

NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

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Calendar of AMS Meetings and Conferences

This calendar lists all meetings which have been approved prior to the date this issue of *Notices* was sent to the 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. 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 organizers of special sessions.

Meetings

Meeting #	Date	Place	Abstract Deadline	Program Issue
855	* March 16-17, 1990	Manhattan, Kansas	Expired	February
856	* March 23-24, 1990	Fayetteville, Arkansas	Expired	February
857	* April 7-8, 1990	University Park, Pennsylvania	Expired	March
858	* April 19-22, 1990	Albuquerque, New Mexico	Expired	March
859	* August 8-11, 1990 (93rd Summer Meeting)	Columbus, Ohio	May 18	July/August
	October 20-21, 1990	Amherst, Massachusetts	August 6	October
	November 2-3, 1990	Denton, Texas	August 6	October
	January 16-19, 1991	San Francisco, California	October 10	December
	(97th Annual Meeting)			
	August 8-11, 1991	Orono, Maine		
	(94th Summer Meeting)			
	March 16-17, 1991	South Bend, Indiana		
	March 22-23, 1991	Tampa, Florida		
	January 8-11, 1992	Baltimore, Maryland		
	(98th Annual Meeting)			
	June 29-July 1, 1992	Cambridge, England		
	(Joint Meeting with the London Mathematical Society)			
	January 13-16, 1993	San Antonio, Texas		
	(99th Annual Meeting)			
	January 5-8, 1994	Cincinnati, Ohio		
	(100th Annual Meeting)			

* Please refer to page 179 for listing of special sessions.

Conferences

June 7-July 4, 1990: Joint Summer Research Conferences in the Mathematical Sciences, University of Massachusetts at Amherst, Massachusetts.

June 18-29, 1990: AMS-SIAM Summer Seminar on Vortex Dynamics and Vortex Methods, University of Washington, Seattle, Washington.

July 8-28, 1990: AMS Summer Research Institute on Differential Geometry, University of California, Los Angeles, California

Events Cosponsored by the Society

February 15-20, 1990: Section A (Mathematics) Sessions at the AAAS Annual Meeting, New Orleans, Louisiana.

Deadlines

	April Issue	May-June Issue	July-August Issue	September Issue
Classified Ads*	March 6, 1990	April 23, 1990	June 14, 1990	July 30, 1990
News Items	March 5, 1990	April 25, 1990	June 18, 1990	August 3, 1990
Meeting Announcements**	Feb 27, 1990	April 16, 1990	May 29, 1990	July 19, 1990

* 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.

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OF THE

AMERICAN MATHEMATICAL SOCIETY

ARTICLES

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Despite the fact that mathematics education reform is being discussed in many forums—from government to business to academia—doctoral education in mathematics has largely gone unexamined. What is the mathematical sciences community saying about graduate education? Allyn Jackson's report focuses on the Joint Mathematics Meetings in Louisville in January, which provided a forum for discussion of this issue.

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OF THE
AMERICAN MATHEMATICAL SOCIETY

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ADVERTISING

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The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability. ☒ Most of this publication was typeset using the T_EX typesetting system.

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AMS Russian Translation Program

I would like to report on dramatic changes taking place in the Society's Russian Translation Program and, more generally, in the relationship between the Society and the Soviet mathematical and publishing communities.

The Society began its Russian Translation Program, with the aid of government grants, in 1949. The Program has been guided over the years by the Committee on Translations from Russian and Other Slavic Languages, now a joint Committee with the Institute of Mathematical Statistics, The Association for Symbolic Logic and the Society for Industrial and Applied Mathematics. By 1988, the Program had grown to include three book series, six Russian translation journals and a Russian-English Dictionary.

The Society is committed to producing high-quality, low-cost translations. The outstanding quality of our Program is recognized in both the Russian- and English-reading communities. Over the years, the Society has received requests from both communities to become more active in seeking and contracting for books and in supporting more translation journals. In 1988, the Society arranged for the consulting services of four distinguished Soviet mathematicians and hired an acquisition editor for the Russian Translation Program to identify Soviet mathematics of the very highest scientific quality.

These acquisition activities have brought exciting additions to our Russian Translation Program. We are adding two new Russian translation journals through cooperation with the Leningrad Mathematical Society, *Leningrad Mathematical Journal* and *Proceedings of the Leningrad Mathematical Society*, in addition to two new Russian translation book series, *Proceedings of Regional Conferences* and *Advances in Soviet Mathematics*. The latter is a joint venture with the Academy of Sciences of the USSR and will be published only in English. There will also be translations of several new Russian books not in series, including expository writings in mathematics to be published in cooperation with the Mathematical Association of America. The Society has co-publishing agreements with several Soviet publishing houses, and the books published under these cooperative activities will appear in the continuing series *Translations of Mathematical Monographs*. Furthermore, the long-awaited update and expansion of the *Russian-English Dictionary* (the Lohwater Dictionary) will be published this year.

Our activities have also led to changes in our interactions with the Soviets. Contractual arrangements concerning copyright have heretofore been conducted on behalf of the Soviet authors through the offices of the state copyright agency, VAAP; now, the Society negotiates directly with Soviet mathematicians (copyright contracts currently must still be countersigned by VAAP). The amount of translation now being done in the Soviet Union has increased considerably. Likewise, scientific editing will now be done in the USSR for some of the new books in the Russian Translations Program. Finally, the Society is training several Soviets for keyboarding in $\mathcal{AMS}\text{-T}_{\text{E}}\text{X}$ for later typesetting at the Society offices.

This account of changes in the Society's relationship with the Soviet mathematical and publishing communities would not be complete without mentioning the most dramatic change of all: the opening of the Soviet Union and the resulting personal contacts and exchanges between Soviet and Western mathematicians. The AMS is discussing cooperative activities with several Soviet mathematical societies. Soviet mathematicians have been most responsive to cooperative activities with the Society, and their support has facilitated many delicate contractual negotiations with Soviet agencies. These new exchanges have resulted in friendships with Soviet mathematicians and their families and friends. The real drama of change is with the lives of individuals.

William Jaco
Executive Director

Letters to the Editor

Boycotting Scientific Visits to China

The undersigned are among those who have had the happy experience of visiting China for mathematical reasons in the past decade. We are saddened by the massacre of June 4, 1989, in Beijing and wish to share our sentiments in this matter with our colleagues.

As scientific visitors we admire the new China and feel fortunate that we could contribute in a very small way to its progress towards modernization. We are, however, appalled by the brutal suppression of peaceful demonstrations of the students and citizens and by the dishonesty of the official government explanation of what happened. Inasmuch as further visits to China might be interpreted as endorsing the course of action of the present government, we shall refrain from such visits until the hunting down of dissident students and the gagging of their free speech cease.

We continue to be willing and eager to help our Chinese colleagues in every other way.

William B. Arveson
Michael F. Atiyah
Hyman Bass

(Received October 10, 1989)

[Note]: This letter was signed jointly by 52 mathematicians of which the above are the first three in alphabetical order. The complete list of all 52 signatories appears on page 362.

A Differing View on Mathematics Education Reform

Teaching high school mathematics must be frustrating! The subject seems to be disliked by students and parents. All seem to find mathemat-

ics difficult and question its value for them. Parents recall their own experiences and readily make excuses for the lack of interest and success of their offspring in mathematics. Government and industry cry for better mathematics education following each report which compares American students' performance in mathematics to that of their foreign counterparts. And the final blow must be the suggestion by the mathematics establishment that the problem lies in what and how mathematics is being taught. That comes very close to saying the problem lies with the teachers! Although that is not the intent of recent calls for reform, I suspect that is at the heart of the recent article "A Differing View on Mathematics Education Reform" by E. G. Palais which appeared in *Notices* (November 1989, p. 1189).

Her article begins by linking current plans for reform to the "New Math". And while we would all like to forget the experience of the mathematics community with "New Math", we can't. But current efforts are truly different. No curricular changes are being imposed from the top, and practicing school teachers are providing much of the impetus and leadership for the proposed reforms.

But let us talk about change itself! First, it has been over a decade since real serious thought was given to the contents of the school mathematics curriculum except on an ad hoc basis. But both mathematics and the mathematical needs of society have changed more in this decade than in the previous century. The now ubiquitous computer has seen to that. Moreover, we are not talking about starting over, and people are looking at what works and what doesn't. Unfortunately, much doesn't work.

Further, although we are somewhat reluctant to admit it, kids are different. While the wistful comment that the real problem is getting students to work may have some va-

lidity, it is analogous to stating that the problem with night is that the sun doesn't shine. In both instances, useful illumination must be achieved some other way. And proposed reforms make clear and underline the need to make mathematics more than a spectator sport. The real issue is can we do better, and many people believe we can. Would it help if students worked harder and were better prepared. Certainly! But that will be true with an old curriculum or a new curriculum. Can we offer a better mathematics education to those who do study mathematics? Can we get more students interested in mathematics, students who will stay with the sciences and mathematics, students who will go on to be engineers, biologists, economists as well as physicists, chemists or mathemati-

Policy on Letters to the Editor

Letters submitted for publication in *Notices* are reviewed by the Editorial Committee, whose task is to determine which ones are suitable for publication. The publication schedule normally requires from two to four months between receipt of the letter in Providence and publication of the earliest issue of *Notices* in which it could appear.

Publication decisions are ultimately made by majority vote of the Editorial Committee, with ample provision for prior discussion by committee members, by mail or at meetings. Because of this discussion period, some letters may require as much as seven months before a final decision is made. Letters which have been, or may be, published elsewhere will be considered, but the Managing Editor of *Notices* should be informed of this fact when the letter is submitted.

The committee reserves the right to edit letters.

Notices does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in *Bulletin of the American Mathematical Society* will be considered for publication. All published letters must include the name of the author.

Letters should be typed and in legible form or they will be returned to the sender, possibly resulting in a delay of publication.

Letters should be mailed to the Editor of *Notices*, American Mathematical Society, P.O. Box 6248, Providence, RI 02940, and will be acknowledged on receipt.

cians? Can we equip students with the increased mathematics necessary for the current job market?

These are the questions and hopefully all of us can work together to answer them in the affirmative. It will not be easy but the stakes are high and the time is right!

Ronald G. Douglas
State University of New York
at Stony Brook
(Received December 15, 1989)

Revamping and Revitalizing *Abstracts*

I would like to propose that the *Abstracts of the AMS* be revamped and revitalized. As it is now, the *Abstracts* serves the function of informing the readers of the contents of talks given at AMS meetings, but the "Abstracts presented by title" section strikes me as totally worthless. It seems that the overwhelming majority of the membership is deliberately boycotting this section, as if it were well known that only "losers" publish there—which soon becomes a self-fulfilling prophecy.

This is really a shame, because I think there is a genuine need for a good early notice medium, and the *Abstracts* could fill this need. I would guess that the average waiting time between submission and publication of an article is at least two years, and there is no sign of this decreasing in the future. But a lot happens during this waiting period. The author is likely to get a lot of useful feedback from those who read the paper in preprint form, often leading to improvements in the published version, and the readers in turn benefit by being able to develop and extend the results of the paper in their own work. But the delivery system for preprints is hit-and-miss at best, and discriminatory at worst. The goal of a good *Abstracts* should be to make preprints available to everyone who is interested.

To this end, I would like to see an expanded *Abstracts*, with many more entries and more space for

each entry. I would also like to see the style of entries changed. Perhaps the term "abstract" should be replaced by "preview," or something else (in some sense they are really advertisements). The preview should be written to stimulate the interest of the reader and attract an audience for the paper. Precise statements of results (incomprehensibly condensed) would not be required, or necessarily encouraged. Some sort of editing and refereeing will undoubtedly be needed, but a publication of a preview should not have to mean that someone vouches for the correctness of the paper—only that it appears to be of interest to a reasonably sized audience. I would hope that an author of a preview would be required to simultaneously submit the preprint, and agree to send it to everyone who requests it.

This proposal makes demands on time and money from the Society. Would it be worth the cost and effort? This is a question the membership should consider. I would say, however, that one more ingredient is needed for this project to succeed: the participation of mathematical authors. Sending previews to the new *Abstracts* has to be a desirable activity for all mathematicians, not just the desperate or the down-and-out. One way to encourage this would be to make the publication of research announcements in the *Bulletin* conditional on an invitation from an editorial committee that selects from submissions to the *Abstracts*.

Robert S. Strichartz
Cornell University
(Received December 26, 1989)

The Boeing Lecture Series in the Mathematical Sciences

We would like to share the development of a successful cooperative program between industry and our department. We hope that other mathematics departments will find our example useful in developing similar programs which gain local industrial support.

In 1987 the Department of Mathematics and Statistics at The Wichita State University approached Boeing Military Airplanes, a company with a local presence, with a proposal to develop a lecture series. The lecture series would bring well-known mathematicians to The Wichita State University to make presentations on selected topics in the mathematical sciences.

A partnership between Boeing Military Airplanes and the Mathematics and Statistics Department at The Wichita State University was established for the purpose of developing the lecture series. Our department agreed to serve as host and to be responsible for presenting the lecture series. In return, Boeing agreed to sponsor the series.

Each partner has enjoyed numerous benefits from the lectures presented in the series. For example, Boeing personnel have found fresh approaches and new insights into technical problems encountered in their work and our faculty members have likewise gained insight into current research areas.

In the first two years of the lecture series, we have been visited by twenty-four noted researchers in the mathematical sciences who represent universities in thirteen states (from coast to coast) and seven foreign countries. As a consequence, The Wichita State University mathematics faculty has become much more widely known. This has contributed to the recognition of our Ph.D. program. Likewise, Boeing Military Airplanes benefits from the broad exposure of the Boeing Lecture Series in the academic world.

Whereas additional public funds for a lecture series would be difficult for us to obtain, Boeing would have an equally difficult time making the arrangements for lecturers to talk to their workforce. This is just one example of the symbiotic relationship established by the series in which both partners received benefits far greater than their individual

contributions.

Cooperative efforts, such as the lecture series, abound with industry and departments of engineering. We believe it is noteworthy that this endeavor involves industry and the Department of Mathematics and Statistics. In fact, we have not been able to identify a similar relationship between industry and a department of mathematics at any other university in the United States.

The opportunity must exist for other departments of mathematics to establish similar partnerships with industry. How does a department solicit financial assistance from business or industry to sponsor such a program? We feel we were successful because we neither went hat-in-hand begging for money, nor did we demand support. Rather, we presented a list of outcomes whose benefits far outweighed the investment. In this way, the company could see exactly what their financial support was buying and make their decision based upon the return on their investment. We like this approach because we feel that mathematics, as the engine which drives the technological development in engineering and related disciplines, offers the greatest return for each dollar invested.

Gary D. Crown
The Wichita State University
(Received November 13, 1989)

Advertisements for Positions

Applicants for positions advertised in *Notices* should be aware that in reality things may not be as stated in the advertisement.

I responded to an advertisement placed by Florida Atlantic University in the November 1989 issue of *Notices* (Vol. 35, No. 9, p. 1429) inviting

applications for a senior level tenured appointment in the Department of Mathematics. I would not have applied if the advertisement had said tenure track rather than tenured. I was fortunate to be offered the position. However, the offer was made without tenure and upon inquiry the Provost of the university wrote "The awarding of tenure upon hiring is something that has not been done here even for holders of our endowed and eminent scholar chairs".

The university explicitly advertised a tenured position knowing that in reality it was only tenure track.

Kenneth S. Williams
Carleton University
(Received October 24, 1989)

Addition versus Replacement

Sandra Harding in her letter (December 1989 *Notices*) quotes Stephen Jay Gould, "Science advances primarily by replacement not by addition." We should, however, be reminded that mathematics advances primarily by addition not by replacement.

John Mitchem
San Jose State University
(Received January 11, 1990)

Author's Note

A reader of my article "Feminist Critiques of Science," which appeared in the July/August 1989 issue of *Notices*, has called to my attention a problem with a statement I made. In the article, I said that the Benbow-Stanley study has been "debunked by many critics." The study found that boys predominate among the high scorers when mathematically talented youngsters take the mathematics portion of the Scholastic Aptitude Test.

My use of the term "debunked" was ill-advised and rather careless. I have not seen studies that have debunked Benbow-Stanley in the sense of finding actual errors or falsehoods in that study. I should have said that many have been critical of the study and the conclusions inferred from it. In addition, a good deal of the negative reaction to Benbow-Stanley seems actually to have stemmed from media accounts which exaggerated and distorted the conclusions of the study—accounts that Benbow and Stanley themselves say they regret. The original study, "Sex Differences in Mathematical Reasoning Ability: Fact or Artifact?" (*Science*, 12 December 1980, volume 210, pages 1262–1264), as well as other writings by these researchers, are generally circumspect and careful in their explanations of the boys' superior achievement on the SAT.

Whether or not their explanations are correct is a different matter, and one which I do not feel qualified to judge without further study of the literature. It is clear, though, that the Benbow-Stanley hypothesis of "superior male mathematical ability" is far from unanimously accepted. For interested readers, a good source of information on both sides of the controversy is *Behavioral and Brain Research*, June 1988, Volume 11, Number 2, pages 169–232, which contains a survey article by Camilla Benbow together with critical commentary by more than 40 other researchers in various fields. The article includes an extensive bibliography of much of the literature on this topic.

Allyn Jackson
Staff Writer

Graduate Education in Mathematics

Is it Working?

Graduate education in mathematics has remained relatively unscathed as the critiques fly back and forth in the current debate on mathematics education reform. But, judging by some of the discussions at the Joint Mathematics Meetings in Louisville in January, this preferred treatment isn't likely to continue. During the Meetings, there were rumblings that perhaps all is not well in doctoral training in mathematics. Some of the problems most frequently cited are too much specialization, too little emphasis on quality teaching, a lack of experience with collaborative research and computation, and an environment that does little to encourage women and underrepresented minorities to enter the field.

Traditional Training

Ivar Stakgold, president of the Society for Industrial and Applied Mathematics and professor at the University of Delaware, was a speaker at a panel discussion on graduate education at the Louisville meeting. He acknowledged that the present doctoral training system has produced a remarkably strong research establishment, "but at what cost?" he asked. "I don't mean financial cost. I mean the cost of unfulfilled obligations and the cost of missed opportunities. There is in my view a very serious mismatch between what graduate education is in mathematics and what the employment needs are."

Graduate students are still trained in the traditional manner with a heavy emphasis on research, Stakgold noted, despite the fact that most new Ph.D.s will end up with positions at institutions where teaching, not research, is the principal duty. As for industrial positions, he asserted that the standard beginning graduate courses "do not provide the intellectual, philosophical, and historical overview" of mathematics that is necessary to develop the skills required in most industrial positions.

Most agree that teaching skills are lacking in Ph.D. training, but some also question the effectiveness of research training. During the panel discussion, Judith S. Sunley, director of the Division of Mathematical Sciences at the National Science Foundation, remarked, "I think mathematicians, more than any other scientific

discipline, have a situation where only a very small percentage of the population ever does any research beyond their Ph.D. It's not clear to me that we're even doing good graduate education to enable people to do mathematics research, much less teaching."

Stakgold went on to offer a number of suggestions for change, such as a balance between group and individual activities (through problem seminars, for example), a component on computation, seminars built around modern mathematical themes to draw connections between different areas, and special programs for those seeking industrial positions. But given the amount of material that graduate students are already expected to master and the ever-lengthening average time to finish the doctorate, is it feasible to require yet more of students? Stakgold suggested that perhaps there could be two tracks to the Ph.D., one for research, and a second that would not necessarily include original research but would produce a scholar with broad mathematical training and skills.

Stakgold said he was not recommending reviving the "doctor of arts" degree of the 1960s, which was created at a time when many feared a shortage of mathematicians to fill faculty vacancies. Because the degree permitted critical, historical, or expository theses in lieu of the traditional research dissertation, it was thought that D.A. students would be able to finish more quickly, thus alleviating the projected faculty shortage. The idea never really caught on, though, and faculty vacancies were quickly filled as the number of mathematics doctorates rose rapidly in the early 1970s. (Some schools still offer the D.A. degree—they are listed periodically in *Notices*.)

Stakgold says he believes current production of traditional, research-oriented doctorates is sufficient. During the Meetings, others echoed this view, including one audience member at another session, who said he welcomed the drop in the number of doctorates, after witnessing the disastrous job market of the early 1970s. At that time, around one-third more Ph.D.s were being produced than now, and many went without jobs. But Kenneth Hoffman, executive director of the Mathematical Sciences Education Board of the National Research Council, offered another view, saying that the problem

was not "overproduction," but "under-utilization." He contrasted the situation in mathematics with that in English, another discipline that produced large numbers of Ph.D.s in the early 1970s. That community saw to it that English departments reduced class sizes and increased the number of faculty, thereby absorbing the large number of new doctorates. By contrast, he said, the mathematical community remained silent as class sizes ballooned and graduate students and part-time faculty were hired to teach. The situation of the 1970s notwithstanding, many projections of faculty supply into the year 2000 indicate that there will be serious shortfalls in the number of mathematicians available to fill retirement vacancies.

More Emphasis on Teaching

Whether the future job market turns out to be good or bad, the fact remains that most academic mathematics positions will emphasize teaching, a skill which is not developed in most graduate programs. During the panel discussion, Stephen B. Rodi of Austin Community College in Texas said he thought the entire mode of instruction in graduate school is "antithetical to the development of undergraduate teaching skills." He says that, by emphasizing "research *über alles*," graduate training develops and promotes a culture which is antagonistic to undergraduate instruction. Some of the specific problems he cited were overspecialization, too much abstraction and generalization, undue emphasis on formality, too much isolation, and too little connection with the important motivations to be found in applied mathematics.

In addition, Rodi spoke of the intensely competitive atmosphere of graduate school. "The student learns it is important who gets the proof first," he asserted. "It is important not only to be error-free but also to root out error in the work of others. All of this creates a future teacher both unreceptive toward and unskilled in the techniques of cooperative learning." Panelist William P. Thurston of Princeton University echoed this view, saying that many students feel their "license to ask stupid questions has been revoked" once they complete the Ph.D.

