers. In the tradition of L. E. J. Brouwer and "Polish topology", they already show considerable technical strength and expertise. As soon as he came to Harvard and Princeton, he broadened his interests, first to algebraic or geometric topology (initially on his own and in a private study group including N. Steenrod and Garrett Birkhoff), and then gradually to transformation groups, which became his major interest for the rest of his career.

His first papers in that area, many written in collaboration with Leo Zippin, were in part in the spirit of earlier work of Brouwer and Kerejarkto, aiming at characterizing groups of familiar euclidean motions such as translations or rotations by topological conditions. They were motivated by questions on the foundations of geometry and, foremost, by Hilbert's fifth problem. In the broad sense, the latter asks, given a locally euclidean topological group acting effectively (i.e., no element $\neq 1$ acts trivially) on an analytic manifold, whether coordinates can be introduced to make the group and the operation analytic (the answer is no). In its narrow sense, it asks whether a locally euclidean topological group is, after a suitable change of coordinates, a(n analytic) Lie group. Variants of the first problem and the second one became points of major interest in the next fifteen years or so, but not of sole interest, though.

Among Deane's contributions to the first question, let me mention the following results pertaining to a (separable metric) locally compact group $G$ acting effectively on a manifold $M$:

(i) If $G$ is compact, $M$ analytic, and each transformation is analytic, then $G$ is a Lie group (1945); (ii) (with S. Bochner, 1946). If $M$ is $C^2$ and every transformation is $C^2$, and no element $\neq 1$ leaves pointwise fixed a nonempty open subset, then $G$ is a Lie group; (iii) (with S. Bochner, 1947). If $M$ is a compact complex analytic manifold and $G$ the group of automorphisms of $M$, then $G$ is a complex Lie group acting holomorphically. On the fifth problem proper, after a series of papers with L. Zippin, Deane gave a positive solution in dimension three (1948). Then came shortly afterwards the decisive results proved jointly with L. Zippin: The existence of a closed subgroup isomorphic to $\mathbb{R}$ in a locally compact, noncompact, connected, separable metric group of strictly
positive finite dimension (1951) (also established by A. Gleason) and then the reduction to groups without small subgroups (1952). Since A. Gleason had just proved that such a group is a Lie group, that gave a positive answer to Hilbert’s fifth problem. In fact, the whole investigation had been carried out for separable metric finite-dimensional locally compact groups and it was shown more generally that such a group is a “generalized Lie group”, i.e., possesses an open subgroup that is a projective limit of Lie groups, hence is a Lie group if it is locally connected. The assumption of finite dimensionality was soon removed by H. Yamabe, who was Deane’s assistant at the time.

This was the climax of a major effort and, as I remember it, some people were mildly curious to see where Deane would turn, now that this big problem had been solved. But he did not have to look around at all. Apart from writing with L. Zippin a systematic exposition of the work on the fifth problem (1955), he just went back full time to what was really his main interest (and is already the subject matter of the last chapter of that book): Lie groups (especially compact Lie groups) of transformations on manifolds, so that, in the context of his whole work, the contributions of the fifth problem appear almost as a digression, albeit a most important one.

Even during that hot pursuit, Lie transformation groups were very much on his mind, and he brought a number of interesting contributions, in particular in joint works with L. Zippin and with H. Samelson. In fact, two papers with H. Samelson on compact Lie groups transitive on spheres or tori (1943) have a special place in my memory: When I was an assistant in Zürich, H. Hopf once gave me copies of them, and I could generalize and sharpen some of their results. This led to my first single author paper, which I submitted for publication in the Proceedings of the AMS to Deane, then an editor; my first contact with him.

The general problem in transformation groups is, roughly, to relate the structures of the group G, the manifold M operated upon, the orbits, fixed points, and the quotient space. At the time, there was one body of special, but deep, work, that of P. A. Smith on homeomorphisms of prime power order of homology spheres or acyclic spaces. Very little was known otherwise, and Deane was a prime mover in the development of a general theory, which he pushed in many directions. He and various collaborators proved a number of foundational results, as well as more special ones, which often opened up fruitful directions for others. A survey of these contributions and of work they led to is given by F. Raymond and R. Schultz in the Proceedings of a Conference honoring Deane on his 75th birthday (Contemporary Mathematics, vol. 36 (1983)), and I shall not try to duplicate it. It ranges from basic results such as the existence of a slice (with C. T. Yang, 1957), a powerful tool to study a group action near an orbit, the existence of a principal type of orbits (with C. T. Yang, 1958), to more special ones, such as actions on euclidean space or spheres with orbits of small codimension or the existence of smooth actions of $SO_3$ on euclidean space without fixed points (with P. E. Conner, 1962). In a first phase, the emphasis was on continuity, i.e., on topological properties, but Deane kept up with the great advances of differential topology and soon veered more and more to differentiable actions, adapting techniques and points of view of differential topology. This led to his last major effort, a long series of joint papers with C. T. Yang on free or semi-free (i.e., free outside the fixed point set) actions of the circle group on homotopy 7-spheres, which produced notably many interesting examples of homotopy complex projective 3-spaces (1966–1973).

During his tenure as a professor at the Institute, Deane was at the center of activity in topology (algebraic, geometric, differential), one of the highlights in the life of the School, first by his seminar, a perennial feature and a meeting ground for topologists in the Princeton community, but also in more informal ways. He frequently organized seminars in his office, usually with some younger members with whom he would go through some recent developments. He was always seeking out and encouraging young mathematicians. He and his wife Kay would regularly and very warmly receive the visiting members at their home. Maybe remembering his own beginnings in an out of the way place, he had a special interest, and talent, in finding out people with considerable potential among some applicants from rather isolated places about whom not much information was available.

His concern for the Institute went far beyond his immediate scientific interests and was all encompassing. He had a very high view of the role the Institute should play and served this ideal with unwavering and thoroughly unselfish loyalty. In day to day contacts, he was very kind, informal, full of understanding, always ready to help, and struck one as a very mild person, but deceptively so for anyone who, in his eyes, would threaten the Institute’s standards, and who would then soon see rising an iron-willed and formidable opponent. His care for the highest standards at the Institute, later gratefully acknowledged in citations by the Trustees, was not always universally understood or shared at the time, so that he and like-minded colleagues had to weather some rather stormy moments, during which he was totally unshakable.

His abiding interest in the welfare of mathematics also led him to accept a number of official positions. In particular, he was Vice President (1952–1953), elected Trustee (1955–1961) and President (1960–1963, includes terms as President-Elect and Ex-President) of the AMS, where he also served on a number of committees, and President of the International Mathematical Union (1974–1978).

Honors, too, came his way: Honorary Doctor of Science from Hamline University (1954), Yeshiva University (1961), the University of Illinois (1977), and the University of Michigan (1986), as well as a Doctor of Laws degree from Tulane University (1967); election to the National Academy of Sciences in 1955, to the American Academy of Arts and Sciences, and the American Philosophical Society in 1958; and receipt of the Steele Prize of the AMS in 1988.

Deane was an early riser and it was a rare event for anyone to be at the Institute before him. Being very gregarious, he talked to practically everybody working in any capacity at the Institute, which won him the respect and affection of members and staff alike and gave him an exhaustive knowledge of the
Institute. Through O. Veblen, to whom he had been very close during the latter's late years, it reached to the very beginnings of the Institute so that he was a walking encyclopedia on all aspects of the Institute's history and operations.

In 1988, he and Kay moved to Chapel Hill, NC to be close to their daughter and granddaughters. That prospect did not fully compensate for the severance of the ties with an institution which had meant and still meant so much to him, and it was altogether a rather sad occasion, the sadness of which was hardly mitigated by promises to keep in touch. Being myself a fairly early riser, I often started my day by knocking at his door, sure to find him, to have a chat, mostly about mathematics, mathematicians, and Institute affairs. That I have not been able to do so after his departure has left for me a void which could not be filled.

Deane died in his sleep in Chapel Hill, on March 15, 1992. He is survived by his wife, his daughter Mary Heck, and two granddaughters.

Armand Borel
Institute for Advanced Study

"This fascinating book is not of math, but of men."

Operations Analysis in the United States Army Eighth Air Force in World War II
Charles W. McArthur

"His straightforward narrative lets the story tell itself and the chips fall where they may. The individual accounts let us hear the voices of the characters. Tragic anecdotes emerge. Personality conflicts over strategy resulted in lost lives. Errors in judgement are made. Politics sometimes prevailed over strategy. Inspirational stories are there too, of those whose contribution to the war was their intelligence, honesty and perseverance. Good ideas did not become strategy by themselves. . . . This fascinating book is not of math, but of men."

—Jerome Stern,
Tallahassee Democrat

Published jointly with the London Mathematical Society, McArthur’s book offers a careful, readable study of an important slice of history on both World War II and operations analysis—one you won’t find anywhere else.
The AMS fSU AID FUND
Your Contribution Now Counts Twice!

To help sustain the mathematical sciences in the former Soviet Union (fSU), the Sloan Foundation has awarded the AMS a $30,000 challenge grant to support the AMS fSU AID FUND. Contributions to the fund will now be matched on a dollar-for-dollar basis.

The AMS fSU AID FUND will support a four-point program:

- Providing small grants to students, young mathematicians, and established scholars.
- Supporting development of the Moscow Mathematics Institute.
- Sending mathematical literature to libraries in the fSU.
- Supporting independent group efforts in the fSU and other special needs, such as workshops, conferences, and exchanges.

Double your gift today and support the AMS fSU AID FUND. Gifts are tax deductible to the limit of Internal Revenue Service regulations. Please clip, complete, and forward the form below with your check or credit card information.

Enclosed is my (our) gift or pledge of:  □ $1000  □ $500  □ $250  □ $100  □ other $________
(Pledges are encouraged to be fulfilled within the year ending 9/1/93.)

Donor's name ______________________ Street address ______________________
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Please make checks payable to the AMS fSU AID FUND and send them to the following address:
American Mathematical Society • P. O. Box 1571 • Annex Station • Providence, RI 02901-1571

For further information, contact the AMS Development Office at 401-455-4114.

To use VISA or MasterCard, send to:
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□ VISA □ MasterCard Card number: ______________________ Expiration date: ______

Signature: ______________________

• Please note: A minimum gift of $20.00 is requested on VISA or MasterCard.
• Please check if you do not wish this information to be printed in the Notices annual listing of contributions.
Sloan Foundation Joins AMS to Aid Mathematics in the Former Soviet Union

As reported in the July/August 1992 issue of the Notices (pages 557–558), the Society has launched the AMS fSU Aid Fund to provide assistance to the mathematical sciences community of the former Soviet Union. Because of political and economic crises in the former Soviet Union and Eastern Europe, the distinctive traditions and future promise of this prolific community could all but disappear without international assistance. There have been a number of developments since the appearance of the previous Notices article.

The Sloan Foundation has awarded the AMS a “challenge grant”, which will match individual contributions to the Fund up to a total of $30,000, to support the small grants component of the assistance program. Since the appearance of the call for contributions in the July/August Notices, the Society has already received a number of contributions. If the fundraising effort goes well, the Sloan Foundation has indicated it will consider making a second challenge grant. The American Physical Society, for example, has received a $100,000 challenge grant from Sloan.

In addition, the Advisory Committee for the program has now been appointed. The members of the Committee are: Michael Artin, AMS President, Massachusetts Institute of Technology; William H. Jaco, AMS Executive Director; Robert D. MacPherson, MIT; Cathleen Morawetz, Courant Institute of Mathematical Sciences; Robert O’Malley, President of the Society for Industrial and Applied Mathematics, University of Washington; John C. Polking, AMS Trustee, Rice University; Linda Preiss Rothschild, University of California at San Diego; and Daniel Stroock, MIT. The Committee will also benefit from the advice of a group of consultants in the former Soviet Union and elsewhere.

Some aspects of the program have evolved since the previous Notices article. The four primary activities, described below, will comprise all areas of the mathematical sciences, including applied areas, statistics, and probability.

- **Small Grants.** These grants will be made directly to individuals, with a focus on graduate students, young mathematicians, and established scholars. Recommendations for grantees will be made by a panel of mathematical scientists in the former Soviet Union. The Sloan Foundation funds will support this activity.

- **Moscow Mathematics Institute.** Directed by Askold Khovanski and established in 1991, the Moscow Mathematics Institute is a gathering place for researchers and students in the mathematical sciences. On the governing board are Pierre Deligne of the Institute for Advanced Study, Vladimir Drinfeld of the Institute of Low-Temperature Physics in Kharkov, Ukraine, and Alexander Beilinson and Robert MacPherson of the Massachusetts Institute of Technology. Its staff will be comprised of a few permanent members, some three-year appointees, and visitors from abroad. The AMS fSU Aid Fund will help support this important institute.

- **Libraries.** An AMS Reading Room, with copies of AMS books and journals and MathSci in CD-ROM, is the centerpiece of this effort. In addition, the AMS plans to identify libraries in the former Soviet Union to receive free subscriptions to Society journals.

- **Independent groups and other needs.** Plans are also being made to support a variety of independent group efforts that have arisen in a number of locations to support and revitalize mathematical sciences research and scholarship. One notable example is the Mathematics Department at the Independent University of Moscow, headed by V. I. Arnold. Other efforts are under way in St. Petersburg, Novosibirsk, Kharkov, Kiev, and other cities. In addition, the AMS is looking into other needs, such as workshops, conferences, and exchanges.

At present, the political and economic climate of the former Soviet Union is quite uncertain. The AMS and the Advisory Committee are monitoring the situation and will make every effort to obtain reliable information from a variety of sources inside and outside the former Soviet Union to insure that the AMS fSU Aid Fund is put to the best possible use. The goal is to provide short-term support to bring a measure of stability to the mathematical sciences community and sustain its intellectual activity during these difficult times.

The AMS calls upon the international mathematical sciences community to contribute toward this important effort to help keep alive mathematical sciences research and scholarship in the former Soviet Union. Please see the accompanying advertisement on the previous page for information on how to make a contribution. Questions about the AMS fSU Aid Fund may be directed to Timothy J. Goggins, AMS Development Officer, 401-455-4110; electronic mail tijg@math.ams.com.

Allyn Jackson
Staff Writer
European Meetings Bring Mathematicians Together

Historic “Firsts” in Cambridge and Paris

This summer, two back-to-back meetings in Cambridge and Paris brought the U.S., Europe, and the former Soviet Union a little closer together. The joint meeting with the London Mathematical Society (LMS), held June 29 to July 2 in Cambridge, England, marked the first AMS international meeting, and its first joint meeting with the LMS. The following week, the first European Congress of Mathematics brought together mathematicians from all over Europe and the former Soviet Union to participate in a wide-ranging program. In between these two events was the inaugural opening of the Isaac Newton Institute, headed by Sir Michael Atiyah of Trinity College, Cambridge University.

The AMS-LMS Meeting

The Joint AMS-LMS Meeting began on a warm Monday evening, when John M. Ball of Heriot-Watt University presented an intriguing talk about the mathematics of microstructure—an unusual physical phenomenon in that certain energy functions associated with microstructure do not attain a minimum. The plenary lectures were, on the whole, expository and accessible to a general mathematical audience. Spanning a range of areas, the list of speakers included Lawrence Craig Evans of the University of California at Berkeley, Benedict Gross of Harvard University, Nigel Hitchin of the University of Warwick, and Edward Witten of the Institute for Advanced Study.

“We were very fortunate to get together such a strong group of speakers from both sides of the Atlantic,” commented Sir John Kingman, President of the London Mathematical Society. “This was partly due to the attraction of Cambridge, but also due to the fact that the program committee had put together a very interesting program.” One participant remarked that this was a very good “working meeting”, unlike many general conferences of this type.

“The impressions I got from talking to quite a few of the participants at the AMS-LMS meeting were very positive,” noted Ronald Graham, AMS President-Elect. “They were very happy with the number and quality of the talks and with the substantial attendance. In fact, many people thought that it would have been better to spread the meeting over three days because it was packed pretty tightly in the two days scheduled.” (Despite the intensity of the schedule, some participants managed to find spare time to punt on the River Cam or quaff beer on the bridges arching over the river.)

A total of 477 people registered, with 162 from the United Kingdom, 220 from the U.S., and 95 from other countries. Ten publishers hawked their wares, some of them in rather steamy conditions in the Mill Lane Lecture building, which, like most buildings in Cambridge, had no air conditioning. Despite the humidity, the hospitality of the LMS was evident through the...
efforts of staff members Susan Oakes and Harvinder Lotay, who, together with AMS housing and registration coordinator Penny Pina, made sure everything ran smoothly.

The social activities of the conference were particularly well attended and jovial. A reception held the first evening of the meeting attracted a crowd of more than five hundred and included a sculpture exhibit of the work of Gabriella Bollobás. The most commanding piece was a full-size sculpture of Newton and Dirac talking together (at one point, someone had placed an apple in Newton’s outstretched palm). The following evening, nearly 300 people attended the conference dinner, the highlights of which were the excellence of the food and service and an eloquent speech by Sir John.

This was a historic venture for the AMS and LMS, in more ways than one. “I think it got the staffs of the two societies to get to know one another better and to work together,” commented Sir John. “We’ve always had a close relationship, but at distance, in the sense that we’ve talked on the telephone and written, but not worked together face to face.” In addition, it was an important event for the British mathematical community, which does not often host meetings of this size. “The significant thing was to get so many North American mathematicians visiting at one time,” said Sir John. “Often we have visitors from the U.S. and Canada, but not as a group at one time, and this was an event we welcomed.”

The Isaac Newton Institute

During the AMS-LMS meeting, workers were rushing to put the finishing touches on the Isaac Newton Institute—rolling out stretches of lawn, polishing the bannisters, arranging the furniture, and hanging a portrait of Sir Isaac Newton. For a visitor arriving on Tuesday June 30, it was a little difficult to believe that everything would be ready for the inaugural opening the following Friday. But Friday came, and everything was in readiness for the opening events.

Light, airy, and elegant without being formal, the Institute building was designed with mathematics in mind. Thirty offices on the second and third levels circle a central open area that brings in light and encourages discussion and interaction. Architect Duncan Annand explains that one can see from anywhere in the building what’s going on in the common areas. There is a library and two seminar rooms, one of which holds about 120 people. “We wanted space where people could interact, so [Annand] came up with this design, and then we commented on it,” notes Sir Michael. “We’re very pleased with it, it worked out exceptionally well... ‘Architects are more often interested in what the outside looks like, they’re not too worried about the inside, whereas people are using the inside, that’s what’s important. So we’re very pleased here, he’s put a lot of thought into it.” Annand came to understand at least a few things about what mathematicians are like: there are chalkboards everywhere, even in the bathrooms—even in the elevator.
quantum field theory and on dynamo theory, and from January to June 1993, the focus will be on $L$-functions and arithmetic and on epidemic models. Next year, there will be programs in computer vision; random spatial processes; cellular automata, aggregation, and growth; and geometry and gravity.

Sir Michael says the Institute will consider nearly any scientific area for a program, provided there is some serious mathematics involved. "Also, it ought to be an area which is going through an exciting stage... And it probably ought to be one which brings people together from different backgrounds, different disciplines, or makes a new contribution. So, we don't go in for orthodox, conventional type meetings, of which there are plenty already. We'll try to do something new."

St. John's College, Cambridge constructed the new building and also provided £750,000 to cover most of the first five years' rent. In addition, Trinity College, Cambridge has established the Newton Trust, which is providing £1 million for other expenses during that period, and other Cambridge colleges have given grants. There are also many donors from outside Cambridge, including the London Mathematical Society, and from outside the U.K. In addition, the Science and Engineering Research Council of the U.K. has awarded the Institute over £1.5 million over the coming four years. Presently, the total funding for the Institute stands at over £5 million. Sun Microsystems and Apple U.K. donated workstations for computing, word-processing, and email.

The inaugural activities for the Newton Institute included talks on pure and applied topics reflecting the diversity of topics in the coming two years of activities. Vaughan Jones of the University of California at Berkeley presented a lucid and entertaining lecture on knots that would have been understandable to a high school student. At one point, Jones broke the "No Smoking" rule of the Institute and lit a cigar to demonstrate the origins of knot theory. "This, believe it or not, is what happened," said Jones. In the 1860s, Lord Kelvin became interested in the idea of knotted vortices when Tait blew some smoke rings during a lecture in Edinburgh. Jones says he's been trying for years to blow a trefoil smoke ring, but without success. After surveying some of the main results in the development of knot invariants, Jones wound up the lecture by touching on some of the recent connections between knot theory and statistical mechanics, quantum field theory, and von Neumann algebras. The other speakers included Sir Peter Swinnerton-Dyer, Senior Fellow at the Newton Institute, who spoke on arithmetic; Keith Moffatt, Cambridge University, who spoke on fluid: Roy Anderson, Imperial College, a biologist who discussed epidemics; and Allan Chapman, Oxford University, who presented a historical perspective on Newton and his work. Sir Michael closed the day's activities with a short talk about the Newton Institute.

Given his responsibilities as President of the Royal Society of London and Master of Trinity College, Sir Michael says he can devote only limited time to the Newton Institute. He acknowledges the efforts of Deputy Director Goddard, who has been involved in the Institute from the early planning stages right through the construction of the building and the appointment of staff. "Goddard is the person who really worked enormously long hours to get things going," says Sir Michael. "I have limited time, so I just help and advise on policy, the scientific mission, things like that... I hope I have some time to come in. I won't really work here; I have offices elsewhere." But maybe he'll come in to do a little mathematics? "Absolutely..."

The European Congress of Mathematics

Following on the heels of the AMS-LMS meeting and the opening of the Newton Institute was yet another historic event: the first European Congress of Mathematics (ECM), held in Paris, July 7–11. Centered at the Sorbonne University in the lively Latin Quarter, the ECM combined French sensibility for the good life with an ambitious vision for the Congress, which included some serious and successful efforts to go beyond the usual presentation of mathematical lectures and reach out to a broader audience of nonmathematicians and young people.

Credit for the idea of a European Congress generally goes to Max Karoubi of the University of Paris V who was named Founder of the Congress. Together with the efforts of Rudolph Rentschler at the University of Paris VI, who joined Karoubi early on in the project, Karoubi began working on preparations for the ECM in mid-1989 and was able to secure funding for the ECM from European Community sources in Brussels and the French government. As the project proceeded, the Société Mathématique de France and the Société des Mathématiques Appliquées et Industrielles agreed to sponsor the Congress, and various committees were appointed to bring the idea to fruition. Among the key players were Fulbert Mignot of Paris VI and Paris XI, chair of the Organizing Committee, and François Murat of Paris VI, who served as treasurer; Hans Föllmer of the University of Bonn, chair of the Scientific Committee; and Henri Cartan, member of the Académie des Sciences de Paris and professor emeritus at the University of Paris XI (Orsay), chair of the Steering Committee. Together with the organizers of the Round Tables, there were nearly one hundred people involved in planning and executing the ECM.
The Congress attracted the attention of the media and resulted in a number of newspaper articles on mathematics in French papers and magazines, as well as periodicals in other countries. The high level of interest the Congress drew was also evident in the speech by Hubert Curien, the French Research Minister, at the Opening Ceremonies. Also presenting a speech was Friedrich Hirzebruch, director of the Max Planck Institute and president of the European Mathematical Society (EMS). Founded in Poland in October 1990, the EMS is intended to serve as an advocate for mathematics on issues that reach beyond national borders. More than thirty mathematical societies belong to EMS, and there are also about 1100 individual members, who have the option of joining through their local mathematical societies.

One of the concerns that prompted the formation of the EMS was the situation for mathematicians in Eastern Europe and the former Soviet Union. Although travel restrictions have eased considerably in recent years, economic problems make travel to conferences effectively impossible for many mathematicians. Moreover, many have had problems obtaining visas to visit other countries. For this reason, the Congress organizers raised funds specifically to cover the living expenses and registration fees for needy participants from the former Soviet Union and Eastern Europe. Although some still could not attend because getting to Paris was prohibitively expensive, the ECM was quite successful in bringing a large contingent from that region: out of a total of 1300 participants, there were about forty registered participants from Russia (the same number as from the U.S.), another forty or so from other states in the former Soviet Union, and nearly two hundred from other countries in Eastern Europe.

Several lavish social events heightened the celebratory spirit of the Congress. The opening reception at the Palais de la Decouverte, a science museum, attracted a substantial fraction of the Congress participants, who feasted on hors d’oeuvres, petit fours, and champagne. On another evening, the various embassies in Paris invited participants from their countries to receptions. One of the largest, with over 200 people, was given by the German Embassy, where, on the occasion of his 88th birthday, Cartan was presented with a bouquet of flowers by the German ambassador. In addition to his mathematical distinctions and his work on the ECM, Cartan has been politically active in advocating for a united Europe.

Perhaps the most important reception, though, was held at the Hotel de Ville, where Jacques Chirac, Mayor of Paris and former Prime Minister of France, presented prizes sponsored by the city of Paris on the occasion of the ECM. The prizes were awarded to ten mathematicians under the age of thirty-two: Richard Borcherds, Jens Franke, Alexander Goncharov, Maxim Kontsevich, François Labourie, Tomasz Luczak, Stefan Müller, Vladimir Sverak, Gabor Tardos, and Claire Voisin. Kontsevich and Borcherds presented parallel session talks during the ECM. In addition, the prize committee paid an eloquent tribute to Andreas Floer, who died last year under tragic circumstances at the age of thirty-four.

The plenary speakers at the ECM spanned a wide range of areas and perspectives. One participant commented that the Scientific Committee must have impressed upon the speakers the need to make their talks accessible to a general mathematical audience, because most were expository with a good balance of technical details. In particular, the lecture by László Babai of the University of Chicago and Loránd Eötvös University about recent work on transparent proofs seemed to be a favorite among the participants, as it touched on the foundations of mathematics and what is meant by the notion of “proof”. David Mumford of Harvard University presented a fascinating survey lecture about the tough mathematical problems posed by computer vision. V. I. Arnold of the Steklov Mathematical Institute was the final speaker on the program, and his lecture on Vassiliev’s knot invariants demonstrated that mathematical research continues to flourish in the former Soviet Union. Two days of the Congress were devoted to parallel sessions that comprised forty lectures, and these featured some of the top mathematicians in Europe. In addition, there were about fifteen more specialized “satellite” conferences that took place before and after the ECM that drew many participants.

Perhaps the most unusual aspect of the ECM, and probably the most difficult to pull off, were the sixteen Round Tables that examined the relations between mathematics and society and connections between mathematics and other areas of science. Given the complexity of the problems they addressed, and the fact that their inclusion in such a conference has almost no precedent, they can be counted as a success. One of the liveliest discussions took place at the Women and Mathematics Round Table, organized by Eva Bayer of Centre National des Recherches Scientifiques, Besançon. The panel, which included women mathematicians from Italy, Germany, Poland, the U.S., and France, brought out some differences among various countries’ representation of women in mathematics. For example, figures presented at the session show that women currently comprise about 35% of the
European Meetings

mathematicians in Italy while in 1987 there were only 3% women among mathematicians in West Germany.

I. M. Gelfand (left) and V. I. Arnold. Photo courtesy of Leon Betute.

At the Round Table on Mathematics and the General Public, Alexei Sossinsky of Moscow described some of the programs that mathematicians in the former Soviet Union have developed to cultivate an interest in mathematics among young people. As the former editor of Kvant, a mathematics and science magazine for young people, Sossinsky has had extensive experience in this area. He described problem-solving seminars, popular mathematics books, olympiads, summer schools, Gelfand’s mathematics correspondence school, and other efforts that have contributed to the distinctive Russian tradition of inspiring mathematical interest in young people.

Many have said that Russian mathematics could all but disappear in ten to fifteen years; Sossinsky stated that the only source of optimism is these kinds of educational programs, though even their fate is uncertain at this time. (Please see the article on p. 688 in this issue for information on the AMS program to assist mathematics in the former Soviet Union.)

There were other unusual features of the Congress that made it clear that mathematics doesn’t just consist of a bunch of experts sitting and talking only to each other. One example was the “Junior Congress”, a three-day event for high school students that kicked off on the second day of the ECM with an afternoon and evening program for high school students featuring talks by mathematicians and by the students themselves. There was also an exhibit called Horizons Mathématiques, which was open to the public and which illustrated various mathematical concepts through manipulatives, puzzles, drawings, soap bubbles, and so on. In addition, David Singmaster of South Bank University in London assembled an extensive exhibit of puzzles containing mathematical content, and there was a program of mathematical films and videotapes shown on three afternoons, as well as a number of musical presentations.

The plan is to hold a European Congress every four years, between the International Congresses. The next ECM, scheduled for Budapest in 1996, will have a tough act to follow to surpass the lively and varied events and the high scientific quality of the Paris conference. But most likely the Budapest Congress will have a flavor all its own, so Vive la différence.

Allyn Jackson
Staff Writer

Why the Boundary of a Round Drop Becomes a Curve of Order Four

University Lecture Series, Volume 3  •  A. N. Varchenko and P. I. Etingof

This monograph concerns the problem of evolution of a round oil spot surrounded by water when oil is extracted from a well inside the spot. Varchenko and Etingof discuss this topic and other recent work in the theory of fluid flows with a moving boundary. Problems are included at the end of each chapter, and there is a list of open questions at the end of the book.

Contents
Mathematical model; First integrals of boundary motion; Algebraic solutions; Contraction of a gas bubble; Evolution of a multiply connected domain; Evolution with topological transformations; Contraction problem on surfaces.

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NSF Graduate Fellowship Program

NSF Graduate Fellowship Panel
Sylvia Wiegand, Chair

We have just served on the panel that awards National Science Foundation (NSF) Graduate Fellowships in mathematics. Part of the purpose of this letter is to explain the selection process to the mathematics community, especially to potential applicants, advisors, and writers of letters of recommendation.

I. The mathematics panel reviewed 257 applications for twenty-six awards. The number of awards in a given discipline is roughly proportional to the number of competitive applications in that discipline. In other words, to a certain extent, we would have more awards in mathematics if more students applied. Physics and chemistry each had almost twice as many applications as mathematics, with a correspondingly greater number of awards; there were 7,723 applications in all fields.

II. In view of the large number of highly qualified candidates and the small number of fellowships, the award of "honorable mention" should be viewed as a competitive recognition of significant achievement.

As an illustration of the quality of the applicants for mathematics, fifteen percent had perfect GRE subject test scores and three and a half percent (nine) had perfect scores on all four parts of the GRE. (Scores on these exams are just one consideration; letters of recommendation, grades, and individual student statements are also very important.)

III. Carefully written and appropriate letters of recommendation are extremely helpful in the evaluation process. In particular, comparisons between two or more applicants make the panel's job easier, and comparisons to successful mathematicians at a similar stage of development are especially influential. Students should be advised that letters from scientists other than mathematicians tend to carry less weight and letters from nonscientists carry virtually no weight at all.

IV. The mathematics panel found research experience desirable but did not consider it essential to a successful application. Many of the applicants have been through one of the Research Experiences for Undergraduates programs sponsored by the NSF; several have even published papers.

The panelists viewed rambling and unfocused statements (under career goals, research experience) as detrimental. It is best to be concise and to the point. Panelists must review many applications in a short time, and information buried in long-winded statements will most likely be overlooked. Applicants should play to their strengths; all relevant experiences should be mentioned.

V. First-year graduate students may apply, as well as senior undergraduates. There are fewer of the former than might be expected—just sixty-four this year, and seven of them received awards. Possibly the graduate students have difficulty finding letter writers at their new institutions. It may be that the fellowships should be better advertised to this group; faculty should be encouraged to bring the fellowships to the attention of their advisees/students.

VI. In its announcement of the competition, the NSF encourages applications from members of minority groups, women, and persons with disabilities, although the panelists are expected to disregard race, sex, and handicap in their deliberations. There is a separate program for minority fellowships. (Many students compete in both.) There is a separate program for women in engineering. There is also additional financing for persons with handicaps who are successful (defined to include honorable mention) in the initial competition.

However, there is no special program for outstanding women in mathematics. The panel wondered if such a program might be initiated for women in mathematics, because (1) there are still various barriers that put women at a disadvantage in this competition and (2) we feel that additional incentives for women would inspire more women to pursue mathematics.

The panel has noticed that women may not do as well in our evaluation process due to a number of factors: perhaps they have had a harder time finding mentors for research projects; women often score lower than men on tests (although they...
may have better grades than men); and references may be written with a bias towards men. The panelists are sensitive to these problems, but have not felt that women's applications should be evaluated differently from men's. The panelists would like to see extra fellowships set aside specifically for women. We need more highly qualified women graduate students, more women writing excellent Ph.D. theses, and more women with outstanding careers in mathematics.

There were fewer female applicants this year (eighty-three) than last year (ninety), although overall the number of applicants went up (257 applicants this year versus 222 last year). This year only three fellowships were awarded to women in mathematics; last year ten were awarded to women. (Last year there were thirty-two awards in all, whereas this year there were only twenty-six.) The picture in computer science and in applied mathematics is equally bleak—last year five fellowships went to women in computer science, this year, two; last year four went to women in applied mathematics, this year, three.

Note: If mathematicians and others are interested in an extra program for women, they should write to Dr. Terry Porter, Division Director for Research Career Development, and to the Division Director for Mathematical Sciences. (Presently that director is Dr. Judith Sunley; for the next few months it will be M. Kent Wilson on an acting basis; after that, another individual will be named to the position.)

VII. The panelists present the NSF with three unordered, alphabetized lists. All the applicants in the first list and half the applicants in the second receive awards. The awardees in the second group are chosen by the National Science Foundation, based on geographical and other considerations. This year the first two lists comprised six and eight percent of the applicants respectively. The third list is for those who will receive honorable mention along with those in group two who don't get awards.

VIII. In giving these details, we are concerned that mathematics faculties should not discourage good mathematics students from applying for an NSF Graduate Fellowship. We submit that it is beneficial for our profession and for students to go through the process of applying, even if the application does not result in an award. We hope faculty will explicitly encourage students who are considering graduate school to apply. This would yield: an early opportunity to think about graduate school; an early opportunity to refine thinking about what one wants to accomplish in graduate school; and experience in writing about oneself and one's goals with respect to mathematics.

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Translations of Mathematical Monographs

Multidimensional Residues and Their Applications

A. K. Tsikh

Volume 103

Tsikh's book presents a systematic account of residues associated with holomorphic mappings and indicates many applications. The book begins with preliminaries from the theory of analytic sets, together with material from algebraic topology that is necessary for the integration of differential forms over chains. Tsikh then presents a detailed study of residues associated with mappings that preserve dimension (local residues). There is also a treatment of residues associated with mappings that reduce dimension—that is, residues of semimeromorphic forms, connected with integration over tubes around nondiscrete analytic sets.

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Computers and Mathematics

This month's column

Primality testing and related computational pastimes frequently put mathematics onto the pages of the national press. I suspect that the general impression created in the public mind by such publicity is that computers will, one day soon, put most mathematicians out of a job. Of course, the reality is—as it is in almost all areas where the computer has had a significant impact—that the computer revolution has certainly changed the nature of what many mathematicians do, and the way they do it, but, if anything, has created more need for mathematicians, not decreased it. I myself fall into the camp of those who think that almost any publicity is good publicity, and pure mathematicians need publicity just as much as any other group, and perhaps more so given our almost invisible profile until recently. But I know that there are many who disagree with this view.

Still, I think we probably all agree that, publicity or not, computational investigations, even in areas of mathematics that are of the "recreational" variety that appeal to journalists, can lead to interesting, nontrivial, and worthwhile mathematical results. Such is the case with Carmichael numbers. Earlier this year, Red Alford, Andrew Granville, and Carl Pomerance of the University of Georgia proved that the set of Carmichael numbers is infinite, thereby solving a problem that has been around for some 80 years or so.

Their joint paper There are infinitely many Carmichael numbers presently exists only in preprint form, but I asked Granville to write an expository article on the work for this column. The result constitutes this month's lead article.

Following on from Granville's piece, Barry Simon presents the results of a series of benchmark tests he has run on a number of computer mathematics systems. The format is much the same as in Simon's previous benchmark evaluation, which he reported in this column in September 1990 (Notices, Volume 37, Number 7, pp. 861–868).

Finally, if any readers are interested in reviewing software for this column, please let me know. The information I need is the equipment at your disposal and the kinds of software you would be interested in reviewing. I currently have more volunteers than I need for trying out NeXT software, but need more people prepared to review software for Macs or PCs.

Editor's address:

Professor Keith Devlin
Department of Mathematics and Computer Science
Colby College
Waterville, Maine 04901

Correspondence by electronic mail is preferred, to:

kjdevlin@colby.edu.

Edited by Keith Devlin

Primality Testing and Carmichael Numbers

Andrew Granville*

The problem of distinguishing prime numbers from composite numbers is one of the most fundamental and important in arithmetic. It has remained as a central question in our subject from ancient times to this day1, and yet still fascinates and frustrates us all. From the very definition of primality, that an integer

\[ n \text{ is prime if it has no divisor between 2 and } \sqrt{n}, \]

one can evolve a simple test for primality: Just check whether any integer \( d \) between 2 and \( \sqrt{n} \) actually divides \( n \). This is an easily implemented test for, say, \( n = 107 \) or \( n = 11035 \), but how about for \( n = 123456789012345677 \)? This requires over a billion test divides, and if one were to try to verify that a given 100 digit integer \( n \) is prime in this way it would take longer than the remaining lifespan of our universe, even on an impossibly fast computer!

One thus needs a more sophisticated approach to handle large numbers. Perhaps a different definition of prime numbers will furnish us with a quicker method? One such definition follows from Wilson's Theorem (1770):

\[ n \text{ is prime if and only if } n \text{ divides } (n-1)! + 1. \]

So, to find out whether \( n \) is prime, we multiply together all integers less than \( n \), add 1, and see whether the resulting number is divisible by \( n \). However, this requires multiplying \( n - 3 \) pairs of numbers together, as opposed to \( \sqrt{n} \) test divides earlier, so it takes even longer than our previous method.

The ancient Chinese made the startling discovery that

If \( n \) is prime then \( n \) divides \( 2^n - 2 \),

which implies that

(1) If \( n \) does not divide \( 2^n - 2 \) then \( n \) is composite (that is, not prime).

So we now have a new, and quite different, criterion, which will tell us that certain numbers \( n \) are composite. However, if

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1from Article 329 of Gauss's Disquisitiones Arithmeticae (1801)

*Andrew Granville is an Assistant Professor of Mathematics at the University of Georgia in Athens, Georgia. He can be reached by email at: andrew@sophie.math.uga.edu.
a number fails this criterion (that is, if \( n \) does divide \( 2^n - 2 \), then it doesn't, \textit{a priori}, tell us that \( n \) is prime; but let's check it out:

\[
\begin{array}{c|c}
2 \text{ divides } 2^2 - 2 &= 2 \\
3 \text{ divides } 2^3 - 2 &= 6 \\
4 \text{ doesn't divide } 2^4 - 2 &= 14 \\
5 \text{ divides } 2^5 - 2 &= 30 \\
6 \text{ doesn't divide } 2^6 - 2 &= 62 \\
7 \text{ divides } 2^7 - 2 &= 126 \\
8 \text{ doesn't divide } 2^8 - 2 &= 254 \\
9 \text{ doesn't divide } 2^9 - 2 &= 510 \\
101 \text{ divides } 2^{101} - 2 \\
103 \text{ divides } 2^{103} - 2 \\
105 \text{ doesn't divide } 2^{105} - 2 \\
107 \text{ divides } 2^{107} - 2 \\
109 \text{ divides } 2^{109} - 2 \\
111 \text{ doesn't divide } 2^{111} - 2 \\
\end{array}
\]

In all of these examples we observe that \( n \) is prime exactly when \( n \) divides \( 2^n - 2 \), and is composite otherwise. According to E. T. Bell, the ancient Chinese thought that this is always true\(^2\), as did Leibniz many centuries later. However, the (smallest such) example, \( n = 341 \), refutes this belief since \( 341 = 11 \times 31 \) is composite, yet 341 divides \( 2^{341} - 2 \).

Further computation shows that such composite \( n \) seem to be rare and so we define a composite number \( n \) to be a \textbf{base 2 pseudoprime} if \( n \) divides \( 2^n - 2 \). To exhibit quite how rare these are, note that up to \( 10^{10} \) there are around 450 million primes, but only about fifteen thousand such base 2 pseudoprimes, while up to \( 2.5 \times 10^{10} \) there are over a billion primes, and yet fewer than 22 thousand base 2 pseudoprimes. So, if you were to choose a random number \( n < 2.5 \times 10^{10} \) for which \( n \) divides \( 2^n - 2 \) then there would be a less than one-in-fifty-thousand chance that your number would be composite.

Testing whether \( 2^{n-1} \equiv 1 \mod n \) is easily implemented on a computer, as follows:

(i) Write \( n - 1 \) in base 2, say \( n - 1 = 2^a + 2^{a+1} + \cdots + 2^1 \) where \( a_k > a_{k-1} > \cdots > a_1 \)

(ii) Compute \( r_j \equiv 2^k \mod n \) for \( 0 \leq j \leq a_k \), by taking \( r_0 = 2 \) and \( r_{j+1} \equiv r_j^2 \mod n \) for each \( j \geq 0 \)

(iii) Finally, since \( 2^{n-1} = 2^{2^k} \cdot 2^{2^{k-1}} \cdots 2^1 \), we have \( 2^{n-1} \equiv r_{a_k} r_{a_{k-1}} \cdots r_{a_1} \mod n \)

This algorithm requires no more than \( 20 \log n \) operations so that, for a 40 digit number \( n \), this "pseudoprime test" takes a few million operations (a few seconds on a PC) whereas test division takes more than a billion billion operations (over a thousand years on a PC). It has been suggested that one might obtain a practical primality test by writing down a list of all base 2 pseudoprimes, and then, if \( n \) divides \( 2^n - 2 \) but is not on the list, one knows that \( n \) is a prime. Since there are less than 22 thousand base 2 pseudoprimes up to \( 2.5 \times 10^{10} \), this method works well in this range, and will continue to work well as long as the base 2 pseudoprimes remain so scarce. However, this won't always be so since Malo proved, in 1903, that there are infinitely many odd composite base 2 pseudoprimes by showing that if \( n = ab \) (with \( a, b > 1 \)) is such a number, then so is \( n' = 2^n - 1 \).\(^3\) This is proved by observing that, since \( a \) divides \( n \) which divides \( n' - 1 \), thus \( x^a - 1 \) divides \( x^n - 1 \), which divides \( x(x^{n-1} - 1) = x^{n'} - x \), and so, in particular with \( x = 2 \), we get that \( 2^n - 1 \) divides \( 2^n - 1 = n' \) which divides \( 2^{n'} - 2 \).

Our hope of obtaining a complete list of base 2 pseudoprimes is thus doomed, but we might still find all base 2 pseudoprimes up to some large number \( x \). However, in 1982, Pomerance showed that there are more than \( e^{\log x} \) base 2 pseudoprimes \( \leq x \), for some constant \( c \), \( 0 < c < 1 \), once \( x \) is sufficiently large.\(^4\) This is quite a fast-growing function of \( x \) and shows that our hoped for, easy and quick primality test would not be practical for large values of \( x \). So what else can we do?

On October 18th, 1640 Fermat wrote, in a letter to his confidante Frenicle, that the fact that \( n \) divides \( 2^n - 2 \) whenever \( n \) is prime is not an isolated phenomenon. Indeed that, if \( n \) is prime then

\[
\begin{align*}
(2) \text{ } n \text{ divides } a^n - a \text{ for all integers } a; \\
\text{ which implies that } \\
\text{ If } n \text{ doesn't divide } a^n - a \text{ for some integer } a \text{ then } n \text{ is composite.}
\end{align*}
\]

So instead of considering pseudoprimes to base 2, we can consider pseudoprimes to any base \( a \): it turns out that such pseudoprimes are rare, though some do exist. However, since base 2 pseudoprimes are rare, and base 3 pseudoprimes are also rare, one would guess that numbers that are both base 2 and base 3 pseudoprimes must be extremely rare; perhaps none exist at all? Unfortunately some do exist, such as 2701, which divides both \( 2^{2701} - 2 \) and \( 3^{2701} - 3 \), yet \( 2701 = 37 \times 73 \) is composite. Numbers that are pseudoprimes to bases 2, 3, and 5 simultaneously should be even rarer, but again do exist, for instance \( n = 181 \times 361 \); and, indeed, there are examples for any finite set of bases. So maybe we should ask whether there are any composite numbers \( n \) that are pseudoprime for every base \( a \), that is, for which (2) holds. Such a number \( n \) would have to have certain extraordinary properties:

(i) \( n \) must be squarefree, else if \( p^2 \) divides \( n \) then \( p^2 \) divides \( n \) divides \( p^n - p \) which is false.

(ii) If prime \( p \) divides \( n \) then \( p - 1 \) must divide \( n - 1 \), for if \( a \) is a primitive root mod \( p \) then \( a \) has order \( p - 1 \mod p \), but \( a^{n-1} \equiv 1 \mod p \) by (2).

In 1899 Korselt\(^5\) observed that these two conditions imply that (2) holds (which the reader may verify—hint: use the Chinese Remainder Theorem). We thus state

Korselt's criterion: \( n \) divides \( a^n - a \) for all integers \( a \) if and only if \( n \) is squarefree and \( p - 1 \) divides \( n - 1 \) for all primes \( p \) dividing \( n \).

So now, to determine whether (2) holds for \( n \), we need only

\(^2\)However, it is now believed that Bell had no evidence of this, but was embellishing a good story. Just as standards of mathematical rigor have greatly improved over the last hundred years, so too the standards of rigor of mathematical history.

\(^3\)Then we get the sequence \( n, 2^n - 1, 2^{2^n - 1} - 1, 2^{2^{2^n - 1} - 1} - 1, \ldots \) of base 2 pseudoprimes by iterating this observation.

\(^4\)For those readers not accustomed to such "estimates", we note that, \( e^{\log x} \) is larger than any given power of \( \log x \), and smaller than any given (positive) power of \( x \), for sufficiently large \( x \).

\(^5\)responding to a "Problème Chinois" from L’Intermédiaire des Mathématiciens, a turn-of-the-century French journal similar to today’s The American Mathematical Monthly.
verify a few simple properties of its prime factors. Korselt did not exhibit an example of such an integer \( n \), and he might have thought that no such \( n \) exist. However, such \( n \) do exist, as was discovered by Carmichael in 1910, the smallest being \( 561 = 3 \times 11 \times 17 \). These numbers are now known as Carmichael numbers, but surely would have been known as Korselt numbers had he just done a few computations!

The first few Carmichael numbers are

\[
\begin{align*}
561 &= 3 \times 11 \times 17 \\
1105 &= 5 \times 13 \times 17 \\
1729^* &= 7 \times 13 \times 19 \\
2465 &= 5 \times 17 \times 29 \\
2821 &= 7 \times 13 \times 31 \\
\end{align*}
\]

Notice how they all have three prime factors. To obtain one with four prime factors we must go out to

\[41041 = 7 \times 11 \times 13 \times 41\]

and for five prime factors to

\[825265 = 5 \times 7 \times 17 \times 19 \times 73.\]

Carmichael computed fifteen such numbers in his 1912 paper and stated that "this list might be indefinitely extended". However, it soon became apparent that it was going to be difficult to prove that his list could be so lengthened, and this statement has since been considered an open problem.\(^6\)

Korselt’s criterion may be rewritten as follows:

\[
n = p_1p_2 \cdots p_k \text{ is a Carmichael number if and only if the } p_i \text{'s are distinct and } L = \text{LCM}[p_1 - 1, p_2 - 1, \ldots, p_k - 1] \text{ divides } n - 1.
\]

So, to verify that those numbers listed above are indeed Carmichael numbers, we only need check that \( L = 80 = \text{LCM}[2, 10, 16] \) divides 560, that \( L = 48 \) divides 1104, that \( L = 36 \) divides 1728, that \( L = 112 \) divides 2464, that \( L = 60 \) divides 2820, that \( L = 120 \) divides 41040, and finally that \( L = 144 \) divides 825264. Notice that \( L \) is extremely small compared to \( n - 1 \) in each example, which gives us a hint as to how to find more Carmichael numbers: Let’s try to find a set of primes where these primes minus one have a surprisingly small common multiple. For example, since the prime divisors of 1729 are \( p = 6 \times 1, \ q = 12 + 1, \ r = 18 + 1 \) giving \( L = 36 \), we can generalize this to

\[
p = 6k + 1, \ q = 12k + 1, \ r = 18k + 1,
\]

\(^*\)1729 is best known from the story of when Hardy visited Ramanujan in the hospital, and pronounced his taxicab number, 1729, to be a dull number. Ramanujan refuted this by noting that it is the smallest number that is the sum of two cubes in two different ways. However, Ramanujan didn’t say that 1729 is also interesting as being the third smallest Carmichael number! Carl Pomerance further observes that the second smallest Carmichael number, 1105, is the sum of two squares in more ways than any preceding number. We leave it to the reader to come up with the analogous remark for 561, the smallest Carmichael number!

\(^6\)See Alford’s forthcoming paper Chasing Carmichael numbers for a revealing discussion of Carmichael’s paper.

for integers \( k \geq 1 \), giving \( L = 36k \). Since \( pqr - 1 = 36k(36k^2 + 11k + 1) \), Korselt’s criterion tells us that \( pqr \) is a Carmichael number provided each of \( p, q, \) and \( r \) are prime. It is easy to find many values of \( k \) for which the three numbers in (3) are simultaneously prime, but can we prove that there are infinitely many such \( k \)? This is considered an outstandingly difficult open problem in analytic number theory, and although experts are certain that infinitely many such \( k \) do exist, there have been no plausible ideas as to how to prove such a result.

One can obtain other sequences in which one expects infinitely many prime triplets or quadruplets or quintuplets, which would give rise to infinitely many Carmichael numbers, for instance

\[
(12k + 5)(36k + 13)(48k + 17), \quad (6k + 7)(12k + 13)(18k + 19),
\]

\[
(28k + 5)(112k + 17)(18k + 17), \quad (30k + 7)(60k + 13)(150k + 31),
\]

\[
(180k + 7)(300k + 11)(360k + 13)(1200k + 41);
\]

but it seems unlikely that this approach will lead to a proof that there are infinitely many Carmichael numbers in the foreseeable future.

Let \( C(x) \) be the number of Carmichael numbers up to \( x \).

The following table gives the number of Carmichael numbers up to various values of \( x \):

<table>
<thead>
<tr>
<th>( x )</th>
<th>( C(x) )</th>
<th>Year</th>
<th>Discoverer(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 10^3 )</td>
<td>1</td>
<td>1910</td>
<td>Carmichael</td>
</tr>
<tr>
<td>( 10^5 )</td>
<td>7</td>
<td>1912</td>
<td>Carmichael</td>
</tr>
<tr>
<td>( 10^6 )</td>
<td>16</td>
<td>1916</td>
<td></td>
</tr>
<tr>
<td>( 10^7 )</td>
<td>43</td>
<td>1925</td>
<td></td>
</tr>
<tr>
<td>( 10^8 )</td>
<td>105</td>
<td>1938</td>
<td>Poulet</td>
</tr>
<tr>
<td>( 10^9 )</td>
<td>646</td>
<td>1975</td>
<td>Swift</td>
</tr>
<tr>
<td>( 10^{10} )</td>
<td>1547</td>
<td>1980</td>
<td>Pomerance, Selfridge, Wagstaff</td>
</tr>
<tr>
<td>( 2.5 \times 10^{10} )</td>
<td>2163</td>
<td>1990</td>
<td>Jaeschke</td>
</tr>
<tr>
<td>( 10^{11} )</td>
<td>3605</td>
<td>1992</td>
<td>Pinch</td>
</tr>
<tr>
<td>( 10^{12} )</td>
<td>8241</td>
<td>1999</td>
<td>Jaeschke</td>
</tr>
<tr>
<td>( 10^{13} )</td>
<td>19279</td>
<td>1992</td>
<td>Pinch</td>
</tr>
<tr>
<td>( 10^{14} )</td>
<td>44706</td>
<td>1992</td>
<td>Pinch</td>
</tr>
<tr>
<td>( 10^{15} )</td>
<td>105212</td>
<td>1992</td>
<td>Pinch</td>
</tr>
</tbody>
</table>

This data suggests that there must indeed be infinitely many Carmichael numbers, even though they remain fairly scarce all the way up to \( 10^{15} \). In 1949 Paul Erdős showed quite how scarce Carmichael numbers are, by proving that the sums of their reciprocals converge; it has since been proved that

\[
C(x) \leq x^{1/2 - 12\log \log x} / \log x
\]

\(^4\)For those not accustomed to such estimates, this is larger than \( x^{1+\epsilon} \) for any fixed \( \epsilon > 0 \), but smaller than any given positive constant times \( x \), once \( x \) is sufficiently large.

In 1956 Erdős took a radically different approach to constructing Carmichael numbers. Earlier we noted that \( L = \text{LCM}[p_1 - 1, \ldots, p_k - 1] \) is much smaller than \( n - 1 \) for most Carmichael numbers \( n = p_1 \cdots p_k \). However, for a typical set of primes, \( \{p_1, \ldots, p_k\} \), there is no particular reason to expect this to happen; indeed we’d expect \( L \) to be just a bit smaller

\[^3\]Unless the primes, whose sums of reciprocals diverge.
than \( n - 1 \). So to construct Carmichael numbers we must find some way of forcing \( L \) to be small. In our constructions above (like (3)), we selected our primes \( p \) to have certain special forms: this guaranteed that the \( p - 1 \) had large common divisors, forcing \( L \) to be small compared to \( n - 1 \). Erdős approached this problem from the other direction. Instead of choosing primes in special ways so as to force \( L \) to be small, he chose \( L \) so that there are many primes \( p \) for which \( p - 1 \) divides \( L \). Once this is done, one need only find a subset of these primes, say \( p_1, p_2, \ldots, p_k \), for which \( n = p_1 p_2 \cdots p_k \equiv 1 \pmod{L} \), to obtain the Carmichael number \( n \) — one sees that \( n \) is a Carmichael number, by using Korselt's criterion, since \( n \) is squarefree, and each \( p_i - 1 \) divides \( L \), which divides \( n - 1 \). Let’s review.

**Erdős's construction of Carmichael numbers**

(i) Select integer \( L \);

(ii) Determine primes \( p \) for which \( p - 1 \) divides \( L \), but \( p \) does not divide \( L \);

(iii) Find a subset of the primes obtained in (ii) whose product is \( \equiv 1 \pmod{L} \).

This product is a Carmichael number.

As an example, let’s try (i) \( L = 120 \). The primes \( p \) that do not divide 120, but for which \( p - 1 \) does divide 120, are (ii) 7, 11, 13, 31, 41, 61. Checking through all subsets of these primes we find that (iii) 41041 = \( 7 \times 11 \times 13 \times 41 \equiv 1 \pmod{120} \), and 172081 = \( 7 \times 13 \times 31 \times 61 \equiv 1 \pmod{120} \), and 852841 = \( 11 \times 31 \times 41 \times 61 \equiv 1 \pmod{120} \), so that 41041, 172081, and 852841 are all Carmichael numbers.

With bigger, highly composite, values of \( L \), we expect to find many more Carmichael numbers. Indeed, if we obtain \( r \) different primes in step (ii) above, then there are \( 2^r - 1 \) distinct products of nontrivial subsets of these primes. It seems plausible that roughly \( 1/L \) of these products are \( \equiv 1 \pmod{L} \), and so we would have approximately \( 2^r/L \) Carmichael numbers so formed. It can be shown that if \( L \) is the product of all the primes up to some sufficiently large point, then we can obtain more than \( 2 \log^2 L \) primes in (ii), and so we’d expect more than \( 1/\log^2 L \) such Carmichael numbers. Erdős gave a similarly reasoned argument to justify his conjecture that for any fixed \( \epsilon > 0 \), there are more than \( x^{1-\epsilon} \) Carmichael numbers up to \( x \), once \( x \) is large enough.\(^8\)

However, we see from our table above that the Carmichael numbers remain scarce all the way up to \( 10^{15} \), which is surprising if Erdős’s conjecture is to be believed. Indeed, Dan Shanks, in his book *Solved and Unsolved Problems in Number Theory*, challenged those who believe Erdős’s conjecture to produce a value of \( x \) for which there are more than \( x^{1/2} \) Carmichael numbers up to \( x \). (Note that up to \( x = 10^{15} \), there are only a few more than \( x^{1/3} \) Carmichael numbers.)

It is important to note that Erdős’s construction is impractical, both theoretically and computationally, if one doesn’t know how to find products, of the primes produced in (ii), that are \( \equiv 1 \pmod{L} \), as required for (iii). At the beginning of this year, there were fewer than ten thousand Carmichael numbers known, and it seemed to be a very difficult task to find many more. Then, suddenly on January 21, “Red” Alford announced that he had proven the existence of at least \( 2^{128} \) Carmichael numbers! Unlike previous computations, which had sought all the Carmichael numbers up to some pre-assigned limit, or had found many in certain sequences (such as in that given by (3)), Alford modified Erdős’s construction so as to make it computationally practical. As we’ve already discussed, it is easy (computationally) to implement steps (i) and (ii) above, but how can we find subsets of the primes in (ii) whose product is \( \equiv 1 \pmod{L} \)? Here’s Alford’s idea:

(iii) Find a subset \( P \) of the primes in (ii), such that for every \( a, 1 \leq a \leq L \) with \( \gcd(a, L) = 1 \), there is a subset \( p_1, p_2, \ldots, p_k \) of \( P \) for which \( p_1 p_2 \cdots p_k \equiv a \pmod{L} \);

(iiib) Let \( Q \) be the primes found in (ii), excluding those belonging to \( P \). For any subset \( q_1, q_2, \ldots, q_r \) of these primes, let \( a \) be that integer, \( 1 \leq a \leq L \), that is \( \equiv (q_1 q_2 \cdots q_r)^{-1} \pmod{L} \). From (iii) we know that there is a subset \( p_1, p_2, \ldots, p_k \) of \( P \) for which \( p_1 p_2 \cdots p_k \equiv a+1 \pmod{L} \) (mod \( L \)), and so \( p_1 \cdots p_k q_1 \cdots q_r \equiv 1 \pmod{L} \). Therefore, by Erdős’s construction, \( p_1 \cdots p_k q_1 \cdots q_r \) is a Carmichael number.

Thus, for each different nontrivial subset of \( Q \) we’ve constructed a different Carmichael number, providing a total of at least \( 2^{2^{10}} - 1 \) Carmichael numbers. This method is very practical, since we don’t need to explicitly write down the Carmichael numbers constructed in (iiib) to be guaranteed of their existence; all we need know is that there is some product of the primes in \( P \) in the congruence class \( (q_1 q_2 \cdots q_r)^{-1} \pmod{L} \) corresponding to each subset \( q_1, q_2, \ldots, q_r \) of \( Q \).

It remains to find a suitable set \( P \) in (iii). To do this, suppose that the primes found in (ii) were \( p_1 < p_2 < \cdots < p_m \), and define \( R_j \) to be the set of products \( (p_m \cdots p_{j+1}) \) of the subsets of \( p_1, p_2, \ldots, p_j \). We easily obtain \( R_{j+1} \) from \( R_j \) by observing that \( R_{j+1} = R_j \cup \{ p_{j+1} R_j \} \) (mod \( L \)): \( r \in R_j \). Once we find \( j \) for which \( R_j \) is the set of all residue classes \( a \pmod{L} \) with \( 1 \leq a \leq L \) and \( (a, L) = 1 \), then we can take \( P = R_j \) and we’re done.

Alford worked with the example (i) \( L = 25 \cdot 3^3 \cdot 5^2 \cdot 7^2 \cdot 11 \), and found that there are (ii) 155 primes \( p \geq 13 \) such that \( p - 1 \) divides \( L \). By computing \( R_1, R_2, \ldots \) as above he got (iii) \( P = R_{27} \), that is, that every residue class \( a \pmod{L} \) with \( (a, L) = 1 \) is given by the product of some subset of the smallest 27 primes found in (ii). Thus if \( Q \) is the set of the largest \( 128 \) (\( 155 - 27 \)) primes found in (ii) then, as described above, each subset of \( Q \) corresponds to a Carmichael number, and we’ve proved the existence of at least \( 2^{128} - 1 \) Carmichael numbers.

So, in an afternoon’s work, Alford increased the number of Carmichael numbers known from fewer than \( 2^{10} \), to more than \( 2^{128} \). Certain faculty members, here at the University of Georgia, taunted the number theory group that there cannot be interesting finite sets that contain more than \( 2^{128} \) elements, and that surely Alford’s idea should provide sufficient impetus to finally prove that there are infinitely many Carmichael numbers.

\(^8\)Taking his argument to its limit, one expects \( C(x) \) to be approximately the size of the function in (4).
numbers. And indeed it did. The theorem that we eventually proved is

**Theorem.** (Alford, Granville, Pomerance—1992): There are more than \(x^{2/7}\) Carmichael numbers up to \(x\), once \(x\) is sufficiently large.

To make Erdős’s construction theoretically practical, one evidently needs a result which guarantees that, given enough primes satisfying (ii), there is some subset whose product is \(\equiv 1 \pmod{L}\). A theorem of van Emde Boas and Kruyswijk implies that if \(m > 2\) is the largest order of an element of the multiplicative group modulo \(L\), then such a subset exists provided there are more than \(m \log L\) primes satisfying (ii). A theorem of Prachar guarantees the existence of integers \(L\) for which there are more than \(\frac{L}{\log \log L}\) primes \(p\) satisfying (ii); however, this quantity is usually a lot smaller than \(m \log L\).

To avoid this difficulty one wishes to select \(L\) so that \(m\) is very small, but Prachar’s construction doesn’t allow this. So instead we showed the existence of integers \(L\) of the form \(L'k\) with \((L', k) = 1\), where the maximal order \(m'\) of an element modulo \(L'\) is extremely small, and there are more than \(m' \log L\) primes \(p\) satisfying (ii), each with the additional property that \(p \equiv 1 \pmod{k}\). The result of van Emde Boas and Kruyswijk then guarantees the existence of a subset of these primes whose product is \(1 \pmod{L'}\) and, since any such product is \(1 \pmod{k}\) (as each such prime is \(1 \pmod{k}\)), thus this product is \(1 \pmod{L}\), and so a Carmichael number, from Erdős’s construction.

Filling in the details of this outline involves some deep tools from analytic number theory, as well as combinatorial techniques involving groups and sets. This will all be described in detail in a forthcoming journal article.

One ingredient needed for the proof is a lower bound for the number of primes in certain arithmetic progressions: As is well known, there are asymptotically \(x/\log x\) primes up to \(x\), and we expect these to be more or less equally distributed amongst the arithmetic progressions \(a \pmod{d}\) with \((a, d) = 1\), provided \(d\) is a little smaller than \(x\). Currently, it is only known how to prove such a result if \(d\) is considerably smaller than \(x\), in fact smaller than a fixed power of \(\log x\). However, for our purposes, we proved

\[
\text{Fix } \epsilon > 0. \text{ If } x \text{ is sufficiently large then for all, but a few, integers } d \leq x^{1/2 - \epsilon} \text{ there are more than } x/2d \log x \text{ primes } \leq x \text{ in the arithmetic progression } 1 \pmod{d}.
\]

It is widely believed that such a result holds for any \(d \leq x^{1 - \epsilon}\). If true this implies Erdős’s conjecture, for we also proved

**Theorem.** (Alford, Granville, Pomerance—1992): Fix \(\epsilon > 0\). Assume that, for sufficiently large \(x\), the arithmetic progression \(1 \pmod{d}\) contains more than \(x/2d \log x\) primes up to \(x\) provided \(d \leq x^{1 - \epsilon}\). Then there are more than \(x^{1 - 2\epsilon}\) Carmichael numbers up to \(x\), once \(x\) is sufficiently large.

This theorem seems to guarantee that Erdős’s conjecture is correct. So, in answer to Shanks’s challenge to find an \(x\) for which \(C(x) > x^{1/2}\), one can extrapolate our tabulated values of \(\log C(x)/\log x\) to guess that one needs \(x\) to be around \(10^{60}\)—it wouldn’t be feasible to write down all the Carmichael numbers up to this point!!

So what does all this tell us about primality tests? Although there are various methods known that will verify that a given number is prime in a “small” number of steps (thanks to Miller, Goldwasser and Killian, Adleman and Huang, and others), they all consist of checking a large number of conditions (polynomial in the number of digits of \(n\)). It would be more elegant if one only needed to check a finite number of such conditions, but it now seems unlikely that any such method proposed thus far will work.

In particular, there are various widely-used software packages that assert that a given integer is prime if it is a “strong pseudoprime” for some given finite set of bases. However, we can prove that, for any given finite set of bases, there are infinitely many Carmichael numbers that are “strong pseudoprimes” to all the bases in that set. Such numbers would be falsely identified as prime by such software packages, so reader, beware!

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**Comparative CAS Reviews**

Barry Simon*

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**Symbolic Math: Problems and Solutions**

I’ve recently written a review for *PC Magazine* of five symbolic math packages (*Derive*, *Maple*, *Mathematica* for DOS, *Mathematica* for Windows, and *Reduce*)—it is scheduled for issue #14 of 1992 and should be out by the time this appears.

As in *PC Magazine’s* last round up in 1990, part of the test procedure was to supply the vendor with a list of twenty problems to solve with their software. We’ll present the problems and solutions here.

*Macsyma* was not included in this review because there hasn’t been a significant upgrade since it was reviewed in 1990; the vendor plans a new release later this year. *MathCAD 3.0* includes some symbols licensed from *Maple*, but it’s a small subset and doesn’t change *MathCAD’s* focus on quick and dirty calculations rather than medium/large projects.

Some comments on the problems and results before turning to the specifics (these are my opinions and not necessarily those of *PC Magazine*):

- *Reduce* and *Derive* will post the solutions on their electronic BBS. For *Reduce*, that’s the internet address *reduce-netlib@rand.org*

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*Barry Simon is a Professor of Mathematics at Caltech. He can be reached by email at: 76004.1664@compuserve.com.*
while for Derive it is 217-337-0926.
• This round of tests included some medium length projects (17, 20, and, to a lesser extent, 18 and 19) as well as short problems. But for many users, the true test is a long project, which just can’t be reasonably simulated under the time scales and circumstances of this review. You can get a feel for somewhat larger projects by looking at some of the books out on these programs—I especially recommend Gray and Glynn’s Exploring Mathematics with Mathematica (Addison Wesley, ISBN 0-201-52818-5, $31.95 PB, $42.95 HC).
• Timing tests were done on the short problems on a 386/25 with 15 MB of RAM for all the products (since the common kernel was involved, we only tested Mathematica for DOS). They are reported in Figure 1. The differences are much less significant than they were in 1990, enough so that I don’t regard them as important any more.
• To me, the biggest surprise is that neither Mathematica nor Maple would simplify Sqrt(4+2 Sqrt(3)) and that both got the wrong answer on the gravitational potential problem (3c)!
• All programs but Derive require a 386 or better. All but Derive recommend a coprocessor. Derive doesn’t need (or use) more than 640K of RAM. The others recommend at least 2 M of RAM, and Mathematica will perform poorly without 6 or 8 MB.
• Reduce is not yet a mature product (ironic since it is by far the “oldest” of these products). It is just starting to make the transition from hacker’s cult to commercial product. It has a solid core, an eclectic collection of library functions, no graphics, and a terrible interface. But that solid core language is critical and means that a competitive product could be out based on Reduce before long. They are already pushing to Windows with graphics and a better interface.
• Derive is little changed from 1990. There has been a key addition of an IF command that accepts iterative constructions. This let them solve virtually all our problems, although the code was often convoluted. Derive’s virtue was its low resource usage, which is important in a world of XTs. But over 60% of the PC compatibles sold in 1991 were 386s and that trend is only accelerating with 386 machines available with VGA and hard disk for under $1000! Derive makes no use of any hardware beyond an XT, and its graphics and interface are getting dated. The program is in need of a major overhaul if it is to survive.
• Robert Cringley, in his fun book Accidental Empires, states the 70/30 rule that most markets have a market leader with 70% of the market and a second company with the bulk of the remainder. While I’ve no idea of precise sales figures, it appears that Mathematica/Maple fit this pattern—Mathematica is the market leader in terms of perception, and Maple has the bulk of the rest.
• Maple’s DOS interface with the possibility of calling previous commands into a full screen editor and customizable menus is by far the slickest DOS interface. Mathematica for Windows’ notebook interface with some word processing and outlining features lets you produce live documents and is also impressive. Maple for Windows, due out later this year, could give it a run for the money on interface.
• Mathematica’s graphics are special. You get programmatic control of the graphics, links to standard graphics file types for import to desktop publishing programs, and more primitives. But its kernel is weak in the area of integration.
• I had a dramatic indication that how you code solutions can make a big difference. One vendor, who shall remain nameless, initially submitted a solution of problem 9 that took over 35 minutes to run. I expressed surprise at the time and that the solution was different from what I’d expected, which was just a set of rules. What I got by return email was a second solution that ran in under 2 secs!!
• Mathematica has added copy protection! It’s worse than merely having to type in your name and having the software branded because the program records hardware information. As happens so often with copy protection, there are glitches that burn users—I was unable to run QEMM with Mathematica without getting a four-question inquisition after EACH command as the copy protection kicked in. American business users rebelled against copy protection roughly five years ago and forced companies to drop it. Should scientists do less?

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<td>1m 12s</td>
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<td>15s</td>
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<td>2s (1 sol)</td>
<td>1m 20s (1 sol)</td>
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<td>6s</td>
<td>9s</td>
<td>43s</td>
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<tr>
<td>12b</td>
<td>BH</td>
<td>3s</td>
<td>NA</td>
<td>1m 36s</td>
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<tr>
<td>12c</td>
<td>1s</td>
<td>2s</td>
<td>3s</td>
<td>17s</td>
</tr>
</tbody>
</table>

Times are rounded, except any time less than 1s is listed as 1s.
BH: The problem was done by hand in multiple steps so no timing is possible.
NA: Couldn’t do problem.
Vendor Information

Note: These products have academic and/or site license discounts.

**Derive, Version 2.10**
Soft Warehouse
3660 Walalae Ave., Suite 304
Honolulu, HI 96818
808-734-5801
Price: $250; $289 for an HP 95LX Rom card
Student Edition: Available from Addison-Wesley,
800-527-5210, $50

**Derive Problem 1a:**
HILBERT(n):=VECTOR(VECTOR(1/(i+j-1),j, 1 ,n),i, 1 ,n)
HILBERT(30rc-1)
Then choose Simplify from the menu.
Note: While I could do the calculation, I was unable
to examine the answer or continue (except to exit) without
getting an out-of-memory error.

**Derive Problem 1c:**
Same as 1a, only choose Options Precision Exact 50,
then Options Notation Decimal, then use Approx rather than Simplify. Actually, you run out of memory if you ask for the
full inverse but you can ask for something like the maximum
element (which is where the time comes from). The vendor
remarks that even though the matrix elements are of order
10^42, taking 42 place accuracy suffices in Derive because of
the method of rational approximation of decimals that is used!

**Maple V, Version 1.1**
Waterloo Maple Software
160 Columbia St. West
Waterloo, Ontario, Canada N2L 3L3
519-747-2373
Price: $695
Student Edition: Available from Brooks/Cole,
408-373-0728, $99

**Maple Problem 1a:**
with(linalg):
h:=hilbert(30):
h:=inverse(h):
“With” loads an external library

**Maple Problem 1c:**
digits = 50
fh:=map(evalf,eval(h)):
ifh:=inverse(fh):
The map function says to apply evalf to each element
of the matrix and evalf forces rational numbers to be floating
point.

**Mathematica for DOS, Version 2.0**
Mathematica for Windows, Version 2.0
100 Trade Center Drive
Champaign, Ill. 61820
800-441-6284
217-398-0700
Price: $995 for Windows version;
$895 for enhanced DOS
(coprocessor) version;
$595 for standard DOS (won’t use a
coprocessor) version.
Student price for standard DOS version: $175

**Mathematica Problem 1a, c:**
HilbertMatrix[n_] := Table[1/(i+j - 1), {i,n},{j,n}]
matrix = HilbertMatrix[30];
inverse = Inverse[matrix];
t = SetPrecision[matrix,50];
inverse = Inverse[t];

**Mathematica Problem 1c:**
off rounded;

**Reduce, Version 3.4**
Calcode Systems
1057 Amoroso Place
Venice, CA 90291
310-399-7612
Price: $495
In the UK: Codemist Ltd,
“Alta”, Horsecombe Vale,
Combe Down, Bath BA2 5QR, UK +44-225-837-430
In Germany: Konrad-Zuse-Zentrum
fuer Informationstechnik Berlin,
Attn: Herbert Melenk,
Heilbronner Str. 10, D 1000 Berlin 31, GERMANY,
+49-30-89604-195

**Reduce general remark:** Expressions in the language end
in ; (answer displayed) or $ (answer not displayed). Comments
start with %.

**Reduce Problem 1a:** matrix m(30,30):
for i:=1:30 do for j:= 1:30 do m(i,j):= 1/(i+j-1);
1/m;

**Reduce Problem 1c:** Given the definition of m:
on rounded;
precision 50; 1/m;
off rounded;

The Problems and Solutions

(Note: Problems 2a, 2b, 3c, 4a, and 4b are suggested by
Kahane. Problem 12 is unchanged from last time.)

1. Hilbert Matrices: Invert a $30 \times 30$ Hilbert matrix—this
   is a matrix whose $i,j$ element (with elements starting at
   1,1) is
   \[(1/i+j-1).
   \]
   (a) First use exact rational arithmetic.
   (b) Then provide a way to estimate the number of decimal
   places needed to be sure that $M^\ast M^\ast (-1)$ is the identity to one
   part in $10^6$ and
   (c) provide the numerical inverse for this accuracy.
   Note: M has elements of order $10^42$ so 50 place accuracy
   was used for 1c.

2. Simplifications
   (a) Simplify \(4 + 2(3)\times(1/2)\) \times(1/2)
   (b) Simplify \((3+4I)^2(1/2)\) (Here I= sqrt of -1)
   (c) Expand Tan (X+Y)
(d) Compute to 6 digit accuracy (at least) \( \tan(10^{100}) \)

**Derive Problems 2a, b:** Type in and choose Simplify; worked fine.

**Derive Problem 2c:** Type in Manage Trigonometry Expand from the menu and then Simplify. Gives answer in terms of sin/cos; not tan.

**Derive Problem 2d:** Options Precision Exact N with N at least 107 (we used 200) and then Author and type in \( \tan(10^{100}) \). Approx will give answer which is

\[ 0.40123196199081435418575434365329495832387 \ldots \]

**Maple Problem 2a:** Such simplifications are not built in!

```maple
q2a := (4+2*3t(l/2)r(l/2));
t := convert(q2a,RootOf);
t1 := traceerror(evala(Normal(t))):
if t1 = lasterror then
tl := map(rhs, t1[2]);
else
a2a := convert(tl,radical);
fi;
```

**Maple Problem 2b:** This is built in!

```maple
a2b := sqrt(3+4*I);
```

**Maple Problem 2c:**

```maple
q2c := tan(x+y);
a2c := expand(q2c);
#optional: express in terms of tan(x) and tan(y)
normal(eval(subs(sin=(atan(tan(a)*cos(a)),a2c)));
```

**Maple Problem 2d:**

```maple
q2d := tan(10^{100});
a2d := evalf(evalf(q2d,106),6)
```

**Mathematica Problem 2c:**

```mathematica
Needs["Algebra`Trigonometry`"]
TrigReduce[Tan[x + y]]
gave the right answer. The Needs command loads an external library.
```

**Mathematica Problem 2d:**

```mathematica
N[Tan[10^{100}],110]
says to work to 110 place accuracy.
```

**Reduce Problem 2a:** Here’s the solution—had to be worked out “by hand”:

% The standard REDUCE simplifier doesn’t handle either of these cases
% directly, so we solve them as factorization problems.
load_package arnum;
defpoly sqrt3**2-3;
factorize(x**2- (4+2*sqrt3)); %Factoring over algebraic domain sqrt(3).
% So { 4 + 2
% (3t(l/2)} A(l/2)
% is one of the expressions:
%for each j in ws collect -sub(x=0,j);
off arnum;
Note: ws = workspace

**Reduce Problem 2b:** Similar solution to 2a

**Reduce Problem 2c:** Not built in but

% We show this solution to demonstrate REDUCE's pattern matching.
(tan(x+y) where {tan(rvx)=sin(x)/cos(x),
cos(rvx +rvy)=cos(x)*cos(y)-sin(x)*sin(y),
sin(rvx+rvy)=sin(x)*cos(y)+cos(x)*sin(y)})
where sin(x)=cos(x)*tan(x);

**Reduce Problem 2d:**

```reduce
on rounded;
precision 120;
print_precision 20;
tan(10^{100});
precision 12;
off rounded;
```

3. Symbolic Integration and Differentiation:

(a) Take the derivative of \( x^{10} \cdot (\cos (x^{5} \cdot \ln (x))) \)'(1/2)

(b) Symbolically integrate the derivative computed in 2(a)

(c) Compute the gravitational potential of a sphere in spherical coordinates—explicitly as a function of \( r \) compute the double integral in \( r, t \) for \( 0 < r < 1 \) and \( 0 < t < \pi \) of

\[ r^2 \cdot \sin (t) / \left( \{x^{2}+r^{2}-2xr \cos (t)\} \right)^{1/2} \]

**Derive Problem 3a:** Enter function and choose Calculus Differentiate x 1

**Derive Problem 3b:** “Derive can’t determine the antiderivative. For other systems I suggest that you save the derivative result and load it into a fresh session because they might simply remember the origin of the derivative.” (which is what I did!)

**Derive Problem 3c:** Enter

```
INT(INT(r^2*Sin(theta)/Sqrt(x^2+r^2-
```

---

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2*x*r*COS(theta),theta,0,pi),x,0,1)
and choose Simplify from the menu. The form of the answer
given was (x^2+2*x-2)*ABS(x-1)/(6*x)+x^2/2+2*x-2)*ABS(x+1)/
(6*x). This was the only automated correct solution!