Despite these problems, Rodi sees some hope on the horizon. "I think it's interesting that over the last few years, there's been a whole lot more interest among prominent mathematicians in issues related to teaching," he said. But he maintained there must be changes in the culture of the community to place good teaching on a par with research. "An isolated course in teaching is not going to do much good," he said. Part of what is needed is for mathematics faculty to take their own teaching more seriously, so that they function as role models for good teaching.

Developing the Students

Many mathematicians see a decline in the quality of American graduate students over the last ten years or so; some say departments have been reluctant in recent years to hire new Ph.D.s in tenure-track positions in part because today's new doctorates are simply not as impressive as in past years. In many departments, the top students are foreigners, who now receive more than half the mathematics doctorates in this country. Weaknesses in the American educational system are partly responsible, but some say the real reason is that the brightest students are going into other fields. Some mathematics departments find that many of their majors are students who could not meet the grade-point-average requirements of computer science or engineering majors. "We get the bottom of the barrel," said one mathematician from a major research institution.

In addition, many see problems with the environment of graduate school. "We tend to forget that life as a graduate student is basically hell," says Lawrence Corwin of Rutgers University. Not only is the material difficult, he notes, but there are rituals analogous to hazing, like the qualifying examination, that add to the strain. "We give the students a bunch of material, and if they can do it, fine, if not, we forget them," he declared. D. J. Lewis of the University of Michigan also says the "sink or swim" attitude should change: "That's okay to produce an elite group, but not for the large numbers of doctorates we need to staff industry and colleges."

Corwin says mathematicians often assume that mathematics will be the obvious choice for the top students, but in fact professors must seek these students out and encourage them. "You have to spend time looking for them," he pointed out. "They may be considering engineering or physics or biology or business, so they need to be convinced to go into mathematics." Lewis says that mathematicians also need to inject an "aspect of discovery" into undergraduate courses from the beginning. Right now, he says, "our beginning courses are like sausage stuffing. They turn students off before the students discover the excitement of mathematics." He noted that, in trying to meet demands from other departments that require mathematics courses, "we've stopped teaching mathematics for mathematics' sake. We've shortchanged the engineer as much as the mathematician."

Postdoctoral Training

The problems associated with graduate training extend to the postdoctoral level as well, an issue discussed at the AMS Council meeting in Louisville. One difficulty is the terminology: generally, in mathematics, the word "postdoc" refers to a position or a fellowship that carries certain prestige or that is conferred as a distinction to

the top students. Sometimes the positions have reduced teaching loads, sometimes they involve only research. In other scientific disciplines, postdocs are more widely available, and are considered simply as the next step in training, rather than a special distinction. But today, as more fresh Ph.D.s are hired in temporary, rather than tenure-track, positions, more positions are being called postdocs.

"We label almost anything in the first two years as a postdoc," noted Ronald G. Douglas of the State University of New York at Stony Brook, but a postdoc should carry with it more training and mentoring, he said. Although those who get postdocs are usually those who became mature mathematicians in graduate school, he said, "others could become better mathematicians with a few years' more training." David Saltman of the University of Texas at Austin agreed, noting that students can spend twenty hours a week teaching while they're in graduate school and may need some uninterrupted research time afterward to develop into mature mathematicians.

One of the problems with most temporary positions for new Ph.D.s is that there often is little or no mentoring involved. Because of grant-seeking and other pressures on faculty, "we've come to a point where our habits make us waste graduate student talent," Douglas asserted. The first years of graduate school are a "Darwinian struggle," he said, and even after receiving their doctorates, young people often receive little encouragement and support. "No one ever takes them by the hand," said Thurston. But he also cautioned that increasing the number of postdocs might not have the intended effect unless faculty attitudes changed.

Some see increasing the number of postdocs as a way to encourage more people to enter the field. However, others expressed caution about increasing the numbers of doctorates, saying that more evidence was needed to show that there are currently too few. Susan Montgomery of the University of Southern California noted that surprisingly few new Ph.D.s were getting positions in doctorate-granting institutions. Noting the increase to 900 new doctorates last year, she remarked that there seem to be reasonably good Ph.D.s having trouble getting jobs. "We should be cautious about trying to greatly increase the current number," she said.

Still, all seemed to agree that having postdocs more widely available would be beneficial. However, Lance Small of the University of California at San Diego objected to the way the AMS Council's entire discussion of postdocs had focused on research. "We haven't talked at all about the principal activity of new Ph.D.s: teaching," he declared. Most individuals coming off postdocs will

be applying for positions where teaching is important, but evaluations of their teaching records will be scanty. As Small put it, "Postdocs deserve to have a letter of recommendation beyond graduate school saying more than, 'Was a good T.A.'"

Women and Minorities

"Is graduate education meeting the needs of women and minorities?" asked Rhonda Hughes of Bryn Mawr College during her presentation at the panel on graduate education. Despite some signs of improvement, her answer was "a resounding, emphatic, No!" Institutional barriers are falling, but old attitudes are slow to change, she notes. Hughes quoted one black woman mathematician: "Mathematicians see themselves as producing the next generation, and tend to do so in their own image. There is a personal cult to graduate education, and the nurturing and mentoring that are key parts of graduate education simply do not occur the same way for these groups. It is difficult for most white males to see blacks and women as their successors." Hughes also pointed out that women and members of underrepresented minorities are often considered "risks" if they are underprepared or have unusual backgrounds. Even though the unproductive mathematicians in most mathematics departments are often white males, she declared, "we don't recall hearing about the risks these once-promising mathematicians posed."

According to Hughes, the biggest obstacle is the small number of women mathematicians being hired at the top universities, but she concedes it's a "very touchy issue." Promising women mathematicians are very much in demand in academia, but the top departments say there are not enough of the high-caliber women to go around. "They say, 'we called all the top ten women and none wanted to come or none was available,'" said Hughes. "Well, I say, what about the fifteenth?" She explained that it's not a matter of lowering standards to let more women in, but rather of balancing diversification of the faculty with the needs of the research mission.

In a community where "research *über alles*" prevails, many will find such a proposal hard to swallow. But Hughes revealed another wrinkle: "You point out to [these departments] that there are people they hired some years back who aren't all that great," said Hughes. "They say, 'Oh, but in those days, we weren't so careful as we are now.'" At this point the audience burst into laughter. Her retort? "Right, but you hired all men in those days."

Allyn Jackson
Staff Writer

Computers and Mathematics

Edited by Jon Barwise

Editorial notes

Computers at the annual meeting

I stopped going to the Annual Meetings in the mid 80's. I found they had become dull and even somewhat depressing. And I never felt that I learned any mathematics from the talks. Maybe it was just a reflection of the hard times mathematics was going through at the time, due to the job market. Or maybe it was me. I don't know. In any event, I would not have thought about going this year if I had not been asked to give an invited address.

I am glad I went. There was quite a different and more exciting atmosphere at the meeting than I can recall in years. The meeting was much better organized than I remember. Most important, though, it seems that we are becoming much more attentive to the task of communicating mathematics—to the public, our students, and even each other. This attitude was palpable in Louisville. The invited lectures were more accessible and stimulating. There were good sessions on teaching mathematics. And there were interesting events of other sorts, like the memorable session on the play *Breaking the code (The life of Alan Turing)* with Peter Hilton and the play's author, Hugh Whitmore. Altogether, a pleasant surprise.

I was also surprised at the extent to which computers were in evidence in various ways: in just behind the scenes in some of the invited talks, in sessions on the use of computers in teaching mathematics, and in the exhibition hall. The amount of mathematics-related software available at the meeting was impressive. And the interest in the sessions on using computers in the classroom was also much greater than I anticipated. The times really are changing.

One thing hasn't changed, though. The message station. It is hard to believe that in 1990, well into the Information Age, we were still trying to get information to one another by writing it on grubby little scraps of paper, sticking it into cubby holes, to be sorted and resorted by every person with a name between "Nom" and "Mus." I stood and timed this process for a while. During my watch, it took between four and ten minutes per person to find out whether they had any messages. The longer times were typically due to people shamelessly reading other people's messages. And I saw people drop messages without realizing it, as they were rifling through the slips. There must be, or should be, software available for this sort of thing. Surely a simple *Hypercard* stack on a couple of Macintoshes would have been quicker, more private, and more reliable. So my suggestion for an additional improvement to the meetings is to have someone spend a little thought on computerizing the

message station.

Time for a change in the column?

The changing role of computers evidenced at the meeting prompts me to wonder whether it isn't time for this column to shift its emphasis a bit. Our mathematics departments are now well on the road to using computers in the classroom and in writing mathematics. But what about research? There is less evidence that as a group we are learning how to exploit the computer in our research.

This imbalance has been reflected in this column. There have been quite a few articles related to teaching and writing mathematics, fewer about the use of computers in research. Frankly, I have had a hard time finding authors for research related articles. I urge readers to suggest research related software that should be reviewed, as well as other sorts of articles on the use of computers in mathematical research. If you have a suggestion for an author of such a paper please let me know.

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This month's column

This month's column contains a discussion of \TeX , by Michael Doob. He starts with a general overview and then discusses versions that are available for the Macintosh. He will discuss PC versions in another issue.

The column also contains several interesting reviews of mathematical software. I would like to draw special attention to two. One of these, by Colin Adams, is of a research related program, Jeff Week's hyperbolic 3-manifold program *SNAPPEA*, mentioned in January's editorial. The other is a review of *Derive*, by Phil Miles. Miles reviews *Derive* in the context of pre-calculus teaching, and raises an important pedagogical issue. I would welcome thoughts on the problem Miles poses.

TeX and the Single CPU

Michael Doob
University of Manitoba

Some of the tools used by computer scientists are purely mathematical, and, perhaps because of this, there is an assumption that most mathematicians, in return, easily use computer-oriented tools. It is my (completely unscientific) observation that in fact there are two types of mathematicians: those who think that small microcomputers are the greatest thing since sliced bread and jump at the opportunity to use new software, and those who think that computers are complicated beasts that are, at best, difficult to master and must be approached with some trepidation. There have been many reviews written for this column, **Computers and Mathematics**, by mathematicians of the first type. I think, however, that this group is in the minority among all mathematicians, and it is to the rest, the majority, that this article is addressed.

There are several purposes to this article. First, we'll get an overview of the mathematical typesetting program TeX, not in the technical sense of bits and bytes and that sort of thing, but rather as an idea of what's going on from the user's viewpoint. It is not an overstatement to say that this single program is revolutionary, as has been indicated in earlier articles in this column. The impact could be as great for the communication of mathematical ideas as was the motor car for transportation. This article, by analogy, is meant to show how to get your own car, try out the gas pedal and the brake, and then how to go from point *A* to point *B*; we won't be concerned with the inner workings of the engine.

After that we'll look at several implementations of TeX on some microcomputers; while we'll be mainly interested in the IBM-PC compatibles and the Macintosh, the predominant hardware in North America (with apologies for this geographic egocentrism), we will comment on others in passing.

So first, in the usual mathematical tradition, we will be sure that we are working with a good set of definitions. TeX is a program whose purpose is to produce printed pages of mathematical text of quality that is equal to the highest standards of typesetting. This is a formidable task, for not only are there many different symbols used, but there are also many subtle conventions that are normally employed for mathematical text. This is why TeX is a large and complicated program, and has only appeared on the microcomputer in the past few years. It is also why many other programs, even those with built-in symbols and mathematical fonts, produce ugly mathematical output. Fortunately, although the program

itself is complicated, the use of it is less so. Here is the typical process you go through to prepare a paper:

1. Use any editor (the simpler the better) to prepare what is called a *source file*. This will contain the text that you want typeset. The usual text is typed in normally, while special words starting with a backslash are used for symbols: $\backslash\alpha$ is used for α , $\backslash\beta$ is used for β , and so forth. There are also commands for positioning the mathematics so that, for example, equations can be centered, numbers can be attached to them for reference from within the text, and other similar things can be done. When desired, many fine details can be controlled, but most of the time text is entered in a reasonably straightforward way.
2. When the source file is complete, it is used as input for the TeX program. As the program runs, any messages from the program to the user are printed on the computer screen and also in a *log file*. When the program is finished, another file called the *DVI file* will have been produced.
3. The DVI file is not readable, at least not by humans. To see the finished product on the computer screen, it is necessary to have another program called a *previewer*. This has nothing to do with TeX *per se*, and, unlike the output of the TeX program, is necessarily dependent on the particular type of computer being used. Unless you are perfect on the first try, it is then necessary to go back and edit the source file some more. It's not unusual to have several passages through the edit-TeX-preview cycle.
4. When the output is just the way you want it, a *printer driver* program is necessary to print the output on an actual sheet of paper.

Thus we see that to use TeX we must not only have the program itself, but we also need an editor, a previewer and a printer driver. Further, although a given source file will result in the identical DVI file when using any version of TeX, some implementations are more efficient than others.

There are several variations called *macro packages* which may be used with TeX. These are, roughly speaking, new commands that are added to the standard ones. By far the best known ones are L^ATeX and $\mathcal{A}\mathcal{M}\mathcal{S}$ -TeX. The former allows for much more general typesetting including such things as tables of contents, indexes, and some elementary graphics. The latter is a standard set of macros that may be used when submitting articles to certain journals of the American Mathematical Society.

The preparation of the source file is essentially a secretarial task, and may not be palatable to some mathematicians. In this case, the comparisons that follow may be of interest to secretaries who use a microcomputer. But even if you never want to type a source file, there

are still interesting reasons to use T_EX. One is as a tool to allow mathematical text to be passed through the electronic networks. *Mathematical Reviews*, for example, will accept contributions in a T_EX format. There are commercially available CD-ROMs that contain the last five years of the same publication, with all reviews in T_EX format. So the T_EX program along with a device driver for printing output is of interest to the mathematician even if he or she does not want to type any papers.

We should also note that there are both commercial and public domain versions of T_EX available. So, one would naturally ask, why buy a commercial version when the public domain version can be had for free (or at least for the cost of the diskettes)? As a general rule, the commercial versions provide two things that are superior to public domain versions: there is much better documentation, and there is telephone support. Also, there is usually easier installation. So, if all other things are equal, and you have a buddy who is used to the ins and outs of your computer, you might give the public domain versions a shot. On the other hand, if you're really in a hurry and are on your own, the commercial versions might be more of your cup of tea.

Now let's look at the different implementation of T_EX. This is a little tricky since new versions and variations of old ones are appearing all the time. I shall only talk about ones that have been around long enough to be stable.

There are two versions of T_EX available for the Macintosh. One of them, *Textures* is commercial, and the other, OzT_EX, is public domain. There is quite a difference in the philosophy of these implementations.

Textures comes with *The T_EXbook* (the standard reference about T_EX), a user's guide with installation instructions, and six diskettes. Installation is relatively easy; it is just a matter of creating one folder, copying the six diskettes into it, moving one set of fonts with the Font/DA mover, and moving seven "suitcase" files into one of the copied folders.

Textures uses approximately 4.5 megabytes of space on your hard disk when fully installed. While it is just possible to get it running on a Mac Plus with one megabyte of memory, two or more megabytes of memory is really much better.

Having done this, the user now has a T_EX system available with pull-down menus to access windows that contain the source file, the previewed output, and the log file. It is also possible to print the file on either an Apple LaserWriter or ImageWriter by another pull-down menu. (See graphic on following page). The fact that you can edit your source file, run T_EX, and preview the results all from within the *Textures* program is both unique and very helpful when learning T_EX. The quick feedback to the user makes the spotting and correcting errors easy. In addition, the previewer is

superb. Particularly striking is its ability to give legible screens at an almost continuous range of magnifications. But there is a price to be paid for this bundling. The DVI file is not created, at least not directly, and a special desk accessory must be installed to import or export DVI files from the program. In addition, the use of new fonts is somewhat less straightforward, and the L^AT_EX and A_MS-T_EX macro packages must be purchased separately. Also, while over 70 fonts may seem like a lot (and indeed would be more than adequate for most work), the *full* set of (Computer Modern) T_EX fonts require an extra purchase. In summary, *Textures* is really wonderful for the new user, but there is a potential for problems when getting into more unusual applications. *Textures* is available from Blue Sky Research, 534 Southwest Third Avenue, Portland, Oregon, 97204, at an educational price of \$395. The L^AT_EX package costs \$75, the A_MS-T_EX package costs \$90. The package of extra fonts costs \$85.

In contrast, OzT_EX is a different implementation in almost every way. First of all, it is in the public domain. That means that you may make copies of it and install it as you wish. It does not, however come with *The T_EXbook*, which you will surely need, nor does it come with printed installation instructions. It does come on ten diskettes, with a short introduction on the first one. It is necessary to adjust a configuration file, and then to print out further instructions if necessary. There is a good user's guide, but it is written in L^AT_EX! While OzT_EX uses separate programs for running T_EX and editing, a desktop accessory editor called Σedit is included. It may be necessary to use a resource editor to make the configuration file accessible.

When OzT_EX is loaded into the Macintosh, it uses just over 5 megabytes of space on the hard disk. Like *Textures*, it can run with only one megabyte of memory, but it really needs two or more megabytes of ram to run easily.

When OzT_EX is run, a screen with different pull-down menus appears. Running T_EX will cause a dialogue box to appear which asks for the input file in the usual Macintosh manner. OzT_EX then produces a DVI file and a log file as mentioned above. There is also a pull-down menu for previewing the file. (See graphic on following page). As a result, the DVI files produced by OzT_EX may be used by other machines, and DVI files produced by other machines may be previewed by OzT_EX. The previewer is definitely slower than that of *Textures* as it paints the fonts on the screen, and there is less flexibility with magnification sizes. This may be a problem with the usual (small) Macintosh screen. Nonetheless, the previewer produces legible screens and are quite usable. OzT_EX also includes the ability (via a pull-down menu) to convert the DVI file to a PostScript one and send it to a LaserWriter or other PostScript printer. There is no printer driver for the ImageWriter.

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Theorem 3. For any $j \geq 1$ and $r \leq -(\tau^{1/2} + \tau^{-1/2})$, there exists a sequence of nonnegative integers $\{n_i \mid i = 1, 2, \dots\}$ such that

$$\lim_{k \rightarrow \infty} \lambda^j(T(n_1, \dots, n_k)) = r.$$

Theorem 3 follows from Theorem 2, since our construction will only use trees in \mathcal{T} , and, since trees are bipartite, they have a symmetric spectrum (see [1], for example).

Proposition 4. Suppose G is a graph with n vertices and eigenvalues $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_n$. H is formed by taking t copies of G , one additional vertex v , and arbitrarily adding edges joining v to the copies of G . Then λ_1

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OzTeX

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OzTeX comes with all that is necessary to use L^AT_EX, and it is also possible to make $\mathcal{A}\mathcal{M}\mathcal{S}$ -T_EX from the source file. In addition, it is easy to add new fonts by putting appropriate files into folders.

Which of the two programs is faster? I used my own 95 page *Gentle Introduction to T_EX* as a test file. This introduction has a mixture of straight text, mathematical text, and tables (it is available from the T_EX Users Group, P.O. Box 9506, Providence, RI, 02940, for \$15). *Textures* produced the (quarter megabyte) DVI file in 8 minutes and 32 seconds while OzTeX took 10 minutes and 22 seconds.

There is one other item of note. Often *Textures* and OzTeX are used with the Apple LaserWriter (PostScript) printer. It is then of interest to insert illustrations (say from MacDraw or MacPaint), to use the PostScript fonts, or to use the PostScript language. Both implementations allow this using the T_EX `\special` command or special names for the PostScript fonts that the T_EX `\font` command understands.

OzTeX is available from Stephen Spencer for \$30. He may be contacted at spencer@cis.ohio-state.edu, or at OSU – ACCAD, 1224 Kinnear Road, Columbus, Ohio 43212. The author of OzTeX is Andrew Trevorrow, Kathleen Lumley College, North Adelaide, S.A., 5006 Australia.

Background

In 1978, Thurston revolutionized the field of 3-manifolds by proving that many 3-manifolds could be decomposed into submanifolds, each of which had one of eight geometries. Thurston has conjectured that in fact all compact 3-manifolds can be so decomposed. The manifolds corresponding to seven of the geometries have been classified. The eighth geometry is that of hyperbolic 3-space.

In order to understand the class of hyperbolic 3-manifolds, it was necessary to compute some examples. Thurston calculated several examples by hand (cf. [4]), however both the combinatorics and the equations that are generated quickly become too difficult to handle without a computer. Several people worked on programs that calculated hyperbolic structures on certain 3-manifolds. In particular, Bob Riley had the first such calculations, but also Daryl Cooper, Martin Hildebrand, Bob Meyerhoff and I worked on programs.

In 1985, Jeff Weeks, then finishing his Ph.D. under Thurston, wrote his first version of a hyperbolic 3-manifolds program. Since then, it has undergone numerous mutations. It is now the state of the art in such programs and an indispensable tool for anyone interested in hyperbolic 3-manifolds or knot theory.

For background on hyperbolic 3-manifolds, [3] and [5] are helpful. More information on the particular invariants appears in [1]. Thurston's notes [4] generated the field of hyperbolic 3-manifold theory.

The Program

I will first describe how to use the program to find the hyperbolic structure of a knot or link complement in S^3 . The program comes with a folder containing all knots of ten or fewer crossings and all links up to nine crossings. However, if you want to enter your own knot or link, you just click on an icon with the name "Crumble". A blank screen appears and you can then use the mouse to draw a rectilinear knot or link. The program picks arbitrarily whether each crossing will be an over or under crossing. Once you are finished drawing the link, you can then go back and change the crossings by clicking on them. Also, there is an option on the menu bar that automatically makes the link alternating.

Then, you save the link as a file in the folder with all the other links. Links are stored as a sequence of numbers and the current program cannot regenerate the picture of the link, so judicious naming is important for remembering which link is which. (Jeff Weeks plans to include the option of saving pictures of links in the next version of the program).