Maple Problem 3a:
q3a := x^110 * ( cos (x^5 * ln (x) ) )^(1/2);
a3a := diff(q3a,x);

Maple Problem 3b:
a3b := int(a3a,x);
The answer came out in a complicated rewriting of the
original function, to wit:
1/2 sqrt(2) *(alb+ c/b)
where a,b,c were written out with (here d = I
x^5)
b = sqrt (x^2d)+1
a = x^3/2 d + 10
c = x^(-1/2 d + 10).

Mathematica Problems 3a,b:
deriv = D[x10* (Cos[x5]*log (x))^(1/2),x]
worked but Integrate[deriv,x] did not return a completely
integrated expression.

Mathematica Problem 3c:
Integrate[r^2 Sin[th]/(r^2 - 2 x r
Cos[th])^(1/2),{r,0,1},{th,0,pi}]
returned
(2 - 3x)Sqrt[(1 - x^2)] + Sqrt[(1 + x^2)](2 + 3x)
-6x + 6x^2
which is the wrong answer for x<1 (but correct if x>1).

Reduce Problems 3a, b:
df(x^10*(cos (x^5 * log (x) ) )^(1/2),x);
int(ws,x);

Reduce Problem 3c: Reduce doesn't do definite integrals.
So a solution by hand was provided where, at a critical point,
the sign of a square root was flipped!

4. Limits
(a) Compute the limit as x goes to infinity of

\[ \frac{\log(x-a)}{(a-b)(a-c)} + \frac{\log(2+x-b)}{(b-c)(b-a)} + \frac{\log(x-c)}{(c-a)(c-b)} \]

(b) Compute the limit as x goes to infinity of the inverse

1/\[exp(x) - exp \{ x - (x-2) \} \]

Derive Problem 4a,b: Enter the function in author mode
and then choose Calculus Limit from the menus; infinity is
entered as "inf".

Maple Problem 4a: q4a := 1/(exp(x) - exp(x-1/x^2));
a4b := limit(expand(q4a),x=inf);
The answer is 0.

Mathematica Problem 4a:
Limit[Log(x - a)/(a-b)(a-c)] +
Log(2 - x-b)/(b-c)(b-a) +
Log(x-c)/(c-a)(c-b), x-> Infinity]
provided the right answer.

Mathematica Problem 4b:
Needs["Calculus\'Limit"]
Limit[1/(E^x - E^(x-x(2))), x-> Infinity]

Reduce Problem 4a:
limit(log(x-a)/(a-b)(a-c) + log(2x-b)/(b-c)(b-a))
+ log(x-c)/(c-a)(c-b),x,inf);

Reduce Problem 4b: Can't be handled directly so the
expression is simplified (by hand!) and l'Hopital's rule is
used. (Hardly counts as a solution).

5. Symbolic Sums and Factoring Polynomials
Factor over the rationals, the sum from 1 to N of j^40 as a
function of N.

Derive Problem 5: Use Calculus Sum to enter the sum
and then Simplify.

Maple Problem 5: a5a:=sum(j^40,j=1..N):
a5b:=factor(a5a);

Mathematica Problem 5:
Needs["Algebra\'SymbolicSum"]
sum= SymbolicSum[j^40,{j,1,n}];
Factor[sum]

Reduce Problem 5:
sum(j^40,j,1,n)$
on factor;
ws;
off factor;

6. Prime Testing
Find the next prime after 10^80

Derive Problem 6: Enter NEXT_PRIME(10^80) and
Choose Simplify from the menu. The answer is 10^80+129.
All these programs use a probabilistic approach so it is
guaranteed this is a prime but it surely is.

Maple Problem 6: a6:=nextprime(10^80);

Mathematica Problem 6:
Needs["NumberTheory\'NumberTheoryFunctions"]
NextPrime[10^80]

Reduce Problem 6: nextprime(10^80);
7. Integer Factoring
(a) Factor 98765432123456789 over the integers.
(b) Factor 13 over the Gaussian integers. (Gaussian integers are of the form \(a+bi\) with \(a, b\) integers; note factorization is NOT unique; you should try to find ALL factorizations into Gaussian primes.)

**Derive Problem 7a:** Enter the number and choose Factor from the menu.
The answer is 449 494927 444444443.

**Derive Problem 7b:** An expression was provided for primes that gave their Gaussian factors explicitly (depending on whether \(p\) is congruent to 1 or 3 mod 4). The prescription is to factor and then apply this function to each prime.

**Maple Problem 7a:** \(a7a:=\text{ifactor}(98765432123456789);\)

**Maple Problem 7b:** Gaussian factorization will be in the next release of Maple but for now the solution is via knowing the way Gaussian factorization takes place—namely solving a Diophantine equation:
\[
t := \{\text{isolve}(a^2+b^2=13)\};
\]
\(a7b := \text{map(proc(x) subs(x,a+l*b); "*evalc(13/" end,t);\)

**Mathematica Problem 7:**
\[
\text{FactorInteger}[98765432123456789]
\]
\(\text{FactorInteger}[13,\text{GaussianIntegers}\rightarrow\text{True}]\)
Currently, the only package that offers built-in support for Gaussian integers.

**Reduce Problem 7a:** (typical of mode turning on/off)
on ifactor;
factorize 98765432123456789;
off ifactor;

**Reduce Problem 7b:** Custom code

**Mathematica Problem 7:**
\[
\text{Sum}[j^(-6),\{j,1,\infty\}]
\]
\(\text{Integrate}[x^{(7/2)} \exp(-x^3),\{x,0,\infty\}];\)
\(\text{Integrate}[x^7 \exp(-x^3),\{x,0,\infty\}];\)

**Reduce doesn't do definite integrals per se, but solutions of sorts were provided:**

**Reduce Problem 8a:** Solved using residue calculus knowledge; hardly counts as a solution:
load_package taylor;
resid := \text{coeftn(taylortostandard taylor(z/tan(pi*z),z,0,6),z,6)}$

**Reduce Problem 8b,c:** Loaded Laplace Transform package and did change of variable by hand.

8. Infinite Sums and Integrals
(a) Compute the sum of \(j^{(-6)}\) for \(j\) from 1 to infinity.
(b) Compute the integral from 0 to infinity of \(x^{(7/2)} \exp(-x^3)\).
(c) Compute the integral from 0 to infinity of \(x^7 \exp(-x^3)\).
If possible see if the answer has an exact answer in terms of \(\pi\), etc.

**Derive Problem 8:** Enter the sum, integral via the Calculus submenu and Simplify. The answers are \(\pi^6/945\), \(\text{Sqrt}(\pi)/6\) and \(5/9 \times (\text{Gamma}(5/3))=0.501525\)

**Maple Problem 8:**
\(a8a:=\text{sum}(1/j^6,\{j,1,\infty\});\)
\(a8b:=\text{int}(x^{(7/2)} \exp(-x^3),\{x,0,\infty\});\)
\(a8c:=\text{int}(x^7 \exp(-x^3),\{x,0,\infty\});\)

**Mathematica Problem 8:**
\[
\text{Sum}[j^{(-6)},\{j,1,\infty\}]
\]
\(\text{Integrate}[x^{(7/2)} \exp(-x^3),\{x,0,\infty\}];\)
\(\text{Integrate}[x^7 \exp(-x^3),\{x,0,\infty\}];\)

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**Reduce Problem 8b,c:** Loaded Laplace Transform package and did change of variable by hand.

9. Rule Based Algebra
Consider the Clifford algebra in 10 variables, that is, the complex algebra with ten generators, \(s_0, \ldots, s_9\) obeying
\(s_i s_j + s_j s_i = 0\) if \(i\) is different from \(j\)
\(s_i s_i = 1\)
That is, multiplication is NOT commutative (but is assumed associative). Compute
\((s_0+s_1+\ldots+s_9)^5\)
NOTE: This must be done with general methods—it is cheating to use the invariance of the Clifford algebra under orthogonal transformations.

**Derive Problem 9:** A solution was provided with 55 lines of function definition of which the following is typical:
\[
\text{ADD}_A\_UX(u,v,j,k):="'
\text{IF}(j=0,\text{HEAD}(v,k),"'
\text{IF}(k=0,\text{HEAD}(u,j),"'
\text{IF}(\text{SIMILAR}(\text{ELEMENT}(u,j),\text{ELEMENT}(v,k)),"'
\text{APPEND}(\text{ADD}_A\_UX(u,v,j-1,k-1),"'
\text{ADDSIMILAR}(\text{ELEMENT}(\text{ELEMENT}(u,j),1)+\text{ELEMENT}(\text{ELEMENT}(v,k),1)+\text{ELEMENT}(\text{ELEMENT}(u,k),1)),"'
\text{IF}(\text{BEFORE}(\text{ELEMENT}(u,j),\text{ELEMENT}(v,k)),"'
\text{APPEND}(\text{ADD}_A\_UX(u,v,j-1,k),\text{ELEMENT}(v,k)),"'
\text{APPEND}(\text{ADD}_A\_UX(u,v,j-1,k),\text{ELEMENT}(u,j))))))"
\]
Anyone who thinks you can't program with just an IF statement should look at this. It's awkward but certainly doable! The answer, by the way, is 100 times the sum of the sigmas.
Maple Problem 9: Here's the code to set up the rule based algebra:

```maple
s(0..9):
readlib(commutat):
for i from 0 to 9 do
    for j from i+1 to 9 do
        &*(s.j,s.i) := -&*(s.i,s.j);
    od;
&*(s.i,s.i) := 1;
od:
```

Mathematica Problem 9:

```mathematica
(* rules for Clifford algebra *)
ncm[s[i_],s[j_]] := -ncm[s[j], s[i]]/;i > j
ncm[s[i_], s[i_]] := 1

(* rules for noncommutative multiplication *)
(* - behavior of multiplication of integers *)
ncm[a_?NumberQ, b_?NumberQ, c___] := ncm[a b, c]
(* - distributivity of addition *)
ncm[m___, a_Plus, b_Plus, n___] :=
    ncm[m, Distribute[tmp[a,b],Plus]/.tmp->ncm, n]
(* - associativity *)
ncm[a___, ncm[r___, b___]] := ncm[a, r, b]
(* here's the expression *)
expr = Plus @@ Map[s, Range[1,9]]
(* and here's the power. Note the output form involves ncm; this could be formatted to look cleaner for one's individual purposes. *) expr^5/
```

Reduce Problem 9: Shows simple elegance of the Reduce language.

```reduce
operator s;
nocom s;
for all i,j such that i>j let s(i)*s(j)=s(j)*s(i);
for all i let s(i)*s(i) = 1;
xxx := for i:=0:9 sum s(i);
xxx^2;
xxx*ws^2;
```

10. Polynomials in Several Variables

(a) Expand \((x+y+z)^20\).
(b) Now factor the polynomial in (a) over the rationals.
(c) Factor \(x^4 + y^4\) over the Gaussian integers.

Derive Problem 10a: Enter Expression and Choose Expand

Derive Problem 10b: Choose Factor Rational

Derive Problem 10c: The solution suggested was to factor over the complexes and by hand pick out the factors that combine to give factors over the complex numbers.

Maple Problem 10a: Expand((x+y+z)^20);
By default, the ordering of terms in the output of such expansions appears to be random and certainly isn't organized in a useful way.

Maple Problem 10b: a10b := factor(a10a);
Maple Problem 10c:
"It is unfortunate that you ask this question at this time. Maple 5.1 has multivariate polynomial factorization over algebraic number fields and also algebraic function fields built in. Maple 5.0 can factor UNIVARIATE polynomials over ANY algebraic number field though." A twelve line program was provided instead.

Mathematica Problem 10:

```mathematica
poly= Expand[(x + y + z)^20];
Factor[poly]
```

Reduce Problem 10a,b:

\((x+y+z)^20\);
on factor; ws;

Reduce Problem 10c:
on complex, factor;
\(x^4 + y^4\);
off complex,factor;

11. Solve Numerically the Triple of Nonlinear Equations

(Real OR Complex Solutions):

\[\sin(x) + y^2 + \ln(z) = 7\]
\[3x^2 + 2y - z^3 = -1\]
\[x^2 + y^2 + z^3 = 5\]

Derive Problem 11: Six approximate complex solutions were found for

Example. \[x = -2.46556 - 1.69474 i, y = -2.89745 + 0.57376 i, z = 0.58869 + 1.91505 i\] This is done by using the Newton's method code from the supplied file Solve.Mth guessing various starting points. Each solution took about 7 seconds to find once typed in. There are no real solutions.

Maple Problem 11: A thirty line program implementing a complex Newton's method was provided; it is not built in.

Mathematica Problem 11:

```mathematica
eq1 = Sin[x] + y^2 + Log[z] == 7;
eq2 = 3x + 2'y - z^3 == -1;
eq3 = x^2 + y^2 + z^3 == 5;
FindRoot[Evaluate[{eq1,eq2,eq3}],
\{x,1+1\},\{y,1+1\},\{z,1+1\}] found the root
\(\{x \rightarrow 0.339961 + 2.36119 i, y \rightarrow 2.39276 - 1.0728 i, z \rightarrow 1.86956 + 0.34026 i\}\)
Taking random starting points found another 11 roots; here’s the code including code for removing duplicates from
a list:

```math
fr = Table[
    FindRoot[ Evaluate[{eq1, eq2, eq3}], {x, #1}, {y, #2}, {z, #3}]& @@
    Table[Random[Complex, {-7 - 7 I, 7 + 7 I}], {3}], {30}];
fr = Select[fr, 
    ((({eq1, eq2, eq3}/.#) === {True, True, True} &) &&
    removedups[{}]) := {}
    removedups[lisL] :=
        Join[{First[list]}, removedups[Select[Rest[list],
            Chop[First[list] - #, 10^-8 ] !=={0,0,0} &]]
      ] removedups[{x,y,z}]/.fr]
```

### Reduce Problem 11:
This requires a package not included with Reduce but available via internet from Rand;
load package numeric;
% This system has no real solution.
% looking for complex solutions:
sys := {sin (x) + y^2 + log(z) = 7,
    3*x + 2*y - z^3 = -1,
    x^2 + y^2 + z^3 = 5};
on rounded, complex;
sol1 := num_solve(sys, x=1+i, y=1+i, z=1+i);
% Found three solutions by this method

### 12. ODE’s and Recursion Relations

(a) Solve y'' + y = cos(x)

(b) Solve x^2 * (dy/dx) + 2*x*y - y^3 = 0

(c) Solve the recursion relation

\[ s(n) = 3^2 s(n-1) - 2^2 s(n-2) \]

\[ s(1) = 1, s(2) = 1 \]

Note: Unfortunately, I copied this problem from the last Notices article which had dropped a minus sign in the initial condition for s(2) so the answer is identically 1!

**Derive Problem 12a:** Use routines from ode2new.mth.
Need to load that and type in LIN2_GEN(0,1,COS(x)) and use Simplify.

**Derive Problem 12b:** Depends on realizing it has Bernoulli form and knowing how to transform it. Load ode1new.mth and use the Solve on the expression

\[ BERNOULLI(2/x, 2, 3) \]

The answer is

\[ 1/y^2 = (c*x^5 + 2)/5*x \]

The Derive solution makes it appear that there are two free parameters but there is only one.

**Derive Problem 12c:** Use routines from recurnew.mth.
Need to load that type LIN2.CCF_BV(-3,2,0,x,1,1,2,1) and use Simplify.
sol:=solve(for each a in ic collect(sub(n=part(lhs a),1),gsol)=rhs a, for i:=1:length ic collect c(i));
% If some c(i) remains it can be arbitrary real.
let sol;
gsol:=gsol;
clearrules sol;
return gsol
end;
solve.line_rec(s(n)=3*s(n-1)-2*s(n-2),{s(1)=1,s(2)=1});

13. External Conversions. Consider the function f(x) := exp{-x^{-2}} + 15*x^{-7}
(a) Translate into \(\LaTeX\) format.
(b) Translate into a C program. Derive
can do (b) but not (a); the other three can do both.

14. Graphing
(a) Graph the parametric curve:
x = cos(3t)
y = 3 sin(5t)
for t from 0 to 2*pi
(b) Graph the surface
sin[x + sin(y)]
with x,y running from 0 to 4*pi
(c) Draw an Icosahedron.
(d) Draw the contour surfaces of y * Sqrt [ 9 - x^2 ] where
x and y run from -3 to 3.
(e) Provide an additional graphical example that you think
shows off your product.

**Derive Problems 14a/b:** Simple applications. Define the function.
Go to the Windows menu and split the window, set the
larger window to 2D or 3D graphics, set some parameters
for optimal display (requires some experimentation) and pick
"plot".

**Derive Problem 14c:** The vendor used the vertices of the
Icosahedron as found in Mathematica's library (!) and entered
them as a complicated data set and used the vector command.

**Derive Problem 14d:** You can define contours as a vector
and plot the values of a vector. Color coding by height is NOT
possible.

**Derive Problem 14e:** The vendor points out that "Unlike many packages, most discontinuities such as tan(x) or
sign(x) are not bridged, and false transformations such as arc-
tan(tan(x)) \rightarrow x are avoided", and provides a graphic sample
to illustrate this.

**Maple Problem 14a:**
aspect_ratio := 1.45; # This depends on your monitor.
w := aspect_ratio*3:
a14a := plot([cos(3*t),3*sin(5*t),t=0..2*Pi],x=-w..w,y=-3..3, resolution=1024, style=LINE);
Once plotted, a small menu can be popped up with F10.

**Maple Problem 14b:**
a14b := plot3d(sin(x+sin(y)),x=0..4*Pi,y=0..4*Pi,
grid=[36,36],axes=BOXED, scaling=CONSTRAINED);

**Maple Problem 14c:** Explicit coordinates for the vertices
of the Icosahedron were provided and could be used via the
grid command to plot the figure. The points were generated
with a little program.

**Maple Problem 14d:**
Maple V cannot in general draw contour surfaces, but it is
possible to do it in this case.
Special code based on the particular example was provided.

**Maple Problem 14e:** If you have Maple try this lovely graphic:
Spiral Tube Around a Torus
with(plots):
N := 10:
a14c := tubeplot([10*cos(t),10*sin(t),0,
t=0..2*Pi, radius=2, numpoints=10*N, tubepoints=2*N],
[cos(t)*(1+4*sin(9*t)),sin(t)*(10+4*sin(9*t)),4*cos(9*t),
t=0..2*Pi, radius=1, numpoints=trunc(37.5*N), tubepoints=N],
scaling=CONSTRAINED, orientation=[76,40]);

**Mathematica Problem 14:**
a) ParametricPlot([Cos[3 t], 3 Sin[5 t], {t,0,2 Pi}]
b) Plot3D[Sin[x + Sin[y]], {x,-3,3}, {y,0,4 Pi}, Plot-
Points \rightarrow 30]
c) Needs["Graphics'Polyhedra' "] Show[Polyhedron[Icosa-
hedron]]
d) ContourPlot[ y Sqrt[9 - x^2], {x,-3,3}, {y,-3,3}]
e) Five extra graphics were provided (graphics is Math-
ematica's strong suit!) including
Show[Polyhedron[GreatIcosahedron]]
and
Needs["Miscellaneous'WorldPlot' "]
WorldPlot[{World,RandomColors},
WorldProjection \rightarrow Sinusoidal]
Reduce has no graphics!

15. For each of the graphs you could draw in problem 14, do the following:
(a) Print it out on a laser jet.
(b) Save it as a vector graphic file - EPS or CGM or ...
(c) Save it as a bitmap file - PCX or TIFF or ...
Reduce has no graphics; Derive has no explicit support for
printing graphs or saving to a file but expects you to use third
party print screen products which capture the graphic and
unfortunately the on screen menu (some third party products
will let you crop this menu out). Maple has support for many
printers— you can print to a file and so capture an HPGL file.
Mathematica has strong support for printers; the DOS version
can send to a file in EPS format. The Windows version adds
BMP and WMF to EPS.
16. Provide a program to draw the Koch snowflake (this is a two-dimensional “curve” obtained as a limit by the following iterative process. Start with an equilateral triangle. At each stage go to the next by adding to each side an equilateral triangle pointing outwards of side 1/3 the size of the current edges, centered on the edge; Contact me if you aren’t familiar with this object already). Clearly you’ll need to end the iteration after finitely many steps. That should be a parameter in the program. Derive Problem 16: A use of IF allows a recursive definition of the Koch snowflake (Note: multiple lines in Derive require a “continuation character, not shown here):

\[
\begin{align*}
\text{s} &:= 3 \cdot \tan(\pi/6) \\
\text{EDGE}(a, b, c, n) &:= \begin{cases} \\
[0, 0], & n = 0; \\
[\text{EDGE}(a, b', c', n-1), \text{EDGE}(b', c', a, n-1), \text{EDGE}(c', a, b', n-1)], & \text{otherwise}.
\end{cases}
\end{align*}
\]

\[
\text{STAR}(n) := \begin{cases} \\
[\text{EDGE}([-s, -1], [s, -1], [0, -4], n), \\
\text{EDGE}([s, -1], [0, 2], [2s, 2], n), \\
\text{EDGE}([0, 2], [-s, -1], [-2s, 2], n)]
\end{cases}
\]

With these definitions STAR(n) is an nth order iterate stating on the star for n=1.

Maple Problem 16: aspect_ratio := 1.45; # This depends on your monitor.
Koch := proc(n) local n1, d, x, y, p, i, h, v;
if type(n, integer) and 0 < n then
n1 := n-1;
d := 3*4^n1;
x := array(0 .. d);
y := array(0 .. d);
evalhf(Kpoint(d, x, y, n1));
p := map(op, [seq([x[i], y[i]], i = 0 .. d)]);
else
ERROR(n must be a positive integer)
fi;
v := 3.*(1/2)/2;
h := aspect_ratio*v;
if h < 1 then v := v/h; h := 1.; fi;
PLOT(RANGE(HORIZONTAL, -h .. h),
RANGE(VERTICAL, -v .. v),
CURVE(FUNCTION(0), BLACK, LINE, p));
end:
Kpoint := proc(d, x, y, n)
local e, f, a, h, R, i, j, xi, yi, u, v, k;
e := iquo(d, 3); f := iquo(e, 4);
t := 3.; a := 1/t; b := 2/t;
h := 0.5; R := h*t*(1/2); r := R/t;
x[0] := 1.; x[e] := -h; x[2*e] := -h; x[d] := 1.;
y[0] := 0; y[e] := R; y[2*e] := R; y[d] := 0;
to n do j := 0;
for i from e by e to d do
xi := x[j+i]; yi := y[j+i]; u := -xi[i] - xi; v := y[i] - yi;
k := k + f; x[k] := xi + u*a; y[k] := yi + v*a;
end:
of
end:

Mathematica Problem 16: KochSnowflake[n_Integer?NonNegative] :=
Show[Graphics[FixedPoint[
(1/Lines[{{start, finish}}]) &,
{Line[{{0, 0}, {1/2, Sqrt[3]/2}}],
Line[{{1/2, Sqrt[3]/2}, {1, 0}}],
Line[{{1, 0}, {0, 0}}]},
To]]].

Derive Problem 17: A sixteen line program using Derive’s IF, ITERATE, and VECTOR functions following the scheme in Gray and Glynn’s book on Mathematica was provided. Of course, the answer is 4.669...

Maple Problem 17: A roughly 50 line program was provided.

Mathematica Problem 17: A 27 line program was provided. The vendor remarked: “As an exercise, we let this run for some time on a SPARC workstation, and derived the following value for the Feigenbaum Constant:

\[
g_{\infty} = 3.569945671870944901842004
\]

Feigenbaum constant := 4.669201609103”

Reduce Problem 17: An elaborate program of many lines was provided.

18. Write a program to generate a list of all triples of positive integers less than n with the property that the difference between the largest and smallest is not greater than 1/2 the middle one.
**Derive Problem 18:** Here it is in one line!!

\[
F(n) := \text{VECTOR}(\text{VECTOR}(\text{VECTOR}(\text{MAX}(k, 2*(h-k)), h), k), h, h, \sim)
\]
\[
\text{MAX}(1, h/2, -1), h, n-1)
\]

**Maple Problem 18:**

\[
\text{triple} := \text{proc}(n)
\text{local} i, j, k, c, t;
\text{c} := 0;
\text{for} i \text{ from} 3 \text{ to} n-2 \text{ do}
\text{for} j \text{ from} i+1 \text{ to} n-1 \text{ do}
\text{for} k \text{ from} j+1 \text{ to} n \text{ while} 2*(k-i) <= j \text{ do}
\text{c} := c+1; t[c] := [i, j, k];
\text{od};
\text{od};
\text{od};
\text{seq}(t[i], i = 1 .. c)
\text{end:}
\]

**Mathematica Problem 18:**

\[
\text{Needs}\{\text{"DiscreteMath'Combinatorica" \}}
\text{myTriples}[n_] :=
\text{Select}\{\text{KSubsets}[\text{Range}[n-1], 3],
\{\text{#[[3]] - \text{#[[1]]}} <= \text{#[[2]]}/2 \&\}
\text{allmyTriples}[n_] :=
\text{Join}[\text{Flatten}[\text{Map}[\text{Permutations}, \text{myTriples}[n]]], 1],
\text{Map}[\{#, #, #\} &, \text{Range}[n-1]]
\]

**Reduce Problem 18:**

\[
\text{procedure} \text{gentriple} n;
\text{for} i := 1 : n-1 \text{ join}
\text{for} i3 := i1 : n-1 \text{ join}
\text{if} i3 < 2*(i3-i1) \text{ then} \{
\text{else for} i2 := \text{max}(i1, 2*(i3-i1)): i3
\text{join} \{\{i1, i2, i3\}\}};
\]

19. Write a program to generate a list of primes between 100,000 and 101,000.

**Derive Problem 19:** It's two lines of general code:
\[
\text{PRIME.COUNT}(m, n) := \text{IF}(\text{NEXT.PRIME}(m) > n, 0, 1)
\]
\[
+ \text{PRIME.COUNT}(\text{NEXT.PRIME}(m), n))
\]
\[
\text{PRIME.LIST}(m, n) := \text{ITERATES}(\text{NEXT.PRIME}(k), k,
\text{NEXT.PRIME}(m), \text{PRIME.COUNT}(m, n)-1)
\]
\[
\text{PRIME.LIST}(100000, 101000)
\]
There are 81 primes in the list.

**Maple Problem 19:**

\[
\text{plist} := \text{proc}(a, b)
\text{local} p, i, t, j;
p := \text{nextprime}(a);
\text{for} i \text{ do}
t[i] := p;
p := \text{nextprime}(p);
\text{if} p > b \text{ then break } fi;
\text{od};
\text{seq}(t[i], j = 1 .. i)
\text{end:}
\]

**Mathematica Problem 19:**

\[
\text{PrimesBetween}[n1_, n2_] :=
\text{Table}[\text{Prime}[t], \{t, \text{PrimePi}[n1] + 1, \text{PrimePi}[n2]\}]
\]
\[
\text{PrimesBetween}[100000, 101000]
\]

**Reduce Problem 19:**

\[
\text{for} i := 100000:101000 \text{ join if primep i} \text{ then} \{i\} \text{ else} \{\}
\]

20. Write a program to find the GCD of two polynomials over the field of order 27.

**Derive Problem 20:** A 26 line program was provided.

**Maple Problem 20:** A solution was even provided for multivariate polynomials. Here is one for single variable polynomials:

\[
\text{Given} a \text{ and} b \text{ in} \text{GF}(p^k)[x] \text{ compute their gcd using the Euclidean Algorithm.}
\]
\[
\text{GcdUniGFq} := \text{proc}(a, b, x, p) \text{ local} c, d, r;
c := \text{Expand}(a) \text{ mod} p;
d := \text{Expand}(b) \text{ mod} p;
\text{while} d <> 0 \text{ do} r := \text{Rem}(c, d, x) \text{ mod} p; c := d; d := r \text{ od;}
\text{Expand}(\text{c}!\text{coeff}(c, x)) \text{ mod} p \# \text{ Make the Gcd monic}
\text{end:}
\]

**Mathematica Problem 20:** A 50 line program was provided.

**Reduce Problem 20:** No general code for finite fields but there is for modulo arithmetic so it wasn't hard to set everything up although there were more than 50 lines of code. Uses the fact that the field of 27 elements is gotten by adjoining an element of order 3 to Z3.
Committee on Human Rights of Mathematicians

Alice T. Schafer, Chair

In the two years since a report from this Committee appeared in the Notices, the Committee has considered cases of human rights violations of mathematicians in Russia, Somalia, Tunisia, and the United States. Three of the cases have been settled somewhat satisfactorily but not ideally. The last of the Russian mathematicians on whose behalf the Committee had worked for some time has been allowed to emigrate and is living in this country, but the latest information from him is that he has been unable to locate a position. The Somalian mathematician has been freed from prison and allowed to leave the country. (His family had been allowed to leave somewhat earlier.) They are now living in the United States where he has a university position. Unfortunately, the Tunisian mathematician on whose behalf this Committee, as well as other human rights groups, has worked diligently for several years is still in prison under a sentence to run through May 1993. (For a more complete report on this case see the report from this Committee in the July/August 1990 issue of the Notices.)

The case in the United States concerned Professor Ethelbert N. Chukwu of North Carolina State University. The Immigration and Naturalization Service (INS) was attempting to deport him on grounds that this Committee, and many other individuals as well, felt were unjustified. The INS eventually brought him to trial and he won. His text, Stability and Time-Optimal Control of Hereditary Systems, has just been published (by Academic Press). Professor Chukwu has dedicated that text to "... the good and courageous men and women whose faith in my family sustained us through our recent difficulties ...". Among those mentioned are some members of this Committee and William Browder, AMS President at the time of Professor Chukwu's trial.

In addition to its efforts on behalf of the mathematicians in the above cases, some members of the Committee felt that the AMS Council should be asked to submit to the Israeli authorities a resolution on behalf of the mathematicians and mathematics students at the universities and colleges in the West Bank and Gaza, which had been closed from time to time. The resolution would urge the Israeli Government and all parties to work together to keep the universities and colleges open. A resolution was submitted to the Council at its meeting in Orono in August 1991. That resolution was tabled. A second resolution was submitted to the Council for consideration at its meeting in Baltimore in January 1992. That resolution was defeated by a vote of 12 to 11.* At the time of the writing of this report, the Israeli Embassy in Washington reports that all universities and colleges in the West Bank and Gaza are open.

Richard Dicker, Director of the New York based Committee to End the Chinese Gulag, met with this Committee at the Joint Mathematics Meetings in Baltimore in January 1992. The Committee to End the Chinese Gulag was formed in 1991 and numbers among its members the astrophysicist Fang Lizhi and the physicist Yuri Orlov. The Committee has written a pamphlet giving suggestions for actions that scientists might take when they attend scientific conferences in China. (For additional information, the Committee may be contacted at 485 Fifth Avenue, New York, NY 10017.)

The Committee wishes to express its appreciation to the following groups for sharing information on human rights violations of individual mathematicians: Committee of Concerned Scientists (New York), the Human Rights Committees of the American Association for the Advancement of Science (AAAS) and of the National Academy of Sciences, and the Chicago Action for Soviet Jewry. I would like to thank personally those members who have retired from the Committee in the last two years for their invaluable contributions to the work of the Committee: Raymond Ayoub, Joan S. Birman, Michael I. Brin, Chandler Davis, and Joel L. Lebowitz.

*The resolution presented at the Baltimore meeting read as follows: "The Council of the AMS takes note of the historical fact that the universities in the West Bank and Gaza came into existence after the 1967 war under Israeli occupation as a result of the initiatives taken by residents of the territories. These initiatives had been ignored by former regimes there. The Council, with this history in mind, deplors the frequent closings of the colleges and universities in the territories. These closings have hurt students and faculty in all fields, including mathematics, and impaired their ability to carry out normal educational activities.

"The Council notes that Birzeit and Al-Najah Universities have been closed for over three years and that the other colleges and universities have been closed for shorter periods of time. It is pleased to note that all of these institutions, with the exception of Birzeit University, have recently been reopened. The Council calls upon the Government of Israel to reopen Birzeit University. The Council asks all sides to work actively to restore conditions which would permit maintaining normal educational and research activities of the colleges and universities."
Once an intriguing albeit academic topic for science policy observers, discussion of how the government allocates resources among the various elements of the scientific enterprise—that is, how it sets priorities—has received more attention from the science policy establishment, including Congress, in the past few years.

The issue is not straightforward, because the R&D budget is necessarily disaggregated in different ways at different stages of the complex federal budget process, but Congress is increasingly concerned that funding decisions need to be made more rationally. Several scientific groups, too, have formulated goals and priorities to guide federal support for their particular areas.

The severity of the federal budget crisis (discussed in previous Washington outlook columns) is one reason improvements in the science budget-making process are so important. Moreover, the political climate of the last decade raised new demands that government be accountable to voters and taxpayers.

Because Congress is not well equipped to determine the scientific merit of R&D proposals, it relies on advice from the science community to sort out the diverse claims on the R&D budget. What many see as a lack of priority-setting by the science community has led to some accusations that it is an insatiable constituency that regards all of its proposals as essential.

The issue is often highlighted—and muddled—by immediate policy concerns, the most controversial of which are “big science” projects like the space station and the Superconducting Supercollider. While the high energy physicists might regard the latter project as crucial to the advancement of high energy physics, and the Office of Energy Research (with advice from scientific panels) decides where the project fits into its goals and budget plan, Congress, facing an up or down vote, will always weigh the project in light of other national needs, including deficit reduction.

Furthermore, the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) and the initiatives it coordinates have added a new layer to the budget-making process. The “top-down” priorities imposed on basic research by FCCSET need to be reconciled with the “bottom-up” priorities coming from the scientific community.

Research and Development in the Federal Budget Process

The executive branch’s prioritization of federal science programs is implicit in its annual budget submissions, in which R&D is highly compartmentalized. The numerous agencies responsible for research set their budgets independently according to their own missions and goals. While the Office of Management and Budget (OMB), in consultation with the Office of Science and Technology Policy (OSTP) approves agency science budgets with broad Administration goals in mind, this cannot be construed as a prioritization of the overall R&D budget.

In fact, federal R&D cannot be prioritized as a bloc since most of it is done for purposes that transcend science—e.g., national defense and public health. Federal Science programs compete within these areas among not only other science programs but other spending as well. Because questions relating to allocation of funds among these and other national needs and public goods belong to the realm of politics, the political process will always be the final arbiter of the trade-offs among competing public needs and, therefore, of the broad structure of the science budget.

In this context, Congress influences the structure of the science budget only at the margins. In responding to the President’s spending proposals, it divides the budget into trade-off areas in different ways for each of the three different stages of the budget process (budget, authorization, and appropriation). While it can assign different relative values to defense and domestic spending, and thus influence the research budget at broad levels, it is logistically difficult to impose an alternative priority scheme on the overall science budget or to directly transfer funds from, say, the space station to AIDS research.

Improving the Science Policy Process

There is a need to consider the science budget as a whole, however, especially since sustaining the U.S. scientific enterprise is an important national goal in itself. The House
Committee on Science, Space, and Technology (HSST), as one of the few mechanisms that could conceivably approach assessment of the federal research enterprise, has made the most progress in addressing science priorities. (The House Budget Committee has also taken up the matter, although in the context of the big science vs. little science debate; also, a few Members of Congress are trying to establish a bipartisan, bicameral Science and Technology Study Conference, which might also choose to look at science priorities.)

At the request of the committee, the Office of Technology Assessment (OTA) last year released a comprehensive report, “Federally Funded Research: Decisions for a Decade,” outlining the major issues involved in priority-setting for science. The thrust of the report is that there will always be more good ideas from the scientific community than there is federal money to support them, and therefore, the government needs to set priorities to guide funding decisions. The report then defines some of the issues arising from the installation of a more rational priority-setting process.

In response to the OTA report, the staff of HSST organized a task force to reexamine the assumptions and conventional wisdom of federal science policy and the criteria used in allocating resources among the elements of the scientific enterprise. A report from this task force is expected imminently, and it will likely focus on how the government might go about setting science policy goals, formulate criteria used to determine which research ought to be funded, and measure progress toward those goals. (See the February 1992 issue of the Notices for a more thorough explanation of this exercise and the contributions of the mathematical sciences community.)

The objective of this exercise is to allow the committee to carry out its authorization responsibilities more systematically and, hopefully, to facilitate optimal decisions. While HSST is charged with determining appropriate funding levels for and setting priorities within the budgets of the agencies under its jurisdiction (the National Science Foundation, NASA, the National Institute for Standards and Technology, and other programs at the Department of Commerce, Department of Energy research programs, and Environmental Protection Agency research programs), it has no methodical procedure to make these decisions.

Concurrently, the committee’s subcommittee on science is holding a series of hearings to examine how priorities are set among research programs of different agencies and programs within those agency budgets and how those priorities are conveyed to Congress. The frustration of the subcommittee clearly stems from the fact that the Administration’s science priorities are rarely made explicit, despite the recent emergence of cross-agency research programs.

Witnesses at these hearings generally concur that a more rational process for determining science budgets is desirable. Here, too, it was made clear that well-defined goals have to be established before priorities can be invested with meaning. The subcommittee appears to be leaning toward assigning specific responsibility for establishing priorities to some executive branch entity; an upgraded FCCSET is a likely candidate. Several witnesses emphasized the importance of involving the scientific community in assessing relative merits of federal science programs, some suggesting an iterative process would be necessary.

**Agencies Plan for Leaner Times**

The federal research agencies are mindful of Congressional frustration with the unending demands on the federal science budget. Coupled with expectations of flat or even declining budgets, several agencies have tackled, or will soon tackle, the process of setting explicit criteria for making choices among competing scientific programs and projects. At the same time, the agencies are in search of new ways to justify growing research budgets in a tight fiscal climate.

In particular, the National Science Foundation (NSF) and the National Institutes for Health (NIH) are responding to new demands on their agencies with strategic goals and plans. NIH Director Bernadine Healy, who is fond of saying, “This is not your father’s NIH,” is dragging the biomedical community through a strategic planning process to frame the agency’s budget in terms of national goals rather than numbers of research grants.

NSF Director Walter Massey, too, is developing a strategic plan for his agency. Massey intends that the result of the strategic planning process will be an agreement with the Administration and Congress for continued NSF budget growth. As does Healy, Massey realizes that NSF cannot keep doing business as usual. It must be a responsible, accountable steward of public funds. It must coordinate its programs with those of other entities (e.g., states, other federal agencies, colleges and universities) and must be responsive to overall federal R&D priorities associated with important national goals, including those initiated by Congress. Specific justifications are necessary for budget increases even in basic research, where level-of-effort, as opposed to goal-driven, programs predominate and the primary criteria for funding decisions is scientific excellence.

**Setting Goals and Priorities for Scientific Disciplines**

At the agency program level, the scientific disciplinary communities contribute greatly to the implementation of priorities for programs associated with their respective discipline. But these programs increasingly have to be reconciled with the broad directives of federal R&D, as well as those of the agency budget. Reconciling “bottom-up” goals and priorities coming from the scientific community with the “top-down” goals and priorities of (in most cases) several agencies that sponsor disciplinary research is an even greater challenge, and leaves many feeling that science budgets are less than optimal.

The science subcommittee hearings also showcased several disciplinary scientific organizations that have undertaken bottom-up goal- and priority-setting exercises for their particular areas of science. It was noted that such statements seem to be faring well in the political process; after all, consensus...
is politically compelling. At the same time, it is not necessarily a simple matter to gain the acceptance of the affected agencies and Congress for a discipline’s self-selected goals. Acceptance of goals is often a function of advocacy even when the political process relies on the scientific community to establish funding criteria.

The astronomers, through an iterative consensus-building process, put together a plan that prioritizes astronomy research and derives from that a ranking of proposed facilities. Space scientists are in the process of a similar exercise. The ecologists recently developed and are promoting a “sustainable biosphere initiative”; the goals for basic ecological science are linked with important socio-environmental goals, a powerful combination. The jury is still out as to whether these efforts will succeed at both of their underlying objectives: more influence for the discipline over federal funding decisions with regard to the discipline, and a higher priority for the discipline relative to other elements of federal research.

While declining research budgets pose a serious threat for the mathematical sciences community, the new emphasis on science priorities provides a challenge and an opportunity to think about how the federal government approaches support for the mathematical sciences and perhaps obtain more support for the legitimate needs of the discipline.
Richard S. Pierce 1927–1992

Richard Scott Pierce, former AMS associate secretary, died on March 15, 1992. Born on February 26, 1927, he received his B.S. in 1950 and his Ph.D. in 1952, both from the California Institute of Technology. He was a Fellow of the Office of Naval Research at Yale University (1952–1953) and a Jewett Research Fellow at Harvard University (1953–1955). He was at the University of Washington until 1970, when he went to the University of Hawaii. In 1975, he joined the faculty at the University of Arizona, where he remained until his death. His mathematical areas were lattice and ring theory, Boolean algebras, and abelian groups.

In addition to serving as associate secretary of the AMS from 1960 to 1971, Professor Pierce served on a number of Society committees, including the Mathematical Reviews Editorial Committee (1968–1973) and the Publications Committee (1968–1970). He was an ex-officio member of the Council from 1960 to 1969.

Prizes of the Parisian Academy

The Académie des Sciences de Paris has announced a number of prizes and awards presented to researchers in the mathematical sciences.

The golden medal “Henri Poincaré” for 1992 has been awarded to JOHN THOMPSON of Cambridge University. This medal has been awarded only on exceptional occasions. The previous two recipients were Jacques Hadamard in 1962 and Pierre Deligne in 1974. Thompson received the medal for his decisive contributions to the development of the theory of finite groups during the past thirty years.

The Ampère Prize of 200,000FF has been awarded to PIERRE-LOUIS LIONS of the University of Paris–Dauphine. This prize is given every year, alternately in mathematics and physics. Lions is honored for his major contributions to the study of nonlinear partial differential equations arising in stochastic analysis, continuum mechanics, and mathematical physics. His Ph.D. thesis, under the direction of Haim Brezis, was concerned with the Hamilton-Jacobi-Bellman equation, which he solved using a combination of partial differential equation and probabilistic techniques. Later, he introduced with Michael Crandall the notion of “viscosity solutions”, which has now become a classical tool. In 1987, Lions and Ronald DiPerna presented the first general existence result of global weak solutions for the Boltzmann equation, using an approach that applies to many models of gas dynamics. Lions is also the inventor of the “concentration-compactness” method which aids the understanding of all possible singular behaviors of sequences in problems which lack compactness; this method has numerous applications, from differential geometry to fluid mechanics.

The Prix de l’Etat of 50,000FF was presented to GILLES PISIER of the University of Paris VI. Awarded every year, this prize rotates among all areas of science. Pisier is a leading expert in the geometry of Banach spaces. Strongly influenced by Laurent Schwartz, he has combined in a very ingenious manner the geometry of Banach spaces with probability techniques. His first works, partly in collaboration with Bernard Maurey, concerned the notion of “type” and “cotype” of Banach spaces. In particular, using martingales, Pisier has studied the type and cotype of uniformly convex spaces. He has solved several conjectures of Grothendieck concerning tensor products of Banach spaces and nuclear operators. In addition, he has made important contributions to random Fourier series and harmonic analysis. His book, Volume Inequalities in the Geometry of Banach Spaces, was published by Cambridge University Press in 1989.

There were several other prizes awarded by the Académie. GILLES LEBEAU of the University of Paris-Sud received the Servant Prize (10,000FF) for his work on the propagation of singularities and controllability. GÉRARD LAU-MON of Centre National des Recherches Scientifiques (CNRS) in Orsay received the E. Dechelle Prize (10,000FF) for his work on the geometric Fourier transform and automorphic forms. BENOÎT PERTHAME of the University of Orléans received the Blaise Pascal Prize (10,000FF) for his work on Boltzmann schemes. CLAUDE BARDOS of the University of Paris VII received the E. Brun Prize (10,000FF) for his work on gas dynamics and its applications to reentry problems. JEAN-JACQUES RISLER of the University of Paris VI received the C. L. de Saulses de Freycinet Prize (8000FF) for his work on real algebraic geometry and differential analysis. ETIENNE PARDOUX of the University of Provence at Marseille received the Montyon Prize (6000FF) for his work on stochastic analysis. FRANÇOIS LEDRAPPIER of CNRS at Paris VI received the...
Carrière Prize (4500FF) for his work on ergodic theory. DANIEL LEHMANN of the University of Toulouse received the V. Thébault Prize (4500FF) for his original book, Initiation to Geometry. GEORGES SKANALIS of the University of Paris VII received the Francoeur Prize (4500FF) for his work on the K-theory of C* algebras and Kasparov’s theory. PIERRE GRISVARD of the University of Nice and Institut Henri Poincaré received the P. D. Emile Blutet Prize (4000FF) for his work on elliptic equations in irregular domains. JEAN-MICHEL GHIDAGLIA of the Université de Paris-Sud at Orsay and Ecole Normale Supérieure de Cachan received the d’Aumale Prize (3000FF) for his work on attractors of some nonlinear evolution problems.

The Parisian Academy also elected a number of foreign members. LENNART CARLESON of the University of Uppsala and the University of California at Los Angeles and JOHN T. TATE of the University of Texas at Austin were elected in Mathematics, and T. BROOKE BENJAMIN of Oxford University was elected in Mechanics.

1992 d’Alembert Prize Awarded
The Société Mathématique de France has announced two winners of the d’Alembert Prize for 1992. Presented every two years, the prize recognizes outstanding books, articles, radio or television broadcasts, films, or other projects that promote public awareness of recent developments in mathematics. This year, the prize amount is 20,000FF.

IVAR EKELAND received the prize for the book Au Hasard: La Chance, La Science, Le Monde (At Random: Chance, Science, and the World), published by Le Seuil. Ekeland is currently president of Paris Dauphine University. The citation for the prize says that Ekeland explains, in a clear, simple, and imaginative way, the great mathematical notions connected to chaos and their applications to physics and economics. This well-written book, says the citation, “is a dialectical fresco on order and disorder, determinism in indeterminism, and indeterminism in determinism.” The book discusses randomness, entropy, unpredictability, game theory, attractors, catastrophe theory, and the use of statistics in these areas. The citation ends by noting, “this book is not only one by a mathematician, but one by a humanist and a writer. It is a book that makes one understand and makes one reflect.”

The other winner is the project “Math en jeans”. The idea of “Math en jeans” is to associate two secondary school mathematics classes with a research project, under the guidance of a teacher and a mathematician. The students (not necessarily those at the top of their class in mathematics) devote two hours per week to learning about such subjects as secret codes, non-Euclidean geometry, or the golden mean. The group defines and explores various questions that arise, and the presentation of “seminars” allows for many fruitful exchanges. The citation notes, “This liberal and open approach to mathematics has encountered unprecedented success among the students, to whom it offers the possibility to create in a domain that had previously seemed cold and inaccessible.” The jury of the d’Alembert prize could certainly not remain insensitive to the spirit of ‘Math en jeans’ which seems to them to be one of the best ways to bring to young people a new vision of mathematics.”

The d’Alembert prize was presented by Professor Hubert Curien, French Minister of Research and Space, during a reception held at the Ministry on May 15, 1992, at the conclusion of a gathering organized jointly by the Société Mathématique de France and the Société Mathématiques Appliquées et Industrielles. Under the title, “Mathématiques au Futur,” this meeting announced to the press the launching of the World Mathematical Year 2000 as decided by the Executive Committee of the International Mathematical Union at its May 6 meeting in Rio de Janeiro.

AWM Announces Schafer Prize Winner
Zvezdelina E. Stankova of Bryn Mawr College has been named the recipient of the third annual Alice T. Schafer Prize, sponsored by the Association for Women in Mathematics (AWM). The prize, given to an undergraduate woman in recognition of excellence in mathematics, carries a $1000 stipend. The prize committee also named Julie B. Kerr of Washington State University as Runner-Up and selected nine other nominees for Honorable Mention. The awards were presented at the annual meeting of the Society for Industrial and Applied Mathematics in Los Angeles in July.

The prize is named in honor of Alice T. Schafer of Marymount University, a former president and a founding member of AWM who has taken a special interest in supporting women at the start of their mathematics careers. The 1992 prize committee consisted of Schafer, Jill P. Mesirov of Thinking Machines Corporation, and Ann K. Stehney of the Center for Communications Research.

The committee noted that the field of thirty-two candidates seemed especially strong. In addition to their impressive achievements in coursework, independent study, competitions, and undergraduate research programs, the nominees devoted themselves to numerous projects on behalf of the mathematical life of undergraduates at their institutions.

Zvezdelina E. Stankova

ZVEZDELINA E. STANKOVA, a 1992 graduate of Bryn Mawr College, has earned wide recognition for her work and her performance in mathematical competitions. She participated last summer in the Research Experiences for
Undergraduates program at the University of Minnesota at Duluth, where her research on classifying permutations with forbidden subsequences of length four was praised as impressive work on a difficult problem. She presented her results at the Joint Mathematics Meetings in Baltimore in January 1992. In nominating Stankova, Rhonda Hughes of Bryn Mawr wrote, "Her results are strikingly original and one is always reminded that her work is that of an extraordinary mathematician." A two-time silver medalist on the International Mathematics Olympiad team from her native Bulgaria, Stankova’s talents as a problem-solver and an expositor earned her the distinction of Runner-Up for the Schafer Prize last year. She returned to the Duluth program this summer before beginning graduate work in mathematics this fall at Harvard University.

MacArthur Fellowships Awarded
Three members of the mathematical sciences community have received MacArthur Fellowships in this year’s round of awards. The fellowships range in size from $150,000 to $375,000 over five years, depending on the age of the recipients. There are no strings attached, and fellows may use the funds in any way they please. Individuals cannot apply for MacArthur Fellowships. Candidates are nominated by a group of one hundred designated nominators, and awardees are chosen by a twelve-member selection committee which meets eight times a year.

INGRID DAUBECHIES, professor of mathematics at Rutgers University, received a $240,000 grant over five years. Daubechies specializes in wavelet theory, a new form of Fourier analysis that may revolutionize the manipulation and storage of data, including voice and image signal analysis, and data compression. In addition, wavelet theory is finding applications in numerical analysis, operator theory, harmonic analysis, and the study of turbulence. Daubechies has also worked on Weyl quantization, continuous-time regularization of coherent state path integrals, and the extension of mathematical models for the stability of matter to include relativistic kinematic effects. She earned her bachelor’s degree (1975) and doctorate (1980) in physics at the Free University in Brussels. Daubechies is organizing an AMS Short Course on Wavelets and Applications, to be held January 11–12, 1993, in conjunction with the Joint Mathematics Meetings in San Antonio.

JOHN HOLLAND, professor of psychology at the University of Michigan and a fellow at the Santa Fe Institute, received a $369,000 grant over five years. In the early 1970s, Holland created the genetic algorithm, a general computational algorithm that can be used to discover better solutions to problems by recombining and mutating previous solutions. In the 1980s, he began to investigate how learning systems generalize, make inductions, and form internal representations of their environments. By studying how biological systems adapt and improve, Holland was able to create classifier systems, which are sets of interacting condition/action rules. With the tool of classifier systems, he solved two practical problems in artificial intelligence: how to design procedures that can learn appropriate behavior rather than have the behavior programmed in; and how to test new behaviors while avoiding system breakdown. He is also beginning to apply his ideas on nonlinear adaptive systems to economics. Holland received his B.S. in physics from the Massachusetts Institute of Technology (1950), his M.A. in mathematics from the University of Michigan (1954), and the first Ph.D. in computer science (at that time called communications sciences) awarded by Michigan (1959).

URI TREISMAN, professor of mathematics at the University of Texas at Austin and director of the Dana Center for Mathematics Education at the University of California at Berkeley, received a $285,000 grant over five years. Treisman works on improving mathematics instruction in high schools and colleges, with an emphasis on ethnic minority students. His research and its applications have led to a dramatic increase in the retention and graduation of minority students. He started the Mathematics Workshop Program at Berkeley in 1978, which reduced to as little as 4% the failure rate in calculus of participating minority students. Adaptations of the workshop have been successfully
used at institutions across the country. He directed an equally influential attempt to alter the freshman year program in calculus and precalculus. He is currently working to assemble a consortium of 200 institutions of higher education to encourage greater representation of minority students in mathematics and related fields. He advocates systemic changes at all levels of educational policy.

**Minority Scholars Receive Fellowship**

The National Research Council has made one hundred awards in two Ford Foundation programs to support minority scholars. The first program supports graduate students, through Predoctoral Fellowships that provide funds for stipends and tuition for three years of tenure, and through Dissertation Fellowships that provide a nine- or twelve-month stipend. The second program provides Postdoctoral Fellowships to allow doctoral recipients to pursue research.

Among this year’s recipients are two in the mathematical sciences: F. DuBois Bowman of Duke University, who works in statistics, and Pablo A. Perez of the University of California at Los Angeles, who works in applied mathematics. Each received a Predoctoral Fellowship.

Plans for the 1993 fellowship competitions are now under way. For information and application materials, write to: Fellowship Office, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418.

**Babbitt Named Executive Editor of MR**

Donald G. Babbitt of the University of California at Los Angeles has been named executive editor of *Mathematical Reviews*. He succeeds Gerald J. Janusz, who served in the post for two years and has now returned to the University of Illinois at Urbana-Champaign.

Babbitt received his Ph.D. from the University of Michigan in 1962 and works in mathematical physics and differential equations in the complex domain. He has been at UCLA since 1962 and has held visiting positions at a number of institutions, including Indiana University (1966), the Institute for Advanced Study in Princeton (1970–1971), and the University of Virginia (Fall 1975). He has been on a number of administrative committees at UCLA and also served as associate dean of the Graduate Division.

**Steen Heads MSEB**

Lynn Arthur Steen of St. Olaf College has taken the position of executive director of the Mathematical Sciences Education Board (MSEB) of the National Research Council (NRC). He succeeds Ray Shifflett, who has returned to his faculty position at California State Polytechnic University at Pomona.

Steen, well known for his influential writings and his advocacy for mathematics education, has had close ties with the MSEB since the Board was established in 1985. He was a member of the original Conference Board of the Mathematical Sciences committee that proposed the formation of a national board on mathematics education, and he was a charter member of MSEB until June 1991. Steen has worked on a number of MSEB publications: he wrote *Everybody Counts* and edited *Reshaping School Mathematics, On the Shoulders of Giants, and Moving Beyond Myths*. In addition, he worked last year on a joint effort of MSEB and the Mathematical Association of America to begin MSEB outreach to the higher education community.

“MSEB will continue to stress policy studies in areas of importance to the mathematics education reform movement,” says Steen. “Our emphasis at the moment is on assessment—to help the nation learn to measure what’s important in ways that improve children’s learning.” In addition, he notes, MSEB is beginning to increase emphasis on minority students and higher education. Two new program directors, J. Arthur Jones and Susan Forman, are in place to head these activities, and task forces have been established.

MSEB will also be tying into an NRC effort, begun this summer, to produce the
nation’s first statement of standards for school science. “There will be many opportunities for cooperation and creative curricular linkages that emerge as the science standards join the [National Council of Teachers of Mathematics] mathematics standards as statements of national expectations for our schools,” Steen remarks.

“I am excited by the challenge of MSEB, especially at this particular time of new opportunity to make learning effective for all students, to cooperate on science standards, and to move beyond myths in higher education,” Steen declares. “MSEB has broken new ground for national leadership within the American tradition of decentralized education and helped create a momentum for change that now has many partners. It is a good time to improve mathematics education, and I feel fortunate to have the opportunity to make a contribution.”

NAS President and Foreign Secretary
Send Letter to I.R. Shafarevich
On July 28, 1992, the National Academy of Sciences (NAS) sent out in a press release the following letter to I. R. Shafarevich of the Steklov Institute in Moscow:

“We are writing to you, a distinguished foreign member of our Academy, by unanimous decision of the Council of the National Academy of Sciences to express our strong aversion to your anti-Semitic writings as contained in Russophobia, a translation of which has been made available to us.

“Moreover, we are informed that there are few, if any, Jewish members of the Steklov Institute in Moscow, even though many of the outstanding mathematicians of Russia are Jewish. It is difficult to avoid the conclusion that the discriminatory practices of the well known anti-Semitic former director persist under present leadership.

“The National Academy of Sciences, as an institution, holds deeply to the principle that discrimination against individuals for reasons of race, sex, or religious beliefs is intolerable. Using your position to speak against Jews because of your perception of their influence upon Russian society is not only deplorable, but violates the principles of our Academy.

“If Russophobia represents an accurate expression of your views, and if our information of the composition of the algebra section is a reflection of your influence on hiring and appointment practices, you may wish to consider whether it is appropriate for you to maintain your membership in the National Academy of Sciences.”

The letter is signed by Frank Press, President, and James B. Wyngaarden, Foreign Secretary, of the NAS.

The press release from the NAS said that this is the first time in the Academy’s history that such a letter has been sent to one of its members. Shafarevich has been at the center of a controversy in the international mathematical community because of Russophobia. In particular, an open letter to Shafarevich, carrying about 425 signatures, was published in the March 1992 issue of the Notices.

Mathematics Advisory Committee to Meet

The Advisory Committee for the Mathematical Sciences for the National Science Foundation (NSF) will meet October 26-28, 1992, at NSF headquarters in Washington, DC.

The Committee provides advice on NSF policy as it relates to the mathematical sciences. The last meeting of the Committee touched on concerns raised within the mathematical sciences community about the Foundation’s budget request for fiscal year 1993. In addition, there was a serious discussion of the idea of revamping the structure of mathematics grants so that grant amounts are based on a tiered, flat-rate system, rather than on principal investigator salary.

The upcoming meeting is likely to center on these and other important issues facing the community. In addition, a new director of the Division of Mathematical Sciences (the successor of Judith Sunley, who is now executive officer of NSF’s Directorate of Mathematical and Physical Sciences) will probably have been chosen by the time of the meeting, making for interesting and lively discussions about the future of the Division.

Most of the meeting will be open to the public. Those interested in attending should contact Trudy Sensibaugh in the Division of Mathematical Sciences; telephone 202-357-9669; tsensiba@nsf.gov (Internet) or tsensiba@nsf (Bitnet).

News from the Mathematical Sciences Research Institute
Berkeley, California

This fall, William Thurston will assume the Directorship of the Mathematical Sciences Research Institute (MSRI) upon the retirement of Irving Kaplansky. Robert Osserman will continue to serve half-time as Deputy Director and will be joined by Lenore Blum who will also serve as half-time Deputy Director.