Now you click on an icon called "Triangulate". This program takes whatever link you give it and cuts the complement of the link up into ideal (vertices missing) tetrahedra. In the case that the link complement is hy-

Reviews of Mathematical Software

SNAPPEA The Weeks Hyperbolic 3-Manifolds Program

Reviewed by Colin Adams
Williams College

Introduction

This article reviews the mathematical software SNAPPEA, also known as the Weeks Hyperbolic 3-Manifolds Program. It was written by Jeff Weeks with support from the Geometry Supercomputer Project. A version of the program which runs on a Macintosh with at least 512 K is available from Jeff Weeks, c/o Geometry Supercomputer Project, 1200 Washington Ave. So., Minneapolis, MN 55415 (email address weeks@poincare.geom.umn.edu). Please specify what model Macintosh you use (for the newer Macs, the program can be compiled to make direct calls to the floating point coprocessor).

perbolic, it is known that the triangulation algorithm will always succeed. For many other links, the program will also yield a triangulation. However, there are examples of non-hyperbolic links for which the algorithm will not generate a triangulation. (In fact, the vast majority of links are hyperbolic, so a random choice of link will rarely stump the algorithm.)

The program then attempts to place the ideal tetrahedra in hyperbolic 3-space so that the angles around the edges add up to 360 degrees and so that the tetrahedra fit together appropriately to yield a complete hyperbolic metric on the manifold. This entails solving numerically a system of n complex polynomial equations in n unknowns. The theory implies that when the manifold is hyperbolic, the system of equations has a unique solution, however the program is not guaranteed to find it. In practice, the program has never failed to find the solution for a manifold known to be hyperbolic.

The solution to the system of equations yields the appropriate dihedral angles on the ideal tetrahedra so that one obtains the hyperbolic structure. The hyperbolic volume of the link complement is then calculated out to fifteen decimal places.

Once the program has stored the triangulation of the manifold, you can run either "Pretty Pictures" or "Dehn Filling", each of which is opened by clicking on the appropriate icon. "Pretty Pictures" takes as input any link that "Triangulate" has been run on. (It can also be run on any cusped hyperbolic manifold for which an ideal triangulation is known.)

The program first retriangulates the manifold utilizing the hyperbolic structure that was computed in "Triangulate" to obtain a canonical triangulation independent of whatever projection of the link you started from. It then calculates several invariants of the hyperbolic structure, including the maximal cusp volume and the conformal invariant of the cusp.

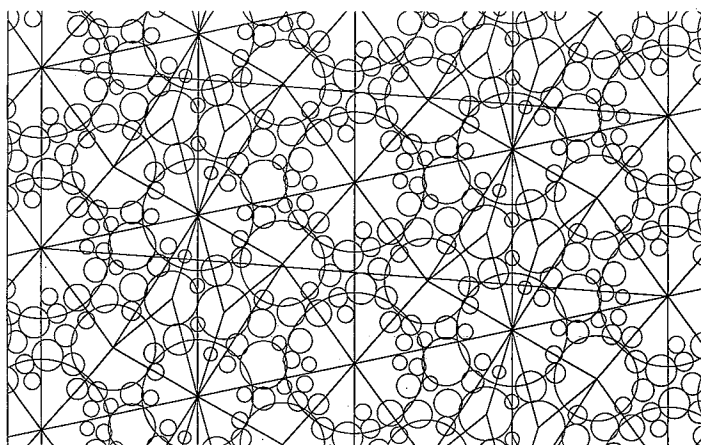


Figure 1. Horoballs and triangulation corresponding to 6_2 knot

A blank screen with a menu bar then appears. When you pull down the menus, you are provided with such

options as "Ford domain", "horoballs", "triangulation" and "parallelogram". You choose which of these items you would like to have displayed on the screen. The picture that the program then generates is a view from up on the positive z -axis looking down at the x - y plane in the upper-half-space model of hyperbolic 3-space. Since hyperbolic 3-space is a covering space of the given hyperbolic 3-manifold, you are seeing the lifts to hyperbolic 3-space of various objects from the original link complement. For instance, "triangulation" displays the tiling of hyperbolic 3-space by ideal tetrahedra which cover the ideal tetrahedra in the triangulation of the link complement. "Horoballs" shows the lift of the maximal cusp in the manifold to a set of disjoint horoballs in hyperbolic space.

For each component of the link, the computer will generate a new picture. If you have a color monitor, the computer displays horoballs corresponding to distinct components of the link in different colors.

The "Dehn Filling" program allows one to investigate manifolds which are obtained by Dehn surgery on links in the 3-sphere. Since all compact 3-manifolds without boundary can be obtained this way, the potential of this program is immense. (Although, as it now stands, this program does not give any insight into the structure of non-hyperbolic 3-manifolds, there are some possibilities for extracting information using this program even in that case.)

"Dehn Filling" takes as input a link on which "Triangulate" has already been run and a choice of surgery coefficients on the components of the link. The program then finds the hyperbolic volume of the resulting surged manifold, if it can. For larger surgery coefficients the program always succeeds as the resulting manifold has a hyperbolic structure close to that of the original manifold. However, for small coefficients, the program is not guaranteed to succeed even if the resulting manifold is known to have a hyperbolic structure.

Many conjectures have been generated from the data obtained from this program. For example, the manifold conjectured to be the minimum volume hyperbolic 3-manifold was discovered by Jeff Weeks using his program [6]. J. Weeks and M. Hildebrand utilized the program to obtain a census of hyperbolic 3-manifolds with triangulations of five or fewer ideal tetrahedra and orientable hyperbolic 3-manifolds obtained from six or fewer ideal tetrahedra [2]. C. Hodgson, R. Meherhoff and W. Neumann have utilized the program to calculate the Chern-Simons invariant. L. Mosher has applied the program to punctured torus bundles.

An extension to the program which calculates the length spectrum of hyperbolic 3-manifolds was written by D. Hoffoss while at the Geometry Supercomputer Project. C. Gunn, also at the Geometry Supercomputer Project, has written a program to display the Dirichlet domains

for these manifolds. Since the program's inception, Weeks has continued to expand and improve it.

This program has already had a large impact on low-dimensional topology. As it continues to evolve, it will be a crucial source of examples and conjectures for many years to come.

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DERIVE as Precalculus Assistant

*Reviewed by Phil Miles**

Derive styles itself a mathematical assistant. It is intended to do far more than standard precalculus problems, and I have colleagues who use it in these grander capacities. But it does do many standard precalculus problems, and precalculus is a course with very large enrollments. The National Research Council appears to favor the idea of a precalculus assistant, saying "Weakness in algebraic skills need no longer prevent students from understanding ideas in more advanced mathematics. Just as computerized spelling checkers permit writers to express ideas without the psychological block of terrible spelling, so will the new calculators enable motivated students who are weak in algebra or trigonometry to persevere in calculus or statistics." (*Everybody Counts*, p. 62).

The demands of *Derive* are relatively modest – a PC compatible computer running DOS and having 512K memory and a graphics adapter. While not the same as being available in a "pocket computer", this is in the right ball park for a precalculus assistant.

A good assistant is biddable and forgiving. One can give it instructions without troubling to know its

psychology, and if one gives it the wrong instructions, one can redirect it quickly and without resistance. *Derive* meets these tests. It displays your input in classic "two-dimensional" notation so you can readily see whether you have entered what you intended. It usually ignores keystrokes which are irrelevant to the current context, sometimes giving a warning beep. And, for times when you regret your original instructions, it has a very easy escape from its current procedure. (Exception: when you want to quit, the program waits for directions on saving recent input. The prompt for these instructions is not displayed when in the text mode, so the program appears to be hung.)

I started working with *Derive* before opening the manual, and used the manual only as necessary to proceed. This worked very well. The major commands of algebra – expand, factor, plot, simplify, solve – appear on the main menu as single keystrokes and, on the whole, do what one expects. A certain amount of "target-seeking behavior" is necessary for this approach. The default parameter settings result in taking roots and solving equations over the complex numbers and do not do certain trig and log expansions. A handy system of sub-menus allows you to tinker with the parameter settings until the desired result is obtained. A quick look at the manual will suggest a likely sub-menu; cut-and-try will get the right setting. With about an hour's experimentation, I was ready to proceed.

On my department's placement test, *Derive* placed out of intermediate algebra and into the precalculus course which immediately precedes scientific calculus, answering correctly almost all the algebra questions. With mechanical transcription supplemented by some cut-and-try, it answered 39 of 67 questions. With transcription, which included entering verbal problems as equations, its scores rose to 48. It cannot do questions emanating from geometry, and these account for almost all the missing answers. Interestingly, this lack prevented *Derive* from placing out of trigonometry despite its ability to do trig equations and identities. Once into precalculus, *Derive* retains its ability to do algebra (in contrast to humans) and can do many exam questions on logs and exponentials (though limited by a disinclination to make substitutions). It can form rules for composite functions and materially assist in finding the rules for inverse functions (e.g., if you tell it to switch and solve, it will do the switching and solving). It can do linear simultaneous equations, but not even simple non-linear ones.

The target-seeking behavior I used in getting answers from *Derive* is certainly natural for students operating in the classical pencil-and-paper context. For a target, they generally have the answer in the back of the book. They use the powerful operators DISTRIBUTE, MOVE and CANCEL in conjunction with the four operations of arithmetic to rearrange and delete symbols until the

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target is attained (see below). I believe they could adapt their behavior to this program with minimal difficulty. So I judge *Derive* is a precalculus assistant in a certain fairy story sense.

The magical assistants in fairy stories grant wishes speedily, effortlessly and in a way that makes the wisher rue the wish. I suggest that algebra utilities may come to play a similar role in mathematics instruction. Precalculus students know the letters of a mathematical statement, but not the words. They see " a^9 " as the concatenation of an "a" and a special "9", not as a word meaning the product of nine a's. A complicated word like $e^{-2\ln 3}$ is seen as a string of symbols from which the powerful operator CANCEL permits deletion of "e" and "ln", leaving $-2(3) = -6$.

English spelling looks arbitrary because it is largely a record of etymology, and in natural language, etymology is unrelated to meaning or usage. In mathematics, spelling can be considered as etymology, but etymology in this sense exactly determines meaning and usage. Our example $e^{-2\ln 3}$ traces back to $1/e^{2\ln 3}$, thence to $(1/e^{\ln 3})^2$ etc. Algebra instruction is ideally an effort to get students to see words whose spelling gives their meaning. Students are disposed to do letter-by-letter symbol manipulation instead. Present teaching practice apparently often supports such an approach—perhaps by soft grading, perhaps by use of simplified and stereotyped problems. Students who are supported in a letter-by-letter approach are thereby supported in their belief that the language of mathematics is meaningless.

Use of an algebra utility can eliminate the need to know the words and usage of algebra—the core of the language of applicable mathematics. Unquestionably one can *persevere* in calculus on this basis—many students already do so without benefit of algebra utilities. Whether one can find *meaning* in doing so is doubtful. And it is a serious question whether colleges can prosper without imparting a greater sense of meaning to their curricula.

The existence of algebra utilities raises a serious problem for teachers of mathematics. Teaching is hard. One must engage oneself with one's students and work to engage them with the material. After making these efforts, an ordinary teacher must still admit to failure in the case of many students. Doing all this when a perfect version of The Answers lies only a few keystrokes away will be hard indeed. This difficulty will weigh upon teachers' minds whether or not such a utility is actually in the hands of their students.

Editorial comment: I can't resist commenting on the worry raised in Miles' review. I share the concern expressed, that symbolic mathematics packages may make it even harder for our students to understand the meaning of mathematics. It will be a disaster if the use of such programs makes mathematics look even more like a formal game than it does to students already. My

own suspicion is that mathematical courseware has to be developed with this pedagogical problem squarely in mind.* It is not going to work to just use software capable of doing symbolic manipulations. I will be interested in the reactions of others.

ISETL - Interactive Set Language

*Reviewed by Donald L. Muench***

ISETL is an interpreted, interactive implementation of the high-level computer language, *SETL* (SET Language) whose syntax is very close to mathematical notation. It contains the usual collection of statements common to procedural languages, but a richer set of expressions. The objects of *ISETL* include finite and heterogeneous sets and tuples, integers, floating point numbers, funcs (function sub-programs), and strings. It was developed so that it can be used effectively in the teaching and learning of mathematical concepts. Indeed, an innovative textbook treating the traditional topics of discrete mathematics was published in late 1988 by Springer-Verlag, "Learning Discrete Mathematics with *ISETL*", written by Nancy Baxter, Ed Dubinsky, and Gary Levin. Gary Levin is the implementer of *ISETL*. I have used this text and the software for three semesters in discrete mathematics.

ISETL is "shareware" and is available from Gary Levin, Department of Mathematics and Computer Science, Clarkson University, Potsdam, NY 13676 and may be freely copied. It runs on IBM PCs under MSDOS and compatibles, Macintosh, (diskettes and documentation cost \$20) and the VAX under either VMS or UNIX (a tape and documentation cost \$25). Since the source code (also freely available) is written in C, *ISETL* should be able to run on any machine having a C compiler. In 1988 *ISETL* was a finalist in the EDUCOM/NCRIPAL awards competition for best educational software.

The version reviewed here is *ISETL* 2.0 (Oct 1989) under MSDOS.

Right at the start I want to say that I am excited about, and impressed with, *ISETL*. It is easy to learn and easy to read and write. Students with no previous programming experience have little difficulty learning the language. To a mathematician the close syntactical resemblance to standard mathematical notation is very appealing. What got me started in it was a Saturday afternoon tutorial by Ed Dubinsky and Nancy Baxter

*John Etchemendy and I wrote on the potential and challenges in creating such courseware in the January 1989 column.

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at the IFRICS program at Clarkson in the summer of 1985. It was there that I met Gary Levin. What captured my attention was this one-line *ISETL* statement which generates the set of prime numbers between 2 and 50 (the ">" is the *ISETL* prompt for input):

```
> {p : p in {2..50} | (forall d in {2..p div 2}
    | p mod d /= 0)};
```

This is nothing more than the precise mathematical definition and yet it is a statement in the language which, upon hitting RETURN, produces the output,

```
{37, 29, 31, 19, 23, 13, 17, 47, 43, 41,
 3, 2, 5, 7, 11};
```

So, by specifying the definition in careful mathematical notation, we have a valid *ISETL* expression. This gives a flavor of the power of *ISETL*.

Sets and Tuples

The previous expression shows that *ISETL* supports sets and quantified expressions. The reader will also note that the output is a set of elements displayed in no pre-set order. That is because sets do not order the elements. However, tuples (sequences) do impose an order on the elements. A tuple can be formed by using square brackets, thus ordering the elements. Hence, we can create a tuple of the primes between 2 and 50 with this statement:

```
> [p : p in {2..50} | (forall d in
    {2..p div 2} | p mod d /= 0)];
```

and produce the output,

```
[2, 3, 5, 7, 11, 13, 17, 19, 23, 29,
 31, 37, 41, 43, 47];
```

Tuples may have any length and elements can be assigned and placed in the tuple at any position. Thus if we have

```
> t := [5,9,"Leo",10,3];
```

where "==" is the assignment operator, the statement,

```
> t(3);
```

asks for the third entry in t and immediately produces the output,

```
"Leo";
```

Furthermore, we can make this assignment,

```
> t(8) := 44;
```

and examine t by

```
> t;
```

and see the immediate output,

```
[5,9,"Leo",10,3,OM,OM,44];
```

The value "OM" means "undefined". This dynamic allocation and assignment of values combines all the advantages of an array and a dynamic linked list in one data structure.

Among the operations which can be performed on sets are union ("+" or "union"), intersection ("*" or "inter"), difference ("-"), and power ("pow"). Thus,

```
> s1 := {5,9,8};
> s2 := {[2,7],5,"Greg",9};
> s1 inter s2;
```

produces

```
{5, 9};
```

and

```
> pow( {5,9} );
```

gives

```
{ {5}, {5,9}, { }, {9} };
```

The language is rich enough to permit the user to define new sets and operations such as Cartesian product and symmetric difference. New operations are defined as functions of two variables, using the type func.

Functions

The function notation is used in tuples and strings to access particular elements or characters. In the previous tuple t, t(3) has the value "Leo". Thus a tuple (sequence) can be used to represent a function whose domain is a set of positive integers and whose image is the set of non-OM elements in the tuple.

However, this isn't the only way to represent a function in *ISETL*. A function is statically defined as a set of ordered pairs in which any two pairs with the same first element must have the same second element. For example we can define

```
> f := {[12,6], ["brady",{5,2}],
    [2, 8], [3, "neon"]};
```

Here, the domain is $\{12, \text{"brady"}, 2, 3\}$ and the image is $\{6, \{5, 2\}, 8, \text{"neon"}\}$. In *ISETL*, two predefined functions can be used to find the domain and image:

```
> domain(f);
{12, "brady", 2, 3};
> image(f);
{6, {5,2}, 8, "neon"};
```

Having defined f in this way, we can evaluate $f(12)$ or $f(\text{"brady"})$ by typing:

```
> f(12); f("brady");
```

and obtain the output,

```
6;
{5, 2};
```

ISETL does not have procedures or subroutines, but does have funcs, which syntactically are reminiscent of Pascal functions (without all the type declaration baggage), with the added advantage that ANY *ISETL* object(s) may be passed to or returned by a func. For example, given a positive integer n , we want the set of the proper divisors of n . All we have to do is form the set in a precise way ($\{d : d \text{ in } \{2..n-1\} | n \bmod d = 0\}$) and wrap it in the correct syntactical blanket. Here is the definition of this func (the ">>" prompt asks for more input from the user):

```
> PropDiv := func(n);
>>   if is_integer(n) and n>0 then
>> return {d : d in {2..n-1} | n mod d = 0};
>>   end if;
>>   end func;
>
```

So, if we type

```
> PropDiv(6);
```

we will see the returned value,

```
{2, 3};
```

As another example, we can pass two functions and return their composition. The composition operation accepts two functions and returns a function. Therefore, we can define the operation of composition,

```
> comp := func (u,v);
>>   return func(x);
>>     return u(v(x));
>>   end func;
>> end func;
>
```

We can compose the func PropDiv and the set of ordered pairs f , defined above, and evaluate the composition at a point in its domain. Consequently, if we type

```
> comp(PropDiv,f)(12);
```

we see its value,

```
{2, 3};
```

Boolean Expressions and Operations

ISETL also supports boolean expressions and the operations of "and", "or", "not", and "impl" (implies). With a for-loop iterating over a set, tuple or string, one can print out a truth table for rules such as DeMorgan's Law:

```
> for p,q in {true,false} do
>>   writeln p,q, not(p and q)
>>       iff (not p) or (not q);
>> end for;
```

Hence, *ISETL* may be used to investigate the validity of arguments, and to study propositional calculus.

The Screen Editor Interface (MSDOS Version)

At the MSDOS prompt, typing

```
isetl
```

puts us immediately into *ISETL* and the screen editor. This editor is very easy to use. We can send lines to *ISETL* by typing them and entering RETURN. Using the arrow keys, groups of earlier lines can be edited and executed again.

There is a menu (entered by the ESC key) which contains selections for saving groups of lines into a file or saving the whole *ISETL* session into a file. Both of these features facilitate the preparation of input and output for handing in exercises by students. Another selection permits the reading of a file of *ISETL* code. Upon hitting "RETURN", the code is executed.

Uses of ISETL

I am personally aware of several uses of *ISETL* in mathematics, besides its use in discrete mathematics (using the book by Baxter, et al.). Because of its mathematical syntax, *ISETL* has inspired new uses in calculus (Ed Dubinsky at Purdue, also using the computer algebra system *MAPLE*) and introductory probability (Arnold Lebow at Yeshiva). Textbook projects are currently underway now which use *ISETL* in calculus (along with the computer algebra system *MAPLE*) and abstract algebra. Some illustrations are in order.

In discrete mathematics *ISETL* makes it possible to think of functions in concrete ways which are familiar to mathematicians: as a set of ordered pairs and as a dynamic process. Of course, not every set of ordered pairs is a function. In a class, students would be invited to write a "tester" that tests a map and tells whether or not it's a function. If we define it to mean that two pairs with the same first element must have the same second element, then we have the following:

```
> is_function := func(M);
>>   if is_map(M) then
>>   return forall u,v in M | u(1)
      = v(1) impl u = v;
>>   end if;
>> end func;
```

An *ISETL* func captures the idea of a dynamic process, where the body of the func is a description of the process.

As an example of its use in calculus (due to Mark Huibregtse of Skikmore), consider how the Riemann integral is defined in most books. In this example *ISETL* can help build Riemann sums (in this case midpoint sums). This leads to a func for making midpoint estimates of definite integrals. The body of the func below was developed right in class ("%" is *ISETL*'s summation notation). Notice that midpts is the sequence of midpoints of subintervals and that heights is the sequence of function values at the midpoints.

```
> MidRiemann := func(f,a,b,n);
>>   local delta,midpts,heights,areas,areaSum;
>>   delta := (b - a) / n;
>>   midpts := [ (a + delta/2) + j *
      delta : j in [0..n-1] ];
>>   heights := [ f(x) : x in midpts ];
>>   areas := [ delta * h : h in heights ];
>>   areaSum := %+ areas;
>>   return areaSum;
>> end func;
```

The nice thing about this calculation is how exactly it corresponds to the concept of Riemann Sum. To find the Riemann sum of the sine function from 0 to pi with n = 100, one simply enters:

```
> MidRiemann(sin, 0, 3.1415926, 100);
```

The interactive nature of *ISETL*, the natural implementation of recursion, and the syntactical similarity to Pascal (which includes the usual control structures of if-then-else and while-do and for-do) make it eminently suitable for teaching and learning computer science. It

is being used in an innovative introductory computer science course at Dickinson College (Nancy Baxter) and in programming languages (Tim Budd at Oregon State).