Three programs are planned for 1992–1993: a full-year program in Algebraic Geometry, a half-year program in the Fall in Symbolic Dynamics, and a half-year program in the Spring on Transcendence and Diophantine Problems.

The following workshops are scheduled for 1992–1993:


The algebraic geometry program will be organized around monthly themes as follows:

September: Algebraic Cycles (Contacts: A. Beilinson, W. Fulton); October:
Vector Bundles (Contact: R. Lazarsfeld); November: Higher Dimensional Geometry (Contacts: J. Kollar, S. Mori); December: Curves, Abelian Varieties, and their Moduli (Contacts: A. Beauville, J. Harris); January: Surface Theory, Classical Projective Geometry (Contacts: R. Friedman, J. Harris); February: Topology of Moduli Spaces (Contact: E. Arbarello); March: Enumerative and Computational Algebraic Geometry (Contact: W. Fulton); March: Crystalline Methods and Hodge Theory (Contacts: A. Beilinson, A. Ogus); April: (Open); and May: Singularity Theory and Hodge Theory (Contacts: M. Green, J. Steenbrink).

1993–1994 will feature a jumbo program in Differential Geometry lasting the full year, and a half-year program in Dynamical Systems and Probabilistic Methods for PDE’s in the Spring: January - June, possibly extending through July. Note that the latter program was referred to as “Coherent Structures” in preliminary announcements and also in the application forms for 1993–1994.

The Differential Geometry program has been organized around a number of themes, running during overlapping periods. The final schedule has not yet been set, but the following is a tentative plan, including members of the organizing committee associated with certain of the themes.

1. Mathematical Physics and Geometry (Bott). This is the main subprogram outside of pure geometry and, in principle, it should run all year. High activity period: January 1994, with a workshop including some other areas, for example: low-dimensional geometry, moduli of Einstein spaces, elliptic genera, etc. Other periods of activity: February and periods in the Fall.

2. Nonlinear Analysis and Geometry (Schoen). Harmonic maps, minimal surfaces, Einstein spaces, scalar curvature, etc. This theme is emphasized in the Fall and late Spring. High activity period: September 1993.

3. Rauch-Gromov Theory (Grove). Positive curvature, convergence and collapse of metrics, finiteness theorems, filling manifolds, Alexandrov spaces and singular metrics, etc. This theme is emphasized in the Fall. High activity period: September – October 1993 with a workshop.

4. Hyperbolic Geometry (Ballmann). Negative curvature, rigidity, geodesic flows, hyperbolic groups, etc. This program is emphasized in the Fall. High activity period: October 1993.


6. Exterior Differential Systems (Bryant). Geometric structures, characteristic classes of systems, control theory, etc. This program is emphasized in the Fall. High activity period: December 1993.

7. Low Dimensional Geometry. Geometry of 3- and 4-manifolds, gauge field theory, monopoles, gravity in 2 + 1 dimensions, twistor theory, etc. High activity period: February 1994.


For more information, write to MSRI at 1000 Centennial Drive, Berkeley, CA 94720. Program information and documents, including application forms are also available on-line by sending email to info@msri.org, consisting of the message “index”.

Note: The Fields Institute in Waterloo, Canada, has scheduled a microprogram in Riemannian geometry for August 1993, in coordination with the MSRI 1993–1994 program in Differential Geometry. Details of the program will be announced shortly.

News from the Institute for Mathematics and its Applications University of Minnesota
The Institute for Mathematics and its Applications (IMA) 1992–1993 academic year program Control Theory and its Applications is now underway, led by program coordinators H.J. Sussmann (Chairman), W.H. Fleming, P.P. Khargonekar, P.R. Kumar, D.L. Russell, and S.E. Shreve. The year is divided into three parts (corresponding to fall, winter, and spring quarters) although it is expected that there will be considerable fluidity between the various parts.

(1) Fall: September 8–December 30, 1992, Linear and distributed parameter systems

(2) Winter: January 2–March 30, 1993, Nonlinear systems and optimal control

(3) Spring: April 1–June 30, 1993, Stochastic and adaptive systems

The fall program was described in the July/August 1992 Notices. Here we provide some details about the winter program.

On January 25–29, 1993 there will be a workshop on Robotics organized by J. Baillieul, S. Sastry, and H.J. Sussmann. This workshop will feature a mathematical introduction to: 1) Kinematics and Fine Motion Planning; 2) The dynamics and control of kinematically redundant robot arms including snake-like robots, multi-fingered robotic hands; 3) Methods of nonholonomic motion planning for space robots, multifingered robot hands, and mobile robots; and 4) New techniques in analytical mechanics for writing the dynamics of complicated multi-body systems subject to constraints on angular momentum or other nonholonomic constraints. The emphasis will be on those conceptual problems of robotics that are fundamental to understanding a very technologically driven and interdisciplinary field. The workshop will highlight the mathematical problems but the participants will also be shown video tapes of multifingered hands, redundant robots, and nonholonomic motion planning for space robots and mobile robots.

W.S. Levine is organizing a mini-symposium February 1–3 on Biological Control of Movement. The study of the means by which animals and humans perform voluntary movements presents interesting and challenging mathematical problems. The primary purpose of this informal workshop is to interest mathematicians in these problems. This will be done by exposing them to recent experimental results that pose fundamental questions about how movement is controlled as well as to recent theoretical results aimed at answering
these questions. The minisymposium will bring together some of the leading experimentalists, analysts, and theoreticians in this broad and deep subject. The talks and discussions will focus on the current status of research and on the formulation of problems of interest to both mathematicians and specialists in the biological control of movement.

A workshop on **Nonsmooth Analysis and Geometric Methods in Deterministic Optimal Control** will be held February 8–17, with V. Jurdjevic, B.S. Mordukhovich, R.T. Rockafellar, and H.J. Sussmann as organizers. The purpose of this two-part meeting is to concentrate on powerful mathematical techniques that have been developed in deterministic optimal control theory after the basic foundations of the theory (existence theorems, Maximum Principle, dynamic programming, sufficiency theorems for sufficiently smooth fields of extremals) were laid out in the 1960s. These advanced techniques make it possible to derive much more detailed information about the structure of solutions than could be obtained in the past, and they support new algorithmic approaches to the calculation of such solutions. In addition to the theoretical side, there will be attention given to applications such as recent work on robotics problems, the control of chemical batch processes, economic models, hierarchical models, and some problems involving uncertainty. Numerical results will also be taken up. The first five days will be devoted to topics primarily involving geometric methods, and the last five to topics related to nonsmooth analysis methods. The two-day overlap will be devoted to the discussion of issues where both lines of research come together.

On March 15–19 there will be a workshop on **Systems and Control Theory for Power Systems**, organized by J. Chow, P.V. Kokotovic, and R.J. Thomas. Future electric power systems will be expected to satisfy extraordinary performance and reliability requirements and to tolerate pronounced dynamic behavior while remaining amenable to diagnostics and maintenance. Mathematical theory is expected to play a significant role in analyzing, designing, and operating these future systems. The emphasis of this workshop will be on the role of mathematical theory in the analysis and control of nonlinear dynamics in large-scale electric power systems. The topics to be discussed will include: 1) Modeling of large power systems using invariant and integral manifold theory; 2) Security assessment and enhancement problems including current research methodology for solution of these problems. Areas such as direct methods, voltage stability analysis, and structural stability analysis will be presented; and 3) Control system design considerations including measurement-based control, nonlinear control, parametric robust control, and decentralized and distributed control.

For more information about IMA activities, see the Meetings and Conferences section of this issue or contact the IMA, (ima_staff@ima.umn.edu). Also, weekly IMA seminar schedules with titles and abstracts are available on Usenet: umn.math.dept, and TeX files for the Newsletter and the Update are available via anonymous ftp (at imn.umn.edu).

**News from the Mathematical Sciences Institute Cornell University**
The Army Research Office Center of Mathematical Excellence, located at Cornell University's Mathematical Sciences Institute (MSI), is preparing to welcome a distinguished group of visiting scholars during the late summer and early fall of 1992.

MSI Director Anil Nerode will host Bakhadyr Khoussainov during the 1992–1993 academic year. Khoussainov has recently been a visitor at the University of Washington. Rod Downey from the University of Wellington, New Zealand is currently in residence at MSI and Professor D. Bridges from the University of Waikato, Hamilton, New Zealand and Dr. Y. Tabesh from Sharif University, Iran are expected to visit.

The Center for Stochastic Analysis, under the direction of Richard Durrett, has filled its two postdoctoral positions for academic years 1992–1994. The Center will host Itai Benjamini from the Hebrew University of Jerusalem and Kathleen Crowe, who has been a visiting assistant professor at UC, Davis. Benjamini will continue his work on Brownian motion on manifolds. Crowe, who received her degree from the University of Arizona, will fill a position reserved for researchers from groups underrepresented in mathematics. She will work on biological problems with Carlos Castillo-Chavez. Ken Hochberg from Bar-Ilan University will visit during the fall semester. R. Dobrushin from the Institute for Problems of Information Transmission, Russia will visit during the spring semester.

The Center for Symbolic Methods in Algorithmic Mathematics, directed by Moss Sweedler, will host visits from Nocolai Vorob'ev and Kiyoshi Shirayanagi. Shirayanagi is with the NTT Communication Science Laboratory.

**News from the Fields Institute**
The Fields Institute Distinguished Lecture Series will continue this fall with lectures by Vaughan Jones, University of California, Berkeley (September 23, 24, and 25, 1992) on operator theory, knots, and mathematical physics and by Michael Berry, University of Bristol, (October 22, 23, and 24, 1992) who will speak on quantum and classical asymptotics, chaosology, and the Riemann zeros.

The main focus of the Institute's activities for 1992–1993 is its program on Dynamical Systems and Bifurcations. The first of the short courses for graduate students and faculty will be given by Institute Director Jerrold E. Marsden. The course, entitled Lectures on Hamiltonian Bifurcation Theory, will run from September 23–26, 1992. The first workshop of the Dynamical Systems year will be on Conservative Systems and Quantum Chaos (October 21–25, 1992). This workshop will focus on bifurcation and integrability problems in Hamiltonian systems.

For further information about the Institute please contact Liz Reidt at The Fields Institute for Research in Mathematical Sciences, 185 Columbia St. West, Waterloo, Ontario Canada, N2L 5Z5; Tel.: 519-725-0096, Fax: 519-725-0704; reidt@fields.utoronto.ca.
For the October workshop please email: chaos@fields.uwaterloo.ca or the organizers: David Goodings (goodings@physun.physic.mcmaster.ca) or David Rod (rod@acs.ucalgary.ca).

Model Programs Sought
The Mathematical Association of America (MAA) has received funding from the National Science Foundation to prepare, for the mathematical community, descriptions of highly successful undergraduate mathematical sciences programs. We are searching for programs that enhance recruitment and retention of mathematics majors; programs that prepare a substantial number of students effectively for teaching school mathematics or for continued graduate study; or programs that are particularly effective in attracting, and addressing the needs of, groups traditionally underrepresented in mathematics. Alan Tucker, chair of MAA’s Education Coordinating Council, is the project director. MAA invites readers to nominate programs (including their own) for possible inclusion in this study project. Send your nomination letter to Professor Alan C. Tucker, Applied Mathematics Department, SUNY-Stony Brook, Stony Brook, NY 11794 (email: atucker@sbccmail.bitnet).

Report on Preparation of Teachers
“Mathematics education in the United States today is a vast enterprise involving millions of teachers and tens of millions of students... Along with reading, it is the most important item on our schools’ agenda. Yet by nearly every measure, mathematics education in the United States today is a failure.” So begins a report of a two-part conference held at the University of Chicago. Bringing together more than three dozen mathematicians, mathematics educators, psychologists, college administrators, and classroom teachers, the conference aimed to identify specific steps that need to be taken at the college level to improve the mathematical preparation of preservice elementary school teachers.

The report, entitled simply “On the Mathematical Preparation of Elementary School Teachers”, is unusually brief for a report on this topic, running only seventeen pages. As the report points out, more detailed ideas and perspectives may be found in such documents as Professional Standards for Teaching Mathematics, Curriculum, and Evaluation Standards for School Mathematics, Everybody Counts, and A Call for Change. This report makes a persuasive case for the idea that there is plenty of information on what to do—what is needed is the will to do it.

The report’s main conclusion is that more attention must be paid to what kind of mathematics elementary school teachers learn, how they learn it, and how they bring their knowledge to bear on actual classroom practice. Among the report’s specific recommendations are a coordinated national effort to bring about “a complete overhaul of the way elementary teachers are taught college mathematics”, the adoption of a 12-semester-hour minimum for the mathematical preparation of elementary school teachers, and “bridges” between colleges and elementary schools for the continued professional development of elementary school teachers. Mathematics faculty don’t get off easy in this report—one recommendation calls for institutes designed to improve the teaching methods of college faculty who are responsible for the mathematical preparation of teachers. The report also declares that “the mathematics community—specifically the AMS and the Mathematical Association of America (MAA)—must go clearly and explicitly on record as recognizing the importance of their critical role in preparing elementary school teachers to teach mathematics”.

Now that the report is out, two other initiatives are under way. The first is a survey of all U.S. colleges graduating significant numbers of education majors, which will gather information on the mathematics components of the preparation of elementary school teachers. The second is a proposal submitted to the National Science Foundation for a planning grant to begin laying the foundation for one of the more significant ideas in the report: the creation of a college mathematics program specifically intended to meet the needs of elementary teachers.

Copies of the report are available for $4 (includes shipping and handling) from Sheila Sconiers, University of Chicago, Department of Education, 5835 South Kimbark Avenue, Chicago, IL 60637-1609; telephone 312-702-1561.

Mathematics Awareness Week 1993
“Mathematics and Manufacturing” April 25–May 1, 1993
Every year, Mathematics Awareness Week celebrates the richness and relevance of mathematics and provides an excellent opportunity to convey this message through local events. During a week-long celebration from Sunday, 25 April – Saturday, 1 May 1993, the festivities will highlight Mathematics and Manufacturing. Mark your calendars now and plan to observe Mathematics Awareness Week in your area, school, or organization. Look for further information from the Joint Policy Board for Mathematics, national sponsor of Mathematics Awareness Week, in future issues of the Notices.

Special Reduced Rates for AMS Members
As a result of negotiations between the American Mathematical Society and J. C. Baltzer AG Scientific Publishing Company, AMS members can now take advantage of a special reduced rate on the following journals:
- Annals of Mathematics and Artificial Intelligence, US $80 per volume
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- Queueing Systems, US $93 per volume
- Telecommunication Systems, US $92 per volume.

This offer is being made exclusively to individual members of the American Mathematical Society.

In order to obtain this special discount, please send your order, stating your AMS membership code, directly

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**Enhanced Employment Register Interview Scheduling System**

Mathematics job seekers and employers will be pleased to learn that an enhanced interview scheduling system is under development by the AMS, and it should be available for use at the upcoming San Antonio Employment Register. The new system is based on computer code being developed by J. P. Jarvis, D. R. Shier, and M. Myers of the Department of Mathematical Sciences, Clemson University, under a contract jointly sponsored by AMS and MAA.

While maintaining the Employment Register tradition of maximizing the number of total interviews, the new system will support assigning various levels of priority to certain classes of interview requests. One class of interviews which will be assigned top priority are mutual requests, i.e., instances where an employer and an applicant request each other. Early tests indicate that virtually all such mutual requests will be scheduled during the two days of the register. A full set of priorities and revised guidelines for the new system are being developed by the AMS-MAA-SIAM Joint Committee on Employment Opportunities.

The October issue of the Notices will contain complete information on the San Antonio Employment Register, including information on preregistration for the register.

**Erratum**

Bylines were inadvertently omitted on two articles in the July/August 1992 issue of the Notices. “Canada's Fields Institute Opens its Doors,” pages 564–566, and “AMS Operating Plan for 1993,” pages 597–598, were both written by AMS Staff Writer Allyn Jackson.

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**Properties of Global Attractors of Partial Differential Equations**

A. V. Babin and M. I. Vishik, Editors

Volume 10

The four papers in this volume examine attractors of partial differential equations, with a focus on investigation of elements of attractors. Considered here is the dependence of attractors on singular perturbations of the equations. The theory of unbounded attractors of equations without bounded attracting sets is also covered. All of the articles are systematic and detailed, furnishing an excellent review of new approaches and techniques developed by the Moscow school.

1991 Mathematics Subject Classification: 35, 58, 76

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Funding Information
for the Mathematical Sciences

Research at Foreign Centers
Through its program for long-term research at foreign centers of excellence, the National Science Foundation (NSF) seeks to increase the presence of young U.S. investigators in foreign laboratories and research institutions.

Awards are made for research in any field of science or engineering supported by the NSF for visits of three to twelve months. Appropriate foreign science and technology centers include industrial research laboratories, government research laboratories and centers, privately sponsored nonprofit institutions, and universities.

The annual deadline for submissions is November 1. For more information, contact: Division of International Programs, Room V-501, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-653-5387.

Grants Available for Calculus Projects
The National Science Foundation (NSF) funds projects to improve mathematics curricula through its Curriculum Development in Mathematics: Calculus and Bridge to Calculus Program. The program is managed by the Division of Undergraduate Education, in cooperation with the Division of Mathematical Sciences and the Division of Elementary, Secondary, and Informal Science Education.

Proposals are solicited in three general categories: 1) projects to revitalize calculus instruction on a large scale involving students at the collegiate and/or secondary levels; 2) new curriculum development projects, particularly for the second year of calculus, including linear algebra and differential equations; and 3) curriculum development projects focused on preparation for calculus.

In recent years, mathematics faculty nationwide have implemented major changes in calculus instruction. While approaches have varied greatly, the emphasis has been on raising student conceptual understanding, problem solving skills, and analytical and transference skills, as well as on implementing new methods that reduce tedious calculations and place the student in the role of an active learner. Some of the projects have had NSF support, some have received other external support, and others have been developed with only institutional support.

Information about more than seventy such projects may be found in the report of the Mathematical Association of America, "Priming the Calculus Pump: Innovations and Resources". Additional reports have appeared in issues of UME Trends and have been presented at conferences and at sessions of meetings of professional societies. With information about successful models at hand, the challenge now is to include large numbers of students in the renewed calculus courses.

The closing date for proposals to the NSF's calculus program is December 7, 1992. More information and program announcements may be obtained from the program director, James Lightbourne, Division of Undergraduate Education, Room 1210, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-7292; email jhlighb@nsf.gov (Internet) or jhlighb@nsf (Bitnet).

Mathematical Sciences Postdoctoral Research Fellowships
The National Science Foundation's (NSF) Mathematical Sciences Postdoctoral Research Fellowship program is designed to permit recipients to choose research environments that will have maximal impact on their future scientific development. Awards will be made for appropriate research in pure mathematics, applied mathematics and operations research, and statistics at an appropriate nonprofit United States institution.

The fellowships will be offered only to persons who 1. are citizens, nationals, or lawfully admitted permanent resident aliens of the United States as of January 1, 1993; 2. will have earned, by the beginning of their fellowship tenure, a doctoral degree in one of the mathematical sciences; 3. will have held the doctorate for no more than five years as of January 1, 1993; and 4. will not previously have held any other NSF postdoctoral fellowship. Subject to the availability of funds, it is expected that in FY 1993, thirty to forty awards will be made. The evaluation of applicants will be based, in part, on ability as evidenced by past research work and letters of recommendation, likely impact on the future scientific development of the applicant, and scientific quality of the research likely to emerge. Applicants' qualifications will be evaluated by a panel of mathematical scientists. Women, underrepresented minorities, and persons with disabilities are strongly encouraged to submit applications.

For copies of the application brochure or further information, contact the Office of Special Projects, Room 339, Division of Mathematical Sciences, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; 202-357-3453; email mspfr@nsf.gov (internet) or mspfr@nsf (bitnet) or the American Mathematical Society, 401-455-4104; email nsfpostdocs@math.ams.com.

The deadline for applications is October 15, 1992. Please note that this deadline is one month earlier than in the years prior to 1991.
Acknowledgment of Contributions

The officers and the staff of the Society acknowledge with gratitude gifts and contributions received during the past year. Contributing members of the Society paid dues of $156 or more. In addition to contributions to the AMS Centennial Fellowship Fund, there were a number of unrestricted general contributions. Some of the contributors have asked to remain anonymous. All of these gifts provide important support for the Society’s programs. Also listed are AMS members who contributed, through the Society, to the International Mathematical Union’s Special Development Fund for travel grants to young mathematicians from developing countries. This year, gifts to the Society’s Memorial Gift Program are included in this list. The names listed below include those whose contributions were received during the year ending March 31, 1992.

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Eilemb, Samuel
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Eisner, Elmer
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•Ekland, Ivar
Ekland, Anthony D.
Eldridge, Klaus E.
Elbadad, Jimmy
El-Hodiri, Mohamed
Elia, Michele
•Elbou, Shadaw
•Ellett, Walter, Jr.
NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY

AMS Centennial Fellowship Fund

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AMS Centennial Fellowship Fund

Nussbaum, Roger D.
Nuss, Helena E.
Nutt, Michael D.

Nykors, Peter J.
Nygaard, James E.
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Oates-Williams, Sheila
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Obediah, Samuel A.
Obuta, Morio

Oberguggenberger, Michael B.
de la Obrera, Carmen
O’Caire, Fiacre Aiibibe
O’Callaghan, Liam J.
Ochmann, Serge
Ochiiai, Mitsuyuki
Ochs, Jon
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Octavio, Alfredo
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Oguchi, Kunio

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Oh, Young Yon
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Olesen, Mogens Norgaard

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AMS Centennial Fellowship Fund
Memorial and Commemorative Gift Listing

Memorial and commemorative gifts are a distinctive and thoughtful way to memorialize or honor a colleague, friend, or family member and to support the Society’s work to promote mathematical scholarship and research.

The Society acknowledges these gifts upon receipt of the gift and through the listing below. The list designates gifts made through March 1992. In addition, notification of the gift is sent to persons designated by the donor.

MEMORIAL GIFT

In Honor of the AMS
   Diethard Pallaschke
   Dieter Pumplun
In Honor of Edward M. Arnold, Sr.
   Stephanie Arnold Walborn
In Honor of Adrian Ayala
   Rafael Ayala-Gomez
In Honor of Monsieur Nicolas Bourbaki
   Alexander Stuebinger
In Memory of Professor Leon W. Cohen
   Beatrice Kleppner
In Honor of Professor Craig Comstock
   Frank D. Faulkner
In Honor of Carl Cowen
   Shamim Ismail Ansari
In Memory of Frances S. Edris
   Gerrit M. Edris
In Honor of the Founders of AMS
   Leonardo D’Atri
In Memory of Izrail Markovich Glazman
   W. Norrie Everitt
In Honor of Professor Emeritus Gustav A. Hedlund
   Leo Hellerman
In Memory of Grant Wallace Heil
   Ruth L. Hughes
In Honor of Domingo Herrero
   Edward A. Azoff
In Memory of Einar Hille
   John Boris Miller
   In Memory of Regina Ruth Love
   Rodrick R. Love
   In Memory of My Father, Giovanni Marchiafava
   Stefano Marchiafava
   In Memory of (Hans Heinrich) Wilhelm Magnus
   Bernhard H. Neumann
In Honor of Professor Carl Maxson
   Gerart Pilz
In Memory of Marilyn Miller Mosier
   Ronald G. Mosier
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   Akira Tsutsumi
   In Memory of Professor Leonard Sulski
   Dr. & Mrs. Vincent McBrien
   In Honor of Professor Hans Suzaki
   Shyuichi Izumiya
   In Memory of Kazimirz Twardowski,
   on the 125th anniversary of his birth
   Giuseppe Scollo
   In Memory of Cuiyi Zhang
   Jie Chen

OTHER MEMORIAL GIFT DONORS

   Gregory A. Bastian
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   Edward Silverman
   James L. Smith
   Sing Keung Wong
   Ken-ichi Yoshihara

CENTENNIAL FELLOWSHIP FUND

   In Honor of Arnold Ross
   G. Baley Price
1992 AMS Elections

In an effort to increase the number of ballots returned in the election process, the Society has decided to include in the Notices all the pertinent election material, including biographies and statements of the candidates in the upcoming election. The information is provided in order to assist the members in filling out the ballots that will soon be mailed. The officers of the Society encourage the members to return ballots.

I urge you to study the material printed below. More importantly, I urge you to look for the ballot that will arrive shortly in the mail and to return a completed ballot. In recent elections, only 15% of the members participated. I hope this figure can be greatly increased.

Robert Fossum
Secretary

Candidates

OFFICERS
Vice-President (one to be elected)
Melvin Hochster
Anil Nerode

Member-at-Large of the Council (five to be elected)
James H. Curry
Peter Li
Gloria C. Hewitt
Kenneth A. Ribet
Svetlana R. Katok
Philip D. Wagreich
Steven George Krantz
Jonathan M. Wahl
James I. Lepowsky
Susan Gayle Williams

Board of Trustees (one to be elected)
Roy L. Adler
Richard W. Beals

NOMINATING COMMITTEE FOR 1993
(Approval voting, three to be elected)
Jerome A. Goldstein
Louise A. Raphael
Vaughan F. R. Jones
Yum Tong Siu
Brian J. Parshall
Nancy K. Stanton

EDITORIAL BOARDS COMMITTEE FOR 1993
(Approval voting, two to be elected)
Bryan J. Birch
Paul H. Rabinowitz
Fan R. K. Chung
Masamichi Takesaki

Election Information

The ballots for election of members of the Council and Board of Trustees of the Society for 1993 will be mailed on or shortly after September 10, in order for members to receive their ballots well in advance of the November 10 deadline. Prior to casting their ballots members are urged to consult the following articles and sections of the Bylaws of the Society: article I, section 1; article II, sections 1, 2; article III, sections 1, 2, 3; article IV, sections 1, 2, 4; article VII, sections 1, 2, 5. The complete text of the Bylaws appears on pages 1177–1182 of the November 1991 issue of the Notices. A list of the members of the Council and Board of Trustees serving terms during 1992 appears in the AMS Reports and Communications section of this issue.

REPLACEMENT BALLOTS

This year ballots for the AMS election will be mailed September 10, 1992, or within a day or two thereafter. The deadline for receipt of ballots is November 10, 1992.

There has been a small but recurring and distressing problem concerning members who state that they have not received ballots in the annual election. It occurs for several reasons, including failure of local delivery systems on university or corporate properties, failure of members to give timely notice of changes of address to the Providence office, failures of postal services, and other human errors.

To help alleviate this problem, the following replacement procedure has been devised: A member who has not received a ballot by October 10, 1992, or who has received a ballot but has accidentally spoiled it, may write after that date to the Secretary of the AMS, Post Office Box 6248, Providence, RI 02940, asking for a second ballot. The request should include the individual’s member code and the address to which the replacement ballot should be sent. Immediately upon receipt of the request in the Providence office, a second ballot, which will be indistinguishable from the original, will be sent by first class or air mail. It must be returned in an inner envelope, which will be supplied, on the outside of which is the following statement to be signed by the member:

The ballot in this envelope is the only ballot that I am submitting in this election. I understand that if this statement is not correct then no ballot of mine will be counted.

signature

Although a second ballot will be supplied on request and will be sent by first class or air mail, the deadline for receipt of ballots will not be extended to accommodate these special cases.

SUGGESTIONS FOR 1993 NOMINATIONS

Each year the members of the Society are given the opportunity to propose for nomination the names of those individuals they deem both qualified and responsive to their views and needs as part of the mathematical community. Candidates will be nominated by the Council to fill positions on the Council and Board of Trustees to replace those whose terms expire January 31, 1994. See the AMS Reports and Communications section of this issue for the list of current members of the Council and Board of Trustees. Members are requested to write their suggestions for such candidates in the appropriate spaces below.

SUGGESTIONS FOR 1993 NOMINATIONS

President-Elect (1)

Vice-President (1)

Members-at-large of the Council (5)

Member of the Board of Trustees (1)

The completed form should be addressed to AMS Nominating Committee, Post Office Box 6248, Providence, RI 02940, to arrive no later than November 10, 1992.
Biographies of Candidates
1992

Biographical information about the candidates has been verified by the candidates, although in a few instances, prior travel arrangements of the candidate at the time of assembly of the information made communication difficult or impossible. A candidate had the opportunity to make a statement of not more than 200 words on any subject matter without restriction and to list up to five of her or his research papers.

Abbreviations: American Association for the Advancement of Science (AAAS); American Mathematical Society (AMS); American Statistical Association (ASA); Association for Computing Machinery (ACM); Association for Symbolic Logic (ASL); Association for Women in Mathematics (AWM); Canadian Mathematical Society, Société Mathématique du Canada (CMS); Conference Board of the Mathematical Sciences (CBMS); Institute of Mathematical Statistics (IMS); International Mathematical Union (IMU); London Mathematical Society (LMS); Mathematical Association of America (MAA); National Academy of Sciences (NAS); National Academy of Sciences/National Research Council (NAS/NRC); National Aeronautics and Space Administration (NASA); National Council of Teachers of Mathematics (NCTM); National Science Foundation (NSF); Operations Research Society of America (ORSA); Society for Industrial and Applied Mathematics (SIAM); The Institute of Management Sciences (TIMS).

An (*) indicates the individual was nominated in response to a petition.

AMS Committees: Committee to Select Hour Speakers for Western Sectional Meetings, 1977–1979 (Chair, 1979); Bulletin Editorial Committee (Associate Editor, Research Announcements), 1981–1983; Program Committee for National Meetings, 1982–1984 (Chair, 1983–1984); Executive Committee of the Council, 1983–1986; Mathematical Reviews Editorial Committee, 1984–1989 (Chair, 1984–1989); Committee on Long Range Planning, Board of Trustees, 1985 (Chair); Committee to Select the 1985 Cole Prize in Algebra; Mathematical Reviews-Zentralblatt Negotiating Team, 1985; Committee to Select the 1990 Cole Prize in Algebra (Chair).


Additional Information: Principal Lecturer, CBMS Regional Conference, University of Nebraska, 1974; Principal Lecturer, CBMS Regional Conference, George Mason University, 1979; Frank Nelson Cole Prize in Algebra, 1980; Guggenheim Fellow, 1982; Board of Trustees, MSI, 1985–1987; Board of Governors, IMA, 1985–1987; Scientific Advisory Council, MSI, 1989–1993 (Chair, 1992–1993); Human Resources Committee, MSI, 1992–(Chair); Member: AMS, MAA, AWM.


Statement: I am concerned with a current paradox. Federal funds are being poured into graduate support at a time when the job market is dreadful, while traditional funding for researchers, already inadequate, is being steadily eroded.

Anil Nerode*
Goldwin Smith Professor of Mathematics and Director of the Mathematical Sciences Institute, Cornell University

Born: June 4, 1932, Los Angeles, California
Ph.D.: University of Chicago, 1956


Vice President
Melvin Hochster
Professor, University of Michigan

Born: August 2, 1943, Brooklyn, New York
Ph.D.: Princeton University, 1967
Biographies of Candidates


Statement: If elected, I would help AMS take a lead in: (1) Promoting the unity of the mathematical sciences; (2) Integrating mathematics with the rest of scientific life; (3) Making contributions of mathematics to government, business and industry known to the Public and Congress; (4) Integrating the teaching community with the research community; (5) Identifying the mathematically talented among minority groups and women, drawing them into our community. Besides a long research career under NSF, ARO, ONR, AFOSR, and many other sources of research support, I have: had thirty-four Ph.D. students, including Louise Hay and Charlotte Lin (I joined AWM at its inception); run MAT programs (NSF); been consultant for MAA for about eighty colleges; initiated a freshman program to hold students in mathematics (EXXON); initiated a program to bring college teachers into the University for updating (PEW, DANA); initiated many dozens of conferences in new areas (MSI); been a consultant for EPSCOR Kentucky and Puerto Rico; initiated cooperative research programs with minority institutions; advised many government and industrial laboratories and institutes. I have also worked with EPA for fourteen years, have been on the U.S. Environmental Protection Agency Science Advisory Board, and am currently Chair, USEPA Global Change Program Technical Advisory Panel.

Member-at-Large of the Council

James H. Curry
Professor of Applied Mathematics, University of Colorado, Boulder

Ph.D.: University of California, Berkeley, 1976

AMS Committees: Committee on Communications, 1992.-


Additional Information: NSF Postdoctoral Fellowship Evaluation Panel, 1990.-


Gloria C. Hewitt
Professor, University of Montana

Ph.D.: University of Washington, 1962


Selected Addresses: Limits of Universal Algebras, Missoula, 1976; Noetherian Conditions, Cleveland, 1978; Category Theory and Automata (Series of Lectures), Cleveland, 1981; Generalized Noetherian Rings, China, 1990; Polynomial Rings Which are Principal Ideal Rings, China, 1990.


Svetlana R. Katok
Associate Professor, Pennsylvania State University

Ph.D.: University of Maryland, 1983


Additional Information: NSF Postdoctoral Research Fellow, 1986–1988;
Seminar Leader, Summer Mathematics Institute, Intensive Mathematics Program for Women Undergraduates, NSF Special Project, Mills-Berkeley, June–July 1991; Member: AMS, AWM.


Statement: I believe that AMS should exercise leadership in the commitment of the research mathematics community to excellence in undergraduate education. Together with improvement in both these categories, this will make mathematics more attractive as a career and will bring the best talent to the profession.

Steven George Krantz
Professor, Washington University

Born: February 3, 1951, San Francisco, California

Ph.D.: Princeton University, 1974


Additional Information: NSF Fellow, 1975–1976; Chauvenet Prize, MAA, 1992; Member: AMS.


Statement: The two most severe crises facing our professions today are the shortage of jobs and the difficulty of obtaining research funding. Although the first crisis stems in part from transient social phenomena, the end is not in sight. The second crisis is also complicated, is linked in part with rising salaries and shortage of money, but also has complex social aspects. In any event, the two problems are proving disheartening both to those who are considering entering the profession and to those who are already established as mathematicians. I would like to see the AMS council seek methods to deal with the job crisis and the funding situation.

I would also like the AMS council to function more openly and to be more accountable to the AMS membership at large. My personal experience with the council in the last few years has suggested that there is room for improvement in both these categories.

James I. Lepowsky
Professor, Rutgers University

Born: July 5, 1944, New York, New York

Ph.D.: Massachusetts Institute of Technology, 1970


Statement: In conjunction with its primary goal of fostering innovative research, the AMS should continue, and seek new ways, to: (1) take an active role in the improvement of mathematics teaching at all levels; (2) emphasize to funding sources and to the general public the importance of mathematics—especially the kind of undirected basic
research carried out by individual investigators; (3) facilitate interdisciplinary interaction both within mathematics and between mathematics and other fields; (4) strongly encourage talented students, including women and members of minority groups, to consider mathematics as a career; and (5) provide a forum for mathematicians to discuss the relations between mathematics and society.

Peter Li
Professor, University of California, Irvine
Born: April 18, 1952, Hong Kong
Ph.D.: University of California, Berkeley, 1979

Kenneth A. Ribet
Professor of Mathematics, University of California, Berkeley
Born: June 28, 1948, New York, New York
Ph.D.: Harvard University, 1973
AMS Committees: Committee on Far Western Sectional Meetings (Select Hour Speakers for), 1980-1981 (Chair).

Statement: I would be honored to serve as Member-At-Large of the Council. I come to the AMS with no platform or political agenda. I am acutely aware of the numerous challenges faced by our profession, and hope that I can make a contribution to sensible and equitable solutions.

Philip D. Wagreich
University of Illinois at Chicago
Born: July 25, 1941, New York, New York
Ph.D.: Columbia University, 1967
AMS Committees: Organizing Committee, 1981 Summer Institute on Singularities; Committee on NCTM Standards, 1989.

Statement: A vigorous research community depends upon a source of new students, the continuation of research funding, and understanding and acceptance by the general public. Therefore, in addition to the direct support of mathematics research, the AMS should involve itself in reform of mathematics education and in communication with government agencies and the general public. The AMS should find appropriate ways to facilitate the process of institutional and cultural change.

Jonathan M. Wahl
Professor, University of North Carolina, Chapel Hill
Born: January 29, 1945, Washington, DC
Ph.D.: Harvard University, 1971


Statement: While the main purpose of the Society is to promote mathematical research, several survival issues must be addressed. Most importantly, the Council needs to have frank discussions about practical ways to stem the flow of American college and graduate students away from mathematics and the sciences. Because of the need to increase research support for individual investigators, a close look ought to be taken at the effect on NSF grants of the removal of the salary cap.

Susan Gayle Williams
Professor, University of South Alabama
Born: May 26, 1953, Orange, New Jersey
Ph.D.: Yale University, 1981
Additional Information: Organizer, Southeast Dynamical Systems Conference, Mobile, February 1990; Program Committee, Mathematical Sciences Research Institute Special Half-Year Program in Symbolic Dynamics, Fall 1992; Member: AMS, AWM.


Statement: A substantial proportion of AMS members are faculty at small colleges and universities which have few resources to support research. This proportion is growing as the bleak job market causes more talented young mathematicians with a strong dedication to research to take jobs at less prestigious schools. This segment of the membership has little representation on the AMS Council, and it is sometimes overlooked. For example, the Academic Hiring Survey in the April Notices sampled only doctorate-granting institutions, and half of the 40 schools surveyed were chosen from the 39 "Group I" institutions.

If we want broad public support for mathematical research, we must convince the public that mathematics is not a product which can be manufactured by a few to be consumed by many; that knowledge and discovery go hand in hand at all levels of mathematics. The AMS will be in a better position to do this if its Council reflects the diversity of its membership.

Roy L. Adler
Research Staff Member and Senior Manager, Mathematical Sciences Department, Research Division, IBM Corporation
Born: February 22, 1931, Newark, New Jersey
Ph.D.: Yale University, 1961
Selected Addresses: Colloquium Lecture, Cornell University, 1964; Invited Address, Kalamazoo, August 1975; Summer Research Conference on Ergodic Theory and Applications, Durham, June 1982 (organizer); Keynote Speaker, Australian Mathematical Society, Monash University, Melbourne, May 1984; Principal Speaker, Special Year in Dynamical Systems, University of Maryland, December 1986; Colloquium Lecture,
Pennsylvania State University, October 1991.


Statement: It is incumbent upon a Trustee to see that issues of our profession are seriously attended to such as: scarcity of jobs, educational reform, inequities due to race and sex, government support of research, and careful use of society funds. I shall try my best.

Richard W. Beals
Professor, Yale University
Born: May 28, 1938, Erie, Pennsylvania
Ph.D.: Yale University, 1964
AMS Committees: Committee on Steele Prizes, 1984–1987 (Chair, 1987); Editorial Board, Contemporary Mathematics, 1989– (Chair, 1990–).
Selected Addresses: Special Session on Partial Differential Equations, Minneapolis, November 1973; Invited Address, Pittsburgh, August 1981; Special Session on Inverse Problems, Newark, April 1987; Summer Research Conference on Inverse Scattering and Applications, Amherst, June 1990.

Additional Information: Co-editor, Communications in Partial Differential Equations, 1976–1986; Member: AMS, MAA.


Nominating Committee
Jerome A. Goldstein
Professor, Louisiana State University
Born: August 5, 1941, Pittsburgh, Pennsylvania
Ph.D.: Carnegie Mellon University, 1967

Additional Information: Member, Institute for Advanced Study, 1967–1968; Sigma Xi Faculty Research Award, Tulane University, 1970–1971; First Annual Excellence in Research Award, Faculty of Arts and Sciences, Tulane University, 1985; Member: AMS, AWM, MAA, Edinburgh Mathematical Society; Institute of Mathematical Statistics, Sigma Xi, Sociedade Matematica Brasileira, London Mathematical Society; served on various committees of the MAA and SIAM and on three editorial boards of research journals.


Statement: The business of the AMS is to promote mathematical activity and scholarship at the highest levels. High standards should be maintained while avoiding elitism. All qualified and interested individuals should be encouraged to pursue careers in mathematics and to advance their careers as far as possible. These positions imply advocacy of affirmative action, concern for the welfare of individual mathematicians, concern over educational issues, and advocacy for research support for larger numbers of mathematicians.

Vaughan F. R. Jones
Professor, University of California, Berkeley
Born: December 31, 1952, Girsonbe, New Zealand
Ph.D.: Université de Geneve, Switzerland, 1979
AMS Committees: Committee on Steele Prizes, 1992.
Selected Addresses: Special Session on $C^*$-Algebras, Reno, April 1981; Invited Address, Amherst, October 1985; Special Session on Braids, Links, and Operator Algebras, Amherst, October 1987; Special Session on Inverse Problems, Newark, April 1987; Summer Research Conference on Inverse Scattering and Applications, Amherst, June 1990.

Additional Information: Sloan Fellow, 1983; Guggenheim Fellow, 1986; Fields Medal, 1990; Executive Committee, International Association of Mathematical Physics.


Statement: With a background in functional analysis, I am interested in the rich interplay between various branches of mathematics, physics and biology. I see such work as vital for the health of mathematics, while not failing to appreciate the value of single-minded dedication to a difficult problem in a specific area.

Brian J. Parshall
Professor of Mathematics, University of Virginia

Born: October 28, 1945 in Penn Yan, New York
Ph.D.: Yale University, 1971
AMS Committees: Committee on Summer Institutes and Special Symposia, 1989–; Chair, Committee on Summer Institutes and Special Symposia, 1991–1993.

Selected Addresses: Invited Address, Michigan State University, March 1988; Special Session on Quantum Groups and Finite Dimensional Algebras, Penn State University, April 1990.

Additional Information: Organizing Committees: (1) AMS Summer Research Conference on Finite and Algebraic Groups: Modular Representations and Cohomology, Arcata, July 1989; (2) MSRI Workshop on Representation Theory of Reductive Groups, November 1990; (3) AMS Summer Research Institute on Algebraic Groups, July 1991; (4) Yale Conference on Lie Algebras, April 1992.


Statement: The American Mathematical Society should aim to promote mathematics in general and mathematical research in particular. Besides through its publications and meetings, it can realize these goals in a number of important ways: by providing meaningful aid to young mathematicians in hard times, by strengthening contacts with other sciences, by aggressively influencing funding agencies (and by coming up with new sources of money), and by educating the public on the importance of mathematics in society. If elected to the Nominating Committee, I will support people with these objectives in mind.

Louise A. Raphael
Professor, Howard University

Born: October 24, 1937, New York, NY
Ph.D.: Catholic University, 1967

AMS Committees: AMS-MAA-SIAM Congressional Science Fellowship Selection Panel, 1985-1986; Liaison Committee on Education in Mathematics, 1989–; Liaison Committee with AAAS, 1992–.


Statement: I will recommend the best qualified mathematicians, with special care to promote the candidacies of women and minorities for AMS offices, council, committees, and boards in order to ensure that the AMS has the benefit of the best mathematical talent and wisdom of all its members.

Yum-Tong Siu
Professor, Harvard University

Born: May 6, 1943, Canton, China
Ph.D.: Princeton University, 1966

AMS Committees: Committee to Select Hours Speakers for Eastern Section Meetings, 1983-1984.

Nancy K. Stanton

Professor, University of Notre Dame

Born: March 23, 1948, San Francisco, California

Ph.D.: Massachusetts Institute of Technology, 1973


Selected Addresses: Invited Address, Bryn Mawr, March 1982; Special Session on Geometry and Analysis on CR Manifolds, Salt Lake City, August 1987; Summer Research Institute on Several Complex Variables, Santa Cruz, July 1989; MAA Invited Address, Boulder, August 1989; Summer Research Institute on Differential Geometry, Los Angeles, July 1990.


Editorial Boards Committee

Bryan J. Birch
Professor, University of Oxford

Born: September 25, 1931, Burton-on-Trent, England

Ph.D.: Cambridge University, 1957


Additional Information: Delegate of Oxford University Press; Editor of Topology; Formerly on editorial boards of Inventiones Mathematicae, of the Journal of Number Theory, and of the journals of the London Mathematical Society; Fellow of the Royal Society; Member: AMS, the Fachbeirat of the Max-Planck-Institut in Bonn, and the Beirat of the Institut für Experimentelle Mathematik in Essen.

Statement: As mathematicians, we are fortunate that our community is an international one, in which cooperation has always been possible; and we must be glad that collaboration has become easier.

Fan R. K. Chung
Bellcore Fellow, Visiting Professor at Harvard University
Born: October 9, 1949, Taiwan
Ph.D.: University of Pennsylvania, 1974
Additional Information: Allendoerfer Award, 1990.
Statement: We are today in the midst of a technological revolution. Mathematics will play a vital role both in laying the foundation for this process and in making crucial contributions throughout the whole spectrum of this development. The AMS, as the major organization for fostering mathematics research, has a special responsibility to maximize the impact of mathematicians and to attract the best talent, including, in particular, women and minorities. The publication program of the AMS is a primary vehicle by which it serves its members as well as the world mathematical community. It is therefore important that editorial boards of the AMS journals reflect the broad spectrum of AMS members and their interests.

Paul H. Rabinowitz
Professor, University of Wisconsin, Madison
Born: November 15, 1939, Newark, New Jersey
Ph.D.: New York University, 1966
Additional Information: Guggenheim Fellow, 1978; Member: AMS.

Masamichi Takesaki
Professor of Mathematics, University of California, Los Angeles
Born: July 18, 1933, Sendai, Japan
Ph.D.: Tohoku University, 1965
Second Announcement

The eight-hundred-and-seventy-sixth meeting of the American Mathematical Society (AMS) will be held at Wright State University, Dayton, Ohio, on Friday, October 30, Saturday October 31, and Sunday, November 1, 1992. Invited addresses will be in the auditorium of the Medical Sciences Building; sessions will be held in the Russ Engineering Center and in Rike Hall.

Invited Addresses

By invitation of the Central Section Program Committee, there will be four invited one-hour addresses. The speakers, their affiliations, and the titles of their talks are:

- **Martin Golubitsky**, University of Houston, *Symmetry and chaos.*
- **Louis H. Kauffman**, University of Illinois at Chicago, *From knots to quantum field theory and back.*
- **J. Toby Stafford**, University of Michigan, Ann Arbor, *Noncommutative graded algebras and projective geometry.*

Special Sessions

By invitation of the same committee, there will be twelve special sessions of selected twenty-minute papers. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

- **Hyperbolic manifolds**, Colin C. Adams, Williams College, and **Ara S. Basmajian**, University of Oklahoma.
- **Quantum groups and regular algebras**, Carolyn A. Dean, University of Michigan, Ann Arbor, **Timothy J. Hodges**, University of Cincinnati, and **J. Toby Stafford**.
- **Combinatorics and graph theory**, **Anthony B. Evans** and **Terry A. McKee**, Wright State University.
- **Groups and geometries**, **Daniel E. Frohardt**, Wayne State University.
- **Control theory and partial differential equations**, **Lop Fat Ho**, Wright State University, **Srdjan D. Stojanovic**, University of Cincinnati, and **Thomas Svobody**, Wright State University.
- **Differential and integral equations**, **Muhammad N. Islam**, University of Dayton, and **Lawrence Turyn**, Wright State University.
- **Knots and topological quantum field theory**, **Louis H. Kauffman**.
- **Riccati equations and transport theory**, Hendrik J. Kuiper, Arizona State University, and **Tapas Mazumdar**, Wright State University.
- **Topology of affine hypersurfaces and related number theory**, **Anatoly S. Libgober**, University of Illinois at Chicago, and **Steven Sperber**, University of Minnesota, Minneapolis.
- **Set-theoretic topology**, **Joe D. Mashburn**, University of Dayton.
- **Function theory**, **C. David Minda**, University of Cincinnati.

Abstracts for consideration for these sessions should have been submitted by the July 13, 1992 deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of the Notices.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts for consideration of these sessions should have been submitted by the August 3, 1992 deadline previously published in the Calendar of AMS Meetings and Conferences. Late papers will not be accommodated.

Registration

The meeting registration desk will be located in the first floor lobby of the Russ Engineering Center. The registration desk will be open from 12:30 p.m. to 5:00 p.m. on Friday, October 30; and 8:00 a.m. to 3:00 p.m. on Saturday, October 31. The registration fees are $30 for members of the AMS, $45 for nonmembers, and $10 for students or unemployed mathematicians.

Accommodations

Rooms have been blocked for participants at the Holiday Inn (Fairborn I-165 location), Homewood Suites, and the Red
Roof Inn (Fairborn location), located just south of the street (Colonel Glenn Highway) that borders the south edge of the Wright State Campus. Rooms have also been blocked at the Ramada Inn (Fairborn location), and the Comfort Inn Wright-Patterson in central Fairborn. Participants should make their own arrangements with the hotel of their choice and ask for the AMS conference rate.

Fairborn is a suburb of Dayton and most lodgings are chains with other locations in the metropolitan Dayton area. Thus, participants are advised to verify the street address of these hotels/motels.

The cafeteria in the University Center (a convenient walk from Engineering Center) is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.

Comfort Inn Wright-Patterson (5 miles from Russ Engineering Center)

616 North Broad Street, Fairborn, OH 45324
Telephone: 513-879-7666 or 800-245-3127
**The deadline for reservations is October 16, 1992.**
Single $39  Double $43

Holiday Inn Fairborn I-675 (0.4 miles from Russ Engineering Center)

2800 Presidential Drive, Fairborn, OH 45324
Telephone: 513-426-7800 or 800-465-4329
**The deadline for reservations is October 9, 1992.**
Flat rate $63 up to four occupants
Please note: The previously published rate was incorrect. We regret any inconvenience this may have caused.

Homewood Suites (0.5 miles from Russ Engineering Center)

2750 Presidential Drive, Fairborn, OH 45324
Telephone: 513-429-0600 or 800-225-5466
**The deadline for reservations is October 9, 1992.**
Flat rate $69
Suite with king bed, sleeper sofa (four occupants)

Ramada Inn (5 miles from Russ Engineering Center)

800 North Broad Street, Fairborn, OH 45324
Telephone: 513-879-3920 or 800-272-6232
**The deadline for reservations is October 16, 1992.**
Single or double occupancy $42

Red Roof Inn - Fairborn, #205 (.7 miles from Russ Engineering Center)

2580 Colonel Glenn Highway, Fairborn, OH 45324
Telephone: 513-426-6116 or 800-874-9000
**The deadline for reservations is October 20, 1992**
When making reservations participants should mention the following confirmation number: 205AA92304.
Single $35.99  Double $42.99  Triple $45.99

Food Service

The cafeteria in the University Center (a convenient walk from the buildings in which the meeting will held) will be open for breakfast, lunch, and dinner on Friday, October 30, and for brunch and dinner on Saturday, October 31 and Sunday, November 1. Several restaurants and fast food establishments are located adjacent to the Wright State campus. Some of these are convenient to the buildings in which the meeting will be held; others are close to the Holiday Inn Fairborn, the Homewood Suites, or the Red Roof Inn-Fairborn. Likewise, other restaurants and fast food establishments are located in downtown Fairborn, near the Comfort Inn Wright-Patterson or the Ramada Inn.

Packing

Free parking will be available to participants throughout the meeting. On the afternoon of Friday, October 30, participants should park in the PE Lot located southwest of the Russ Engineering Center. From Friday night through Sunday afternoon, participants may park in essentially all campus lots (excepting those spaces marked as reserved). The most convenient will be FW Lot, Health Sciences Lot, Biological Sciences Lot, Rike Lot, Visitor Lot, Allyn Lot, and PE Lot. These lots are shown on the campus map, as are the buildings in which the sessions will be held: Russ Engineering Center (RC on the map), Rike Hall (R), and Medical Sciences Building (MS).

Travel and Local Information

Arriving by air: Dayton International Airport is served by several major airlines. Car rental agencies are located in the airport terminal. Ground transportation is available by Dayton Yellow Cab (513-228-1155) and Charter Vans, Inc. (513-898-4043 or 898-7171). The airport is approximately a thirty-minute drive from the campus. Rental car companies are located in the airport terminal.

Arriving by car: The principal highways through the Dayton metropolitan area are I-70, I-75, and US Route 35. Participants arriving from the north of Dayton on I-75 should take I-75 South to I-70 East, then Ohio Route 4 South to Ohio Route 444 North to Kauffman Avenue.

Participants arriving from south of Dayton on I-75 should take I-75 North to I-675 North and exit at the North Fairfield Road exit (exit 17). Turn left on North Fairfield and left on Colonel Glenn Highway. (Alternatively, at exit 17 one may take 444A and follow it to the Wright State exit).

Participants arriving from east of Dayton on I-70 should take I-70 West to I-675 South and exit at North Fairfield Road (exit 17). Turn right on North Fairfield and left on Colonel Glenn Highway.

Participants arriving from east of Dayton on US 35 should take US 35 West and exit onto I-675 North. On I-675 North, exit at the North Fairfield Road exit (exit 17) and turn left on North Fairfield and left on Colonel Glenn Highway. (Alternatively, at exit 17 one may take 444A and follow it to the Wright State exit).

Participants arriving from west of Dayton on I-70 should take I-70 East to Ohio Route 4 South to Ohio Route 444 North to Kauffman Avenue.
Meetings

Participants arriving from west of Dayton on US 35 should take US 35 East to I-675 North to the North Fairfield Road exit (exit 17). Turn left on North Fairfield and left on Colonel Glenn Highway. (Alternatively, at exit 17 one may take 444A and follow it to the Wright State exit).

Ohio Route 4 may be under construction when this meeting occurs. Therefore, participants arriving by car from north of Dayton on I-75 or from west of Dayton on I-70 should be prepared to alter the directions above as follows: follow I-70 East; skip the exit at Ohio Route 4 and continue on I-70 East to I-675 South and exit at North Fairfield Road (exit 17). Turn right on North Fairfield and left on Colonel Glenn Highway.

Weather and Local Attractions

The average temperatures in Dayton for early November are 57-58°F (high) and 38-39°F (low). The closest local attraction is the United States Air Force Museum, approximately a ten-minute drive from campus. This is the largest military aviation museum in the world. Admission is free. The museum is open from 9:00 a.m. to 5:00 p.m. every day. Exhibits include about two hundred aircraft and missiles, many other displays of related historical artifacts, and free documentary films. For a $4 admission, one can also view films in the huge-screen IMAX Theater. Rounding out the facility are a book shop, gift store, and cafe.

Andy R. Magid
Associate Secretary
Norman, Oklahoma
The eight-hundred-and-seventy-seventh meeting of the American Mathematical Society (AMS) will be held at the University of Southern California (USC) on Saturday, November 7, and Sunday, November 8, 1992. This meeting will take place concurrently with a meeting of the Southern California section of the Mathematical Association of America (MAA).

The invited addresses will be held in the Seeley G. Mudd Building, one block east of the Denny Building, and most other sessions will be held in Kaprielian Hall, north across 36th Place from the Denny Building.

**Invited Addresses**

By invitation of the Western Section Program Committee, there will be three invited addresses. The speakers, their affiliations, and the titles of their talks are:

Robert L. Lazarsfeld, University of California, Los Angeles, *Syzygies of algebraic varieties.*

Tomasz S. Mrowka, California Institute of Technology, *Gauge theory and embedded surfaces.*

Thomas C. Sideris, University of California, Santa Barbara, *The life span of 3D compressible and incompressible flow.*

**Special Sessions**

By invitation of the same committee, there will be eight special sessions of selected twenty-minute papers. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

Finite and algebraic groups, Michael Aschbacher, California Institute of Technology, Robert M. Guralnick, University of Southern California, and David B. Wales, California Institute of Technology.

Spectral Geometry, Robert Brooks, University of Southern California, and Peter A. Perry, University of Kentucky.

Hyperbolic geometry, Francis Bonahon and Robert Meyerhoff, University of Southern California.

Algebraic and complex geometry, Lawrence Ein, University of Illinois at Chicago.

Dynamical systems, Eugene Gutkin and Nicolai T. A. Haydn, University of Southern California.

Gauge theory and four manifolds, Tomasz S. Mrowka.

Topics in geometry and physics, Robert C. Penner, University of Southern California, and Edward Witten, School of Natural Science, IAS.

Nonlinear hyperbolic PDE and fluid mechanics, Gustavo Ponce, University of California, Santa Barbara, and Thomas C. Sideris.

Abstracts for consideration for these sessions should have been submitted by the July 13, 1992 deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of the Notices.

**Contributed Papers**

There will also be sessions for contributed ten-minute papers. Abstracts for consideration of these sessions should have been submitted by the August 3, 1992 deadline previously published in the Calendar of AMS Meetings and Conferences. Late papers will not be accommodated.

**Registration**

The meeting registration desk will be located in the lobby of the Denny Research Center, on the southeast corner of Vermont Avenue and 36th Place, and will be open on Saturday, November 7, from 7:30 a.m. to 5:00 p.m. and on Sunday, November 8, from 7:30 a.m. to noon. The registration fees are $30 for members of the AMS, $45 for nonmembers, and $10 for students or unemployed mathematicians.

**Accommodations**

Rooms have been blocked for participants at the University Hilton hotel located across from the university on Figueroa Street at Exposition Boulevard. Participants should make their own reservations directly with the hotel, and participation in the AMS-MAA meeting should be mentioned to receive the special rates quoted below. The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.

University Hilton
3540 South Figueroa Street
Los Angeles, CA 90007
Meetings

Telephone: 213-748-4141
800-244-7331 (within California)
800-872-1104 (outside California)

Single $70  Double $75

Food Service

On campus facilities include the Commons Cafeteria, located in the Commons Building, open on Saturday from 9:00 a.m. to 5:00 p.m.; Carl's Junior, located south of the Commons Building, open on Saturday from 9:00 a.m. to 5:00 p.m. and on Sunday from 11:00 a.m. to 5:00 p.m.; and Cafe 84, located in the Frank L. King Hall, open on Saturday from 11:00 a.m. to 8:00 p.m., and on Sunday from 11:00 a.m. to 11:00 p.m. Cafe 84 has a soup, sandwich, and salad bar, as well as a grill, pizza, pasta, pastries, and ice cream. In addition to the restaurant in the University Hilton, several chains have outlets on Figueroa Street.

Parking

Parking permits are required and cost $5 per day. Participants should park in Parking Structure A and note that the west end of Structure A is closest to the registration area. There are stairwells at each corner of the building, although the only elevator in Structure A is at the northeast corner.

Travel

The campus is located about four miles south of downtown Los Angeles near the intersection of the Santa Monica Freeway (10) and the Harbor Freeway (110). Shuttle service is readily available from the Los Angeles International Airport to the campus. The fare for the "Super Shuttle" (limo service) from the airport to the University Hilton is $12 per person, each way. To reach the campus by car, exit the Harbor Freeway (110) at Exposition Boulevard. The Hilton is on the right at Figueroa Street, and Main Entrance I to the university is approximately one-quarter mile farther down Exposition Boulevard, at Hoover Street.

Weather and Local Information

The average high temperature in Los Angeles in the month of November is 73°F, and the average low temperature is 52°F. Rain is possible, but not very likely. Hot weather of approximately 90°F is also possible at this time of year. The city of Los Angeles and the surrounding area have many worthwhile museums and other interesting attractions. Those closest to campus are the Los Angeles County Museum of Science and Industry, and the Museum of Natural History located directly opposite the campus, across Exposition Boulevard. The Natural History Museum has recently opened the third largest live insect zoo in the nation, and also has a Discovery Center of hands-on exhibits for children. The Science and Industry Museum runs IMAX theater presentations. Use of the pool and gym at the Lyon University Center is possible by presenting a meeting badge and a $5 entry fee.

Lance W. Small
Associate Secretary
La Jolla, California

Journal of the American Mathematical Society

When the Journal of the American Mathematical Society first appeared in 1988, it gained instant respect for its careful selection of relevant, important, and timely research. The editors are devoted to publishing research articles of the highest quality in all areas of pure and applied mathematics. Editors of this journal include: H. Blaine Lawson, Jr., Robert D. MacPherson, Richard Melrose, Andrew Odlyzko, and Wilfried Schmid.

1993 Subscription Prices

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Invited Addresses and Special Sessions

Invited Addresses at AMS Meetings
The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings, the list of speakers is incomplete. Invited addresses at Sectional Meetings are selected by the Section Program Committee, usually twelve to eighteen months in advance of a meeting. Members wishing to nominate candidates for invited addresses should send the relevant information to the Associate Secretary for the Section who will forward it to the Section Program Committee.

Dayton, OH, October 1992
Please see the second announcement of this meeting elsewhere in this issue.

Los Angeles, CA, November 1992
Please see the second announcement of this meeting elsewhere in this issue.

San Antonio, TX, January 1993
George E. Andrews (AMS-MAA)  Robert Osserman (AMS-MAA)
Richard A. Brualdi (AMS-MAA)  Charles S. Peskin (Gibbs Lecture)
Luis A. Caffarelli (Colloquium Lectures)  Bernd Sturmfels
Jim Douglas, Jr.  Leon Takhtajan
Carolyn S. Gordon  Alexander Varchenko
Wu-Yi Hsiang (AMS-MAA)

Knoxville, TN, March 1993
Paul R. Blanchard  Richard A. Tapia
Olav Kallenberg  Michelle L. Wachs

Washington, DC, April 1993
Fan R. K. Chung  Joel Spruck
Leopold Flatto  A. Zamolodchikov

Dekalb, IL, May 1993
Susan J. Friedlander  Clark Robinson
Russell D. Lyons

Vancouver, British Columbia, Canada
August 1993
Louis Nirenberg (AMS-CMS)  Jill Pipher (AMS-CMS)

College Station, TX, October 1993
Steven P. Lalley  Stephan A. Stolz
Gilles Pisier

Organizers and Topics of Special Sessions
The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of the Notices went to the printer. The section below entitled Information for Organizers describes the timetable for announcing the existence of Special Sessions.

October 1992 Meeting in Dayton, Ohio
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: Expired
Deadline for consideration: Expired
Please see the second announcement of this meeting elsewhere in this issue.

November 1992 Meeting in Los Angeles, California
Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: Expired
Please see the second announcement of this meeting elsewhere in this issue.

January 1993 Meeting in San Antonio, Texas
Associate Secretary: W. Wistar Comfort
Deadline for organizers: Expired
Deadline for consideration: September 17, 1992
Kathleen T. Alligood and Judy A. Kennedy, Continuum theory and dynamical systems
Thomas Archibald and Victor Katz, *History of mathematics*
Alvaro Arias, *Banach space theory*
Charles E. Aull, *History of general topology*
Melvyn S. Berger and Daniel Goroff, *Small divisor problems in nonlinear analysis*
Scott T. Chapman, *Commutative algebra*
William J. Coles and B. A. Fusaro, *Environmental modeling*
David Cox and Bernd Sturmfels, *Combinatorial methods in computational algebraic geometry*
Raúl E. Curto and David R. Larson, *Operator theory and triangular operator algebras*
Michael R. Darnel, *Orderered algebraic structures*
Robert S. Doran, *C*-algebras: 1943 – 1993 (a 50-year celebration)*
Ed Dubinsky, *The state of research in undergraduate mathematics education: problems and prospects (AMS-MAA)*
Krishan L. Duggal, *Differential geometry*
Saber N. Elaydi, John R. Graef, and William F. Trench, *Stability and asymptotic behavior of difference equations*
Dennis R. Estes and Donald James, *Quadratic forms*
Naomi Fisher, Harvey B. Keynes, and Philip D. Wagreich, *Mathematics and education reform (AMS-MAA)*
Robin Forman and John E. Luecke, *Topology and geometry*
Dennis DeTurck and Carolyn Gordon, *Eigenvalues in Riemannian geometry*
Morris W. Hirsch and Halbert White, *Dynamics and computation in neural networks*
Hans A. Koch, Rafael de la Llave, and Charles Radin, *Dynamics of systems with infinitely many degrees of freedom*
Xinzhi Liu and Seenith Sivasundaram, *Integro-differential equations: stability and control*
David E. Marker and Philip H. Scowcroft, *Model theory and algebra*
John E. McCarthy, *Holomorphic spaces*
Alec Norton and Mary Lou Zeeman, *Low dimensional geometric dynamical systems*
L. Alayne Parson and Mark Sheingorn, *Modular forms and related topics*
Nikolay Reshetikhin, Leon Takhtajan, and Alexander Varchenko, *Quantum groups*

**March 1993 Meeting in Knoxville, Tennessee**
Southeastern Section
Associate Secretary:
Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
Deadline for organizers: Expired
Deadline for consideration: December 15, 1992
David F. Anderson and David E. Dobbs, *Commutative ring theory*
Bettye Anne Case, *Interventions to assure success: calculus through junior faculty*
Ben G. Fitzpatrick and Suzanne M. Lenhart, *Optimal control and applications*
Alexandre S. Freire, *Variational problems in geometry*
Don B. Hinton and Kenneth Shaw, *Sturm-Liouville operators, applications, and extensions*
Tim Kelley, *Numerical methods in optimization*
John C. Mayer, *Continua theory and dynamical systems*
Balram S. Rajput and Jan Rosinski, *Stochastic processes*
Michelle L. Wachs, *Algebraic combinatorics*

**April 1993 Meeting in Salt Lake City, Utah**
Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: January 6, 1993
Roy L. Adler and Leopold Flatto, *Geodesic flows, hyperbolic geometry, and symbolic dynamics*
Joseph A. Ball and Cora S. Sadosky, *Dilation and interpolation: operator theoretic methods*
John J. Benedetto and Rodney B. Kerby, *Wavelets in sampling theory and signal processing*
Joseph E. Bonin, *Geometric methods in combinatorics*
Nathaniel Dean, *Graph theory*
Edward Frenkel, *Mathematical physics*
Anant P. Godbole and Gary J. Sherman, *Undergraduate research in applied mathematics*
Anant P. Godbole and Gary J. Sherman, *Undergraduate research in pure mathematics*
Valentina S. Harizanov and James C. Owings, *Pure and applied recursion theory*
Kevin G. Hockett and E. Arthur Robinson, *Ergodic theory, dynamical systems, and applications*
Yongwu Rong, *Low dimensional topology*
Joel Spruck, *Nonlinear elliptic problems in geometry and physics*

**May 1993 Meeting in DeKalb, Illinois**
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: Expired
Deadline for consideration: February 3, 1993
Michael A. Filaseta, *Number theory*
Susan J. Friedlander, *Mathematical topics in fluid dynamics*
Zoltan Furedi, *Combinatorics*
Andrew J. Granville, *Analytic number theory*
Frank Harary, *Beautiful graph theory*
Mohsen Pourahmadi, *Stochastic processes*
Linda R. Sons, *Function theory*
Joel H. Spencer, *Probabilistic methods*
Peter Waterman, *Discrete groups*

**August 1993 Meeting in Vancouver, British Columbia, Canada**
Associate Secretary: Lance W. Small
Deadline for organizers: November 11, 1992
Deadline for consideration: April 27, 1993
Invited Addresses and Special Sessions

September 1993 Meeting in Syracuse, New York
Eastern Section
Associate Secretary: Lesley M. Sibner
Deadline for organizers: December 17, 1992
Deadline for consideration: April 27, 1993

October 1993 Meeting in Heidelberg, Germany
(Joint Meeting with the Deutsche Mathematiker-Vereinigung e.V.)
Associate Secretary: Robert M. Fossum
Deadline for consideration: July 14, 1993

October 1993 Meeting in College Station, Texas
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: January 22, 1993
Deadline for consideration: April 5, 1993
Randall K. Campbell-Wright, Carl C. Cowen, and Barbara D. MacCluer, Composition operators on spaces of analytic functions
David R. Larson, Non self adjoint operator algebras
Efton L. Park, Noncommutative differential geometry
Sung Yell Song and Paul M. Terwilliger, Algebraic combinatorics

January 1994 Meeting in Cincinnati, Ohio
Associate Secretary: Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
Deadline for organizers: April 5, 1993
Deadline for consideration: September 23, 1993

March 1994 Meeting in Lexington, Kentucky
Southeastern Section
Associate Secretary: Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
Deadline for organizers: June 18, 1993
Deadline for consideration: To be announced

March 1994 Meeting in Manhattan, Kansas
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 25, 1993
Deadline for consideration: To be announced

June 1994 Meeting in Eugene, Oregon
Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: September 7, 1993
Deadline for consideration: To be announced

October 1994 Meeting in Stillwater, OK
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: January 28, 1994
Deadline for consideration: To be announced

January 1995 Meeting in Denver, Colorado
Associate Secretary: Andy R. Magid
Deadline for organizers: April 20, 1994
Deadline for consideration: To be announced

March 1995 Meeting in Chicago, Illinois
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 24, 1994
Deadline for consideration: To be announced

January 1996 Meeting in Orlando, Florida
Associate Secretary: Lance W. Small
Deadline for organizers: April 12, 1995
Deadline for consideration: To be announced

March 1996 Meeting in Iowa City, Iowa
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 22, 1995
Deadline for consideration: To be announced

Information for Organizers
Special Sessions at Annual and Summer Meetings are held under the supervision of the Program Committee for National Meetings (PCNM). They are administered by the Associate Secretary in charge of that meeting with staff assistance from the Meetings Department in the Society office in Providence.

According to the “Rules for Special Sessions” of the Society, Special Sessions are selected by the PCNM from a list of proposed Special Sessions in essentially the same manner as individuals are selected to give Invited Addresses. The number of Special Sessions at a Summer or Annual Meeting is limited. The algorithm that determines the number of Special Sessions allowed at a given meeting, while simple, is not repeated here, but can be found in “Rules for Special Sessions” on page 614 in the April 1988 issue of the Notices.

Each person selected to give an Invited Address is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the PCNM or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an ex-officio member of the committee and whose address may be found below). These proposals must be in the hands of the PCNM at least nine months prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Proposals that are sent to the Providence office of the Society, to the Notices, or directed to anyone other than the Associate Secretary will have to be forwarded and may not be received in time to be considered for acceptance.

It should be noted that Special Sessions must be announced in the Notices in such a timely fashion that any member of
the Society who so wishes may submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration. This deadline is usually three weeks before the deadline for abstracts for the meeting in question.

Special Sessions are very effective at Sectional Meetings and can usually be accommodated. The processing of proposals for Special Sessions for Sectional Meetings is handled in essentially the same manner as for Annual and Summer Meetings by the Program Committee. Again, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline after which members can no longer send abstracts for consideration for presentation in that Special Session.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. These proceedings appear in the book series *Contemporary Mathematics*.

More precise details concerning proposals for and organizing of Special Sessions may be found in the “Rules for Special Sessions” or may be obtained from any Associate Secretary.

**Proposals for Special Sessions to the Associate Secretaries**

The programs of Sectional Meetings are arranged by the Associate Secretary for the section in question:

**Western Section**
- Lance W. Small, Associate Secretary
  - Department of Mathematics
  - University of California, San Diego
  - La Jolla, CA 92039
  - Electronic mail: g_small@math.ams.com
  - (Telephone 619–534–3590)

**Central Section**
- Andy R. Magid, Associate Secretary
  - Department of Mathematics
  - University of Oklahoma
  - 601 Elm PHSC 423
  - Norman, OK 73019
  - Electronic mail: g_magid@math.ams.com
  - (Telephone 405–325–6711)

**Eastern Section**
- W. Wistar Comfort, Associate Secretary (until January 31, 1993)
  - Department of Mathematics
  - Wesleyan University
  - Middletown, CT 06457
  - Electronic mail: g_comfort@math.ams.com
  - (Telephone 203–347–9411)

- Lesley M. Sibner, Associate Secretary (beginning February 1, 1993)
  - Department of Mathematics
  - Polytech University of New York
  - Brooklyn, NY 11201–2990
  - (Telephone 718–260–3505)

**Southeastern Section**
- Joseph A. Cima, Associate Secretary (until January 31, 1993)
  - Department of Mathematics
  - University of North Carolina, Chapel Hill
  - Chapel Hill, NC 27599–3002
  - Electronic mail: g_cima@math.ams.com
  - (Telephone 919–962–1050)

**Proposals for Special Sessions at the October 1–3, 1993 meeting in Heidelberg, Germany, only, should be sent to Professor Fossum at the Department of Mathematics, University of Illinois, Urbana, IL 61801, Telephone: 217–244–1741, email: rmf@math.ams.com.**

**Information for Speakers**

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled. Contributors should know that there is a limitation in size of a single Special Session, so that it is sometimes true that all places are filled by invitation. Papers not accepted for a Special Session are considered as ten-minute contributed papers.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Meetings Department, American Mathematical Society, P. O. Box 6887, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Electronic submission of abstracts is available to those who use the TeX typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to abs-request@math.ams.com. Requesting the files electronically likely will be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Electronic Abstracts, American Mathematical Society, Meetings Department, P.O. Box 6887, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain TeX, AMS-TeX, or the \TeX{} package.

**Number of Papers Presented**

**Joint Authorship**

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

An individual may contribute only one abstract by title in any one issue of *Abstracts*, but joint authors are treated as a separate category. Thus, in addition to abstracts from two
individual authors, one joint abstract by them may also be accepted for an issue.

**Site Selection for Sectional Meetings**

Sectional Meeting sites are recommended by the Associate Secretary for the Section and approved by the Committee of Associate Secretaries and Secretary. Recommendations are usually made eighteen to twenty-four months in advance.

Host departments supply local information, ten to twelve rooms with overhead projectors for contributed paper sessions and Special Sessions, an auditorium with twin overhead projectors for invited addresses, and registration clerks. The Society partially reimburses for the rental of facilities and equipment, and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the Associate Secretary for the Section.

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**1992 Symposium on Some Mathematical Questions in Biology**

*Cell Biology*

Denver, Colorado, November 1992

The twenty-sixth annual Symposium on Some Mathematical Questions in Biology, focusing on *Cell Biology*, will be held during the annual meeting of the American Society for Cell Biology, November 15–19, 1992, at the Colorado Convention Center in Denver, Colorado. The symposium is sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics (SIAM), and the Society for Mathematical Biology (SMB).

The AMS-SIAM-SMB Committee on Mathematics in the Life Sciences serves as the Organizing Committee for the symposium. The committee members are Jack D. Cowan, James W. Curren, Marcus W. Feldman, Eric S. Lander, Marc Mangel (Chair), and James D. Murray. Byron Goldstein and Carla Wofsy serve as organizers.

There will be sessions on Monday and Tuesday afternoons, November 16 and 17, each including three invited lectures on mathematical and biophysical approaches to problems in cell biology. The speakers and their topics are: **Micah Dembo** (Los Alamos National Laboratory), *Modeling cell adhesion*; **Elliot Elson** (Washington University School of Medicine, St. Louis), *Interpretation of measurements of cellular deformability*; **Byron Goldstein** (Los Alamos National Laboratory), *Cell activation through the aggregation of cell surface receptors*; **Jennifer Linderman** (University of Michigan, Ann Arbor), *Cell-cell interactions and the activation of T cells in an immune response*; **George Oster** (University of California, Berkeley), *The dynamics of single-motor molecules*; and **Michael Reed** (Duke University), *The transport of organelles in axons*.

Proceedings of the symposium will be published by the AMS in the series *Lectures on Mathematics in the Life Sciences*.

Discount airfares are available from United Airlines for travel November 12–22, 1992. Call 1-800-521-4041 and refer to file number 524YM.

For further information on the symposium, contact the Symposium Conference Coordinator, AMS, P.O. Box 6887, Providence, RI 02940, or DLS@MATH.AMS.COM by electronic mail.
Joint Mathematics Meetings in San Antonio
AMS Special Sessions and Contributed Papers
MAA Contributed Papers

The Joint Mathematics Meetings in San Antonio will be held January 13–16 (Wednesday – Saturday), 1993. (Please note that incorrect dates were published in this article in the May/June issue.) The first full announcement of the meetings will appear in the October 1992 issues of the Notices and FOCUS. This preliminary announcement is made to encourage member participation and to provide lead time for submission of abstracts for consideration for presentation in AMS Special Sessions and for submission of abstracts for AMS and MAA Contributed Paper Sessions.

AMS Special Sessions
A list of Special Sessions for this meeting can be found in the Invited Addresses and Special Sessions section of this issue.

Most of the papers to be presented at these Special Sessions will be by invitation; however, anyone contributing an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these sessions should indicate this clearly on the abstract, and should submit it by September 18, 1992, three weeks earlier than the normal deadline for contributed papers, in order that it be considered for inclusion.

Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics and should be sent to Abstracts, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940. A charge of $16 is imposed for retyping abstracts that are not in camera-ready form.

AMS Contributed Paper Sessions
Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics and should be sent to Abstracts, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940, so as to arrive by the abstract deadline of October 8, 1992. A charge of $16 is imposed for retyping abstracts that are not in camera-ready form. Late papers will not be accepted.

Electronic Submission of AMS Abstracts
This service is available to those who use the \TeX\ typesetting system and can be used for abstracts of papers to be presented at this meeting in AMS sessions only. Requests to obtain the package of files may be sent by electronic mail on the Internet to abs-request@math.ams.com. Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Director of Meetings, American Mathematical Society, P.O. Box 6887, Providence, RI 02940. When requesting the abstracts package, users should be sure to specify whether they want the plain \TeX, \LaTeX\ or the \LaTeX\ package. Only abstracts should be sent to abs-submit@math.ams.com. Questions regarding an abstract should be addressed to abs-misc@math.ams.com. Questions regarding meetings should be addressed to meet@math.ams.com.

MAA Contributed Papers
Contributed papers are being accepted on several topics in collegiate mathematics for presentation in contributed paper sessions at the meeting. The organizers listed below solicit contributed papers pertinent to their sessions’ interests and concerns; material should be sent to the organizer whose name is followed by an asterisk (*). A full description of each session appeared in the May/June and July/August Notices. Please note that any days scheduled for any session are tentative. The topics, organizers, and their affiliations are:

- Assessment programs for the undergraduate major, Friday morning and Saturday afternoon
  Charles F. Peltier*
  Department of Mathematics
  Saint Mary’s College
  Notre Dame, IN 46556
  email: cpeltier@bach.helios.nd.edu
  fax: 219-284-4492

- “Capstone” courses for senior mathematics majors, Wednesday and Thursday mornings
  Christopher E. Barat and Pamela Crawford*
  Department of Mathematics
  Randolph-Macon College
  Ashland, VA 23005

- Empowering the mathematical community, Wednesday morning and Thursday afternoon
  Marilyn Frankenstein, University of Massachusetts, Boston
  Patricia C. Kenschaft, Montclair State College
  Alvin M. White, Harvey Mudd College

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  Marilyn Frankenstein, University of Massachusetts, Boston
  Patricia C. Kenschaft, Montclair State College
  Alvin M. White, Harvey Mudd College
• Impact of non-traditional instructional methods on testing and evaluation, Wednesday and Thursday afternoons

Linda H. Boyd*
Mathematics Department
DeKalb College
555 North Indian Creek Dr.
Clarkston, GA 30021

Elizabeth Teles, Montgomery College, Maryland
• Interactive learning environments, Wednesday and Thursday mornings

Katherine Pedersen*
NSF Statewide Systemic Initiative
435 S. Chapelle
Pierre, SD 57501

Sandra Z. Keith, St. Cloud State University
• Linear algebra, Wednesday and Friday afternoons, and Thursday evening

Donald R. LaTorre*
Department of Mathematical Sciences
Clemson University
Clemson, SC 29634-1907

Steven J. Leon, University of Massachusetts, Dartmouth
A. Duane Porter (for the LACSG), University of Wyoming
• Mathematics and the arts, Thursday afternoon and Saturday morning

JoAnne S. Growney*
Department of Mathematics and Computer Science
Bloomsburg University
Bloomsburg, PA 17815

• Recreational mathematical computing, Friday morning and Saturday afternoon

Dr. Michael W. Ecker*
Editor/Publisher
Recreational & Educational Computing
909 Violet Terrace
Clarks Summit, PA 18411

• Recruitment and retention of women in mathematics revisited, Saturday morning and afternoon

Marcelle Bessman*
328 Braddock, #212
Frostberg, MD 21532
email: r2nkbes@fre.towson.edu
fax: 813-872-9342
(May 10 – Aug. 20, mailing address will be 644 Geneva Place, Tampa, FL 33606)

• Teaching mathematics to multicultural and multilingual students, Friday morning and afternoon

Richard O’Lander*
Division of Computer Science, Mathematics & Science
St. John’s University
St. Vincent’s College
Grand Central & Utopia Parkways
Jamaica, NY 11439

• Use of visualization in the teaching of mathematics, Friday morning and Saturday afternoon

Howard Lewis Penn*
Mathematics Department
572 Holloway Rd.
United States Naval Academy
Annapolis, MD 21402-5002
e-mail: hlp@math2.sma.usna.navy.mil

James R. King, University of Washington
• Using data and computers in teaching statistics, Wednesday morning and Thursday afternoon

Mary Parker*
Department of Mathematics
Austin Community College
11928 Stonehollow Drive
Austin, TX 78758-3101

George Cobb, Mount Holyoke College

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes. Individuals wishing to submit a paper for any of these sessions should note the following NEW PROCEDURES: The name(s) and address(es) of the author(s) and a one-page summary of the paper should be sent directly to the organizer whose address is given. The purpose of this summary is to enable the organizer(s) to evaluate the appropriateness of the paper for the session, so this summary should be as detailed and informative as possible within the one-page limitation. This summary must reach the organizer by September 10, 1992. Summaries should NOT be sent to the MAA Washington office.

The organizer will acknowledge receipt of the summary. If the paper is accepted for presentation, the organizer will send the author(s) a standardized abstract form to be used to prepare a brief abstract, which will be published in the journal Abstracts (copies will be available in the registration area).

Completed abstract forms must be returned to the organizer promptly and no later than September 24. Do not send the abstracts to the AMS, and do not submit them electronically. Abstracts not received by that date cannot be published. If desired, an abstract form may be obtained in advance from either the AMS office in Providence or the MAA Washington office and the abstract may be submitted along with the summary.

Rooms where MAA contributed paper sessions will be held are equipped with an overhead projector and screen. Blackboards are not available. Persons having other equipment needs should contact the MAA Associate Secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403-1222; electronic mail: ross@math.uoregon.edu) as soon as possible, but in any case prior to November 9. Upon request, the following will be made available: one additional overhead projector/screen, 35mm carousel slide projector, or \( \frac{1}{2}'' \) or \( \frac{3}{4}'' \) VHS video cassette recorder with one color monitor.
1992


September 1992

16–18. Second SIAM Conference on Control in the 90s, Minneapolis, MN. (Feb. 1991, p. 148)


21–24. Colloque de Probabilites, Marseille, France. (Jul./Aug. 1992, p. 627)


21–25. Introduction to Industrial Engineering, Dallas, TX.

PROGRAM: This seminar is designed to strengthen job performance and to give a thorough indoctrination in industrial engineering basics. It focuses on the basics of methods engineering, work measurement, capital investment analysis, quality control, production/inventory control, material handling, and plant layout.

INFORMATION: Call IIE Customer Service Center at 404-449-0460.


28–October 2. Sixth Workshop on Computer Science Logic, San Miniato, Italy. (Jul./Aug. 1992, p. 627)


ORGANIZING COMMITTEE: S. Prößdorf (Berlin), B. Silbermann (Chemnitz).

CONFERENCE TOPICS: Approximation methods for integral and pseudodifferential equations; Numerical analysis for boundary integral equations on nonsmooth surfaces; Banach algebra techniques in operator theory; Applications of integral and pseudodifferential equations.

INFORMATION: S. Prößdorf/M. Teuchert (Conference Manager), Institute for Applied Analysis and Stochastics (IAAS), Hausvogteiplatz 5–7, D-O-1086 Berlin, Germany; Tel: + 030 20377 555/+ 030 20377 594; FAX: +030 2004975.

29–October 2. Théorie Analytique des Nombres, Marseille, France. (Jul./Aug. 1992, p. 627)
October 1992

October 1992. Workshop on Superprocesses and Interacting Systems, Centre de Recherches Mathématiques, Université de Montréal, Montréal, Quebec, Canada. (Apr. 1992, p. 148)


9–12. Workshop on Vector Bundles on Algebraic Varieties, University of California, Los Angeles.


Information: R. Lazarsfeld, Dept. of Math., UCLA, Los Angeles, CA 90024; email: rkl@math.ucla.edu.


16–17. Fourteenth Midwest Probability Colloquium, Northwestern University, Evanston, IL.

Invited Speakers: H. Kesten (two lectures on first- and last-passage percolation); T. McConnell and S. Evans (one lecture).

Information: M. Pinsky, Dept. of Math., Northwestern U., Evanston, IL 60208; email: m.pinsky@math.nwu.edu.

16–17. 1992 Mathematical Sciences Department Chairs Conference, Arlington, VA. (See the News and Announcements section of the 1992 July/August Notices, p. 601, for further details.)

Conference Theme: Chairs of Mathematics in the 1990s.

Keynote Speaker: D. Allan Bromley, Assistant to the President for Science and Technology.

Information: Board on Mathematical Sciences, National Research Council, NAS 210, 2101 Constitution Ave., NW, Washington, DC 20418; 202-334-2421; FAX: 202-334-1597; email: bms@nas.edu or bms@nas.bitnet.


19–23. Modèles Arch et Applications a la Finance, Marseille, France. (Jan. 1992, p. 54)


22–23. Conference on Modular Forms and Number Theory to Celebrate the 80th Birthday of Joe Lehner, Swarthmore College, Swarthmore, PA.


Information: D. Rosen (215-543-2752, drosen1@cc.swarthmore.edu.) and M. Knopp (215-664-3534 or 215-787-7589), 410 Lancaster Ave., Apt. 221, Haverford, PA 19041.


22–25. Semi-Annual Regional Workshop in Dynamical Systems and Related Topics, Penn State University, State College, PA. (May/June 1992, p. 493)


27–29. NSF/DOD’s National SBIR Conferences, Washington, DC.

Program: The NSF/DOD-sponsored National Small Innovation Research (SBIR) Conferences provide a unique marketing opportunity by bringing together scores of personnel from Federal agency and major corporations in one place at one time. Representatives from the Depts. of Defense, Health & Human Services (including NIH), Energy, Education, Transportation, Commerce, and NASA, National Science Foundation, Environmental Protection Agency, and Nuclear Regulatory Commission will discuss R&D opportunities at their agencies in seminars and one-on-one meetings. Also participating are companies such as Boeing, General Dynamics, Martin Marietta, Motorola, TRW, Honeywell, IBM, Hughes, Texas Instruments, United Technologies, and Teledyne.

Information: Contact the Conference Coordinator at 407-274-4005.

November 1992


November 1992. Workshop on Stochastic Control, Centre de Recherches Mathématiques, Université de Montréal, Montréal Quebec, Canada. (Apr. 1992, p. 349)


2–6. Workshop on Symbolic Dynamics, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)


5–8. Eighteenth Annual Conference of the American Mathematical Association of Two Year Colleges, Indianapolis, IN. (Jul./Aug. 1992, p. 628)

7–11. Mathematics and Molecular Biology III: Computational Approaches to Nucleic Acid Structure and Function, Santa Fe, NM. (May/June, 1992, p. 494)


9–11. Fundamental Problems in Quantum Field Theory, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)


*9–13. Introduction to Industrial Engineering, Seattle, WA.

Program: This seminar is designed to strengthen job performance and to give a thorough indoctrination in industrial engineering basics. It focuses on the basics of methods engineering, work measurement, capital investment analysis, quality control, production/inventory control, material handling, and plant layout.

Information: Call IIE Customer Service Center at 404-449-0460.

10–13. Interdisciplinary Studies on Number Theory, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)


16–18. Hardy Spaces and Uniform Algebras, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)


Program: The program will include 18 tutorials, 8 invited lecturers, and 80 technical paper presentations. There will be exhibitions sponsored by over 50 companies plus Research Exhibits, a Visualization Theater, and Poster Exhibits. The education program at Supercomputing ’92 will introduce secondary school teachers to high-performance computing and will host over 100 high school students visiting Supercomputing ’92. Also, current developments in supercomputing technology utilizing the scientific network, SCinet ’92, a high-speed communications network linking exhibitors and remote locations will be featured. SCinet offers an opportunity to see and experience hands-on demonstrations of the technical feasibility for building a networked supercomputing environment using HIPPI, FDDI, Ethernet, local fiber, T3, and other technologies. In addition, a heterogeneous computing challenge will be hosted.


*17–19. NSF/DoD’s National SBIR Conferences, Phoenix, AZ.

Program: The NSF/DoD-sponsored National Small Innovation Research (SBIR) Conferences provide a unique marketing opportunity by bringing together scores of personnel from Federal agency and major corporations in one place at one time. Representatives from the Dept. of Defense, Health & Human Services (including NIH), Energy, Education, Transportation, Con-
Meetings and Conferences


Program: This school is meant for Ph.D. students who are willing to prepare themselves thoroughly in order to reach research level in this subject. The school consists of three courses of eight lectures each, exercising hours and discussions.

Speakers and Topics: V. Guillemin symplectic aspects of multiplicity theory; A. Kirillov - geometric quantization and the orbit method; P. Van Moerbeke - integrable Hamiltonian systems.

Information: Autumn School "Geometry of Hamiltonian Systems", Att: Jean Arthur, Math. Instituut RUU, P.O. Box 80010, 3508 TA Utrecht, The Netherlands; email: arthur@math.ru.nl.


23–27. Séminaire Sud-Rhodanien de Géométrie, Marseille, France. (Jan. 1992, p. 54)


December 1992


7–11. Algebraic Number Theory—Recent Developments and Their Backgrounds, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)


17–19. Algebraic Combinatorics, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)


1993


Spring 1993. IMACS Symposium on Mathematical Modelling, Wiener Neustadt, Germany. (Jan. 1992, p. 54)


January 1993


4–9. Advances in Computational Mathematics, India International Center, New Delhi, India. (Feb. 1992, p. 149)

*5. Short Course on Nonlinear Dynamics and Chaos, Arizona State University, Tempe, AZ.

Short Course Topics: Introduction and basic concepts; strange attractors; bifurcations to chaos; fractal basin boundaries; attractor reconstruction (time series analysis); controlling chaos.


*6–9. Dynamics Days Arizona, Twelfth Annual International Workshop, Arizona State University, Tempe, AZ.