The concepts of group theory can be expressed naturally in *ISETL* by defining a set (G) and its operation (op). For example, the identity element can be found by the expression ("arb" selects an element from the set) :

```
> arb( {e:e in G|forall g in G| op(g,e)=g} );
```

Encouraging results in student learning and understanding of cosets and Lagrange's theorem have been obtained in a project at Technion in Israel (Uri Leron, with Ed Dubinsky).

Other Features

ISETL has the usual predefined transcendental functions and many others such as floor and ceiling (ceil), max, min, and random. There are also input and output functions for opening and closing files, reading from and writing to files.

Integer arithmetic can be done to any degree of precision. For example, here is 625812 to the 15th power:

```
> 625812**15;
88441947633347013524989387609185053900125
6868407452024352291484380889922344\
005159354368;
>
```

Documentation and Information

The documentation is contained in "An Introduction to *ISETL*" by Gary Levin, which accompanies the software. The documentation is thorough, but is not intended as a tutorial. There are very few examples, although dozens of examples are contained in files which are included in the *ISETL* disks and tapes. The documentation is most valuable if you already know the language. But, not to worry: a friendly guidebook is now being written and will be available from West Publishing Company. I have not yet seen the draft version of the guidebook, but the author promises an easy-to-read introduction to the language.

There is an occasionally lively *ISETL* discussion group which is available to users who have access to electronic mail (UUCP, BITNET, etc.). The documentation contains information on how to join the group. Many of the improvements in the language arose from the discussion in the group.

Inside the AMS

The Membership Committee

Frederick W. Gehring, Chair

The AMS was founded to stimulate research, scholarship, and education in the mathematical sciences. The Society pursues this charge in a variety of ways, including the publication of books and journals, meetings and conferences, and various member services.

The AMS Membership Committee, which was reactivated in 1985, has two objectives. The first is to insure that the Society represents a broad spectrum of the mathematical community in order to reflect the needs and desires of this diverse group. The Committee helps to make the membership aware of AMS activities through mailings, advertisements, and personal contacts.

The second goal of the Committee is to communicate with the members to ensure that the Society is doing all it can to serve the membership. Here are some of the activities the Committee has helped to implement.

Membership Cards are mailed to all members of the Society annually. Each card contains the member's customer code and other useful information, such as the Society's toll-free telephone number and the address to use for correspondence with the AMS. Many members use these cards for identification, especially when purchasing publications at Society meetings.

Discounts on books or computer products purchased from particular commercial firms are available to Society members.

Inside the AMS, the column in which this article appears, is designed to make the membership aware of the full range of Society operations and activities.

The Information Booth at both the Annual Winter and Summer Meeting gives participants an opportunity to ask questions about Society activities and membership benefits. Members can air their suggestions or complaints (and compliments!) at the booth. Coffee and tea are served at the booth, making it a convenient place to stop for a chat with colleagues.

The Multi-Year Dues plan allows payment of dues in advance for any number of years (up to five) at the current dues rate for the coming calendar year.

The Life Membership option allows members to enjoy a reduced dues rate.

The Sponsored Membership Program was established to encourage individuals (and, ultimately, corporations) to pay for AMS memberships for those in third-world and/or currency-poor countries who would not otherwise be able to afford membership.

The 25-Year Member Banquet, held annually at the Winter Meeting, is open to all meeting participants. The banquet provides an excellent opportunity to socialize with fellow participants in a relaxed atmosphere and to honor those who have been Society members for 25 years or more.

New Members are now listed in *Notices*, together with their institutional affiliations.

Lower Fees at the Employment Register make this important service available to a wider range of employers and jobseekers.

Complimentary Membership for one year is offered to non-member participants (including students) who register at an annual Winter or Summer meeting.

Nominee Memberships are now available to an unlimited number of full-time graduate students at member institutions. The Committee supported this proposal because a 1988 membership survey, sent to 1200 individual members, revealed that 62% of them first joined the Society as nominees.

A Change in Services for Emeritus Members allows them to receive the Bulletin of the AMS as a privilege of membership, starting this year. Previously, Emeritus members wishing to subscribe to the Bulletin had to do so at the member rate.

No member should be made to feel like just another name in a computer system. The role of the Membership Committee is to provide avenues for members to make their voices heard in the governing of what is, after all, their Society. The Committee would like to see a broader spectrum of members involved in Society governance and solicits suggestions for new and innovative ways in which the Society can better serve its members.

For more information, contact Membership Manager

Carol-Ann Blackwood at the AMS headquarters in Providence 800-321-4AMS (800-321-4267) in the U.S. and Canada or 401-455-4115.

AMS Ad Hoc Committee on Cooperation with Latin American Mathematicians

A committee has been formed by the American Mathematical Society to help facilitate initiatives in research mathematics in Latin America and/or involving Latin American mathematicians. Although this committee has no budget for projects of its own, it hopes to get people with good ideas for projects (and some resources to carry them out) together with additional resources, be they human or material.

We list below the members of the committee and how you can get in touch with them. If you have a good project of joint research, conferences, publications, etc., which some of the membership of the American Mathematical Society could help along a bit, please let one of us know.

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Herb Clemens

Notice of Deaths of Two Society Staff Members

In the past year, two longtime employees of the Society who were known to many AMS members passed away.

Lev Liefman, a Russian translations editor for the Society, died on February 9, 1989. Dr. Liefman, a native Russian, studied mathematics at Kiev University and received his Ph.D. in 1962 from Moscow University. After spending more than a decade at Novosibirsk University and at the Siberian Branch of the Soviet Academy of Sciences, he and his family emigrated to Israel, where he took a position in the mathematics department at Haifa University. When the family emigrated to the U.S. in 1979, Dr. Liefman took the AMS position, which he held until his death.

Dorothy (Smith) Peckham, well-known to many members as the assistant director for AMS meetings, died on August 30, 1989 at the age of 63. Born in Warwick, Rhode Island, Mrs. Peckham (or "Dottie," as she was known) worked at the AMS for fourteen years. Starting in the Meetings Department in 1973 as departmental secretary, she later served as the assistant to Hope Daly, director of Meetings. For many years, Dottie organized the Summer Institutes and the Symposia on Pure and Applied Mathematics and worked closely with the AMS Associate Secretaries on sectional meetings. She was a permanent fixture at the transparency desk in the registration area during the national meetings. While many members will recall Dottie's meticulous organizational skills, most who knew her will remember the parties she orchestrated and the liveliness she brought to them. Her zest for life and work made her a favorite among the staff and the membership.

Washington Outlook

This month's column is written by Hans J. Oser, who is a consultant to the Office of Governmental and Public Affairs of the Joint Policy Board for Mathematics in Washington, D.C.

The Bush administration sent its first budget proposal to Congress on January 29. Even though President Bush was in office last year, the 1990 budget was of course the handiwork of the outgoing Reagan administration. The submission of the President's budget to Congress is only the opening salvo in a battle that will be fought with great seriousness over the next 8 months. It is well known that the interest in this annual ritual drops exponentially with the distance from the beltway around Washington. But there are moments when the process is sensitive to critical inputs that can materially alter the outcome. That is why the Office of Governmental and Public Affairs (OGPA) is here to monitor the hearings and the policy statements from the White House, departments, and independent agencies. Only by keeping a close watch over the events can we alert the mathematics community to take action when necessary in the form of testimony on the Hill and direct contact with the policy makers, in person or by mail. That is one of the functions for which the OGPA was created.

Science and Technology in the President's Budget for 1991

According to D. Allan Bromley, civilian R&D will receive a 12% increase, from \$23.8 billion to \$26.7 billion. (In this presentation the baseline for FY 1990 is the congressionally enacted budget for FY 1990, not what the Reagan administration asked for last year). Defense R&D will increase by 4%, from \$39.9 billion to \$41.4 billion. If these figures hold up, the civilian share of total R&D will actually increase from 37.4% to 39.2%, certainly a welcome step.

The basic research part of the R&D budget would increase by 8%, from about \$11.5 billion to \$12.4 billion. This is about 17% of the total R&D budget. Civilian basic

research would go up 9% under the President's proposal, and defense basic research about 6% (while the overall defense budget is supposed to rise only 1%). Needless to say, this is the area where Congress will spend most of its time arguing over the "peace dividend", real or imaginary.

Total R&D, civilian and defense, would rise 7%, to \$68.1 billion. The President proposes another \$3.06 billion for the construction, repair and modernization of R&D facilities. On top of this, the Administration is committed to doubling the NSF budget by 1993 from the 1987 base year.

The President plans for substantial increases in the following programs (among others):

* **Science, mathematics, and engineering education:** +26%, from \$841 million to \$1.06 billion, distributed over NSF, Department of Education, Department of Energy, NASA, and the National Institutes of Health. Emphasis is on "revitalization of mathematics, science, and engineering education to produce the technological workforce and scientifically literate population needed to maintain a globally competitive economy".

* **Global Change:** +57% to over \$1 billion to support the interagency U.S. Global Change Research Program. This involves eight different departments and/or agencies that include National Oceanographic and Atmospheric Administration, Department of Interior, and the NSF, to name just the three that represent almost 75% of the total program.

* **Exploration beyond the Earth** will be strengthened by a new initiative to develop the new technologies needed for future manned exploration of the Moon and Mars. The 1991 budget calls for a nearly 50% increase to about \$1.27 billion in programs in NASA, the Department of Energy and the Department of Defense.

National Science Foundation Budget Request for FY 1991

The Bush administration proposes to increase the NSF budget from \$2.08 billion to \$2.38 billion, or by 14.4%, in FY 1991. While announcing his proposed budget,

NSF director Erich Bloch said "Today education and research are critical to the country's economic security," and "our strategy emphasizes support of the core disciplines and research facilities, and a large investment in human resource development through education and research initiation. These investments are the cornerstone of increased national productivity and economic competitiveness."

The NSF strategy is to strengthen the research base and improve academic research equipment and facilities. A total of \$1.81 billion would be spent for this purpose, up 11% over the current year. For development of human resources, broadening participation and improving science and engineering education at all levels, NSF would spend \$463 million next year, an increase of 30% over the FY 1990 plan.

Increases in the NSF research and facilities budget (which comprises over 70% of the total) are planned for:

- * Presidential Global Change Program: +100% to \$103 million
- * Mapping and sequencing the plant genome.
- * Funding a second class of 10-12 science and technology centers, that were deferred from FY 1990 because of budget constraints.

- * Support of world-class facilities in astronomy and gravitational wave detection.

The following is how the Directorate for Mathematical and Physical Sciences allocated its research funds for three successive fiscal years:

Mathematical and Physical Sciences Directorate at NSF (\$1000's)

	1989	1990#	1991#
Mathematical Sciences	66,019	69,118 (4.7)	73,720 (6.7)
Astronomical Sciences	89,224	91,647 (2.7)	100,700 (9.9)
Physics	122,284	123,831 (1.3)	130,230 (5.2)
Chemistry	96,745	97,945 (1.2)	103,350 (5.5)
Materials Research	115,084	116,939 (1.6)	123,460 (5.6)
Science & Tech. Ctrs.	13,947	14,536 (0.3)	27,040 (86)
Major Research Equipment	500	42,990 -	63,000 (47)

Numbers in parentheses indicate the percentage increase over the prior year.



American Mathematical Society

Manager Russian Translation Program Position Open

The Society is seeking applications from individuals with a broad-based background in mathematics and fluent Russian. Publishing experience or participation in a translation program would be helpful.

The manager will be expected to provide long-range planning for the translation program. Responsibilities will include identifying and developing real or potential projects and authors, acting as liaison between consultants and the Translation Editorial Committee, serving as the interface between the Society and appropriate Soviet agencies and publishing houses, and directing the activities of the translations editorial staff.

The person selected will work in the Society's Providence Office. Travel to the Soviet Union will be necessary.

Applications should be sent to:

Director of Publication
American Mathematical Society
P.O. Box 6248
Providence, RI 02940

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News and Announcements

Mark Grigorievich Krein 1907–1989

One of the most eminent mathematicians of our time, Mark Grigorievich Krein, passed away on October 17, 1989. He is the author of more than 270 papers and monographs of unsurpassed breadth and quality. His work opened up new areas of mathematics and greatly enriched the more traditional ones. He educated dozens of brilliant students in the USSR and inspired the work of many mathematicians, engineers and physicists all over the world.

In 1982 M. G. Krein was awarded the prestigious international Wolf Prize in Mathematics in Jerusalem. The citation to this prize reads in part as follows: "His work is the culmination of the noble line of research begun by Chebyshev, Stieltjes, S. Bernstein and Markov and continued by F. Riesz, Banach and Szego. Krein brought the full force of mathematical analysis to bear on problems of function theory, operator theory, probability and mathematical physics. His contributions led to important developments in the applications of mathematics to different fields ranging from theoretical mechanics to electrical engineering. His style in mathematics and his personal leadership and integrity have set standards of excellence."

Among his honorary awards, he was elected: corresponding member of the Ukrainian Academy, 1939; honorary member of the American Academy of Arts and Sciences, 1968; Foreign Member of the National

Academy of Sciences of the United States of America, 1979. Recently he was awarded the N. M. Krylov Prize of the Ukrainian Academy of Sciences.

Mark G. Krein was born on April 3, 1907, in Kiev into a Jewish family of modest means. His father was a lumber merchant. From early on he showed a talent for mathematics. At the age of 14 he already attended research seminars. He never got his undergraduate degree. In 1924 he ran away from home to Odessa and in 1926 he was accepted for his doctoral studies by N. G. Chebotarev at Odessa University. He completed his studies in 1929.

An excellent and enthusiastic teacher, he attracted many students. In the thirties he created one of the strongest centers of functional analysis throughout the world at Odessa University. His interests included geometry of Banach spaces, moment problems, integral equations and matrices, spectral theory of linear operators, extension problems and applications. Many of his results from this period, as well as joint results together with his friends and colleagues (N. I. Achiezer, F. R. Gantmacher), and his outstanding students (A. B. Artemenko, M. S. Livsic, D. P. Milman, M. A. Naimark, V. P. Potapov, M. A. Rutman, V. L. Shmuljan) are now characterized as classical and appear in all textbooks on functional analysis.

During World War II, from 1941 to 1944, he held the chair of theoretical mechanics at the Kuibyshev

(on the Volga) Industrial Institute. In 1944 he returned to Odessa but was soon dismissed from the University. This was the end of the famous center of functional analysis at Odessa University. From 1944 to 1952, M. G. Krein held a part time position as head of the department of functional analysis and algebra at the Mathematical Institute of the Ukrainian Academy of Science in Kiev. He was dismissed from this post in 1952. The official reason given was that he was not a permanent resident of Kiev. From 1944 to 1954 he held the chair of theoretical mechanics at the Odessa Marine Engineering Institute, and from 1954 till his retirement he held the chair of theoretical mechanics at the Odessa Civil Engineering Institute. During the last few years of his life he was a consultant to the Institute of Physical Chemistry of the Ukrainian Academy of Sciences in Odessa.

A list of themes where M. G. Krein's research was fundamental, and in many cases even determined the future of the field, includes: oscillating (totally positive) kernel functions and matrices; problem of moments, orthogonal polynomials, and approximation theory; cones and regular convex sets in Banach spaces; the theory of gaps and spaces with two norms; the extension theory of operators, Hermitian-positive functions and helical arcs; integral operators, string problems and method of directing functionals; stability theories for differential equations; Wiener-Hopf, Toeplitz and singular integral

operators; scattering theory and inverse spectral problems; operator theory in spaces with an indefinite metric; indefinite extension problems; nonselfadjoint operators; triangular models; perturbation, interpolation and factorization theories; problems in elasticity theory, and ship waves and water resistance.

A profound intrinsic unity and a close interlacing of general abstract and geometric ideas with concrete and analytical results and applications are characteristic of Krein's work.

Krein was a very fine pedagogue and lecturer. He would always share his new ideas and plans with his students and colleagues. He was known for his scientific generosity and enthusiasm, as well as his kindness and attention to young mathematicians. The author of these lines was very privileged to have, during many years, such a teacher, coauthor and friend. He will always remember M. G. Krein with gratitude, affection and admiration.

In general, M. G. Krein was a fair, very amiable and kind person. However, all of his life he battled against mediocrity. After the Second World War he had to contend with hostile elements which fought fiercely against him using the officially supported antisemitism which was rife in the Ukraine, and especially so in Odessa. He was accused of Jewish nationalism, presumably for having had too many Jewish students before the War. This accusation was certainly included in his classified file and was held against him all of his life. Presumably, it played a significant role in his two dismissals which were mentioned earlier. He was not allowed to have Jewish students and was deprived of a university base. All attempts on the part of various societies and individuals in the Soviet Union to gain for him some measure of the official recognition which he so richly deserved, were unsuccessful. Worse than that, there were times when his friends feared that he

was in serious danger of arrest.

M. G. Krein liked to tell stories and jokes, some of which he invented himself. At one time he went to the rector of his institute and asked if there was any danger that he could be accused of Armenian nationalism since he had four graduate students who were Armenians. The rector did not understand the joke and tried, in all seriousness, to explain that in this case there was no danger.

M. G. Krein responded to his hostile surroundings in the only way open to him, by deep research and hard work. He and many of his students were protected by virtue of his outstanding achievements. In retrospect, it seems clear that he won this very difficult struggle. Firstly, he was able to devote all his life to mathematics (teaching and research), the work he loved so much. Secondly, he was able to spend most of his life in Odessa, a town which he had always regarded with love and affection (some of his friends thought that his life would have been much easier in Moscow or Leningrad). Thirdly, he was always the leader of a strong and dedicated group of colleagues and followers who loved and respected him. (This group existed almost on a private basis, holding many of its meetings in his house, or at the Scientists Club.) Fourthly, he had a great impact on the development of mathematics and its applications throughout the world. Even though he was never allowed to travel abroad, his brilliant work knew no borders.

This fight took a heavy toll on his health, and towards the end of his life he suffered from depression. This condition worsened after the tragic loss within one year of his wife, Rachel, and his only grandson, Aleosh. M. G. Krein died in Odessa (USSR) where he is buried. He is survived by his daughter, Irma Krein (Kozdoba), and a great-grandson, Mark Kozdoba.

Israel Gohberg
Tel-Aviv University

Morris H. DeGroot 1931-1989

Morris DeGroot, University Professor of Statistics and Industrial Administration at Carnegie-Mellon University, died on November 2, 1989. He was the leading national figure in Bayesian statistics, and had a profound influence on the development of the discipline.

Morrie worked in a wide variety of areas within Bayesian statistics, but is most identified with the area of rational decision-making under uncertainty. He was an originator, often opening up entirely new avenues of research. He wrote three books, edited four volumes, and authored over one hundred papers. In addition to fundamental work in statistics itself, these included works with economists and other social scientists in a wide variety of disciplines. From many such I have heard that Morrie was the best collaborator they ever had; his brilliance and personality made working with him a joy.

Research was but one of the ways in which Morrie profoundly influenced statistics. His textbook *Optimal Statistical Decisions* is one of the great books in the field. Morrie worked extensively on editorial boards, his two most influential stints being his editorship of the *Journal of the American Statistical Association* from 1971 to 1978, and his role from 1984-1988 as founder and first Executive Editor of the highly acclaimed journal *Statistical Science*. Morrie was also extremely active in professional societies and in governmental (National Institute of Health and National Research Council) advisory committees; his wisdom and guidance were sought by all.

Morrie was born on June 8, 1931 in Scranton, Pennsylvania. He graduated from Roosevelt University in 1952 with a B.S. in mathematics, and received a Ph.D. in statistics from the University of Chicago in 1958. He spent his academic career at Carnegie-Mellon University, serving as founding Head of the Depart-

ment of Statistics in 1966. In 1984 he was named University Professor.

Morrie's brilliance and creativity existed in concert with exceptional warmth and good humor. He not only led scientifically, but was the source of personal inspiration for many. His work and his personality will remain inextricably woven into the fabric of statistics.

James Berger
Purdue University

1990 Wolf Prizes

The 1990 Wolf Foundation Prize in mathematics will be shared by Ennio De Giorgi and Ilya Piatetski-Shapiro. The \$100,000 prize will be presented to the winners in May 1990 by President Chaim Herzog at the Knesset (Parliament) in Israel.



Ennio De Giorgi

Professor De Giorgi was cited for his "innovating ideas and fundamental achievements in partial differential equations and calculus of variations." Professor De Giorgi was born in Italy in 1928 and received his degree in mathematics from the University of Rome in 1950. Since 1959 he has been Professor of Algebraic and Infinitesimal Mathematical Analysis at the Scuola Normale Superiore di Pisa.

Professor De Giorgi's work is among the most important and creative accomplishments in the theory of partial differential equations and the calculus of variations. At the time he began his studies, mathematicians were unable to handle anything beyond second-order nonlinear elliptic equations in two variables. His first major breakthrough came in 1957, when he proved that measurable coefficients were Holder continuous. Perhaps his greatest contribution was his 1960 regularity theory for minimal hypersurfaces. These arise as surfaces of smallest area spanning a given boundary. The proof required Professor De Giorgi to develop his own version of what we now call geometric measure theory, along with a related key compactness theorem. He was then able to conclude that a minimal hypersurface is analytic outside a closed subset of codimension at least two. Since then, he and his school have settled many of the outstanding problems in this area.



Ilya Piatetski-Shapiro

Professor Piatetski-Shapiro was cited for his "fundamental contributions to the fields of homogeneous complex domains, discrete groups, representation theory and automorphic forms." Born in the U.S.S.R. in 1929, Professor Piatetski-Shapiro

received his Ph.D. in mathematics from the Moscow Pedagogical Institute and his Doctor of Science in 1959 from the Steklov Mathematical Institute. He currently holds joint positions as professor of mathematics at Tel Aviv University and Yale University.

For almost forty years, Professor Piatetski-Shapiro has been making major contributions to mathematics by solving outstanding open problems and by introducing new ideas in the theory of automorphic functions and its connections with number theory, algebraic geometry, and infinite-dimensional representations of Lie groups. His work has been a major and often decisive factor in the great progress this theory has seen in the last three decades.