Conference Topics: Mathematical, numerical, and experimental aspects of nonlinear dynamics and chaos; pattern formation; turbulence; applications to the physical, chemical and biological sciences; and related topics.


*7–11. Conference on Evolution Equations, Louisiana State University, Baton Rouge, LA.

Conference Topics: Linear and nonlinear partial differential equations, semigroups of operators, equations of evolution, control theory, calculus of variations, and related topics.


Meetings and Conferences

13–16. Joint Mathematics Meetings, San Antonio, TX. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.


*15–17. International Conference on Complex Analysis and its Applications, Hong Kong University of Science and Technology, Hong Kong. (Please note the updated Information section from Jul./Aug. 1992, p. 630)

INFORMATION: Chung-Chun Yang or Yuen-Kwan Kwok, Mathematics Dept., Hong Kong Univ. of Science and Technology, Clear Water Bay Rd., Hong Kong; email: maykwok@usthk.bitnet; FAX: 852-358-1643.


February 1993

1–3. IMA Minisymposium on Biological Control of Movement, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

*5–7. Representation Theory and Analysis on Homogeneous Spaces in Memory of Lawrence Corwin, Rutgers University, New Brunswick, NJ.

PROGRAM: The main objective of the conference is to present recent developments in representation theory and analysis on homogeneous spaces, with an emphasis on nilpotent Lie groups and reductive p-adic groups, two fields to which L. Corwin made important contributions. The program of invited one-hour talks will include both surveys and more specialized lectures, directed toward mathematicians working in a broad range of areas related to Lie group representations.

ORGANIZING COMMITTEE: S. Gindikin (Rutgers), R. Goodman (Rutgers), F. Greenleaf (Courant), R. Howe (Yale), J. Lepowsky (Rutgers), L. Rothschild (UC San Diego), P. Sally (Chicago), N. Wallach (UC San Diego), J. Wolf (UC Berkeley).

INFORMATION: R. Goodman, S. Gindikin, or J. Lepowsky, Dept. of Math., Rutgers Univ., New Brunswick, NJ 08903; Fax: 908-932-5530; goodman@math.rutgers.edu.

*7–11. The 29th Australian Applied Mathematics Conference (AMC '93), Höchstens, Hahndorf, South Australia.

PROGRAM: The conference provides an interactive forum for presentation of results and discussions on applied problems derived in many scientific fields and amenable to quantitative description and solution.

SPEAKERS AND TOPICS: J. Filar (Univ. of South Australia) - greenhouse modelling, control/system theoretic approach to greenhouse effect; R. May (Oxford U.) - mathematical biology, spatial chaos and its role in ecology and evolution; B. Moran (Flinders U.) - neural networks and image processing; C.J. van Duijn (Delft U.) - nonlinear diffusion, convection/diffusion, groundwater hydraulics; B. Haverkort (U. of Twente) - performance analysis of communication networks and computer systems; K.R. Sreenivasan (Yale U.) - self-similarity, self-affinity and turbulence dynamics.

INFORMATION: Conference Secretary, 29AMC, Dept. of Applied Math., The Univ. of Adelaide, GPO Box 498, Adelaide, South Australia 5001.


PROGRAM: The goals of the study group are: To stimulate greater awareness in Australian industry of the need for and role of mathematics; to establish better links between industry and academic mathematicians; to provide improved university education of mathematicians through 1). expanded employment prospects for mathematicians graduates, 2). fresh research problems for mathematicians, and 3). innovative material for teaching courses; and to provide an opportunity for industrial scientists to receive expert training in mathematical modelling.

INFORMATION: N.G. Barton, CSIRO Division of Math. and Stats., P.O. Box 218, Lindfield, NSW 2070; tel: (02) 413 7702; FAX: (02) 416 9317; email: noel@syd.dms.csiro.au.


March 1993


*15–18. Arithmetic Geometry with an Emphasis on Iwasawa Theory, Arizona State University, Tempe, AZ.

ORGANIZERS: N. Childress, J. Jones.

INVITED SPEAKERS: Tentative: N. Elkies (Harvard), B. Gross (Harvard), T. Metsankyla (Finland), B. Perrin-Riou (France), K. Ribet (California), K. Rubin (Ohio State), G. Stevens (Boston U.).

TALKS: Participants wishing to give a talk should send an abstract to the address below. Please indicate the desired length for the talk (30 or 50 minutes). The deadline for submission of abstracts is January 15, 1993. Submissions by email (in TeX) are welcome.
Meetings and Conferences

Funding: Graduate students and recent Ph.D.s are encouraged to apply for funding by sending a C.V. to the address below. The deadline is December 15, 1992.

Information: Arithmetic Geometry Meeting, Dept. of Math., Arizona State Univ., Tempe, AZ. 85287; email: meeting@artin.la.asu.edu.


29-April 2. Workshop on Diophantine Geometry, Mathematical Sciences Research Institute, Berkeley, CA. (May/June 1992, p. 495)

April 1993

4-7. First International Conference on Mathematical Linguistics, Barcelona, Spain.

Chairman: C. Martin-Vide.

Information: C. Martin-Vide, Univ. de Barcelona, Facultat de Filologia, Seccio de Linguistica, Gran Via de les Corts Catalanes, 585, E-08007 Barcelona.


8-10. Clifford Algebras in Analysis, University of Arkansas, Fayetteville, AR.

Principal Speaker: A. McIntosh, Macquarie University, Australia.


Call for Papers: Contributed papers should be submitted before February 15, 1993.

Information: J. Ryan or I. Monroe, Dept. of Math. Sci., SCEN 301, Univ. of Arkansas, Fayetteville, AR 72701.

9-10. Western Section, University of Utah, Salt Lake City, Utah.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.


14-16. The Mathematics of Food Production, Processing, and Presentation, Belfast, Great Britain.

Information: The Conference Officer, The Institute of Math and its Applications, 16 Nelson St., Southend-on-Sea, Essex, SS1 1EF, UK.


27-29. NSF/DoD's National SBIR Conferences, Minneapolis, MN.

Program: The NSF/DoD-sponsored National Small Innovation Research (SBIR) Conferences provide a unique marketing opportunity by bringing together scores of personnel from Federal agency and major corporations in one place at one time. Representatives from the Depts. of Defense, Health & Human Services (including NIH), Energy, Education, Transportation, Commerce, and NASA, National Science Foundation, Environmental Protection Agency, and Nuclear Regulatory Commission will discuss R&D opportunities at their agencies in seminars and one-on-one meetings. Also participating are companies such as Boeing, General Dynamics, Martin Marietta, Motorola, TRW, Honeywell, IBM, Hughes, Texas Instruments, United Technologies, and Teledyne.

Information: Contact the Conference Coordinator at 407-274-4005.

May 1993

3-7. IMA Tutorial: Verification Issues in Discrete Event Systems, as well as Performance and Control, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)


10-12. IMACS Symposium on Signal Processing and Neural Networks--SPAN '93, Université du Québec at Montréal, Canada. (Jan. 1992, p. 56)


21-22. Central Section, Northern Illinois University, DeKalb, IL.

Information: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.


*30-June 1. Canadian Society for the History and Philosophy of Mathematics, Carleton University, Ottawa, Ontario, Canada. (Please note additions to Jul/Aug. 1992, p. 631)

Special Session: There will be a special session on the philosophy of mathemat-
ics organized by R.S.D. Thomas, Applied Math. Dept., University of Manitoba, Winnipeg, Manitoba, R3T 2N2, Canada.


June 1993


Program Committee: H.A. Eschenauer (Siegen), P. Kaul (Zürich), K. Marti (Neuburg), F. Pfeiffer (München), G.I. Schueler (Innsbruck).

Information: K. Marti, Institut für Mathematik und Rechneranwendung, Fakultät für Luft - und Raumfahrttechnik, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, D-8014 Neuibberg/München, Tel: (089) 6004-2541/2109; Fax: (089) 6004-3560.


7–11. IMA Tutorial: Mathematical Theory which Has become an Integral Part of Modern Financial Economics, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)


14–18. IMA Workshop on Mathematical Finance, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)


Information: SPA '93, c/o CWI, P.O. Box 4079, NL-1009 AB Amsterdam.

21–25. Graphs on Surfaces, Johns Hopkins University, Baltimore, MD.

Program: The 16th Mathematical Sciences Lecture Series will feature ten lectures by C. Thomassen on the subject “Graphs on surfaces”. A few additional invited talks will supplement Thomassen’s lectures.

Information: Organizer, E.R. Scheinerman, Dept. of Math. Sciences, The Johns Hopkins Univ., Baltimore, MD 21218-2689; voice: 410-516-7249; Internet: ers@jhunix.ers@cs.jhu.edu or Bitnet: ers@jhunix.


Program: There will be invited and contributed talks, a poster session, and a problem session.


Conference Topics: Factoring and primality testing; computational algebraic number theory; number-theoretical methods in computing; irreducible, primitive, permutation and other special polynomials; recurring sequences and finite automata; algebraic methods in complexity theory; algebraic coding theory; and cryptography.

Call for Topics: A three page summary of proposed talk should be submitted by November 15, 1992.

Information: I. Shparlinski, Dept. of Mathematics, ICSTI, Kusuminina str., 21 B, Moscow, 12552, Russia; Fax: (095) 943 00 89; email: shpar@plb.icsti.su or G.L. Mullen, Math. Dept., Pennsylvania State Univ., University Park, PA 16802; email: mullen@math.psu.edu.

July 1993


Scientific Committee: P. Corsini (Italy), J. Jantosciak (U.S.A.), J. Mittas (Greece), Y. Sureau (France), T. Vougiouklis (Greece).

Conference Topics: Semihypergroups, hypergroups, hyperrings, hyperspaces; Ordered hyperstructures; Related topics as join spaces, cogroups, polygroups, and other multivalued structures.

Invited Speakers: P. Corsini (Italy), J. Mittas (Greece).

Call for Papers: Abstracts should be typewritten, ready for reproduction, and should not exceed one page. The deadline is May 1, 1993.

Information: M. Stefanescu, I. Tofan, and M. Gutsan, Faculty of Math., Al.I.Cuza University, 6600 - Iasi - Romania.


*7–10. The Second International Conference on Fluid Mechanics (ICFM-II), Beijing, China.

Conference Topics: Flow instability and turbulence; aerodynamics and gas dynamics; geophysical and astrophyiscal fluid mechanics; hydrodynamics; plasma dynamics and magneto-hydrodynamics; biofluid mechanics; physico-chemical fluid dynamics; non-Newtonian fluid and multiphase flows; industrial and environmental fluid mechanics; and others.

Information: Z. Zhaoxun, Dept. of Engineering Mechanics, Tsinghua University, 100084, Beijing, China.

11–17. Nonlinear Evolution Equations, Solutions and the Inverse Scattering Transform, Oberwolfach, Federal Republic of Ger-
many. (Jan. 1992, p. 57)


 INFORMATION: J. Fountain, Dept. of Math., Univ. of York, Heslington, York Y01 SDD, UK.

9–13. Sixth International Conference on Structural Safety and Reliability (ICOSAR '93), Innsbruck, Austria.

 CHAIRMEN: G.I. Schueller, Innsbruck; M. Shinozuka, Princeton.
 INFORMATION: ICOSAR '93 Secretariat, c/o Institute of Engineering Mechanics, Univ. of Innsbruck, Technikerstrasse 13, A-6020 Innsbruck.


 CONFERENCE TOPICS: Qualitative analysis of nonlinear dynamic systems; quantitative methods for nonlinear systems; bifurcation theory; numerical methods in nonlinear dynamics; nonlinear random vibrations; phenomena and criteria of chaotic oscillations; computer aided symbolic methods in dynamics; vibration control; experimental methods in vibration theory; and applications in mechanical engineering, electrical engineering, physics, biology, chemistry, and other sciences.

 CALL FOR PAPERS: Prospective authors are invited to submit three copies of a 300-400 word summary (one single page only) indicating one of the topics from above to which it should be assigned. Summaries must be received by February 1, 1993.

 INFORMATION: Ing. E. Kreuzer, Arbeitsbereich Meerestechnik II, Technische Universit鋟 Hamburg-Harburg, Ei鋟endorfer Str. 42, D-2100 Hamburg 90, Tel: (040) 7718-3120; FAX: (040) 7718-2684.


 PROGRAM: The conference will feature several invited one-hour lectures and several invited half-hour lectures. There will also be sessions for 15 minute contributed papers. A refereed conference proceedings is planned.


 INFORMATION: P. Shieue or D. Wan, Dept. of Math. Sci., Univ. of Nevada, Las Vegas, NV 89154; 702-739-3748; FAX: 702-597-4343; email: shieue@nevada.edu, dwan@nevada.edu, or G. Mullen, Math. Dept., Pennsylvania State Univ., University Park, PA 16802; 814-865-9413; mullen@math.psu.edu.

 August 1993


 PURPOSE: The symposium offers theoretically oriented engineers and mathematicians in systems, control, and circuit theory a platform to discuss recent developments, to exchange new ideas, and to analyze trends for future research.

 CONFERENCE TOPICS: Mathematics for control, multivariable and robust control, system modeling, system identification, stochastic and adaptive control, optimal control, filtering, robotics, signal processing and circuit theory, VLSI, neural networks and control theoretical aspects of artificial intelligence.

 CALL FOR PAPERS: Deadline for submission of papers and proposals of special sessions: November 1, 1992. Please submit three copies of an unpublished paper in English. The length of the paper should not exceed 10 pages.

 INFORMATION: MTNS 93, U. Helmke, Department of Math., University of Regensburg, D-8400 Regensburg, Germany; FAX: +49-941-943-4005/2305; email: helmke@vax.1z.uni-regensburg.dbp.de.


Meetings and Conferences

September 1993
22–23. Central Section, Texas A&M University, College Station, TX.

November 1993

January 1994
5–8. Joint Mathematics Meetings, Cincinnati, OH. (including the annual meetings of the AMS, AWM, MAA, and NAM)

February 1994
*2–4. IMACS Symposium on Mathematical Modelling, Vienna, Austria.

March 1994
25–26. Central Section, Kansas State University, Manhattan, KS.

May 1994

The following new announcements will not be repeated until the criteria in the last paragraph in the box at the beginning of this section are met.

October 1993

November 1993

January 1994
5–8. Joint Mathematics Meetings, Cincinnati, OH. (including the annual meetings of the AMS, AWM, MAA, and NAM)

February 1994
*2–4. IMACS Symposium on Mathematical Modelling, Vienna, Austria.

March 1994
25–26. Central Section, Kansas State University, Manhattan, KS.

May 1994

Program: The 150th anniversary of the publication of Graßmann’s major mathematical work, the “lineale Ausdehnungslehre” (1844), will be the occasion to present a comprehensive picture of this great scholar’s life and work. Particular emphasis will be given to his influence, which has scarcely been studied in detail as yet—in mathematics as well as in physics and in linguistics.

Information: G. Schubring, Institut für Didaktik der Mathematik, Universität Bielefeld, Postfach 100131, D-W 4800 Bielefeld 1.

June 1994

August 1994

1995
Second International Conference on Numerical Methods for Volterra and Delay Equations (A conference to celebrate the 100th anniversary of Volterra’s birth.), Italy. (Mar. 1992, p. 251)

March 1995
24–25. Central Section, DePaul University, Chicago, IL. (Please note date was previously incorrectly listed as 1993.)

Information: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.
Entire and Subharmonic Functions

B. Ya Levin, Editor
Volume 11

The papers in this collection, written by participants of the Research Seminar on the Theory of Functions at Kharkov University, primarily address the theory of entire and subharmonic functions. Founded in 1953 by B. Ya. Levin and still functioning today, this seminar ranges over different problems in the theory of functions, functional analysis, and related problems in calculus and mathematical physics. Entire and Subharmonic Functions contains works presented recently in the seminar.

Contents


1991 Mathematics Subject Classification: 14H05, 30B05, 30C80, 30D15, 30D20, 30D35, 30E05, 30E25, 31A02, 31A05, 34A55, 34B24, 42B10, 60E10; 31A05, 34L10, 34L15, 42A75
ISBN 0-8218-4110-6, LC 91-640741, ISSN 1051-8037
275 pages (hardcover), September 1992
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Second Siberian Winter School "Algebra and Analysis"
I. A. Aleksandrov, L. A. Bokut', and Yu. G. Reshetnyak, Editors
Volume 151

This book, the second in the series of proceedings of Soviet Regional Conferences, contains papers presented at the Second Siberian Winter School: Algebra and Analysis, held at Tomsk State University in 1989. The papers touch on a variety of topics, including Lie algebras and Lie groups, sheaves, superalgebras, graded Lie algebras, Teichmüller theory, nonstandard functional analysis, hyperbolic geometry, p-adic L-functions, automorphic forms, and resolution of singularities.

Contents


1991 Mathematics Subject Classification: 11SXX, 14F05, 17-XX, 32-XX, 46S20, 11FXX, 30-XX, 58-XX
ISBN 0-8218-3142-9, LC 92-15960, ISSN 0065-9290
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Use the order form in the back of this issue or call 800-321-4AMS (800-321-4267) in the U.S. and Canada to use VISA or MasterCard.
Subjects covered here range from topology and geometry to logic and theoretical computer science, from homotopy to braids and conformal field theory. Although generally aimed at experts in the various fields represented, the book will also provide an excellent opportunity for nonexperts to get a feel for the diversity of current applications of category theory.

Contents

A. Bagchi, DeMorgan’s law and related identities in classifying topoi; B. Banaschewski and A. Pultr, A Stone duality for metric spaces; R. Betti, Sheaves in cocomplete categories; D. Bourn, Low dimensional geometry of the notion of choice; M. Bunge, Classifying toposes and fundamental localic groupoids; A. Carboni, M. C. Pedicchio, and N. Pirovano, Internal graphs and internal groupoids in Mal’cev categories; G. Castellini, J. Koslowski, and G. E. Strecker, Hereditary and modal closure operators; H. A. Chen and P. H. Chu, What is a Gabriel topology over a graded ring?; J. R. B. Cockett and D. Spencer, Strong categorical datatypes I; Y. Diers, The Zariski category of graded commutative rings; R. C. Flagg, Completeness in continuity spaces; K. A. Hardile and K. H. Kamps, Variations on a theme of Dold; H. Hiai, Dualities for accessible categories; J. Isbell, Some problems in descriptive locale theory; J. F. Jardine, Modelling homotopy coherence; G. Jarzembski, Elementary reflections of concrete categories of mixed structures; M. Johnson and S.-H. Sun, Remarks on representations of universal algebras by sheaves of quotient algebras; V. Lychaschenko, Categorical aspects of conformal field theory; S. Mac Lane, Coherence theorems and conformal field theory; S. Majid, Braided groups and duals of monoidal categories; C. J. Mulvey and J. W. Pelletier, A quantization of the calculus of relations; D. Pavlovic, A logical view on the adjoint functor theorem; G. Richter, axiomatizing algebraically behaved categories of Hausdorff spaces; R. Rosebrugh and R. J. Wood, Relational databases and indexed categories; K. I. Rosenthal, Linear indexed quantales and quantalic hyperdoctrines; M. Sobral and W. Tholen, Effectve descent morphisms and effective equivalence relations; V. Trnkova, Functorial selection of morphisms.

1991 Mathematics Subject Classification: 18B10, 18B20
ISBN 0-8218-6018-6, LC 92-24186, ISSN 0731-1877
447 pages (softcover), September 1992
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CONTEMPORARY MATHEMATICS

Deformation Theory and Quantum Groups with Applications to Mathematical Physics
Murray Gerstenhaber and James D. Stasheff, Editors
Volume 134

Quantum groups are not groups at all, but special kinds of Hopf algebras of which the most important are closely related to Lie groups and play a central role in the statistical and wave mechanics of Baxter and Yang. Those occurring physically can be studied as essentially algebraic and closely related to the deformation theory of algebras (commutative, Lie, Hopf, and so on). One of the oldest forms of algebraic quantization amounts to the study of deformations of a commutative algebra A (of classical observables) to a noncommutative algebra AH (of operators) with the infinitesimal deformation given by a Poisson bracket on the original algebra A.

SEPTEMBER 1992, VOLUME 39, NUMBER 7
Symbolic Dynamics and its Applications

Peter Walters, Editor
Volume 135

This volume contains the proceedings of the conference, Symbolic Dynamics and its Applications, held at Yale University in the summer of 1991 in honor of Roy L. Adler on his sixtieth birthday. The conference focused on symbolic dynamics and its applications to other fields, including ergodic theory, smooth dynamical systems, information theory, automata theory, and statistical mechanics. One hundred thirty-nine participants attended from thirteen countries, representing mathematics, applied mathematics, electrical engineering, and physics departments in universities and in industry. Featuring a range of contributions from some of the leaders in the field, this volume presents an excellent overview of the subject.

Contents

R. L. Adler, The torus and the disk; B. Weiss, On the work of Roy Adler in ergodic theory and dynamical systems; B. Marcus, The impact of Roy Adler’s work on symbolic dynamics and applications to data storage; J. Ashley, L. R. conjugacies of shifts of finite type are uniquely so; C. Bernhardt and E. M. Coven, A polynomial time algorithm for deciding the forcing relation on cyclic permutations; F. Blanchard, Fully positive topological entropy and topological mixing; M. Boyle, The stochastic shift equivalence conjecture is false; A. Broglio and P. Lillard, Predictions with automata; D. Fiebig, Common closed extensions and finitary regular isomorphism for synchronized systems; D. Fiebig and U.-R. Fiebig, Covers for coded systems; L. Flatto, 2-numbers and 2-transformations; M. V. Jakobson, Quasisymmetric conjugacies for some one-dimensional maps inducing expansion; J.-M. Gambaudo and C. Tresser, A monotony property of one-dimensional dynamics; D. Handelman, Finiteness of conjugacy classes of restricted block upper triangular matrices; D. Handelman, Polynomials with some power being positive; D. Handelman, Spectral radii of primitive integral companion matrices and log concave polynomials; R. Kenyon, Self-replicating tilings; B. P. Kitchens and K. Schmidt, Markov subgroups of (Z/2)2; F. Ledrappier, On the dimension of some graphs; D. Perrin and M. P. Schutzenberger, Synchronizing prefix codes and automata and the road coloring problem; S. Mozes, A zero entropy mixing of all orders tiling system; W. Parry, A cocycle equation for shifts; W. Parry, In general a degree 2 map is an automorphism; C. Radin, 2n versus Z for systems of finite type; F. Rhodes, Principal vectors of commuting block maps; I. A. Salama, On the recurrence of countable topological Markov chains; B. Solomyak, Substitutions, adic transformations and beta-expansions; M. Smorodinsky, Finitary isomorphism of m-dependent processes; P. Trow, Constant to one factor maps and dimension groups; S. Tuncel, Faces of Markov chains and matrices of polynomials; J. B. Wagoner, Classification of subshifts of finite type; R. F. Williams, Strong shift equivalence of matrices in GL(2, Z).
This work deals with the two broad
problems of interpolation theory. In addition, the volume provides a concise and
extensive theory with applications in several fields, including
harmonic analysis, partial differential equations, and geometry of Banach spaces.

Interpolation Spaces
and Related Topics
Michael Cwikel,
Mario Milman, and
Richard Rochberg, Editors
Volume 5

This book contains the proceedings
of the International Workshop on
Interpolation Spaces and Related Topics,
held at Technion in Haifa, Israel, in the
summer of 1990. Interpolation spaces have their roots in the classical
interpolation theorems of Marcinkiewicz and Riesz-Thorin. In the
last three decades, the study of these spaces has developed into an
extensive theory with applications in several fields, including harmonic
analysis, partial differential equations, and geometry of Banach spaces.
Substantial contributions have come from both sides of the former
“Iron Curtain”, and the Haifa Workshop was the first time that sizable
contingents of experts from East and West could meet and interact.

The twenty-one research papers in this volume reflect recent
developments at the frontier of research in several directions in
interpolation theory. In addition, the volume provides a concise and
convenient summary of interesting but hitherto less well-known work
in interpolation from the Russian schools of Yaroslav and Kazan. One
highlight is an extensive list of unsolved problems in interpolation
theory, including contributions from a number of experts who were
unable to attend the workshop. This volume was published by Bar-Ilan
University and is distributed by the AMS.

Contents
A. Bernal, Some results on complex interpolation of \( T_p \) spaces; Y. A.
Brudnyi, Some recent general results in interpolation theory; M. J. Carro and
J. Cerda, On the interpolation of analytic families of operators; F. Cobos and
I. Resina, An interpolation formula for approximation spaces; W. C. Connett
and A. L. Schwartz, Interpolation of Banach algebras; M. Cwikel and
A. Sharif, Complex interpolation spaces generated by the Gagliardo completion
of an arbitrary Banach couple; E. Hernández and J. Soria, Interpolation
theorems of some weighted quasi-Banach spaces; B. Jawerth and M. Milman,
New results and applications of extrapolation theory; B. Jawerth and
M. Milman, Wavelets and best approximation in Besov spaces; N. J. Kalton,
On a question of Piets; N. J. Kalton, Remarks on lattice structure in \( L_p \) and
\( L_q \) when \( 0 < p < 1 \); R. A. Kerman, Convergence of approximate identities
in weighted Lebesgue spaces; M. Mastyło, Interpolation functors commuting
with direct products; M. Milman, Local operators vs Lorentz-Marcinkiewicz
spaces; I. Ya. Novikov, Inner estimates; B. P. Osilenker, The generalized
\( \Lambda \)-translation in a multiple orthogonal polynomial system; V. I. Ovchinnikov,
On the description of interpolation orbits in couples of \( L_p \) spaces when they
are not described by the \( K \)-method; Y. Raynaud, On Lorentz-Sharpley spaces;

R. Rochberg, A correspondence principle for Toeplitz and Calderon-Toeplitz
operators; P. A. Shvartsman, \( K \)-functionals of weighted Lipschitz spaces and
Lipschitz selections of multivalued mappings; L. V. Veselova and N. M. Zobin,
On a tensor approach to interpolation theory.

Contents
Deformation theorems; Cohomogicity; Coverings between knot exteriors;
Subgroups of finite index; Knot subgroups of torus-knot groups; Depth, and
loose and tight subgroups; Knot subgroups of knot groups.

On the Existence of Feller Semigroups with Boundary Conditions
Kazuaki Taira
Volume 99, Number 475

This monograph provides a careful and accessible exposition of functional
analytic methods in stochastic analysis. The author focuses on the relationship
among three subjects in analysis: Markov processes, Feller semigroups, and elliptic boundary value problems.
The approach here is distinguished by the author’s extensive use of
the theory of partial differential equations. Filling a mathematical gap
between textbooks on Markov processes and recent developments in
analysis, this work describes a powerful method capable of extensive further development. The book would be suitable as a textbook in a one-year, advanced graduate course on functional analysis and partial differential equations, with emphasis on their strong interrelations with probability theory.

Contents
Introduction and results; Theory of Feller semigroups; Theory of pseudo-differential operators; Proof of Theorem 1; Proof of Theorem 2; Appendix the maximum principle.

1991 Mathematics Subject Classification: 35R25, 47D07; 47D05, 60J35, 60J60
ISBN 0-8218-2535-6, LC 92-18061, ISSN 0065-9266
65 pages (softcover), September 1992
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The Subregular Germ of Orbital Integrals
Thomas C. Hales
Volume 99, Number 476

Langlands theory predicts deep relationships between representations of different reductive groups over a local or global field. The trace formula attempts to reduce many such relationships to problems concerning conjugacy classes and integrals over conjugacy classes (orbital integrals) on $p$-adic groups. It is possible to reformulate these problems as ones in algebraic geometry by associating a variety $Y$ to each reductive group. Using methods of Igusa, the geometrical properties of the variety give detailed information about the asymptotic behavior of integrals over conjugacy classes. This monograph constructs the variety $Y$ and describes its geometry. As an application, the author uses the variety to give formulas for the leading terms (regular and subregular germs) in the asymptotic expansion of orbital integrals over $p$-adic fields. The final chapter shows how the properties of the variety may be used to confirm some predictions of Langlands theory on orbital integrals, Shalika germs, and endoscopy.

Contents
Basic constructions; Coordinates and coordinate relations; Groups of rank two; The subregular spurious divisor; The subregular fundamental divisor; Rationality and characters; Applications to endoscopic groups.

1991 Mathematics Subject Classification: 20G25; 12B27, 22E35
ISBN 0-8218-2539-9, LC 92-18060, ISSN 0065-9266
142 pages (softcover), September 1992
Individual member $17, List price $28, Institutional member $22
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The Continued Fractions Found in the Unorganized Portions of Ramanujan’s Notebooks
George E. Andrews, Bruce C. Berndt, Lisa Jacobsen, and Robert L. Lamphere
Volume 99, Number 477

Among his thirty-three published papers, Ramanujan had only one continued fraction, the Rogers–Ramanujan continued fraction. However, his notebooks contain over 100 results on continued fractions. At the end of his second notebook are 100 pages of unorganized material, and the third notebook comprises thirty-three pages of disorganized results. In these 133 pages of material are approximately sixty theorems on continued fractions, most of them new results. In this monograph, the authors discuss and prove each of these theorems. Aimed at those interested in Ramanujan and his work, this monograph will be of special interest to those who work in continued fractions, q-series, special functions, theta-functions, and combinatorics. The work is likely to be of interest to those in number theory as well. The only required background is some knowledge of continued fractions and a course in complex analysis.

1991 Mathematics Subject Classification: 30B70, 40A15
ISBN 0-8218-2538-0, LC 92-18059, ISSN 0065-9266
71 pages (softcover), September 1992
Individual member $14, List price $23, Institutional member $18
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The Scope and History of Commutative and Noncommutative Harmonic Analysis

History of Mathematics, Volume 5 • George W. Mackey, Editor

This volume presents a sweeping view of the importance, utility, and beauty of harmonic analysis and its connections to other areas of mathematics and science. Aimed at mathematicians in all areas as well as mathematically-oriented theoretical physicists and advanced graduate students, Mackey’s book is not directed to specialists but is intended to help specialists learn about fields other than their own and about the relationships among fields. Readers will appreciate this book for its lucid expository presentations and for its wide-ranging treatment of the subject. This volume is published jointly with the London Mathematical Society.

1991 Mathematics Subject Classification: 00; 01, 11, 22, 81
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At its August 1985 meeting, the Council of the AMS approved a motion to regularly assemble and report in the Notices information on the relative numbers of men versus women in at least the following categories: membership in the AMS; invited hour addresses at AMS meetings; speakers at special sessions at AMS meetings; and members of editorial boards of AMS journals.

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

- **Male**: names that were obviously male;
- **Female**: names that were obviously female;
- **Unknown**: names that could not be identified as clearly male or female (e.g., only initials given); and
- **Foreign**: foreign names that could not be identified as clearly male or female.

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

### Members of the AMS Residing in the U.S.

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<tr>
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<td>14,423</td>
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### Invited Hour Address Speakers at AMS Meetings (1982–1991)

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<tr>
<td>Members</td>
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### Trustees and Council Members

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### Members of Editorial Boards of AMS Journals

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### Members of Editorial Boards of AMS Journals

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### Ph.D.s Granted to U.S. Citizens

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## Officers and Committee Members

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

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

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

### 1. Officers

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Year</th>
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<tbody>
<tr>
<td>President</td>
<td>Michael Artin</td>
<td>1992</td>
</tr>
<tr>
<td>President-Elect</td>
<td>Ronald L. Graham</td>
<td>1992</td>
</tr>
<tr>
<td>Vice-Presidents</td>
<td>Lenore Blum</td>
<td>1992</td>
</tr>
<tr>
<td></td>
<td>Chandler Davis</td>
<td>1993</td>
</tr>
<tr>
<td></td>
<td>Linda Keen</td>
<td>1994</td>
</tr>
<tr>
<td>Secretary</td>
<td>Robert M. Fossum</td>
<td>1992</td>
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<tr>
<td>Associate Secretary</td>
<td>Joseph A. Cima</td>
<td>1992</td>
</tr>
<tr>
<td>Treasurer</td>
<td>W. Wistar Comfort</td>
<td>1992</td>
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<tr>
<td>Associate Treasurer</td>
<td>Andy Roy Magid</td>
<td>1993</td>
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<td></td>
<td>Lance W. Small</td>
<td>1993</td>
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<td></td>
<td>Franklin P. Peterson</td>
<td>1992</td>
</tr>
<tr>
<td></td>
<td>Steve Armentrout</td>
<td>1992</td>
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</table>

### 1.1. Liaison Committee

All members of this committee serve *ex officio*.

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chair</td>
<td>Michael Artin</td>
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<td></td>
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<tr>
<td></td>
<td>Franklin P. Peterson</td>
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### 2. Council

#### 2.0.1. Officers of the AMS

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>President</td>
<td>Michael Artin</td>
<td>1992</td>
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<tr>
<td>President-Elect</td>
<td>Ronald L. Graham</td>
<td>1992</td>
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<tr>
<td>Vice-Presidents</td>
<td>Lenore Blum</td>
<td>1992</td>
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<tr>
<td></td>
<td>Chandler Davis</td>
<td>1993</td>
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<td></td>
<td>Linda Keen</td>
<td>1994</td>
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<tr>
<td>Secretary</td>
<td>Robert M. Fossum</td>
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#### 2.0.2. Representatives of Committees

<table>
<thead>
<tr>
<th>Committee</th>
<th>Name</th>
<th>Year</th>
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<tbody>
<tr>
<td>American Journal of Mathematics</td>
<td>M. Salah Baouendi</td>
<td>1992</td>
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<tr>
<td>Bulletin</td>
<td>Frank S. Quinn</td>
<td>1993</td>
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<tr>
<td>Colloquium</td>
<td>G. D. Mostow</td>
<td>1993</td>
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<tr>
<td>Executive Committee</td>
<td>Arthur M. Jaffe</td>
<td>1994</td>
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<td>Executive Committee</td>
<td>Hugo Rossi</td>
<td>1992</td>
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<td>Journal of the AMS</td>
<td>Wilfried Schmid</td>
<td>1993</td>
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<tr>
<td>Committee to Monitor Problems in Communication</td>
<td>Judy Green</td>
<td>1992</td>
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<tr>
<td>Mathematical Reviews</td>
<td>B. A. Taylor</td>
<td>1992</td>
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<td>Mathematical Surveys and Monographs</td>
<td>Marc A. Rieffel</td>
<td>1994</td>
</tr>
<tr>
<td>Mathematics of Computation</td>
<td>Walter Gautschi</td>
<td>1992</td>
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<tr>
<td>Proceedings</td>
<td>Irwin Kra</td>
<td>1994</td>
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<tr>
<td>Science Policy Committee</td>
<td>Frank W. Warner III</td>
<td>1993</td>
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<tr>
<td>Transactions and Memoirs</td>
<td>James E. Baumgartner</td>
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### 2.0.3. Members-at-Large

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<tr>
<td>Sheldon Axler</td>
<td>Rebecca A. Herb</td>
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<td>Joan S. Birman</td>
<td>Elliott H. Lieb</td>
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<td>Ruth M. Charney</td>
<td>Carl Pomerance</td>
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<td>Charles Herbert Clemens</td>
<td>Gunther A. Uhlmann</td>
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<td>Carl C. Cowen, Jr.</td>
<td>Steven H. Weintraub</td>
<td>1993</td>
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<tr>
<td>David A. Cox</td>
<td>Ruth J. Williams</td>
<td>1993</td>
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<td>John M. Franks</td>
<td>Shing-Tung Yau</td>
<td>1992</td>
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<td>Frank Gilfeather</td>
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### 2.1. Executive Committee of the Council

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<td></td>
<td>Arthur M. Jaffe</td>
<td>1994</td>
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### 3. Board of Trustees

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<tr>
<td>Treasurer</td>
<td>Steve Armentrout</td>
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*Only one Associate Secretary at a time is a voting member of the Council, namely the cognizant Associate Secretary for the scientific sessions.*
### Officers and Committee Members

<table>
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<tr>
<th>Officer</th>
<th>Years</th>
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<tr>
<td>Secretary</td>
<td>1995</td>
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<td>M. Susan Montgomery</td>
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<td>Franklin P. Peterson</td>
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<td>John C. Polking</td>
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<td>Paul J. Sally, Jr.</td>
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<td>Gregory L. Chetin</td>
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<td>Zoltan Furedi</td>
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<td>William G. Dwyer</td>
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<td>Harry Kesten</td>
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<td>Guido L. Weiss</td>
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### Committees

#### 4. Committees

#### 4.1. Committees of the Council

##### Standing Committees

**4.1.1. Editorial Boards**

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<tr>
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<td>Linda Keen</td>
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<td>Richard James Milgram</td>
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<td>Barry Simon</td>
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<td>Bhama Srinivasan</td>
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<td>Nolan R. Wallach</td>
<td>1993</td>
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<td>Robert J. Zimmer</td>
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**Chair**

Michael Aschbacher 1993

<table>
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<tr>
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<tbody>
<tr>
<td>Daniel M. Burns, Jr.</td>
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<td>Jerry L. Kazdan</td>
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<td>Barbara Lee Keyfitz</td>
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<tr>
<td>Ray A. Kunze</td>
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<td>Joseph Lipman</td>
<td>1994</td>
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<td>Walter David Neumann</td>
<td>1993</td>
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<td>Robert F. Williams</td>
<td>1992</td>
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<td>Carol S. Wood</td>
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**Ad Hoc Committee**

**4.1.3. Nominating Procedures**

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<td>Robert M. Fossum</td>
<td>1993</td>
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<tr>
<td>Frank L. Gilfeather</td>
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<tr>
<td>Jerry L. Kazdan</td>
<td>1992</td>
</tr>
<tr>
<td>Ray A. Kunze</td>
<td>1992</td>
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<tr>
<td>James W. Maxwell</td>
<td></td>
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<tr>
<td>ex officio</td>
<td></td>
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<tr>
<td>Ruth J. Williams</td>
<td>1994</td>
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**Chair**

Michael Aschbacher 1993

<table>
<thead>
<tr>
<th>Chair</th>
<th>Years</th>
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<tbody>
<tr>
<td>Robert M. Fossum</td>
<td>1993</td>
</tr>
<tr>
<td>Andy Roy Magid</td>
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<tr>
<td>Lance W. Small</td>
<td>1992</td>
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**4.2. Editorial and Communications Committees**

**4.2.1. Abstracts Editorial Committee**

All members of this committee serve ex officio.

<table>
<thead>
<tr>
<th>Name</th>
<th>Years</th>
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<tbody>
<tr>
<td>Joseph A. Cima</td>
<td></td>
</tr>
<tr>
<td>W. Wistar Comfort</td>
<td></td>
</tr>
<tr>
<td>ex officio</td>
<td></td>
</tr>
<tr>
<td>Robert M. Fossum</td>
<td>1993</td>
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<tr>
<td>Andy Roy Magid</td>
<td></td>
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<tr>
<td>Lance W. Small</td>
<td>1992</td>
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**Chair**

Michael Aschbacher 1993

<table>
<thead>
<tr>
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<th>Years</th>
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<tbody>
<tr>
<td>M. Salah Baouendi</td>
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**4.2.2. American Journal of Mathematics, Society’s Representatives**

<table>
<thead>
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<th>Years</th>
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<tr>
<td>Richard S. Palais</td>
<td>1992</td>
</tr>
<tr>
<td>Murray H. Protter</td>
<td>1994</td>
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<td>Frank S. Quinn</td>
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**4.2.3. Bulletin (New Series)**

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<thead>
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<th>Years</th>
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<tr>
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<td>1992</td>
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<tr>
<td>Murray H. Protter</td>
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<tr>
<td>Frank S. Quinn</td>
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**4.2.4. Collected Works**

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**4.2.5. Colloquium**

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**4.2.6. Committee to Monitor Problems in Communication**

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**4.2.7. Contemporary Mathematics**

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**4.2.8. Graduate Studies in Mathematics**

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**4.2.9. Journal of the AMS**

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**Chair**

Wilfried Schmid 1993

**4.2.10. Mathematical Reviews**

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**Chair**

B. A. Taylor 1992

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**Chair:** Marc A. Rieffel 1994

Franklin Tall 1993
John Trangenstein 1995
James E. West 1995

### 4.2.12. Mathematics of Computation

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**Chair:** Walter Gathschi 1992

**Associate Editors:**
- James Bramble 1994
- Carl Pomerance 1994
- E. W. Cheney 1994
- René Schoof 1992
- James W. Demmel 1994
- Ridgway Scott 1992
- Eugene Isaacson 1992
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- Heinz-Otto Kreiss 1993
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- Hans J. Stetter 1994
- Harald Niederreiter 1993
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- Syvert P. Nersett 1993
- Vidar C. Thomée 1994
- John Osborn 1992
- Hugh C. Williams 1994
- Stanley J. Osher 1992
- John W. Wrench, Jr. 1993

### 4.2.13. Notices

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**Chair:** Robert M. Fossum ex officio 1994

**Associate Editors:**
- Ronald L. Graham 1994
- Jeffrey C. Lagarias 1994

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**Chair:** Jeffrey C. Lagarias 1994

### 4.2.15. Proceedings of Symposia in Applied Mathematics

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**Chair:** Walter Gathschi 1992

**Associate Editors:**
- Bhama Srinivasan 1993
- Mathematics 1993
- Chair: Walter Gathschi 1992
- Björn E. J. Dahlberg 1991
- Ronald L. Graham 1992

### 4.2.16. Transactions and Memoirs

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**Chair:** John S. Bradley 1994

**Associate Editors:**
- Sun-Yung Alice Chang 1993
- S.-Y. Cheng 1993
- Chair: Ronald L. Graham 1992

### 4.2.17. Translation from Chinese

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**Chair:** Ronald L. Graham 1994

**Special Articles:**
- Ronald L. Graham 1994
- Jeffrey C. Lagarias 1994

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**Chair:** Ronald L. Graham 1994

**Special Articles:**
- Shoshichi Kobayashi 1994
- Katsumi Nomizu 1994

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**Chair:** Nancy Anderson 1993

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- Keith J. Devlin 1992
- John M. Franks 1994
- Maria M. Klave 1994
- Frank S. Quinn 1993

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**Chair:** Charles W. Curtis 1993

**Special Articles:**
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- Harold M. Edwards 1994
- Guido Weiss 1994

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**Chair:** Theodore W. Gamelin 1994

**Special Articles:**
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- Donald S. Ornstein 1995
- Lawrence J. Scott 1995

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**Chair:** Judy Green 1994

**Special Articles:**
- Judy Green 1994
- Sheldon Axler 1994
- John H. Ewing 1994
- John M. Franks 1994
- Judy Green 1994
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John C. Polking
ex officio
Paul J. Sally, Jr.
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4.3.13. Staff and Services
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Arthur M. Jaffe
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Chair Frederick W. Gehring
Wen-Ching Winnie Li
1994
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1994

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ex officio
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1992

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Paul J. Sally, Jr.

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William H. Jaco
Arthur M. Jaffe
Franklin P. Peterson
Paul J. Sally, Jr.

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Chair Frederick W. Gehring
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Hugo Rossi
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Paul J. Sally, Jr.
ex officio
B. A. Taylor
1992

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Paul J. Sally, Jr.

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Consultant Carol-Ann Blackwood
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Chair Frederick W. Gehring
Wen-Ching Winnie Li
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Hugo Rossi
1994

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ex officio
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Paul J. Sally, Jr.

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Paul J. Sally, Jr.

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Chair
Andrew M. Gleason
Franklin P. Peterson

4.3.15. Long Range Planning
All members of this committee serve ex officio.

Chair M. Salah Baouendi
Robert M. Fossum
William H. Jaco
Arthur M. Jaffe
Franklin P. Peterson
Paul J. Sally, Jr.

4.3.16. Membership
M. Salah Baouendi
1993
Consultant Carol-Ann Blackwood
Susan Friedlander
1992
Chair Frederick W. Gehring
Wen-Ching Winnie Li
1994
Hugo Rossi
1994

4.3.17. The Publication Program
Chair Steve Armentrout
Robert L. Devaney
Robert M. Fossum
ex officio
Eric Friedlander
1992
Ramesh A. Gangolli
1992
William H. Jaco
ex officio
Elliott H. Lieb
1994
Andrew M. Odlyzko
1992
John C. Polking
ex officio
Paul J. Sally, Jr.
ex officio
B. A. Taylor
1992

4.3.18. Salaries
Chair Steve Armentrout
Franklin P. Peterson
Paul J. Sally, Jr.

4.3.19. Staff and Services
Chair Steve Armentrout
Franklin P. Peterson
Paul J. Sally, Jr.

Ad Hoc Committee

4.3.20. Institutional Membership
Consultant Carol-Ann Blackwood
Ramesh A. Gangolli
Chair Frederick W. Gehring
Jeremy J. Soldevilla
William A. Veech
ex officio

4.4. Internal Organization of the American Mathematical Society

Standing Committees

4.4.1. Archives
Andrew M. Gleason
Chair Everett Pitcher

4.4.2. Committee on Committees
Chair
Andrew M. Gleason
Franklin P. Peterson

4.3.15. Long Range Planning
All members of this committee serve ex officio.

Chair M. Salah Baouendi
Robert M. Fossum
William H. Jaco
Arthur M. Jaffe
Franklin P. Peterson
Paul J. Sally, Jr.
### 4.4.3. Subcommittee to Study the Committee Structure

<table>
<thead>
<tr>
<th>Name</th>
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<tr>
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<td>William H. Jaco</td>
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<td>Tsit-Yuen Lam</td>
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<td>Sylvia M. Wiegand</td>
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### 4.4.4. Library Committee

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<tr>
<td>Nancy Anderson</td>
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<td>Mary Ann Southern</td>
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<td>Jack Weigel</td>
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<td>Co-chair</td>