Among Professor Piatetski-Shapiro's main achievements are: the solution of Salem's problem about the uniqueness of the expansion of a function into a trigonometric series; the example of a nonsymmetric homogeneous domain in dimension four answering Cartan's question and the complete classification (with E. Vinberg and G. Gindikin) of all bounded homogeneous domains; the solution of Torelli's problem for K-3 surfaces (with I. Shafarevich); and a solution of a special case of Selberg's conjecture on unipotent elements, which paved the way for important advances in the theory of discrete groups. In addition, he proved many results in the theory of automorphic functions, such as the extension of the theory to the general context of semi-simple Lie groups (with I. M. Gel'fand), the general theory of arithmetic groups operating on bounded symmetric domains, the first "converse theorem" for $GL(3)$, the construction of L-functions for automorphic representations for all the classical groups (with S. Rallis), and the proof of the existence of nonarithmetic lattices in hyperbolic spaces of arbitrarily large dimension (with M. Gromov).

Mathematicians Honored in Germany

Alexander Mielke of Stuttgart University has been named as the first recipient of the Richard von Mises Award of the Gesellschaft für Angewandte Mathematik und Mechanik. The award of DM 2,500 is in recognition of Mielke's solution of the Saint-Venant problem (Saint-Venant's Problem and Semi-Inverse Solutions in Nonlinear Elasticity, *Archive for Rational Mechanics and Analysis*).

Winners in the area of applied mathematics of the Heinz Maier Leibnitz Award (DM 6,000 - DM 12,000 to facilitate recognition of young researchers and encourage further scientific work) were: ROLAND FREUND of Würzburg University for his work "On a Class of Chebyshev Approximation Problem which Arise in Connection with a Conjugate Gradient Type Method"; ENNO MAMMEN of Heidelberg University for his work "Asymptotics with Increasing Dimension for Robust Regression with Applications to the Bootstrap"; ALEXANDER MIELKE of Stuttgart University for his work "Saint-Venant's Problem and Semi-Inverse Solutions in Nonlinear Elasticity"; TOBIAS VON PETERSDORFF of Technische Hochschule for his work "Boundary Integral Equations for Mixed Dirichlet, Neumann and Transmission Problems"; MICHAEL RÖCKNER of the University of Edinburgh for his work "Traces of Harmonic Functions and a New Path Space for the Free Quantum Field"; and GABRIEL WITTUM of Heidelberg University for his work "Multi-Grid Methods for Stokes and Navier-Stokes Equations - Transforming Smoothers: Algorithms and Numerical Results."

Graduate Student Fulbrights

The United States Information Agency and the Institute of International Education have announced the names of U.S. graduate students who have received Fulbright awards for 1989-1990. Those receiving awards in mathematics are listed below, together

with their home institutions and the countries in which they will study.

Apparna Bhattacharya, University of California at Davis, West Germany; Lynn Fryberger, St. Olaf College, Hungary; Laura Green, Clemson University, West Germany.

1989 Autumn Prize of the Mathematical Society of Japan Awarded

The Autumn Prize of the Mathematical Society of Japan in 1989 was awarded to Shinzo Watanabe, Professor of Kyoto University, for his outstanding contribution to Stochastic Analysis.

1990 URI Awards Announced

The Department of Defense (DOD) has announced the 1990 awards in its University Research Initiative (URI) Program. The Air Force Office of Scientific Research (AFOSR) and the Defense Advanced Research Projects Agency (DARPA) were the two DOD agencies that made URI awards in the mathematical sciences.

The URI program was begun in 1986 as a way to enable universities to strengthen their ability to conduct basic research in areas important to national defense. One purpose of the URI program is to stimulate interdisciplinary, collaborative research, so the URI grants typically provide support for workshops, visitors, postdoctoral researchers, and graduate students. Individuals interested in these activities should contact the URI principal investigators directly.

The Directorate for Mathematical Sciences at AFOSR made five, three-year URI awards, out of a total of forty proposals submitted. The names of the principal investigators, their affiliations, the titles of their projects, and the sizes of the grants are listed below. The amounts stated will be given each year for three years.

H. THOMAS BANKS; University of Southern California; Modeling, estimation, and control of distributed parameter systems; \$400,000. ALAN

C. NEWELL; University of Arizona; Nonlinear optics and turbulence; \$500,000. ROBERT V. KOHN; New York University; Center for analysis of heterogeneous and nonlinear data; \$500,000. DAVID KUCK; University of Illinois, Urbana-Champaign; An integrated environment for the development of scientific and engineering applications; \$600,000. P. S. KRISHNAPRASAD; University of Maryland; Control of complex multibody spacecraft; \$400,000.

In an effort to distribute DOD research and development funds more broadly, Congress instructed the DOD to use part of the URI funds to make grants to schools whose total R&D funds from DOD fall below \$4 million. In fiscal year 1989, AFOSR's mathematics directorate made nine such awards (see *Notices*, October 1989, page 1004). This year, the Applied and Computational Mathematics Program at DARPA made five such awards in the area of wavelet theory and its applications. Each year for the three years, a total of \$1.25 million will go to support six grants.

The names of the DARPA/URI principal investigators and their institution, are: CHING-CHUNG LI, University of Pittsburgh; WOŁODYMYR R. MADYCH, University of Connecticut; REESE T. PROSSER, Dartmouth College; GUIDO L. WEISS, Washington University; GRANT V. WELLAND, University of Missouri at St. Louis; and R. O. WELLS, JR., Rice University.

Instrumentation Awards Announced

The National Science Foundation (NSF) has announced awards in its Undergraduate Instrumentation and Laboratory Improvement (ILI) program. The awards were made to community colleges, four-year colleges, and doctoral universities across the nation.

The proposals are evaluated and funded collaboratively by the NSF's Division of Undergraduate Science, Engineering, and Mathematics Edu-

cation and by the NSF's research directorates. The awards encompass a wide range of science and engineering disciplines.

Below are listed the principal investigators and their institutions for the awards in the mathematical sciences. The list includes awards made fiscal 1989 and some from fiscal 1990.

B. BRADEN, Northern Kentucky University; J. W. BURGMEIER, University of Vermont; J. CALLAHAN, Smith College; W. D. CURTIS, Kansas State University; R. L. DEVANEY, Boston University; E. L. DUBINSKY, Purdue University; J. A. FEROE, Vassar College; ULF GRENANDER, Brown University; M. HOFT, University of Michigan, Dearborn; A. L. HUDSON, Armstrong State College; J. F. HURLEY, University of Connecticut, Storrs; M. B. JACKSON, Earlham College; D. J. JOHN, Wake Forest University; P. T. JUDSON, Trinity University; W. J. KAMMERER, Georgia Institute of Technology; W. H. KRAUS, Wittenberg University; D. R. LATORRE, Clemson University; D. LOVELOCK, University of Arizona, Tucson; J. C. MATHEWS, Iowa State University of Science and Technology; L. D. MEEKER, University of New Hampshire; J. R. MICHEL, Marietta College; L. C. MOORE, Duke University; D. B. O'SHEA, Mount Holyoke College; H. C. PINKHAM, Columbia University; G. E. RUBIN, Marshall University Foundation, Inc.; B. TRAVIS, University of Texas at San Antonio; A. J. SCHAEFFER, Eastern Illinois University; D. H. SCHULTZ, University of Wisconsin, Milwaukee; D. D. SCHWARTZ, Ithaca College; T. S. SHORES, University of Nebraska, Lincoln; A. H. SHUCHAT, Wellesley College; D. C. SLOUGHTER, Furman University; D. B. SMALL, Colby College; J. R. SMART, University of Wisconsin, Madison; P. N. SOMERVILLE, University of Central Florida; K. D. STROYAN, University of Iowa; D. P. SUMNER, University of South Carolina at Columbia; G. J. WITT, Glendale Community College;

J. E. WHITE, Kenyon College; B. J. WINKEL, Rose-Hulman Institute of Technology; W. ZIMMERMAN, University of the Pacific.

The deadline for the next ILI competition will probably be in mid-November, 1990. Gerald Chachere of the Division of Mathematical Sciences handles proposals from Ph.D.-granting institutions; he can be reached at 202-357-3453 or via electronic mail, gchachere@nsf.gov (Internet) or gchachere@nsf (Bitnet). Spud Bradley, program director for calculus curriculum development in the Division of Undergraduate Science, Engineering, and Mathematics Education, handles proposals for all other institutions; he can be reached at 202-357-7051 or via electronic mail, sbradley@nsf.gov (Internet) or sbradley@nsf (Bitnet). The street address is National Science Foundation, 1800 G Street, NW, Washington, DC 20550.

MAA Prizes Presented in Louisville

The Mathematical Association of America (MAA) presented a number of prizes during the Joint Mathematics Meetings in Louisville, Kentucky in January.

The Award for Distinguished Service, consisting of \$4000 and a certificate, is made for outstanding service to mathematics through activities that significantly influence the field of mathematics or mathematics education on a national scale. The Chauvenet Prize of \$500 and a certificate recognizes a noteworthy mathematics paper which would make interesting and profitable reading for all MAA members.

LEON HENKIN of the University of California at Berkeley received the 1990 Award for Distinguished Service. A former president of the Association for Symbolic Logic, Professor Henkin has an outstanding record of scholarly work in his field of logic and the foundations of mathematics. He has also found the time

and energy to make a variety of contributions to the improvement of mathematical instruction at the pre-college and college levels, particularly in the area of encouraging minority students. For example, last year he helped to organize a six-week, national program funded by the Sloan Foundation to encourage mathematically talented women and minority undergraduates to pursue careers requiring the mathematics doctorate. In addition to serving as an advisor to graduate students in mathematics, he has had five doctoral students over the last twenty years in an interdisciplinary program in mathematics and science education. His founding 25 years ago of the Mathematics Opportunity Committee in the Berkeley mathematics department has helped to increase the number of women and minorities receiving mathematics Ph.D.s. Also well known as an excellent expositor of mathematics (as a writer and lecturer), Professor Henkin received the 1964 MAA Chauvenet Prize. He was born in Brooklyn, New York in 1921 and received his Ph.D. in 1947 from Princeton University.

DAVID HOFFMAN of the University of Massachusetts at Amherst received the 1990 Chauvenet Prize for his article, "The Computer-Aided Discovery of New Embedded Minimal Surfaces" (*The Mathematical Intelligencer*, volume 9, 1987, pages 8-19). The article presented a many-faceted description of recent progress in the theory of minimal surfaces. The role of the computer in the discovery of new complete minimal surfaces of finite total curvature in R^3 gives this story a fascinating new twist. The excellence of the exposition and the many computer-generated illustrations (some in full color) combined to produce a marvelous article of interest to the entire mathematical community. Born in 1944 in Far Rockaway, New York, Professor Hoffman received his Ph.D. in 1972 from Stanford University.

MSEB Issue Two Reports

The Mathematical Sciences Education Board (MSEB) of the National Research Council has issued two reports on improving mathematics teaching and learning in the U.S. Taken together, the reports cover two important aspects of the mathematics education reform effort: the impetus and support coming from business and industry, and the intellectual groundwork needed to rethink the mathematics curriculum.

The first report, "Mathematics Education: Wellspring of U.S. Industrial Strength," represents the proceedings of a symposium held in December, 1988. The symposium brought together representatives from business, industry, government, and education to discuss shared concerns about the quantitative and problem-solving skills of the work force. "The rudimentary skills that satisfied the needs of the workplace in the past no longer suffice," says the 20-page report, noting that today's workers need to be able to work with data and computers, solve problems and make estimates, and collaborate and communicate with other workers. Peppered with quotes from the participants, the report describes some of the problems and outlines means for change.

The other report, entitled "Reshaping School Mathematics: A Philosophy and Framework for Curriculum," is a more ambitious document. The 60-page report proposes a framework for reform of school mathematics by means of changes in the curriculum. Two issues are central to the report: the changing perspectives on the need for mathematics, the nature of mathematics, and the learning of mathematics; and the changing roles of calculators and computers in the practice of mathematics. Ideas for reform are outlined in both what is taught and how it is taught; the focus is on curricular change, but the report also addresses teacher education, assessment, and instructional materials.

The report is not intended to detail the specifics of an ideal curriculum, but rather to lay out goals and principles as the groundwork for the formulation of new curricula. Stating that "Foundations for an improved mathematics curriculum must rest on analysis of the nature of mathematics and the goals of mathematics education," the report describes some aspects of the nature of the subject, as well as principles of education, that must guide curricular reform. Illustrated with pictures and enlivened with a number of examples of mathematical problems, the report is required reading for those with a stake in improving mathematics education.

Copies of the "Wellspring" report are available free of charge by calling the MSEB office at 202-334-3294, or writing to them at 818 Connecticut Avenue, NW, Suite 500, Washington, DC 20006.

"Reshaping School Mathematics" is available from National Academy Press for \$7.95. There is a 15% discount for 5-24 copies and a 25% discount for 25-499 copies. All orders must be prepaid, and there is a \$2.00 fee for shipping and handling. To order by phone using a credit card, call toll-free, 1-800-624-6242, Monday through Friday, 8:30-5 (ET). The mailing address is National Academy Press, 2101 Constitution Avenue, NW, Washington, DC 20418.

NSF's Fiscal 1990 Budget

Due to budgetary pressures, the National Science Foundation (NSF) has foregone plans for a new round of Science and Technology Centers for the current fiscal year. And, because of a Gramm-Rudman sequester and other across-the-board reductions that affected a number of government agencies, all increments planned for continuing NSF grants and cooperative agreements will be reduced by 2%. The steps were taken as the NSF formulated its spending plan after receiving its

fiscal year 1990 budget appropriation from Congress in December.

Compared to other areas in the NSF's Mathematical and Physical Sciences directorate, the Division of Mathematical Sciences (DMS) fared well, with a 5% increase; overall, the directorate received an increase of about 3%. The 12% increase for the directorate for Computer and Information Science and Engineering will be used primarily for the NSF supercomputing centers and networking. Overall, NSF's research activities received only a 6% increase over the fiscal 1989 level, a far cry from the original requested increase of about 14%.

Funds originally intended for the Science and Technology Centers will be used to ease tight funding in certain research divisions and also to allow for an increase of around 11% for the existing Centers which were funded last year. The current batch of Centers proposals are to be evaluated this Spring and funded out of the fiscal 1991 budget.

The 2% reduction will take a bite out of the yearly increments the NSF makes on continuing grants to offset inflation, which was around 4% last year. Within the DMS, all budget categories on such grants will be scaled back by 2%, but grantees will be encouraged, to the extent that they can, to restore the original amounts intended for student support. However, the Division will not decrease its total allocation for support of graduate students. Certain NSF programs, such as the graduate fellowships, will be protected from the 2% reduction.

In a notice to colleges, universities, and other organizations, NSF Director Erich Bloch stated that the Foundation believes the 2% scaleback of increments on continuing grants "is the fairest way to ensure that the effect of the across-the-board [NSF budget] reductions is shared equitably among new and prior grantees. The budget amounts freed up will remain with the programs, divisions,

and directorates that funded the original awards and will be used to ease the disproportionate impact on new and renewal proposals in those fields."

Congress again boosted the budget of Science and Engineering Education (SEE) above the level the NSF had requested, providing a 19% increase. Within the SEE directorate, funding for the calculus curriculum development program will remain level. However, a significant portion of the DMS increase for fiscal 1990 will go toward funding new calculus curriculum development projects, increasing the total funding for this activity by 25-35%. This year, the NSF will also begin supporting curriculum development projects in other undergraduate courses (see *Notices*, February 1990, page 145).

In addition, the appropriations legislation for the NSF's fiscal 1990 budget reinstates the salary cap instituted last year. This rule stipulates that no individual may receive salary reimbursement on any NSF grant at a rate that exceeds the equivalent of \$95,000 per year.

Bush Names Science Council

In mid-February, President Bush named the members of the President's Council of Advisers on Science and Technology. The appointment of the Council represents a change from the Reagan Administration, which relied only on the Science Adviser and the Office of Science and Technology Policy. D. Allan Bromley, the President's Science Adviser, chairs the Council. The other members are: Norman E. Borlaug, Texas A&M University; Solomon J. Buchsbaum, AT&T Bell Laboratories; Charles L. Drake, Dartmouth College; Ralph E. Gomory, Sloan Foundation; Bernadine Healy, Research Institute of the Cleveland Clinic; Peter W. Likens, Lehigh University; Thomas E. Lovejoy, the Smithsonian Institution; Walter E. Massey, University of Chicago; John P. McTague, Ford Motor Company; Daniel Nathans, Johns Hop-

kins University Medical School; David Packard, Hewlett-Packard Company; Harold T. Shapiro, Princeton University.

News from the Mathematical Sciences Research Institute Berkeley, California

The Mathematical Sciences Research Institute (MSRI) Board of Trustees has voted to appoint Robert Osserman of Stanford University to a three year term as MSRI's Deputy Director, beginning September 1, 1990. He will succeed Emery Thomas, the present Deputy Director, who has held the post since April, 1987.

Events of 1989-1990

At the halfway point in the academic year a great deal of activity has already taken place in our two main programs - Logic and Algebraic Topology and its Applications. In October MSRI held a workshop on Set Theory and the Continuum (organized by H. Woodin), while in November two workshops took place: Homotopy Theory (organized by G. Carlsson) and one on Logic Related to Computer Science and Programming Language Theory (organized by Y. Moschovakis). Two events occurred in January, 1990: The Pacific Geometry Seminar met at MSRI January 13-14, while during the week of January 22-26 there was a workshop on Applications of Algebraic Topology to Geometry and Analysis (organized by R. Cohen and J. Jones). The period March 19-April 20 is a special month devoted to Number Theory and Algorithms, organized by H. Lenstra, with a workshop (with the same title) the week of March 26-29. In May (14-18), MSRI will host a workshop on K-Theory (organized by W. C. Hsiang and J. Jones). The final event of the year is a workshop on Model Theory, organized by E. Hrushovski, June 4-8, 1990.

Future Events

Future programs, presently in place, are as follows:

1990-1991: Partial Differential Equations and Continuum Mechanics, Representations of Finite Groups (first half), Strings in Mathematics and Physics (second half).

1991-1992: Statistics, Lie Groups and Ergodic Theory, Mathematical Biology (Summer 1992).

1992-1993: Algebraic Geometry, Symbolic Dynamics (first half), Transcendence and Diophantine Problems (second half).

MSRI welcomes suggestions and proposals for future programs.

Applications are currently invited for 1991-1992. MSRI will offer postdoctoral fellowships and senior memberships; the deadline for applying is **November 30, 1990**. In addition, the program of research professorships will be repeated; this has the earlier deadline of **October 1, 1990**. Candidates are welcome in all areas of the mathematical sciences as well as in the main programs. Watch for detailed announcements in an advertisement in the AMS *Notices* and in a widely distributed poster.

The MSRI Scientific Advisory Council recently appointed the following research professors for 1990-1991: Robert Friedman, Jerome Goldstein, Corinne Manogue, Emma Previato, Robert Robson, Gilbert Stengle. Offers are presently going out for postdoctoral fellowships and senior memberships for 1990-1991.

News from the Institute for Mathematics and its Applications University of Minnesota

The Institute for Mathematics and its Applications (IMA) is initiating a Summer Program for Graduate Students from the 19 IMA Participating Institutions. Each year the program will bring together for four weeks in the summer, a select group of 30-40 students from the Participating Institutions. The students will live in a dormitory on one of the PI cam-

puses; the location of the campus may change from year to year. During the four weeks, there will be a series of (related) lectures to be given by four senior mathematicians. The summer 1990 program is on Algebra and will be held July 2–27 at the University of Michigan, Ann Arbor. Melvin Hochster is the coordinator; the speakers are Craig Huneke, Hyman Bass, Charles Curtis and Philip Hanlon.

The 1989–1990 academic year program at the IMA is Dynamical Systems and their Applications. The early spring (March 19–April 13) portion of the program is a period of concentration on Mathematical Physiology and Differential-Delay Equations, organized by Michael Mackey, Jack Hale, Nancy Kopell, and John Mallet-Paret. The central theme is the effects of delays in biological dynamics. Following introductory expository talks by the organizers, overview talks of 2–3 hours each will be given on the weekly topics by William Brock and Doyné Farmer (Time Series Analysis and Chaotic Dynamics); Jeffrey Grinstein and Roger Traub (Genesis of Large Scale Collective Activity in Higher Order Neural Nets); Uwe an der Heiden and John Rinzel (Single Neuron Models and Small Neural Networks); and Scott Fraser and James Murray (Developmental Biology: Dynamics of Pattern Formation and Morphogenesis).

Based on the success of the symbol manipulation workshop offered last year, the IMA has added a special workshop to the spring schedule: Using Algebraic Processors in Dynamical Systems (April 16–20, 1990). The organizers are Ken Meyer and Peter Olver. The main purpose of this workshop is to introduce researchers in dynamical systems to the capabilities of automated algebraic processors like *MACSYMA*, *MAPLE* and other such systems. Several series of tutorial lectures and research lectures will teach the participants

about how specific algebraic processors work and how researchers have used these systems. Each participant will be given a computer account on one of the IMA's workstations with easy access to six computer algebra systems.

From mid-April to mid-June 1990 there will be a period of concentration on Fluid Flow and Convection Dynamics, organized by George F. Carnevale, Ciprian Foias, Raymond Pierrehumbert, Roger Temam, and David Yuen. Workshops during this period are Dynamical Theories of Turbulence in Fluid Flows (May 29–June 2, 1990); Nonlinear Phenomena in Atmospheric and Oceanic Sciences (June 4–8, 1990); and Chaotic Processes in the Geological Sciences (June 11–15, 1990). The last two are sponsored jointly with the Minnesota Supercomputer Institute.

The IMA will run two summer programs in 1990. The first of these is Radar and Sonar (June 18–29), organized by Alberto Grunbaum, Marvin Bernfeld, Richard E. Blahut and Richard Tolimieri. The first week will be run as a summer school with minicourses by Richard E. Blahut, Willard Miller, Jr., and C. H. Wilcox. During the second week scientists (from industry, universities and government agencies) who are working on Radar or Sonar will present research problems.

The other 1990 summer program is New Directions in Time Series Analysis (July 2–27), organized by Emanuel Parzen, David Brillinger, Murray Rosenblatt, Murad Taqqu, John Geweke and Peter E. Caines. The weekly topics are Non-Linear Models, Self-Similar Processes & Long Range Dependence, Interactions of Time Series & Statistics, and Time Series Research Common to Engineers & Economists.

For more details concerning the two summer programs, see the advertisements in the January 1990 *Notices*.

News from the Mathematical Sciences Institute Cornell University

The second of two summer workshops at the Mathematical Sciences Institute (MSI) will be Function Estimation and Statistical Applications, June 14–16, 1990. Organized by David Ruppert, Operations Research and Industrial Engineering, Cornell University and J. S. Marron, University of North Carolina, Chapel Hill, this workshop will focus on using data to estimate unknown functions. Much of statistics concerns the estimation of functions, such as conditional expectations (regression functions), probability densities, and hazard functions. In classical statistics, these functions are generally assumed to be known a priori, except for a finite number of real valued parameters which are estimated. Such assumptions are often unrealistic and can cause features of the data to be obscured because they do not exist in the assumed model.

This workshop is on modern statistical methods not relying on parametric assumptions. Nonparametric estimation of functions is based on locally averaging, for example, through splines, kernels, or estimation of coefficients in a series expansion. The degree of smoothing or local averaging is controlled by a "smoothing parameter." Although many nonparametric estimation methods for functions have been known for several decades and some, such as the histogram for much longer, the difficult problem of choosing the smoothing parameter has been addressed only recently. There now exist a variety of methods for data-based selection of a smoothing parameter, rather precise asymptotic descriptions of their behavior, and bounds on the convergence rate of any estimator of the optimal smoothing parameter. This is still an area of intense research activity, and the speakers at this workshop include

leaders in this field: N. Altman, R. J. Carroll, D. Cline, D. Cox, R. Eubank, P. Hall, I. Johnstone, R. Liu, J. S. Marron, D. Nychka, J. Rice, D. Scott, P. Speckman, and M. Wells.

Function estimation has close ties with other areas of mathematics including numerical, functional, and Fourier analysis and probabilistic limit theory.

This workshop will be held at Cornell University. For more information about the scientific content, contact David Ruppert, School of Operations Research and Industrial Engineering, Cornell University, 343A Upson Hall, Ithaca, NY 14853, 607-255-9136. davidr@orie.cornell.edu.

To register for the workshop, contact Valerie Styles, Mathematical Sciences Institute, Cornell University, 201 Caldwell Hall, Ithaca, NY 14853-2602, 607-255-7740.

MSI is sponsoring a major symposium on "Modern Perspectives of Mathematics: Mathematics as a Consumer Good, Mathematics in Academia," March 29-31, 1990, at Cornell University. See this column in the

November 1989 *Notices* for a full description. Registration packets are now available. Contact conference secretary Diana Drake at the MSI address listed above, phone number 607-255-7752.

The Fermat Prize for Research in Mathematics

The Fermat Prize will reward the research of mathematicians working in the areas in which the contributions of Pierre de Fermat have been significant: principles of variational theory, the foundations of the calculus of probabilities and of analytic geometry, and number theory. The list, however, is not restrictive; the spirit of the prize is rather to reward the results of research that is accessible to the greatest number of professional mathematicians.

The amount of 100,000 FF (U.S. \$17,500) has been designated by MATRA-Espace for the Fermat Prize, which will be awarded every other year in Toulouse. The second award will take place in the spring of 1991.

Application deadline is **December 21, 1990**. Further information, such as the rules of the contest, should be available by March 1990 from Prix Fermat de Recherche en Mathématiques, Service des Relations Publiques, Université Paul Sabatier, 118 route de Narbonne, 31062 Toulouse Cédex, France.

Erratum

Postdoctoral Positions Research or Research/Teaching

In the December 1989 *Notices*, page 1454, it was reported that Memphis State University had 21 postdoctoral research or research/teaching positions available. The actual number of positions available is 2.

Errata to 1989 Index

The following are corrected entries for the 1989 Index to *Notices*, which appeared on page 1558 in the December issue.

PRIZE RECIPIENTS

Calderón, Alberto, 267, 833
Kawamata, Yujiro, 43

Acquisition Editor

Lance W. Small is serving as Acquisition Editor for the Society. He is available to assist potential authors in developing projects and referring book manuscripts to the appropriate editorial committee for final acceptance. Authors with manuscripts or publication proposals of various types including lecture notes, surveys, advanced research monographs, graduate level textbooks or books of general mathematical interest should contact Professor Small at the address below.

Professor Lance W. Small
Department of Mathematics
University of California
at San Diego
La Jolla, CA 92093
LWSMALL@UCSD.EDU

AMS Reprint Series

Changes in tax laws have made it less profitable and sometimes even unprofitable for commercial publishers to keep books in print. As a result, some good books have been allowed to go out of print. The Society has established a reprint series as a service to the mathematical community. The Series will contain books of lasting interest and value. A Committee on Reprinted Books has been appointed to judge the suitability of available books for reprinting. Suggestions of books to be included should be sent to:

Mary Lane
Director of Publication
American Mathematical Society
P.O. Box 6248
Providence, RI 02940

It would be helpful if a short description and information such as the original publisher were included.

Funding Information for the Mathematical Sciences

Proposals for the NSF's

Division of Mathematical Sciences

Research proposals submitted to the Division of Mathematical Sciences (DMS) of the National Science Foundation should be submitted six to nine months prior to the expected start date, to ensure timely notification of outcome. The DMS will accept such proposals at any time of the year. The program officers in the DMS are listed below:

Algebra and Number Theory

Ann Boyle 202-357-3695

Jonathan Lubin

Applied Mathematics

Alfonso Castro 202-357-3686

Fred Howes

Classical Analysis

John Ryff 202-357-3455

Computational Mathematics

Alvin Thaler 202-357-3691

Geometric Analysis

Russell Walker 202-357-3451

Modern Analysis

Ira Herbst 202-357-3697

Special Projects

Deborah Lockhart 202-357-3453

Gerald Chachere

Statistics and Probability

Mary Ellen Bock 202-357-3693

Peter Arzberger

Topology and Foundations

Ralph Krause 202-357-3457

Program officers may be contacted via electronic mail. To form an individual's address, take the first initial and last name, and append @nsf.gov for Internet or @nsf for

BITNET. For example, to contact Ann Boyle via Internet, use the address aboyle@nsf.gov.

The street address for the DMS is National Science Foundation, Room 339, 1800 G Street, NW, Washington, DC 20550.

Access for Women, Minorities and the Disabled

Career Access Opportunities in Science and Technology for Women, Minorities, and the Disabled is a program of the National Science Foundation (NSF) which seeks to enhance opportunities for those groups that have historically been underrepresented in science and engineering. The program supports two kinds of activities.

Comprehensive Regional Centers for Minorities involve a systemic approach to increasing the minority presence in science and engineering. The projects are focused in regions of high minority population and are developed through partnerships among colleges and universities, school systems, state and local governments, business and industry, etc. The Centers are comprehensive in their coverage of science, mathematics, and engineering; in addressing all educational levels from elementary through graduate; and in emphasizing interaction among cooperating organizations.

Specific activities within the centers might include teacher workshops, faculty seminars, enrichment experiences for students at all lev-

els, materials development, conferences for parents and other interested members of the public, and regional networks. Because of the complexity and coordination involved in the Centers, a blend of development and implementation activities is quite appropriate for these projects. The Centers are intended to be long term efforts and should at the outset have significant contributions from non-NSF sources.

Model Undergraduate Projects for Women, Minorities, and the Disabled seek to encourage colleges, universities, and other organizations to design and create highly focused activities at the undergraduate level. With an emphasis on testing new ideas (rather than replicating proven programs), the projects design learning experiences in science and mathematics that will encourage entry or improve retention for underrepresented groups. In addition, this program supports regional workshops and national conferences.

The deadline for proposals for both activities is **April 2, 1990**. For more information, contact Theodore Reid, Program Director, Career Access Opportunities in Science and Technology for Women, Minorities, and the Disabled, Office of Undergraduate Science, Engineering, and Mathematics Education, Room 639, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-7051; electronic mail undergrad@note.nsf.gov (Internet) or undergrad@nsf (Bitnet).

For Your Information

Bucharest Library

The Society has received a letter from Dr. Ion Stoica, director of the Central University Library in Bucharest, Romania. In part, this letter says:

"At the end of 1989, the Central University Library in Bucharest passed through the historic events which resulted in the overthrowing of the Ceausescu dictatorship, suffering great losses in all categories of collections. Half a million volumes belonging to the most valuable collections were burnt by the fire caused by the terrorists.

There were destroyed special collections of inestimable value: manuscripts and correspondence signed by personalities of the universal culture, collections of unique photographs and documents, collections of microfilms and microfiches, etc. There were also destroyed library microfiche producing devices, such as printing machines, copying machines, typewriters, computers, etc. The building of the Central Library, a monument of architecture in Bucharest, was gravely damaged."

If you are interested in these problems or have information which could be of help to our Romanian colleagues, please contact the chairman of the AMS Committee on Service to Mathematicians in Third World Countries:

Professor Raymond Ayoub
Department of Mathematics
The Pennsylvania State University
University Park, PA 16802
email: RGA1@PSUVM.BITNET,

who will act as a coordinator of individual efforts in this matter.

Polish Mathematical Publications

The Society received a letter from Professor Stefan Rolewicz of the Mathematics Institute of the Polish Academy of Sciences. Professor Rolewicz stated that, as of January 1990, the Banach Center Publications and the following mathematical journals are published and distributed by the Institute:

Acta Arithmetica
Annales Polonici Mathematici
Applicationes Mathematicae (*Zastosowania Matematyki*)
Colloquium Mathematicum
Dissertationes Mathematicae (*Rozprawy Matematyczne*)
Fundamenta Mathematicae, and
Studia Mathematica.

Professor Rolewicz wrote that he would appreciate publication of this information to help support the Polish mathematical community. Scientific research there has met with difficult times as a result of Polish economic instability, he said.

All inquiries concerning subscriptions, sale, exchange, etc., should be sent to Professor Rolewicz at the following address:

Mathematical Institute
ul. Śniadeckich 8
P. O. Box 137
PL-00-950 Warszawa
Poland

Telexes may be sent to Professor Rolewicz at the number PL 816112.

1990 AMS Elections

Nominations by Petition

Vice-President or Member-at-Large

One position of vice-president and member of the Council ex officio for a term of two years is to be filled in the election of 1990. The Council intends to nominate two candidates, whose names may be expected to appear in the June issue of *Notices*, which is scheduled to be mailed by the printer on 23 May. Nominations by petition as described in the rules and procedures are acceptable.

Five positions of member-at-large of the Council for a term of three years are to be filled in the same election. The Council intends to nominate seven candidates, whose names may be expected to appear in the June *Notices*. Nominations by petition in the manner described in the rules and procedures are acceptable. The Council has stated its intent to have at least ten candidates and will bring the number up to ten if the nominations by petition do not do so.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions.

Prior to presentation to the Council, petitions in aid of a candidate for the position of vice-president or of member-at-large of the Council must have at least 50 valid signatures and must conform to several rules and operational considerations, which are described below.

Editorial Boards Committee

Two places on the Editorial Boards Committee will be filled by election. There will be four continuing members of the Editorial Boards Committee, namely:

Linda Keen	Barry Simon
Carlos Kenig	Daniel Zelinsky

The new members will be elected in a preferential ballot. The President will name three candidates for these two places. The names may be expected to appear in the June issue of *Notices*. Nominations by petition, in the manner described in the rules and procedures, will be accepted. Should the final number of candidates be less than four, the President will bring it up to four.

The name of a candidate for member of the Editorial Boards Committee may be placed on the ballot by petition. The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations, described below, should be followed.

Nominating Committee

Three places on the Nominating Committee will be filled by election. There will be seven continuing members of the Nom-

inating Committee, namely:

Joan S. Birman	Ray A. Kunze
James E. Humphreys	Alan D. Weinstein
Barbara Lee Keyfitz	Robert F. Williams
Victor Klee	

The new members will be elected in a preferential ballot. The President will name five candidates for these three places. The names may be expected to appear in the June issue of *Notices*. Nominations by petition, in the manner described in the rules and procedures, will be accepted. Should the final number of candidates be less than six, the President will bring it up to six.

The name of a candidate for member of the Nominating Committee may be placed on the ballot by petition. The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations, described below, should be followed.

Rules and Procedures

Use separate copies of the form for each candidate for vice-president, member-at-large, or member of the Nominating and Editorial Boards Committees.

1. To be considered, petitions must be addressed to Robert M. Fossum, Secretary, P.O. Box 6248, Providence, Rhode Island 02940, and must arrive by 6 July 1990.

2. The name of the candidate must be given as it appears in the *Combined Membership List*. If the name does not appear in the list, as in the case of a new member or by error, it must be as it appears in the mailing lists, for example on the mailing label of the *Notices*. If the name does not identify the candidate uniquely, append the member code, which may be obtained from the candidate's mailing label or the Providence office.

3. The petition for a single candidate may consist of several sheets each bearing the statement of the petition, including the name of the position, and signatures. The name of the candidate must be exactly the same on all sheets.

4. On the next page is a sample form for petitions. Copies may be obtained from the Secretary; however, petitioners may make and use photocopies or reasonable facsimiles.

5. A signature is valid when it is clearly that of the member whose name and address is given in the left-hand column.

6. The signature may be in the style chosen by the signer. However, the printed name and address will be checked against the *Combined Membership List* and the mailing lists. No attempt will be made to match variants of names with the form of name in the CML. A name neither in the CML nor on the mailing lists is not that of a member. (Example: The name Robert M. Fossum is that of a member. The name R. Fossum appears not to be.)

7. When a petition meeting these various requirements appears, the Secretary will ask the candidate whether he is willing to have his name on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.

NOMINATION PETITION FOR 1990 ELECTION

The undersigned members of the American Mathematical Society propose the name of

as a candidate for the position of (check one):

- ☐ **Vice-President**
- ☐ **Member-at-Large of the Council**
- ☐ **Member of the Nominating Committee**
- ☐ **Member of the Editorial Boards Committee**

of the American Mathematical Society for a term beginning 1 January, 1991.

Name and Address (printed or typed)

Signature

Signature

Signature

Signature

Signature

Signature

University Park, Pennsylvania State University April 7 – 8

Program

The eight-hundred-and-fifty-seventh meeting of the American Mathematical Society will be held at the Pennsylvania State University in University Park, Pennsylvania, on Saturday, April 7, and Sunday, April 8, 1990. This meeting will be held in conjunction with a meeting of the Association for Symbolic Logic (ASL).

Invited Addresses

By invitation of the Eastern Section Program Committee, there will be four invited addresses. The speakers, their affiliations, the titles of their talks where available, and the scheduled times of presentation are:

ROBERT T. GLASSEY, Indiana University, *On collisionless plasmas and the Vlasov-Maxwell equations*, 11:00 a.m. Sunday.

KARSTEN GROVE, University of Maryland, College Park, *Geometry and topology of manifolds curved from below*, 1:30 p.m. Sunday.

LOWELL EDWIN JONES, State University of New York at Stony Brook, *Rigidity for non-positively curved manifolds*, 11:00 a.m. Saturday.

GANG TIAN, Princeton University, *Einstein metrics on algebraic manifolds*, 1:30 p.m. Saturday.

Special Sessions

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

Classical and quantum groups, RANEE KATHRYN BRYLINSKI, Pennsylvania State University.

Algebraic topology, DONALD M. DAVIS, Lehigh University.

Geometric topology, THOMAS FARRELL, Columbia University.

Recent progress on Einstein manifolds and related topics, GANG TIAN.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Late papers will not be accommodated.

Registration

The meeting registration desk will be located in the lobby of the Keller Conference Center. The registration fees are \$30 for members of the AMS or ASL, \$45 for nonmembers, and \$10 for students and unemployed mathematicians.

Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Louisville meeting announcement in the October 1989 issue of *Notices*.

Activities of Other Organizations

The Pennsylvania Prognostic Testing Conference will be held on Friday, April 6, from 1:30 p.m. to 4:30 p.m. BERT K. WAITS, Ohio State University, will discuss the *Ohio Early Mathematics Placement Testing Program*. JOHN G. HARVEY, the University of Wisconsin, Madison, will briefly describe prognostic testing programs in the United States and discuss the effects of calculators on mathematics testing.

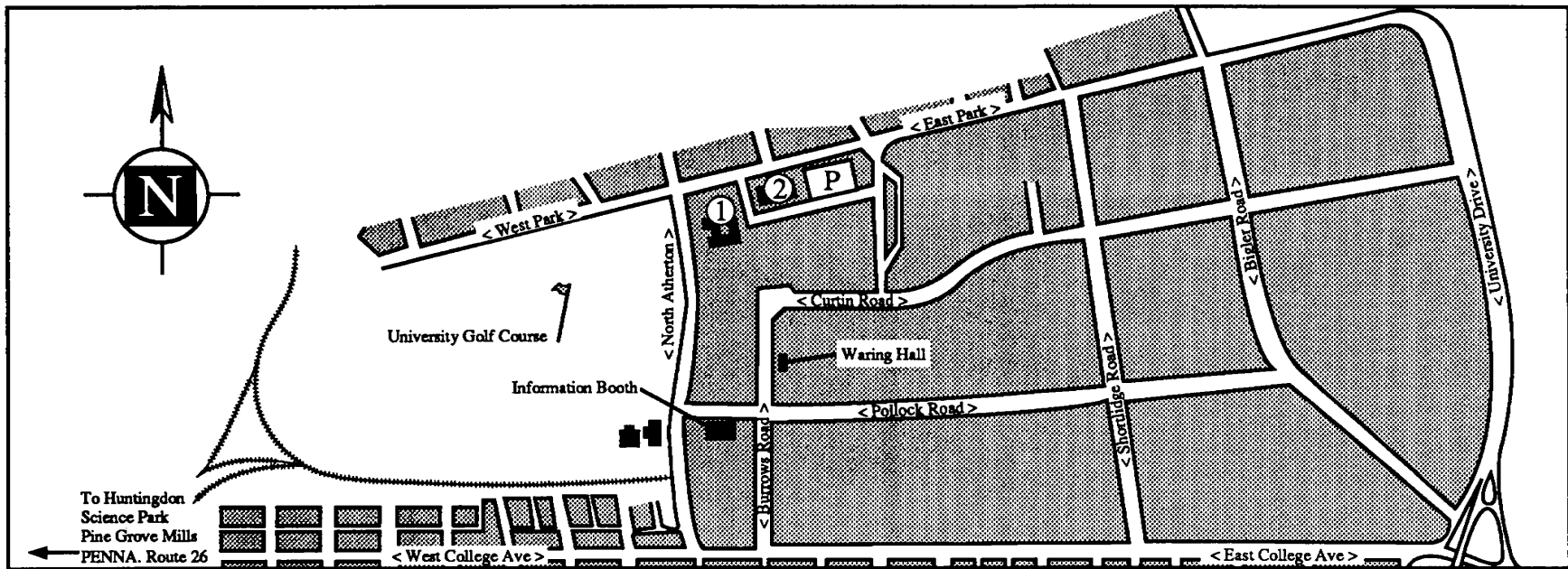
The ASL will have three invited one-hour addresses. The speakers are HARVEY M. FRIEDMAN, Ohio State University, Columbus; LEONARD LIPSCHITZ, Purdue University; and ATHANASIOS C. PHEIDAS, the University of Illinois at Urbana-Champaign.

The ASL and the AMS will co-sponsor a symposium on *Number theory and decidability* to be moderated by BARRY MAZUR, Harvard University, and STEPHEN G. SIMPSON, Pennsylvania State University. The panelists will be SERGE LANG, Yale University, ANGUS MACINTYRE, Oxford University, and LOU VAN DEN DRIES, the University of Illinois, Urbana.

Social Event

A wine and beer reception will be held Saturday evening, April 7, from 5:00 p.m. to 7:30 p.m. in the Fireside Lounge at the Nittany Lion Inn. The admission price is \$5 per person.

PENNSYLVANIA STATE UNIVERSITY



1 – Nittany Lion Inn 2 – Conference Center P – Parking

Accommodations

A block of rooms has been reserved at each of the following hotels/motels. The American Mathematical Society is not responsible for rate changes or accommodations offered by hotels/motels.

Nittany Lion Inn

North Atherton Street,
University Park, PA 16802
Telephone: 814-231-7500

Single \$58 Double \$68

Hampton Inn

1101 East College Avenue,
University Park, PA 16802
Telephone: 814-231-1590

Single \$46 Double \$50

Sheraton/Days Inn

240 South Street,
University Park, PA 16802
Telephone: 814-238-8454

Single \$53 Double \$63

Food Service

The Nittany Lion Inn, adjacent to the Keller Conference Center, has a full service restaurant offering breakfast, lunch, and dinner. Complete listings will be available at the meeting registration desk.

Travel

US Air/Allegheny Commuter Airlines serve the State College area through the University Park Airport located five miles from campus. Limousine or taxi service is available for all flights. For reservations and information on US Air/Allegheny Commuter, please call 814-238-8414 or 800-428-4253. By bus, Trailways and Greyhound Lines connections are available to and from State College. For Trailways information, please call 814-238-7362; for Greyhound information, please call 814-237-5865. If traveling by car, University Park is readily accessible from both ends of the state via Interstate 80 (I-80).

Parking

Parking is available on campus for a fee of \$2 on Monday through Friday. There is no parking fee on Saturday. Parking permits will be available at the registration desk located in the Keller Conference Center.