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### 4.4.5. Applications of Mathematics

<table>
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<tr>
<td>Frederick J. Almgren, Jr.</td>
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<td>Barbara Lee Keyfitz</td>
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### 4.5. Program and Meetings

#### 4.5.1. Program Committee for National Meetings

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### 4.5.2. Short Course Subcommittee

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<td>Stefan Burr</td>
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<td>Lisl Novak Gaal</td>
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<td>Jeffery C. Lagarias</td>
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<td>Patrick D. McCray</td>
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### 4.5.3. Central Section Program Committee

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<tr>
<td>Rodrigo Banuelos</td>
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<td>Julia Knight</td>
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### 4.5.4. Eastern Section Program Committee

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<td>Roy Adler</td>
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<td>W. Wistar Comfort</td>
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<td>John C. Moore</td>
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<td>Lesley M. Sibner</td>
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<td>Gregg J. Zuckerman</td>
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### 4.5.5. Southeastern Section Program Committee

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<td>Joseph A. Cima</td>
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<td>Sue E. Goodman</td>
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### 4.5.6. Western Section Program Committee

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<td>F. Michael Christ</td>
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### 4.5.7. Agenda for Business Meetings

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<tr>
<td>M. Salah Bauendi</td>
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### 4.5.8. Gibbs Lecturer for 1993 and 1994 Committee to Select

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<tr>
<td>Michael Atiyah</td>
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<td>Cathleen S. Morawetz</td>
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### 4.5.9. Progress in Mathematics

<table>
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<tr>
<td>Hyman Bass</td>
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<td>Peter W. K. Li</td>
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### 4.5.10. Arnold Ross Lecture Series Committee

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<tr>
<td>Harvey B. Keynes</td>
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<td>Paul J. Sally, Jr.</td>
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<td>Jean E. Taylor</td>
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### 4.5.11. Meetings Committee

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<tr>
<td>Lenore Blum</td>
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<td>Nancy K. Stanton</td>
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<td>Ruth J. Williams</td>
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### 4.6. Status of the Profession

#### 4.6.1. Academic Freedom, Tenure, and Employment Security

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Josefa Alvarez</td>
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<td>Leon Brown</td>
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<td>Lawrence E. Morris</td>
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<td>Mary Ellen Rudin</td>
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<td>Gail S. Young</td>
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</table>
4.6.2. Academic Review
Frederick W. Gehring
Frank L. Gilfeather
Andrew M. Gleason
Chair
J. K. Goldhaber

4.6.9. Service to Mathematicians in Developing Countries
Chair
Raymond G. Ayoub
James A. Donaldson
James Ellis
Donald M. Hill

4.6.3. Education
Michael Artin, ex officio
Ramesh A. Gangolli, 1992
Andrew M. Gleason, 1992
Fern Y. Hunt, 1992
William H. Jaco, ex officio
Harvey B. Keynes, 1992
Don J. Lewis, 1992
Richard A. Tapia, 1992
Alan C. Tucker, 1993
Frank W. Warner III, ex officio

4.6.10. Advisory Committee on Former Soviet Union Mathematics
Chair
Michael Artin, William H. Jaco, ex officio
Robert D. MacPherson
Cathleen S. Morawetz
John C. Polking
Linda Preiss Rothschild
Daniel Stroock

4.6.4. Human Rights of Mathematicians
Raymundo Bautista, 1994
Sufian Y. Husseini, 1994
Wen-Ching Winnie Li, 1993
Cora S. Sadosky, 1992
Chair
Alice T. Schafer, 1993
Jonathan M. Wahl, 1994
Steven H. Weintraub, 1992
Hung-Hsi Wu, 1993

4.6.11. Advisory Committee on Professional Ethics
Murray Gerstenhaber
Frank L. Gilfeather
Judy Green
Chair
Linda Keen
Elliott H. Lieb

4.6.5. Liaison Committee on Education in Mathematics
John A. Dossey
Melvin Hochster
Rogers J. Newman
Louise A. Raphael
Chair
Paul J. Sally, Jr.
James D. Stasheff
Lynn Arthur Steen

4.6.12. CAFTES (Academic Freedom, Tenure and Employment Security) and COPE (Committee on Professional Ethics)
Chair
Joan S. Birman
Frank L. Gilfeather
Elliott H. Lieb

4.6.13. Cooperation with Latin American Mathematicians
Chair
Charles Herbert Clemens
Samuel Gitler
Carlos E. Kenig
Joseph J. Kohn
Horacio A. Porta
Cora S. Sadosky

4.6.14. Coordinating Committee for the Doctoral Program in Mathematics
Chair
R. Creighton Buck
Franklin P. Peterson
Murray H. Protter

4.6.6. Pi Mu Epsilon Liaison Committee
David W. Bailew, 1993
Lynne M. Butler, 1993
Mary B. Martin, 1994
Chair
Eileen Poiani, 1992
Bruce Reznick, 1993
De Witt Sumners, 1994

4.6.7. Professional Ethics
Leonard D. Berkovitz, 1993
Donald J. Lewis, 1994
Albert Marden, 1994
Chair
Everett Pitcher, 1992
Judith Roitman, 1993

4.6.15. Employment Task Force
S.-Y. Cheng
Ronald M. Davis
Helen G. Grundman
Chair
D. J. Lewis
Bernard L. Madison
James W. Maxwell, ex officio
Donald E. McClure
Calvin C. Moore
Carol S. Wood

4.6.8. Science Policy
Michael Artin, ex officio
James A. Donaldson, 1993
Eric M. Friedlander, 1994
Chair
Ramesh A. Gangolli, ex officio
Ronald L. Graham, ex officio
Rhonda J. Hughes, 1993
William H. Jaco, ex officio
Linda Keen, 1993
Joseph J. Kohn, 1992
Joel L. Lebowitz, 1992
William James Lewis, 1994
Michael C. Reed, 1992
Linda Preiss Rothschild, 1994
Chair
Paul J. Sally, Jr., 1992
Frank W. Warner III, 1993
Mary F. Wheeler, 1992

4.6.16. Soviet Mathematicians, Committee to Study Relations with
Chair
Chandler Davis
Robert D. MacPherson
Hugo Rossi
Lance W. Small
### 4.7. Prizes and Awards

#### Standing Committees

**4.7.1. Award for Public Service, Committee to Select the Winner of**

**Chair**
- William Browder 1995
- Kenneth M. Hoffman 1996
- Robert M. Fossum 1992
- John C. Polking 1994
- David P. Roselle 1993

**4.7.2. Centennial Fellowships**

Terms expire on June 30

<table>
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<td>Douglas A. Lind</td>
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<td>Henry Pinkham</td>
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<td>Peter Sarnak</td>
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<td>Birgit Speh</td>
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**Chair**
- Irwin Kra
- John C. Polking

**4.7.3. National Awards and Public Representation**

**Chair**
- Michael Artin 1993
- Joan S. Birman 1993
- Robert M. Fossum 1993
- Ronald L. Graham 1993
- Richard S. Palais 1993

**4.7.4. Subcommittee on Appointments of the Committee on National Awards and Public Representation**

**Chair**
- Robert M. Fossum 1993
- Irwin Kra 1993
- John C. Polking 1993

**4.7.5. Satter Prize for 1993, Committee to Select the Winner of the**

**Chair**
- Joan S. Birman 1992
- Dusa McDuff 1993
- Alan D. Weinstein 1993

**4.7.6. Steele Prizes**

Terms expire on June 30

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<td>Eugenio Calabi</td>
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<td>Sylvain E. Cappell</td>
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<td>Vaughan F. R. Jones</td>
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<td>Harry Kesten</td>
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<td>Joseph J. Kohn</td>
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<td>Robert P. Langlands</td>
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<td>Paul Rabinowitz</td>
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<td>Jane Cronin Scanlon</td>
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**Chair**

**4.7.7. AMS Prizes and Awards**

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<td>Joseph J. Kohn</td>
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<td>Gian Carlo Rota</td>
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**Chair**
- Joseph L. Taylor

**4.7.8. Automatic Theorem Proving, Committee to Recommend Winners of Prizes for**

**Chair**
- David Mumford
- Jacob T. Schwartz
- John L. Selfridge

**4.7.9. Cole Prize, Committee to Select the Winner of**

**Chair**
- Gerd Faltings
- Wolfgang Schmidt
- Harold M. Stark

### 4.8. Institutes and Symposia

#### Standing Committee

**4.8.1. Liaison Committee with AAAS**

<table>
<thead>
<tr>
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<td>Efraim P. Armendariz</td>
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<td>Raymond Johnson</td>
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<td>Philip C. Katzko</td>
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<td>Louise A. Raphael</td>
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<td>V. Frederick Rickey</td>
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<td>M. Beth Ruskai</td>
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<td>Chih-Han Sah</td>
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<td>Melvin Thornton</td>
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**Chair**
- Brian Parshall 1993
- Francois Treves 1993
- Edward Witten 1994

**4.8.2. Summer Institutes and Special Symposia**

Terms expire on February 28

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<td>Lawrence Craig Evans</td>
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<td>Melvin Hochster</td>
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<td>Nicholas Katz</td>
<td>1993</td>
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<tr>
<td>Brian Parshall</td>
<td>1993</td>
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<tr>
<td>Francois Treves</td>
<td>1993</td>
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<td>Edward Witten</td>
<td>1994</td>
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**Chair**
- Brian Parshall 1993
- Francois Treves 1993
- Edward Witten 1994

**Consultant**
- Argelia Veléz-Rodriguez

**4.9. Joint Committees**

**4.9.1. AMS-AAAS-MAA Committee on Opportunities in Mathematics for Underrepresented Minorities**

<table>
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<td>Claudette Bradley</td>
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<td>Johnny E. Brown</td>
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**Chair**
- Gloria F. Gilmer 1992
- Shirley Malcolm 1992

**Consultant**
- Argelia Veléz-Rodriguez

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

<table>
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<td>Nancy Flournoy</td>
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<td>Sue E. Goodman</td>
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<td>Jean Hutchinson (AWM)</td>
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<td>Patricia C. Kenschaft</td>
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<td>Jeanne W. Kerr (AMS)</td>
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<td>Don J. Lewis (MAA)</td>
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<td>J. Peter May (AMS)</td>
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<td>Anita McDonald (MAA)</td>
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<td>Joyce R. McLaughlin (SIAM)</td>
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<td>Anne Parkhurst (ASA)</td>
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<td>Magda Peligrad (IMS)</td>
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<td>Linda R. Petzold (SIAM)</td>
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<td>Frances Rosamond (MAA)</td>
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<td>M. Beth Ruskai (AMS)</td>
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<td>Evelyn Silvia (AWM)</td>
<td>1993</td>
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<tr>
<td>Patricia S. Wilson (NCTM)</td>
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NCTM members’ terms expire April 1 of the year given.
### 4.9.3. AMS-ASL-IMS-SIAM Committee on Translations from Russian and Other Slavic Languages

<table>
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<tr>
<th>Position</th>
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<tr>
<td>Chair</td>
<td>Peter S. Landweber</td>
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<td>Luchezar Avramov</td>
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<td>Igor Dolgachev</td>
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<td>W. J. Studden</td>
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### 4.9.4. AMS-CMS Joint Program Committee

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<th>Position</th>
<th>Name</th>
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<tr>
<td>Chair</td>
<td>Spencer Bloch</td>
<td>CMS</td>
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<td>David W. Boyd</td>
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<td>Dusa McDuff</td>
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<td>Nancy K. Stanton</td>
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### 4.9.5. AMS-DMV Liaison Committee

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<tr>
<td>Heinz Bauer</td>
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<td>Klaus D. Bierstedt</td>
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<td>Albrecht E. Dold</td>
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<td>Robert M. Fossum</td>
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<td>Dale Husemoller</td>
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<td>Bernd Ulrich</td>
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### 4.9.6. AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences

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<thead>
<tr>
<th>Terms expire on June 30</th>
<th>Name</th>
<th>Institution</th>
<th>Year</th>
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<tr>
<td>John A. Burns (SIAM)</td>
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<td>Fan R. K. Chung (AMS)</td>
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<tr>
<td>Leonard Evens (AMS)</td>
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<td>Alan F. Karr (AMS)</td>
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<td>Stewart B. Priddy (AMS)</td>
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<td>Robert J. Serfling (IMS)</td>
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<td>Sue Whitesides (AMS)</td>
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### 4.9.7. AMS-LMS Joint Program Committee

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<tr>
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<td>Sir Michael Atiyah (LMS)</td>
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<td>J. M. Ball (LMS)</td>
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<td>Sir John Kingman (LMS)</td>
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### 4.9.8. AMS-MAA Data Committee

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<tbody>
<tr>
<td>Edward A. Connors</td>
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<td>Lincoln K. Durst</td>
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<td>John D. Fulton</td>
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<td>Charlotte Lin</td>
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<td>James W. Maxwell</td>
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### 4.9.9. AMS-MAA Committee on Teaching Assistants and Part Time Instructors (TA/PTI)

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<tr>
<td>Thomas F. Banchoff</td>
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<td>Reuben C. Drake</td>
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<td>Deborah Hughes Hallett</td>
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<td>Timothy L. Lance (AMS)</td>
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### 4.9.10. AMS-MAA Joint Archives Committee

<table>
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<td>Chair</td>
<td>Sanford L. Segal</td>
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### 4.9.11. AMS-MAA Joint Meetings Committee

All members of this committee serve ex officio.

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>H. Hope Daly</td>
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<td>1994</td>
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<td>Kenneth A. Ross</td>
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<td>Marcia P. Sward</td>
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### 4.9.12. AMS-MAA Arrangements Committee for the San Antonio Meeting January 13-16, 1993

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### 4.9.13. AMS-MAA Joint Program Committee for the San Antonio Meeting

<table>
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### 4.9.14. AMS-MAA Committee on Summer Meetings

<table>
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<tr>
<td>H. Hope Daly</td>
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<td>John M. Smith (MAA)</td>
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4.9.15. AMS-MAA-SIAM Joint Administrative Committee

All members of this committee serve ex officio.

Gerald L. Alexanderson (MAA)
I. Edward Block (SIAM)
Samuel Gubins (SIAM)
William H. Jaco (AMS)
Donald L. Kreider (MAA)
Robert E. O'Malley, Jr. (SIAM)
Franklin P. Peterson (AMS)
Marcia P. Sward (MAA)

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

Stanley Benkoski (AMS) 1993
Peter E. Castro (SIAM) 1992
Ronald M. Davis (MAA) 1992
Frank R. Demeyer (AMS) 1993
James W. Maxwell ex officio 1994

S. Brent Morris (MAA) 1994
Leon H. Seifertman (SIAM) 1994

4.9.17. AMS-MAA-SIAM Joint Policy Board for Mathematics

Marsha J. Berger 1994
Paul C. Fife 1994
James M. Hyman 1993
Andrew J. Majda 1992
Michael Shub 1993
Joel Spencer 1992

4.9.19. AMS-SIAM Committee to Select the Winner of the Birkhoff Prize for 1993

Constantine M. Dafermos
Andrew Chi-Chih Yao

4.9.20. AMS-SIAM Committee to Screen Applicants for Graduate Study from the People's Republic of China

David Benney
Robert Bryant

4.9.21. AMS-SIAM-SMB Committee on Mathematics in the Life Sciences

James W. Curran 1993
Leah Edelstein-Keshet 1994
Eric S. Lander 1993

Marc Mangel 1992
James Murray 1992

4.9.22. AMS-MAA Committee on Cooperation

Gerald L. Alexanderson (MAA) ex officio
Michael Artin (AMS)
Susan Forman (MAA)
Robert M. Fossum (AMS)
Ramesh A. Gangolli (AMS)
Deborah Tepper Haimo (AMS) ex officio

William H. Jaco (AMS)
Donald L. Kreider (MAA)
M. Susan Montgomery (AMS)

5. Representatives

5.0.1. Advisory Board of the National Translations Center of the John Crerar Library

Ralph P. Boas

5.0.2. American Association for the Advancement of Science

Terms expire on February 21

Section A Raymond Johnson 1995
Section B Chih-Han Sah 1995
Section L V. Frederick Rickey 1995
Section Q Efrem P. Armendariz 1995
Section T Melvin Thornton 1995

5.0.3. Commission on Professionals in Science and Technology

Edward A. Connors

5.0.4. Committee on the American Mathematics Competition

Term expires on June 30

Richard P. Stanley 1994

5.0.5. Conference Board of the Mathematical Sciences

Michael Artin 1992

5.0.6. Fulkerson Prize Committee

Alan J. Hoffman

5.0.7. MAA Committee on Guidelines

Donovan H. Van Osdol 1992

5.0.8. MAA Committee on Undergraduate Program in Mathematics

Harvey B. Keynes 1992
Kathy O'Hara 1993

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

Term expires on October 31

Constantine M. Dafermos 1996

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SEPTEMBER 1992, VOLUME 39, NUMBER 7 791
Matching of Asymptotic Expansions of Solutions of Boundary Value Problems

Translations of Mathematical Monographs, Volume 102 • A. M. Il’in

This book deals with the solution of singularly perturbed boundary value problems for differential equations. It presents, for the first time, a detailed and systematic treatment of the version of the matching method developed by Il’ in and his colleagues. The book covers formal constructions of asymptotic expansions and provides rigorous justifications of these asymptotics. One highlight is a complete asymptotic analysis of Burger’s equation with small diffusion in the neighborhood of the gradient catastrophe point. The book is suitable as a text for graduate study in asymptotic methods in calculus and singularly perturbed equations.

1991 Mathematics Subject Classification: 34; 41
Individual member $101, List price $169, Institutional member $135
Your ordering code is MMONO/102NA

All prices subject to change. Free shipment by surface: for air delivery, please add $6.50 per title. Prepayment required. Order from: American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.
Personals
Rose Ann Dios, of the New Jersey Institute of Technology, was presented the Outstanding Women Scientist award of the Metro New York Chapter of the Association for Women in Science Inc. She was honored for her accomplishments and contributions in the areas of teaching and research in mathematics and for serving as an exceptional role model for other women.

John H. Morrison, of the University of Delaware, Newark, has taken a position as an options research associate at Meredith Overbrook Partners, L.P., Inc., a member of the Cooper-Neff Group.

Paul Rabinowitz, of the University of Wisconsin, Madison, was awarded an honorary degree (Doctorat Honoris Causa) by the University Pierre et Marie Curie (Paris VI) for his exceptional contributions to the analysis of nonlinear problems.

Deaths
Ralph P. Boas, Professor Emeritus of Northwestern University, died on July 25, 1992, at the age of 79. He was a member of the Society for 56 years.

Donald J. Brown, of Saint Albans School, died on January 13, 1992, at the age of 39. He was a member of the Society for 1 year.

Henry L. Garabedian, of Laguna Hills, California, died on May 24, 1992, at the age of 90. He was a member of the Society for 65 years.

Albert E. Heins, of the University of Michigan, died on June 24, 1992, at the age of 79. He was a member of the Society for 52 years.

M. F. Khalifah, of the Teacher Training College, Ruwi, Oman, died on April 2, 1992, at the age of 50. He was a member of the Society for 11 years.

James A. King, of Brooklyn, New York, died on October 27, 1991, at the age of 62. He was a member of the Society for 8 years.

Morris Monsky, of Westborough, Massachusetts, died on June 28, 1990, at the age of 85. He was a member of the Society for 61 years.

J. Ian Richards, of the University of Minnesota, died on June 21, 1992, at the age of 56. He was a member of the Society for 34 years.

G. de B. Robinson, Professor Emeritus of the University of Toronto, died on April 8, 1992, at the age of 85. He was a member of the Society for 59 years.

Bernard W. Roos, of Rancho Santa Fe, California, died on February 29, 1992, at the age of 64. He was a member of the Society for 32 years.

Sergei A. Schelkunoff, Professor Emeritus of Columbia University, died on May 2, 1992. He was a member of the Society for 65 years.

Roland F. Smith, Professor Emeritus of Russell Sage College, died on April 21, 1992, at the age of 75. He was a member of the Society for 44 years.

Frank L. Spitzer, of Cornell University, died on February 1, 1992, at the age of 65. He was a member of the Society for 39 years.

Elmer Tolsted, Professor Emeritus of Pomona College, died on June 23, 1992, at the age of 72. He was a member of the Society for 49 years.

Herbert E. Vaughn, Professor Emeritus of the University of Illinois at Urbana-Champaign, died on April 21, 1992, at the age of 81. He was a member of the Society for 58 years.
The Mathematics Department at the University of Arizona invites applications for faculty positions available beginning Fall 1993. We especially encourage applications from women and minority candidates. Tenure-track positions. Excellent research and teaching record or potential, strong commitment to teaching required. Fields to include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Applications should be sent to Professor Mark A. Pinsky at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, applicants must do so by January 1, 1993.

The Mathematics Department at the University of Arizona is an Affirmative Action/Equal Opportunity Employer.

## POSITIONS AVAILABLE

### ARIZONA

#### UNIVERSITY OF ARIZONA

Department of Mathematics

Tucson, AZ 85721

The Mathematics Department at the University of Arizona will have tenure-track and postdoctoral positions available beginning Fall 1993.

**Tenure-track positions.** Excellent research record or potential, strong commitment to teaching required. Fields to include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply.

**Postdoctoral Fellowships (Research Associates).** Applicants with strengths in all areas of expertise desirable. Applications are especially encouraged. The Mathematics Department may also have several visiting positions for next year. We encourage early applications. Deadline date will be December 15, 1992, or whenever positions are filled.

Applications are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada for further information.

**SEND AD AND CHECK TO:** Advertising Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940. AMS location for express delivery packages is Providence, Rhode Island 02904. Individuals are requested to pay in advance, institutions are not required to do so. AMS FAX 401-455-4004.

### FLORIDA

#### UNIVERSITY OF FLORIDA

Department of Mathematics

Gainesville, FL 32611-2082

Applications are invited for one or more anticipated tenure-track positions starting September 1993. Priority will be given to young, exceptional research mathematicians; however, more senior candidates with very exceptional credentials may be considered for a tenured position. Fields of interest within the department include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Applications should be sent to Professor Mark A. Pinsky at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, applications must be received by January 1, 1993. Hiring is contingent upon eligibility to work in the United States.

## NORTHEASTERN UNIVERSITY

Mathematics Department

2033 Sheridan Road

Evanston, Illinois 60208-2730

Applications are invited for one or more anticipated tenure-track positions starting September 1993. Priority will be given to young, exceptional research mathematicians; however, more senior candidates with very exceptional credentials may be considered for a tenured position. Fields of interest within the department include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Applications should be sent to Professor Mark A. Pinsky at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, applications must be received by January 1, 1993. Hiring is contingent upon eligibility to work in the United States.

## MARYLAND

#### THE JOHNS HOPKINS UNIVERSITY

Department of Mathematical Sciences

Applications are invited for 3 anticipated faculty positions within the areas of

1) numerical linear algebra (Senior applicants preferred), 2) statistics, 3) operations research, 4) applied discrete mathematics.

Selection is based on demonstration and promise of excellence in research, teaching, and innovative applications.

Minority and women candidates are encouraged to apply. The Johns Hopkins University is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Applications are especially encouraged. Applicants with strengths in all areas of expertise desirable. Applications are especially encouraged.

The Mathematics Department may also have several visiting positions for next year. We encourage early applications. Deadline date will be December 15, 1992, or whenever positions are filled.

Applications are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada for further information.

**SEND AD AND CHECK TO:** Advertising Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940. AMS location for express delivery packages is Providence, Rhode Island 02904. Individuals are requested to pay in advance, institutions are not required to do so. AMS FAX 401-455-4004.

## ILLINOIS

#### NORTHWESTERN UNIVERSITY

Department of Mathematics

2033 Sheridan Road

Evanston, Illinois 60208-2730

Applications are invited for one or more anticipated tenure-track positions starting September 1993. Priority will be given to young, exceptional research mathematicians; however, more senior candidates with very exceptional credentials may be considered for a tenured position. Fields of interest within the department include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Applications should be sent to Professor Mark A. Pinsky at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, applications must be received by January 1, 1993. Hiring is contingent upon eligibility to work in the United States.
is an Affirmative Action/Equal Opportunity Employer.

Applications are asked to furnish a curriculum vitae, transcripts (junior applicants only), reprints (if available), a letter describing professional interests and aspirations, and to arrange for three letters of recommendation to:

Prof. John C. Wierman, Chair
Department of Mathematical Sciences
220 Maryland Hall
The Johns Hopkins University
Baltimore, Maryland 21218-2689

Applications are requested by January 15, 1993.

Applicants whose primary research is in algebra, analysis, geometry, logic, number theory, or topology will not be considered.

MASSACHUSETTS

WILLIAMS COLLEGE
Department of Mathematics
Williamstown, Massachusetts 01267

One or possibly two anticipated positions, one of them preferably in statistics, probably at the rank of assistant professor, for Fall 1993. Strong commitment to both teaching and scholarship is essential.

Please have a vita and three letters of recommendation on teaching and research sent to the Hiring Committee. Formal evaluation of applications will begin November 15, 1992, and continue until the positions are filled. AA/EOE.

NEW YORK

STATE UNIVERSITY OF NEW YORK
AT BUFFALO

The Department of Mathematics anticipates the appointment of several tenured or tenure-track faculty members beginning September 1, 1993. Salary will be competitive. We seek applicants in all areas with excellent research accomplishments/potential and a strong commitment to teaching.

Applicants should send supporting information, including a c.v. with a list of research interests, and have four letters of recommendation sent to:

Search Committee Chairman
Department of Mathematics
SUNY/Buffalo
106 Diefendorf Hall
Buffalo, New York 14214

The deadline for applications is November 1, 1992. Late applications will be considered until positions are filled.

SUNY/Buffalo is an Equal Opportunity/Affirmative Action Employer. We are interested in identifying prospective minority and women candidates. No person, in whatever relationship with the State University of New York at Buffalo shall be subject to discrimination on the basis of age, creed, color, handicap, national origin, race, religion, sex, marital or veteran status.

Pennsylvania

BRYN MAWR COLLEGE
Department of Mathematics

Applications are invited for positions in Mathematics and Computer Science, starting September 1993. They should be sent to the appropriate committee, Department of Mathematics, Bryn Mawr College, Bryn Mawr, PA 19010.

MATHEMATICS POSITIONS: One tenure track assistant professorship and one three-year renewable lecturership. Candidates must have completed a doctorate in a mathematical science by the starting date, and must show promise in research and a serious commitment to undergraduate and graduate teaching. All fields are acceptable, with a preference for applied mathematics or geometry. Please send a vita, research plan and three letters of recommendation to the Mathematics Search Committee.

COMPUTER SCIENCE POSITION: Three-year renewable lecturership. Candidates should have completed a doctorate in computer science or a related field by the starting date, and must display a commitment to both teaching and scholarship, and an interest in curriculum development in a joint program with Haverford College. Please send a vita and three letters of recommendation to the Computer Science Search Committee.

Bryn Mawr College is an equal opportunity affirmative action employer. The college wishes particularly to encourage applications from individuals interested in joining a multicultural/international academic community. Minority candidates and women are especially encouraged to apply. CLOSING DATE: 1 January 1993 (late applications may be considered). Telephone: (215) 526-5348. Email: msearch@cc.brynmawr.

Carnegie Mellon University
Department of Mathematics

The Department invites applications for a senior level appointment in Computational Mathematics/ Numerical Analysis. We are particularly interested in candidates who will enhance existing computational and analytical programs which involve continuum models in fluid dynamics, mechanics of solids including microstructure, phase transitions as well as other aspects of materials science. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to: Computational Mathematics Search Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

Carnegie Mellon University
Assistant Professorship in Mathematics

The Zeen Nehari Assistant Professorship has been instituted in the Department of Mathematics of Carnegie Mellon University to honor the memory of Professor Zeen Nehari, a member of the Department from 1954 to his death in 1978. The position available is for an initial period of one or two academic years, beginning in September 1993, and extendable for one additional year when mutually agreeable. It carries a reduced academic year teaching load of six hours per week during one semester and three hours per week during the other. Applicants are expected to show exceptional research promise, as well as clear evidence of achievement and should have research interests which intersect those of current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have three letters of recommendation sent to the committee. All communications should be addressed to: Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.
Carnegie Mellon University

Richard J. Duffin

Assistant Professorship in Mathematics

The Richard J. Duffin Assistant Professorship was established in 1990 to honor Professor Emeritus Duffin. The position available is for an initial period of one or two academic years, beginning in September 1993, and extendable for one additional year when mutually agreeable. It carries a reduced academic year teaching load of six hours per week during one semester and three hours per week during the other. Applicants are expected to show exceptional research promise, as well as clear evidence of achievement and should have research interests which intersect those of current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have three letters of recommendation sent to the committee. All communications should be addressed to: Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

THE UNIVERSITY OF THE SOUTH

Department of Mathematics and Computer Science

Tenure-track position in mathematics, to begin Fall 1993, at a highly selective church-related (Episcopal) liberal arts college of 1100 students located on a 10,000-acre forested domain in the Tennessee uplands. Applicants should have an appreciation for the liberal arts and some interest in computing. Applications from women and minorities are especially encouraged. The position is at the level of assistant professor, with excellence in teaching and continued interest in research expected. A complete application will include a letter stating one’s professional aims, a résumé, graduate and undergraduate transcripts, and three recommendations. All should be sent to Sherwood F. Ebye, The University of the South, 735 University Avenue, Sewanee, TN 37375-1000. Applications received by November 27 will have first consideration. AA/EOE.

Texas A&M University

Head, Department of Mathematics

Texas A&M University is a major coeducational institution, serving over 40,000 students, and ranks in the top ten nationally in research funding, number of National Merit Scholars, and value of its permanent endowment. The College of Science has a research and teaching budget of approximately $40,000,000 and comprises the Departments of Biology, Chemistry, Mathematics, Physics, and Statistics and the Cyclotron Institute. The Mathematics Department is large, energetic, and committed to excellence. Its dynamic faculty, representing pure and applied mathematics, is actively involved in research and both graduate and undergraduate education.

The position of Head will be filled by a person with an outstanding record of achievement in research and teaching, and with demonstrable administrative skills. Effective communication, a talent for management, and ability to provide visionary leadership are especially important.

Applications, consisting of a resume and the names of five persons from whom we may request letters of reference, will be accepted until November 1, 1992, or until the position is filled. Women and minorities are especially encouraged to apply. Texas A&M University is an equal opportunity, affirmative action employer:

Respond to: Dr. Jon Pitts, Chair Mathematics Department Head Search Committee College of Science Texas A&M University College Station, TX 77843-3257 Phone: 409-845-7825 FAX: 409-845-6077 Email: search@math.tamu.edu

Southern Methodist University

Department of Mathematics

The Department of Mathematics at Southern Methodist University invites applications for a senior level tenure track position, with employment beginning in Fall 1993. Applicants must have demonstrated leadership in research in applied mathematics, must have a strong commitment to high quality undergraduate and graduate teaching, and must be ready and qualified to offer supervision in some area of the doctoral program in physical applied mathematics, numerical analysis and scientific computation. A strong grant record would be advantageous. The standard teaching load is two courses (six hours) per semester.

Departmental research interests include asymptotic and perturbation methods, bifurcation theory, combustion theory, dynamical systems, fluid mechanics, mathematical biology, mathematical software, nonlinear waves, and numerical analysis of differential equations. Thirteen of the sixteen faculty are applied mathematicians. Senior faculty include W.E. Ferguson (numerical partial differential equations), I. Gladwell (mathematical software), R. Haberman (perturbation methods and nonlinear waves), M.V. Melander (computational fluid dynamics), G.W. Reddien (numerical bifurcation theory), D.A. Reinelt (fluid mechanics), and L.F. Shampine (numerical ordinary differential equations).

The application deadline is October 15, 1992. Send a letter of application and a vita to: Professor I. Gladwell, Chairman, Department of Mathematics, Southern Methodist University, Dallas, TX 75275; tel: 214-692-2506.

I. Gladwell’s email addresses: gladwell@csvax.seas.smu.edu; h5nr1001@smuv1.bitnet; or h5nr1001@vm.cis.smu.edu.

SMU is an equal opportunity/affirmative action>Title IX employer.

Washington and Lee University

Department of Mathematics

Lexington, VA 24450

Radford Professor / Department Head

The Radford Chair of Mathematics will be filled in September 1993. An applicant should have a background that warrants tenure and the rank of full professor, a record of effective teaching and scholarship, and a commitment to mathematics education in a liberal-arts setting. The Radford Professor will assume the position of department head for a five-year term.

The mathematics faculty numbers seven, all with Ph.D.s. The University is primarily a liberal-arts college with 1600 undergraduates. It is 240 years old and is located in the lower Shenandoah Valley. Address inquiries to Prof. T. O. Vinson, Search Committee, Mathematics Department. The selection process will begin in November 1992. AA/EOE.
UNIVERSITY OF TORONTO
Department of Mathematics
The Department solicits applications for a tenure-stream appointment in Analysis. Preference will be given to researchers in the areas of non-linear analysis and geometric analysis. The appointment is at the Erindale campus at the level of Assistant Professor, to begin July 1, 1993. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should clearly demonstrate excellence in each. In particular, a candidate's research should clearly show the ability to make significant original and independent contributions to Mathematics. Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by December 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

UNIVERSITY OF TORONTO
Department of Mathematics
The Department solicits applications for a tenure-stream appointment in Geometric Analysis. The position is subject to budgetary approval. The appointment is at the downtown (St. George) campus at the level of Assistant Professor, to begin July 1, 1993. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics. Salary commensurate with qualifications.

Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by December 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

UNIVERSITY OF TORONTO
Department of Mathematics
The Department solicits applications for a tenure-stream appointment in Applied Mathematics. Preference will be given to researchers in the areas of probability and nonlinear partial differential equations. The position is subject to budgetary approval.

The appointment is at the downtown (St. George) Campus at the level of Assistant Professor, to begin July 1, 1993. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should clearly show the ability to make significant original and independent contributions to Mathematics. Salary commensurate with qualifications.

Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by December 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

FOR SALE
PASCAL-XSC
The programming language for mathematicians. Compilers and documentation. FBSoftware, P.O. Box 44666, Madison, WI 53744-4666. (608) 273-3702.

PUBLICATIONS FOR SALE

PUBLICATIONS WANTED
Applications and recommendations are invited for a one- or two-year half-time appointment as an Associate Editor of *Mathematical Reviews* (MR), to commence in January 1993. Applications will be welcome from persons taking leave from other positions and in particular from tenured faculty members who can take leave to come to *MR* for one or two years.

The *MR* office of the American Mathematical Society is located in Ann Arbor, Michigan, not far from the campus of the University of Michigan. The editors, although employees of the AMS, enjoy many privileges at the University. At present, *MR* employs fourteen mathematical editors, about six consultants, and over sixty nonmathematicians. It produces *Mathematical Reviews, Current Mathematical Publications*, various indexes, the on-line service MathSci and MathSci Disc. The responsibilities of an Associate Editor fall primarily in the day-to-day operations of selecting articles and books suitable for review, classifying these items, assigning them to reviewers, editing the reviews when they are returned, and correcting the galley proof. An individual with considerable breadth in pure or applied mathematics is sought and preference will be given those applicants with expertise in numerical analysis. The ability to write good English is essential and the ability to read mathematics in major foreign languages is important. (The ability to read mathematical articles in Russian or Chinese is especially desirable.)

Persons interested in combining a sabbatical or other leave with this half-time appointment as an Associate Editor are encouraged to write (by letter or email) for further information. The twelve-month salary is negotiable and will be commensurate with the experience the applicant brings to the position.

Applications (including curriculum vitae, bibliography, and names and addresses of at least three references) should be sent to

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Dr. D. G. Babbitt, Executive Editor
Mathematical Reviews
P. O. Box 8604
Ann Arbor, MI 48107-8604
Telephone: 313-996-5255
FAX: 313-996-2916
INTERNET: DGB@MATH.AMS.COM
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Interested applicants are urged to inquire without delay.

The American Mathematical Society is an equal opportunity employer.
Then consider joining a highly talented group of mathematicians whose job it is to deduce structure where structure is not apparent, to find patterns in seemingly random sets, to create order out of chaos.

These are the mathematicians of the National Security Agency. They contribute to the solution of cryptologic problems using Number Theory, Group Theory, Finite Field Theory, Linear Algebra, Probability Theory, Mathematical Statistics, Combinatorics and more. And they function as a true community, exchanging ideas and working with some of the finest minds—and most powerful computers—in the country.

If you love problem-solving and like the idea that those solutions will be applied to real world problems, look into a career with NSA. Send your resume to the address below or contact your campus placement office.

Attn: M322 (AFL), Ft. Meade, Maryland 20755-6000

An equal opportunity employer. U.S. citizenship required for applicant and immediate family members.
Applications are invited for a Chair of Pure Mathematics. The successful applicant will have an outstanding academic and research background in some branch of Pure Mathematics with personal qualities and experience which will enable her/him to contribute significantly to the continuing development of Pure Mathematics at Auckland both in research and teaching.

This position, is one of four established Chairs in the Department of Mathematics and Statistics, two being in Pure Mathematics and one in each of Applied & Computational Mathematics and statistics. Three other staff hold Personal Chairs. The Department has research strength in a number of areas of Pure Mathematics, including logic, group theory, discrete mathematics, finite geometry, functional analysis, summability theory, complex analysis, quasiconformal analysis, topology and differential equations.

The Department of Mathematics and Statistics at the University of Auckland is the largest Department of the largest University in New Zealand. It is in the process of boosting its graduate student enrolments. The Department has an undergraduate computing laboratory currently being enlarged and has a collection of Macintosh microcomputers and Sun workstations. The Pure Mathematics collection of periodicals in the University Library is the best in the country and includes a number of journals obtained by exchange with the New Zealand Journal of Mathematics (formerly known as the Mathematical Chronicle), produced locally in collaboration with the New Zealand Mathematical Society.

Commencing salary will be established within the range NZ$80,080 - NZ$94,840 per annum.

Further information, Conditions of Appointment and Method of Application, should be obtained from the Assistant Registrar, Academic Appointments, The University of Auckland, Private Bag 92019, Auckland, New Zealand, telephone (64) 9 373-7999, fax (64) 9 373-7454. Three copies of applications should be forwarded to reach the Registrar by 20 November 1992.

Please quote Vacancy Number UAC.197 in all correspondence.

W B NICOLL, REGISTRAR.

An Equal Employment Opportunity Employer

The Department of Mathematics invites applications and nominations for the Kerr Chair in Mathematics. Candidates should have an outstanding record of scholarly accomplishments and a strong commitment to research. The person selected to fill this position will be expected to maintain a strong research program and be actively involved in the development of the department, including the graduate and undergraduate programs. Salary, discretionary fund, and teaching load are negotiable.

Send inquires, nominations, and applications to:

Alan Adolphson
Chairman, Chair Search Committee
Department of Mathematics,
Oklahoma State University
Stillwater, Oklahoma 74078
Email: adolphson@math.okstate.edu

For full consideration, applications should be received by November 1, 1992. Applications should include a vita and names and addresses of references. Oklahoma State University is an affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.
Applications are invited for faculty positions/appointments in one of the following disciplines from candidates who must possess a relevant PhD degree. Preference will be given to those who are able to teach in more than one of the areas listed under the discipline they are applying to and with proven ability in research.

**MATHEMATICS**

Pure Mathematics • Applied Mathematics • Operations Research • Statistics

**COMPUTATIONAL SCIENCE PROGRAMME**

Computational Mathematics—Applicants should specialize in either geometric modelling or statistical computing. Experience with UNIX graphics workstations is essential.

Besides appointments on normal 3-year contracts, visiting appointments for one or two years will also be considered.

Gross annual emoluments range as follows:

- Lecturer: S$50,390–64,200
- Senior Lecturer: S$58,680–100,310
- Associate Professor: S$98,650–122,670

(USS1.00 = S$1.62 approximately)

The commencing salary will depend on the candidate's qualifications, experience and the level of appointment offered.

Leave and medical benefits will be provided. Depending on the type of contract offered, other benefits may include: provident fund benefits or an end-of-contract gratuity, a settling-in allowance of S$1,000 or S$2,000, subsidised housing at nominal rentals ranging from S$100 to S$216 p.m., education allowance for up to three children subject to a maximum of S$16,425 per annum per child, passage assistance and baggage allowance for the transportation of personal effects to Singapore. Staff members may undertake consultation work, subject to the approval of the University, and retain consultation fees up to a maximum of 60% of their gross annual emoluments in a calendar year.

There are eight faculties in the National University of Singapore with a current student enrolment of some 18,000. All departments are well-equipped with a wide range of facilities for teaching and research.

All academic staff have access to the following computer and telecommunication resources: an individual microcomputer, an IBM 3090 mainframe, an NEC SX supercomputer, an on-line library catalogue, all networked through optical fibre based FDDI technology. International contact is maintained through BITNET and INTERNET. In addition, the Computational Science Laboratory is equipped with a SUN parallel processing and scientific visualization platform and two clusters of DECstation 5000 workstations.

Application forms and further information on terms and conditions of service may be obtained from:

The Director
Personnel Department
National University of Singapore
10 Kent Ridge Crescent
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0 & 1 & 0 & \cdots & 0 \\
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