UNFOLDINGS AND BIFURCATIONS OF QUASI-PERIODIC TORI

H. W. Broer, B. Huitema, F. Takens, and B. L. J. Braaksma

(Memoirs of the AMS, Number 421)

In the theory of dynamical systems, the occurrence of equilibria and periodic motions, as well as their general persistence and stability properties, are now fairly well understood. Researchers also have some systematic insight into the role of external parameters. This book aims to mimic this classical theory in the case of quasi-periodic motions. These motions are most familiar in the context of the conservative dynamics of classical mechanics, but they also occur with dissipative dynamics—for example, quasi-periodic attractors play a role in the onset of turbulence.

In the first part of the book, the authors present a general treatment of the use of external parameters in various contexts, employing notions such as integrability and transversality. The second part, dealing only with dissipative cases, studies bifurcations when the hyperbolicity is mildly violated. Readers will appreciate the way the book systematically ties together a number of cases of quasi-periodicity and the resulting improvement of accuracy. In addition, a number of new applications are presented.

1980 *Mathematics Subject Classifications*: 58, 34
ISBN 0-8218-2483-X, LC 89-18093

ISSN 0065-9266

188 pages (softcover), January 1990

Individual member \$13, List price \$22,
Institutional member \$18

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All prices subject to change. Shipment will be made by surface. For air delivery add, 1st book \$5, each additional book \$3, maximum \$100. *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.

Program of the Sessions

The time limit for each contributed paper in the sessions is ten minutes. In the special sessions, the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

Abstracts of papers presented in the sessions at this meeting will be found in the April 1990 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

Saturday, April 7

Special Session on Classical and Quantum Groups, I

9:00 a.m.–10:50 a.m. Room 501, Keller Conference Center

- 9:00 a.m. *Sequences of divided powers in coalgebras and Hopf algebras.*
(1) **Earl J. Taft**, Rutgers University, New Brunswick (857-16-13)
- 9:30 a.m. *Quantum $GL(n)$ and q -Schur algebras.*
(2) **Richard Dipper**, University of Oklahoma (857-20-07)
- 10:00 a.m. *Integral and modular representations of q -Schur algebras.* Preliminary report.
(3) **Jie Du** and **Leonard Scott***, University of Virginia (857-20-65)
- 10:30 a.m. *Symbols and modular forms.*
(4) **Alvany Rocha*** and **Carlos J. Moreno**, Graduate School and University Center, City University of New York (857-17-53)

Special Session on Algebraic Topology, I

9:00 a.m.–10:50 a.m. Room 507, Keller Conference Center

- 9:00 a.m. *Chern character for proper Γ -manifolds.*
(5) **Hitoshi Moriyoshi**, Pennsylvania State University, University Park (857-55-55)
- 9:30 a.m. *Noncompact hyperbolic 3-orbifolds of small volume.*
(6) **Colin Adams**, Williams College (857-57-30)
- 10:00 a.m. *Geometry of the space of knots.* Preliminary report.
(7) **Jean-Luc Brylinski**, Pennsylvania State University, University Park (857-57-17)
- 10:30 a.m. *Adams operations in Hochschild and cyclic homology and applications to the topology of free loop spaces.* Preliminary report.
(8) **Dan Burghel**, **Z. Fiedorowicz** and **W. Gajda**, Ohio State University, Columbus (857-55-71)

Special Session on Recent Progress on Einstein Manifolds and Related Topics, I

9:00 a.m.–10:50 a.m. Room 506, Keller Conference Center

- 9:00 a.m. *Compactness for families of constant mean curvature surfaces.* Preliminary report.
(9) **Rob Kusner**, University of Massachusetts, Amherst (857-53-16)
- 9:30 a.m. *Which 2-tensors can be Ricci tensors? (The rotationally symmetric case).*
(10) **Jianguo Cao**, Institute for Advanced Study (857-53-45)
- 10:00 a.m. *A construction of scalar-flat Kähler surfaces.*
(11) **Claude LeBrun**, Institute for Advanced Study and State University of New York, Stony Brook (857-53-47)
- 10:30 a.m. *The characterized standard sphere by the spectrum.*
(12) **Xingwang Xu***, University of Connecticut, Storrs, and **Paul C. Yang**, University of Southern California (857-58-46)

Special Session on Geometric Topology, I

9:30 a.m.–10:50 a.m. Room 502, Keller Conference Center

- 9:30 a.m. *An extension of simple-homotopy theory.* Preliminary report.
(13) **Steven C. Ferry**, State University of New York, Binghamton (857-55-44)
- 10:00 a.m. *Local properties of decomposition spaces.*
(14) **Steve Armentrout**, Pennsylvania State University, University Park (857-57-14)
- 10:30 a.m. *The relationship between the boundedly controlled K_1 and Whitehead groups.*
(15) **Douglas R. Anderson**, Syracuse University (857-57-19)

Session on Convergence Problems and Differential Equations

9:35 a.m.–10:45 a.m. Room 508, Keller Conference Center

- 9:35 a.m. *Means and Taylor polynomials.*
(16) **Alan Horwitz**, Pennsylvania State University, Media (857-26-67)
- 9:50 a.m. *Comparison theorems for the ν -zeroes of Legendre functions $P_\nu^m(z_0)$ when $-1 < z_0 < 1$.*
(17) **Frank E. Baginski**, George Washington University (857-33-33)
- 10:05 a.m. *Sequences of quotients and homogeneous functions.*
(18) **Alejandro Necochea***, University of Texas, Pan American, and **Larry F. Bennett**, South Dakota State University (857-40-61)
- 10:20 a.m. *A three point connection problem for a certain third order differential equation.*
(19) **T. K. Puttaswamy**, Ball State University (857-34-70)
- 10:35 a.m. *Reflection and jump boundaries associated with the process of capital accumulation.*
(20) **Guillermo Leon Gómez Martínez**, University of Erlangen-Nürnberg, Federal Republic of Germany (857-90-01)

Invited Address

11:00 a.m.–12:00 noon Room 104, Keller Conference Center

- (21) *Rigidity for non-positively curved manifolds.*
Lowell Edwin Jones, State University of New York, Stony Brook (857-18-39)

Invited Address

1:30 p.m.–2:30 p.m. Room 104, Keller Conference Center

- (22) *Einstein metrics on algebraic manifolds.*
Gang Tian, Princeton University (857-53-31)

Special Session on Classical and Quantum Groups, II

2:45 p.m.–5:05 p.m. Room 501, Keller Conference Center

- 2:45 p.m. *Irreducible representations of quantum groups at roots of 1.*
(23) **V. G. Kac**, Massachusetts Institute of Technology (857-17-25)
- 3:15 p.m. *Twisted vertex representations of quantum affine algebras.*
(24) **Naihuan Jing**, Institute for Advanced Study (857-17-32)

- 3:45 p.m. *Tangent bundles of reductive groups. Preliminary report.*
(25) **Ivan Mirkovic**, University of Massachusetts, Amherst (857-22-43)
- 4:15 p.m. *Cyclic homology of quantum groups.*
(26) **Boris Tsygan*** and **Ping Feng**, Harvard University (857-17-69) (Sponsored by Rane Kathryn Brylinski)
- 4:45 p.m. *Hidden quantum group symmetries and integrable perturbations of conformal field theories.*
(27) **Nikolai Reshetikhin**, Harvard University (857-17-68) (Sponsored by Rane Kathryn Brylinski)

Special Session on Algebraic Topology, II

2:45 p.m.–5:05 p.m. Room 507, Keller Conference Center

- 2:45 p.m. *K theory for bisimplicial algebras.*
(28) **Paul Baum*** and **Crichton Ogle**, Pennsylvania State University, University Park (857-55-58)
- 3:15 p.m. *A pairing theorem for group cohomology.*
(29) **Paul Baum** and **Crichton Ogle***, Pennsylvania State University, University Park (857-55-59)
- 3:45 p.m. *Cohomology of finite simple groups.*
(30) **Alejandro Adem***, Institute for Advanced Study, **John Maginnis**, University of Michigan, Ann Arbor, and **R. J. Milgram**, Stanford University (857-55-08)
- 4:15 p.m. *Rational functions and configuration spaces.*
(31) **Ralph L. Cohen**, Stanford University, and **Don H. Shimamoto***, Swarthmore College (857-55-50)
- 4:45 p.m. *Some features of the mod 2 cohomology ring of $B\text{Spin}(n)$ revealed by computer computations. Preliminary report.*
(32) **Jay A. Wood**, Bowdoin College and Lehigh University (857-55-37)

Special Session on Geometric Topology, II

2:45 p.m.–4:05 p.m. Room 502, Keller Conference Center

- 2:45 p.m. *Controlled topology and algebra over non-locally compact spaces. Preliminary report.*
(33) **Christopher W. Stark**, University of Maryland, College Park and University of Florida (857-57-34)
- 3:15 p.m. *Continuous cohomology and real homotopy type II.*
(34) **Edgar H. Brown**, Brandeis University, and **Robert H. Szczarba***, Yale University (857-55-42)
- 3:45 p.m. *Finitely generated module structures on the Nil-K-theory of group rings.*
(35) **Frank Connolly*** and **Mario Da Silva**, University of Notre Dame (857-57-63)

Saturday, April 7 (cont'd)

Special Session on Recent Progress on Einstein Manifolds and Related Topics, II

2:45 p.m.–5:05 p.m. Room 506, Keller Conference Center

- 2:45 p.m. *An inequality between energy and intersection.*
(36) **C. Croke***, University of Pennsylvania, and **A. Fathi**, University of Florida (857-53-35)
- 3:15 p.m. *The Ricci flow on compact 2-orbifolds with curvature negative somewhere.*
(37) **B. Chow***, Courant Institute of Mathematical Sciences, New York University, and **N. F. Wu**, University of California at San Diego, La Jolla (857-58-40) (Sponsored by Gang Tian)
- 3:45 p.m. *Isotopy irreducible Riemannian manifolds.*
(38) **Wolfgang Ziller***, University of Pennsylvania, and **M. Wang**, McMaster University (857-53-49)
- 4:15 p.m. *Kähler-Einstein metrics of positive scalar curvature: Global algebro-geometric criteria for existence.*
(39) **Alan M. Nadel**, Massachusetts Institute of Technology (857-53-24)
- 4:45 p.m. *Applications of Einstein metrics to moduli of Calabi-Yau manifolds.*
(40) **Andrey N. Todorov**, Max-Planck-Institute für Mathematik, Bulgaria (857-53-48)

Session on Algebra, Geometry, and Homotopy

2:45 p.m.–4:10 p.m. Room 508, Keller Conference Center

- 2:45 p.m. *On characterizations of quasi-cyclic submodules.*
(41) **Johnny A. Johnson**, University of Houston, University Park, and **Monty B. Taylor***, University of Texas, Pan American (857-13-62)
- 3:00 p.m. *Paths of unimodular vectors.*
(42) **Edward K. Hinson**, University of New Hampshire (857-13-09)
- 3:15 p.m. *Coproduct decompositions of finitely generated subsemigroups of free semigroups.*
(43) **Tom Head**, State University of New York, Binghamton (857-20-15)
- 3:30 p.m. *Convexity preserving summability matrices.*
(44) **C. R. Selvaraj**, Pennsylvania State University, Sharon (857-40-22)
- 3:45 p.m. *Subvarieties of Severi varieties.* Preliminary report.
(45) **Robert Treger**, Pennsylvania State University, Delaware County Campus (857-14-23)
- 4:00 p.m. *Basic dual homotopy invariants of Riemannian foliations.*
(46) **Peter Y. Pang**, National University of Singapore, Republic of Singapore (857-57-05)

Sunday, April 8

Special Session on Classical and Quantum Groups, III

8:30 a.m.–10:50 a.m. Room 501, Keller Conference Center

- 8:30 a.m. *Compactifications of symmetric spaces and buildings associated to classical groups.*
(47) **Paul Gerardin**, Pennsylvania State University, University Park (857-22-41)
- 9:00 a.m. *Quantum deformation of Flaj manifolds.*
(48) **Jacob Towber**, DePaul University (857-22-56) (Sponsored by J. Marshall Ash)
- 9:30 a.m. *Sklyanin algebras.*
(49) **S. Paul Smith***, University of Washington, and **J. T. Stafford**, University of Michigan, Ann Arbor (857-16-06)
- 10:00 a.m. *Deformation methods in quantum groups.*
(50) **Murray Gerstenhaber*** and **Anthony Giaquinto**, University of Pennsylvania (857-16-60)
- 10:30 a.m. *Finite dimensional algebras and quantum groups.*
(51) Preliminary report.
Brian Parshall, University of Virginia (857-20-64)

Special Session on Algebraic Topology, III

8:30 a.m.–10:50 a.m. Room 507, Keller Conference Center

- 8:30 a.m. *Spin^c cobordism determines complex K-theory.*
(52) Preliminary report.
Michael J. Hopkins, Massachusetts Institute of Technology, and **Mark Hovey***, University of New Haven (857-55-18)
- 9:00 a.m. *Splitting off H-spaces and Conner-Raymond splitting theorem.*
(53) **Giora Dula*** and **Daniel Gottlieb**, Purdue University, West Lafayette (857-55-57)
- 9:30 a.m. *Periodic families and connective cobordism via the classical Adams spectral sequence.*
(54) **Mark Mahowald**, Northwestern University, and **Paul Shick***, John Carroll University (857-55-51)
- 10:00 a.m. *Covering spaces as geometric models of cohomology operations.* Preliminary report.
(55) **Terrence P. Bisson***, Canisius College, and **André Joyal**, Université du Québec, Montréal (857-55-29)
- 10:30 a.m. *h_0 -torsion in the cohomology of subalgebras of the Steenrod algebra.*
(56) **Kenneth Monks**, Wilkes College (857-55-27)

Special Session on Geometric Topology, III

9:30 a.m.–10:50 a.m. Room 502, Keller Conference Center

- 9:30 a.m. *Closed incompressible surfaces of arbitrarily high genus in the complements of certain star knots.*
(57) **Richard F. Gustafson**, State University of New York, College at Oneonta (857-57-21)
- 10:00 a.m. *Branched covers of nonpositively curved manifolds.*
(58) **Michael Davis*** and **Ruth Charney**, Ohio State University, Columbus (857-57-10)
- 10:30 a.m. *A differential geometric characterization of symmetric spaces of higher rank.*
(59) **Patrick Eberlein***, University of North Carolina, Chapel Hill, and **Jens Heber**, Universität of Augsburg, Federal Republic of Germany (857-53-20)

Invited Address

11:00 a.m.– noon Room 104, Keller Conference Center

- (60) *On collisionless plasmas and the Vlasov-Maxwell equations.*
Robert T. Glassey, Indiana University, Bloomington (857-35-03)

Invited Address

1:30 p.m.–2:30 p.m. Room 104, Keller Conference Center

- (61) *Geometry and topology of manifolds curved from below.*
Karsten Grove, University of Maryland, College Park (857-53-38)

Special Session on Classical and Quantum Groups, IV

2:45 p.m.–4:35 p.m. Room 501, Keller Conference Center

- 2:45 p.m. *Decompositions of some S_n -modules arising in the free Lie algebra.*
(62) **Sheila Sundaram**, Université du Québec, Montréal (857-22-36)
- 3:15 p.m. *A Bernstein-Beilinson theorem for $U_q(\mathfrak{sl}(2))$.*
(63) Preliminary report.
T. J. Hodges, University of Cincinnati (857-16-02)
- 3:45 p.m. *Schubert calculus for generalized cohomology.*
(64) **Paul Bressler**, Purdue University, West Lafayette, and **Sam Evens***, Rutgers University, New Brunswick (857-57-52)

- 4:15 p.m. *Good bases for G -modules.*
(65) **Olivier Mathieu**, Institute for Advanced Study (857-22-72)

Special Session on Algebraic Topology, IV

2:45 p.m.–4:35 p.m. Room 507, Keller Conference Center

- 2:45 p.m. *On the self-homotopy equivalences of an infinite cell complex.*
(66) **Joseph Roitberg**, Hunter College, City University of New York (857-55-28)
- 3:15 p.m. *Rational homotopy types with cohomology of stunted complex projective space.*
(67) **Gregory M. Lupton**, Dartmouth College, and **Ronald N. Umble***, Millersville University of Pennsylvania (857-55-26)
- 3:45 p.m. *2-Primary, v_1 -periodic homotopy of $SU(n)$.*
(68) **Martin Bendersky**, Hunter College, City University of New York (857-55-12) (Sponsored by Donald M. Davis)
- 4:15 p.m. *On splittings of the tangent bundles of 4-manifolds.*
(69) **Duane Randall**, Loyola University (857-55-11)

Special Session on Geometric Topology, IV

2:45 p.m.–4:05 p.m. Room 502, Keller Conference Center

- 2:45 p.m. *Group actions and cohomology of discrete groups.*
(70) **Alejandro Adem**, Institute for Advanced Study (857-57-04)
- 3:15 p.m. *Examples of lack of rigidity in crystallographic groups.*
(71) **Frank Connolly** and **Tadeusz Koźniewski***, University of Notre Dame (857-57-66)
- 3:45 p.m. *Topological realization of the Dennis trace.*
(72) **Ross Geoghegan**, State University of New York, Binghamton (857-57-54)

W. Wistar Comfort
Associate Secretary
Middletown, Connecticut

Presenters of Papers

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* AMS Special Session Speaker

- | | | | |
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ACCESSIBLE CATEGORIES: THE FOUNDATIONS OF CATEGORICAL MODEL THEORY

Michael Makkai and Robert Paré

(Contemporary Mathematics, Volume 104)

Intended for category theorists and logicians familiar with basic category theory, this book focuses on categorical model theory, which is concerned with the categories of models of infinitary first order theories, called accessible categories. The starting point is a characterization of accessible categories in terms of concepts familiar from Gabriel-Ulmer's theory of locally presentable categories. Most of the work centers on various constructions (such as weighted bilimits and lax colimits), which, when performed on accessible categories, yield new accessible categories. These constructions are necessarily 2-categorical in nature; the authors cover some aspects of 2-category theory, in addition to some basic model theory, and some set theory. One of the main tools used in this study is the theory of mixed sketches, in which the authors specialize to give concrete results about model theory. Many examples illustrate the extent of applicability of these concepts. In particular, some applications to topos theory are given.

Perhaps this book's most significant contribution is the way it sets model theory in categorical terms, opening the door for further work along these lines. Requiring a basic background in category theory, this book will provide readers with an understanding of model theory in categorical terms, familiarity with 2-categorical methods, and a useful tool for studying toposes and other categories.

1980 *Mathematics Subject Classifications*: 18C10, 03G30, 03C95, 18D05; 18B25, 03E55, 03C75

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Albuquerque, New Mexico

University of New Mexico

April 19 – 21

Program

The eight-hundred-and-fifty-eighth meeting of the American Mathematical Society will be held at the Sheraton Old Town Hotel in Albuquerque, New Mexico, on Thursday, April 19, Friday, April 20, and Saturday, April 21, 1990. This meeting is being held in cooperation with the Society for Industrial and Applied Mathematics (SIAM) and being hosted by the University of New Mexico.

Invited Addresses

By invitation of the Far Western Section Program Committee, and in cooperation with SIAM, there will be six invited addresses. The speakers, their affiliations, and the titles of their talks are:

DAVID CAMPBELL, Los Alamos National Laboratory, *Solitary waves and their interactions in non-integrable nonlinear partial differential equations*, 11:00 a.m. Saturday.

PETER B. GILKEY, University of Oregon, *Can one hear the shape of a drum?*, 11:30 a.m. Thursday

GERHARD KRISTENSSON, Lund University, *Recent development in time domain inverse scattering theory using invariant imbedding techniques*, 11:30 a.m. Friday.

ROBERT M. MAY, Oxford University, *Transmission dynamics of HIV/AIDS*, 1:30 p.m. Saturday.

ALAN C. NEWELL, University of Arizona, *Convection patterns in large containers*, 5:00 p.m. Thursday.

MARC A. RIEFFEL, University of California, Berkeley, *Quantum groups and operator algebras*, 5:00 p.m. Friday.

Special Sessions

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

Numerical solution of partial differential equations, RICHARD C. ALLEN, Sandia National Laboratory, JOSÉ CASTILLO, San Diego State University, and STANLEY STEINBERG, University of New Mexico.

Geometry and topology of moduli spaces, CHARLES P. BOYER, and BENJAMIN M. MANN, University of New Mexico.

Real algebraic geometry, MICHAEL A. BUCHNER, University of New Mexico, and WOJCIECH KUCHARZ, University of Hawaii and University of New Mexico.

Dynamical systems: low dimensional behavior in partial differential equations, DAVID CAMPBELL, and JAMES M. HYMAN, Los Alamos National Laboratory.

Invariant imbedding and inverse problems, JAMES CORONES, Ames Laboratory, PAUL NELSON, Texas A&M, and DANIEL SETH, Ames Laboratory.

Differential geometry, HOWARD FEGAN and ALEXANDER P. STONE, University of New Mexico.

Mathematical biology, JAMES M. HYMAN, W. T. KYNER, University of New Mexico, ANN STANLEY, Los Alamos National Laboratory, DEBORAH SULSKY, University of New Mexico, and CARLA WOFSY, University of New Mexico.

Contributed Papers

There will also be a session for contributed ten-minute papers. Late papers will not be accommodated.

Council

The Council of the AMS will meet at 7:00 p.m. on Thursday, April 19, 1990, in the Fireplace Room at the Sheraton Old Town Hotel.

Activities of Other Organizations

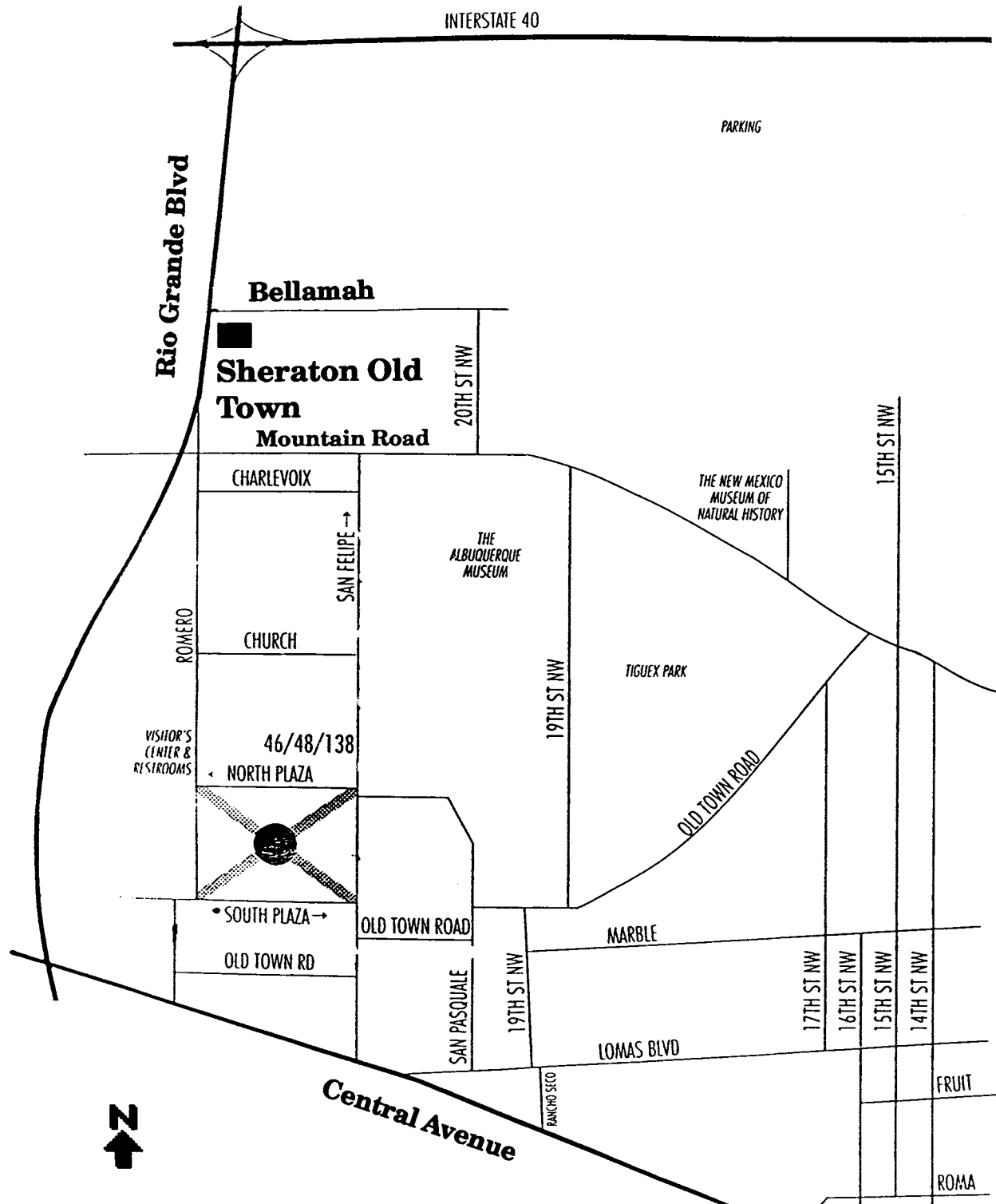
The Great Plains Operator Theory Seminar is being held at the Sheraton Old Town Hotel, April 19-21, 1990.

Registration

The meeting registration desk is located in the lobby of the Sheraton Old Town Hotel. The meeting registration desk is open from 6:00 p.m. to 9:00 p.m. on Wednesday, April 18, and from 8:00 a.m. to noon on Thursday, April 19, Friday, April 20, and Saturday, April 21.

The registration fee is \$45, with a special \$25 fee for graduate students and unemployed mathematicians, and a one-day fee of \$25.

Albuquerque, New Mexico



Social Event

On Friday evening, April 20, there will be a reception and a no-host bar at the New Mexico Museum of Natural History. During the evening participants will have exclusive access to most of the exhibits at this outstanding museum.

Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Louisville meeting announcement in the October 1989 issue of *Notices*.

David II Report

The special presentation and discussion scheduled at the reception Friday evening concerning the upcoming National Research Council David II Report has been cancelled.

Accommodations

A block of rooms is being held at the Sheraton Old Town Hotel and at the Rio Grande Inn, which is within walking distance. Participants should make their own reservations directly with the hotels listed below and identify themselves as participants of the AMS and SIAM meeting in order to obtain the rates listed. Participants must make reservations 45 days in advance of the meeting to be assured of the quoted rates. The American Mathematical Society is not responsible for rate changes or accommodations offered by hotels/motels in the following list.

Sheraton Old Town Hotel

800 Rio Grande Boulevard NW
Albuquerque, NM 87104
Telephone: 505-843-6300 or 800-237-2133

Single or Double \$53

Rio Grande Inn

1015 Rio Grande Boulevard NW
Albuquerque, NM 87104
Telephone: 505-843-9500

Single \$29

Double \$32

Food Service

There are a number of restaurants on the square and in the downtown area. Complete listings are available at the meeting registration desk.

Travel

The Albuquerque Airport is served by most airlines. Both the Sheraton Old Town Hotel and the Rio Grande Inn provide free airport shuttle service. The Albuquerque City Bus (Sun-Tran) runs from the airport through the downtown area at seven minutes after the hour, and at thirty-seven minutes after the hour. The Sun-Tran Bus number is #50. Participants may board the bus on the west side of the airport on the lower level and the fare is sixty cents one-way. Cab service is also available for approximately \$7 one-way.

Weather and Local Attractions

April temperatures in Albuquerque are mild, although participants are advised to bring a sweater or light jacket. Nearby ski areas may still be open at the time of the meeting. Old Town, in Albuquerque, has a historic plaza, Museum of Art, Museum of Natural History, and many restaurants, shops, and galleries. Albuquerque is also home to the world's longest tramway, the Sandia Peak Tramway.

Program of the Sessions

The time limit for each contributed paper in the sessions is ten minutes. In the special sessions, the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

Abstracts of papers presented in the sessions at this meeting will be found in the April 1990 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

Thursday, April 19

AMS Special Session on Real Algebraic Geometry, I

8:30 a.m.–10:50 a.m. Potters Room, Sheraton Old Town Hotel

- 8:30 a.m. *Elliptic curves and real algebraic morphisms into*
(1) *2-spheres.*
Wojciech Kucharz, University of Hawaii, Honolulu (858-14-91)
- 9:00 a.m. *Some new results on the topology of nonsingular real*
(2) *algebraic sets.*
Selman Akbulut*, Michigan State University, and
Henry King, University of Maryland, College Park (858-57-65)
- 9:30 a.m. *Relative real holomorphy rings.*
(3) **M. Buchner***, University of New Mexico, and **W. Kucharz**, University of Hawaii, Honolulu (858-14-48)
- 10:00 a.m. *Real algebraic tranformation groups.*
(4) **Karl Heinz Dovermann**, University of Hawaii, Honolulu (858-57-49)
- 10:30 a.m. Discussion

AMS Special Session on Invariant Embedding and Inverse Problems, I

8:30 a.m.–10:50 a.m. Weaver Room, Sheraton Old Town Hotel

- 8:30 a.m. *An electromagnetic inverse problem in medical*
(5) *science.*
Richard A. Albanese* and **John W. Penn**, Radiation Sciences Division, Brooks AFB, Texas (858-35-10)
- 9:00 a.m. *The inverse scattering problem for hyperbolic systems*
(6) *in semi-infinite media.*
Isam S. Ayoubi, King Fahd University of Petroleum and Minerals, Saudi Arabia (858-35-20) (Sponsored by Faruk F. Abi-Khuzam)

- 9:30 a.m. *Invariant imbedding, layer-stripping, and impedance*
(7) *imaging.* Preliminary report.
Margaret Cheney* and **David Isaacson**, Rensselaer Polytechnic Institute (858-35-13)
- 10:00 a.m. *Exact and approximate solutions of the (Helmholtz)*
(8) *Weyl composition equation in direct and inverse scattering.*
Louis Fishman, Colorado School of Mines (858-35-06)
- 10:30 a.m. *Inverse problems in underwater acoustics.*
(9) **Robert P. Gilbert*** and **Y. Xu**, University of Delaware (858-35-22)

AMS Invited Address

- 11:30 a.m.–12:20 p.m.** Rio Grande Ballroom, Sheraton Old Town Hotel
- (10) *Can one hear the shape of a drum?*
Peter B. Gilkey, University of Oregon (858-58-11)

AMS Special Session on Geometry and Topology of Moduli Spaces, I

2:00 p.m.–5:00 p.m. Isleta Room, Sheraton Old Town Hotel

- 2:00 p.m. *The topology of certain holomorphic mapping spaces.*
(11) **Benjamin M. Mann***, University of New Mexico, and **R. James Milgram**, Stanford University (858-58-44)
- 2:30 p.m. *On the structure of certain spaces of polynomials.*
(12) Preliminary report.
Martin Guest, University of Rochester (858-55-35)
- 3:00 p.m. *On some spaces of real algebraic cycles.* Preliminary report.
(13) **T. K. Lam**, State University of New York, Stony Brook (858-55-36)
- 3:30 p.m. *Rational functions, Cayley-Dickson algebras, and the*
(14) *Whitehead product.* Preliminary report.
Fred Cohen, University of Rochester (858-55-66)
- 4:00 p.m. Discussion

AMS Special Session on Differential Geometry, I

2:00 p.m.–5:00 p.m. Potters Room, Sheraton Old Town Hotel

- 2:00 p.m. *Finiteness of diffeomorphism types of isospectral manifolds.*
(15) **Robert Brooks***, University of California, Los Angeles, **Peter Perry**, University of Kentucky, and **Peter Petersen, V**, University of California, Los Angeles (858-58-18)
- 2:30 p.m. *Vibrating fractal drums, the Weyl-Berry problem for the eigenvalues of the Laplacian, and spectral zeta-functions.* Preliminary report.
(16) **Michel L. Lapidus**, University of Georgia (858-58-33)
- 3:00 p.m. *The spectrum of a surface of revolution.* Preliminary report.
(17) **Martin Engman**, University of New Mexico (858-53-89)
- 3:30 p.m. *The functional determinant and eta invariant in 3 and 4 dimensions.*
(18) **Thomas P. Branson**, University of Iowa (858-53-77)
- 4:00 p.m. *The isospectral problem on manifolds with boundary.*
(19) **Matthew J. Gursky**, California Institute of Technology (858-58-63)
- 4:30 p.m. Discussion

AMS Special Session on Numerical Solution of Partial Differential Equations, I

2:00 p.m.–5:00 p.m. Jemes Room, Sheraton Old Town Hotel

- 2:00 p.m. *Symmetric differencing of symmetric operators.*
(20) **Stanly Steinberg***, University of New Mexico, and **Patrick J. Roache**, Ecodynamics Research Associates Inc., Albuquerque, New Mexico (858-39-54)
- 2:30 p.m. *High order finite volume approximations of differential operators on nonuniform grids.*
(21) **James M. Hyman*** and **Robert J. Knapp**, Los Alamos National Laboratory (858-65-71)
- 3:00 p.m. *On discretization errors in the numerical solution of PDE's on generalized coordinate meshes.*
(22) **Richard G. Hindman**, Iowa State University (858-35-83) (Sponsored by Stanly L. Steinberg)
- 3:30 p.m. *Multipoint constraints through projection operators with applications to the finite element method.*
(23) **Howard L. Schreyer**, University of New Mexico (858-65-84) (Sponsored by Stanly L. Steinberg)
- 4:00 p.m. *Conservative, staggered grid discretization for general curvilinear coordinates.*
(24) **Marcel Vinokur**, Sterling Software, Palo Alto, California (858-39-92) (Sponsored by Stanly L. Steinberg)

- 4:30 p.m. *Supraconvergent difference schemes for high performance computational problems.*
(25) **Andrew B. White, Jr.**, Los Alamos National Laboratory (858-35-98) (Sponsored by Stanly L. Steinberg)

AMS Invited Address

5:00 p.m.–5:50 p.m. Rio Grande Ballroom, Sheraton Old Town Hotel

- (26) *Convection patterns in large containers.*
Alan C. Newell, University of Arizona (858-99-95)

AMS Council

7:00 p.m.– Fireplace Room, Sheraton Old Town Hotel

Friday, April 20

AMS Special Session on Geometry and Topology of Moduli Spaces, II

8:30 a.m.–10:50 a.m. Isleta Room, Sheraton Old Town Hotel

- 8:30 a.m. *Morse theory and the hyperkähler geometry of $k = 2$ instantons on S^4 .*
(27) **Charles P. Boyer*** and **Benjamin M. Mann**, University of New Mexico (858-58-45)
- 9:00 a.m. *Monopoles, braid groups and the Dirac operator.*
(28) **Ralph L. Cohen***, Stanford University, and **John Jones**, Mathematical Sciences Research Institute, Berkeley (858-55-56)
- 9:30 a.m. *Metric properties of monopole moduli spaces.*
(29) Preliminary report.
Jacques Hurtubise, McGill University (858-53-67)
- 10:00 a.m. *The moduli space of instantons.*
(30) **Ralph L. Cohen**, Stanford University, and **John Jones***, Mathematical Sciences Research Institute, Berkeley (858-55-57)
- 10:30 a.m. Discussion

AMS Special Session on Real Algebraic Geometry, II

8:30 a.m.–10:50 a.m. Potters Room, Sheraton Old Town Hotel

- 8:30 a.m. *Convex sets and metrics over non-archimedean ordered fields.*
(31) **Robert O. Robson**, Oregon State University (858-46-81)

Friday, April 20 (cont'd)

- 9:00 a.m. *Noncommutative real algebraic geometry*. Preliminary report.
(32) **Victoria Powers**, Emory University (858-14-74)
- 9:30 a.m. *Separating ideals*. Preliminary report.
(33) **James Madden**, Indiana University, South Bend (858-14-69)
- 10:00 a.m. *Suprema of infima of rational functions*. Preliminary report.
(34) **Charles N. Delzell**, Louisiana State University, Baton Rouge (858-14-80)
- 10:30 a.m. Discussion

AMS Special Session on Dynamical Systems: Low Dimensional Behavior in Partial Differential Equations, I

- 8:30 a.m.–10:50 a.m.** Jemes Room, Sheraton Old Town Hotel
- 8:30 a.m. *Calculating stable and unstable manifolds*.
(35) **Eric J. Kostelich***, Arizona State University, **James A. Yorke** and **Zhiping You**, University of Maryland, College Park (858-34-40)
- 9:00 a.m. *Homoclinic chaos and vorticity explosions in Navier-Stokes flows*.
(36) **Basil Nicolaenko**, Arizona State University (858-76-39)
- 9:30 a.m. Discussion

AMS Special Session on Mathematical Biology, I

- 8:30 a.m.–10:50 a.m.** Sandia Room, Sheraton Old Town Hotel
- 8:30 a.m. *Numerical methods for structured population models*.
(37) **Deborah Sulsky**, University of New Mexico (858-92-94)
- 9:00 a.m. Discussion and Open Problems

AMS Special Session on Invariant Embedding and Inverse Problems, II

- 8:30 a.m.–10:50 a.m.** Weaver Room, Sheraton Old Town Hotel
- 8:30 a.m. *Tomography with diffusion*.
(38) **F. Alberto Grunbaum**, University of California, Berkeley (858-60-29) (Sponsored by Paul Nelson)
- 9:00 a.m. *Wave propagation in gyrotropic media*.
(39) **Anders Karlsson***, **Henrik Otterheim**, Stockholm, Sweden, and **Gerhard Kristensson**, Lund University, Sweden (858-35-30) (Sponsored by Paul Nelson)

- 9:30 a.m. *A wave splitting approach to transient electromagnetic scattering for the dispersive sphere*. Preliminary report.
(40) **Kevin Kreider**, University of Akron (858-78-15) (Sponsored by Subramaniya I. Hariharan)
- 10:00 a.m. *An optimization problem in electromagnetic wave propagation*.
(41) **Robert Ochs***, University of Toledo, and **Curtis Vogel**, Montana State University (858-78-16)
- 10:30 a.m. *Inverse scattering for electromagnetically dispersive media*. Preliminary report.
(42) **Thomas M. Roberts*** and **Mike Hobart**, Ames Laboratory, Ames, Iowa (858-78-31) (Sponsored by Paul Nelson)

AMS-SIAM Invited Address

- 11:30 a.m.–12:20 p.m.** Rio Grande Ballroom, Sheraton Old Town Hotel
- (43) *Recent development in time domain inverse scattering theory using invariant imbedding techniques*.
Gerhard Kristensson, Lund University, Sweden (858-78-61) (Sponsored by Paul Nelson)

AMS Special Session on Geometry and Topology of Moduli Spaces, III

- 2:00 p.m.–4:50 p.m.** Isleta Room, Sheraton Old Town Hotel
- 2:00 p.m. *Vortices and stable bundles*.
(44) **Steve Bradlow**, University of California at San Diego, La Jolla (858-58-37)
- 2:30 p.m. *Real analytic structures on the moduli space of curves*.
(45) **Michael Wolf**, Rice University (858-58-46)
- 3:00 p.m. *Vortices on asymptotically Euclidean Riemann surfaces*.
(46) **Yisong Yang**, University of New Mexico (858-58-47)
- 3:30 p.m. *The geometry of complex superspaces*. Preliminary report.
(47) **D. Sundararaman**, University of California at San Diego, La Jolla (858-58-90)
- 4:00 p.m. *Closed string field theory: Topology and convolution algebra*. Preliminary report.
(48) **Jim Stasheff**, University of North Carolina, Chapel Hill (858-55-58)
- 4:30 p.m. Discussion

AMS Special Session on Differential Geometry, II

2:00 p.m.–5:00 p.m. Potters Room, Sheraton Old Town Hotel

- 2:00 p.m. *Spectral invariants for the conformal Laplacian.*
(49) Preliminary report.
Paul Yang, University of Southern California (858-53-82)
- 2:30 p.m. *Hamilton-Jacobi distributions and the Lorentz force law.*
(50) **Geoffrey Martin**, University of Toledo (858-53-09)
- 3:00 p.m. *An algorithm for exact linearization.* Preliminary report.
(51) **Robert B. Gardner***, University of North Carolina, Chapel Hill, and **William F. Shadwick**, University of Waterloo (858-93-21)
- 3:30 p.m. *Local existence of multivalued solutions to simplectic Monge Ampere equations.*
(52) **Marek Kossowski**, University of South Carolina, Columbia (858-35-96) (Sponsored by Robert B. Gardner)
- 4:00 p.m. *Absolute equivalence of differential systems and dynamic feedback linearization.* Preliminary report.
(53) **William F. Shadwick**, University of Waterloo (858-34-12)
- 4:30 p.m. Discussion

AMS Special Session on Mathematical Biology, II

2:00 p.m.–5:00 p.m. Sandia Room, Sheraton Old Town Hotel

- 2:00 p.m. *Stochastic and deterministic models of HIV transmission in IVDU populations.*
(54) **Michael Altmann***, **Keith Willard**, **Denton Peterson** and **Laël Gatewood**, University of Minnesota, Minneapolis (858-92-73)
- 2:30 p.m. *Modeling early stages of HIV infection.*
(55) **Stephen J. Merrill**, Marquette University (858-92-60) (Sponsored by Walter T. Kyner)
- 3:00 p.m. *Modeling the effects of HIV on the human immune system.*
(56) **Alan S. Perelson**, Los Alamos National Laboratory (858-92-72) (Sponsored by James M. Hyman)
- 3:30 p.m. *Functional differential equations in age-structured AIDS epidemic models.*
(57) **Jia Li***, Los Alamos National Laboratory, and **Hisashi Inaba**, University of Leiden, The Netherlands (858-92-42)
- 4:00 p.m. Discussion

AMS Special Session on Numerical Solution of Partial Differential Equations, II

2:00 p.m.–5:00 p.m. Jemes Room, Sheraton Old Town Hotel

- 2:00 p.m. *Multilevel adaptive methods for partial differential equations.*
(58) **Steve McCormick**, University of Colorado, Denver (858-65-85) (Sponsored by David E. Womble)
- 2:30 p.m. *A parallel time stepping algorithm for nonlinear equations.*
(59) **David E. Womble*** and **Lorraine S. Baca**, Sandia National Laboratories, Albuquerque, New Mexico (858-65-87)
- 3:00 p.m. *Lattice gas methods for hydrodynamics.*
(60) **Gary Doolen**, Los Alamos National Laboratory (858-65-88) (Sponsored by David E. Womble)
- 3:30 p.m. *Solution of PDEs on a hypercube: Algorithms and applications.*
(61) **Robert E. Benner**, Sandia National Laboratories, Albuquerque, New Mexico (858-65-86) (Sponsored by David E. Womble)
- 4:00 p.m. Discussion

AMS Invited Address

5:00 p.m.–5:50 p.m. Rio Grande Ballroom, Sheraton Old Town Hotel

- (62) *Quantum groups and operator algebras.*
Marc A. Rieffel, University of California, Berkeley (858-46-28)

Saturday, April 21

AMS Special Session on Dynamical Systems: Low Dimensional Behavior in Partial Differential Equations, II

8:30 a.m.–10:50 a.m. Isleta Room, Sheraton Old Town Hotel

- 8:30 a.m. *Low dimensional dynamical approximations.*
(63) **Lawrence Sirovich**, Brown University (858-76-38)
- 9:00 a.m. *Dynamics of the nonlinear Schrodinger equation.*
(64) Preliminary report.
Stephen Wiggins*, California Institute of Technology and Los Alamos National Laboratory, and **David McLaughlin**, Princeton University (858-35-75) (Sponsored by Heinz-Otto Kreiss)
- 9:30 a.m. Discussion

Saturday, April 21 (cont'd)

AMS Special Session on Differential Geometry, III

8:30 a.m.–10:50 a.m. Potters Room, Sheraton Old
Town Hotel

- 8:30 a.m. *Non-existence of 4-dimensional almost Kaehler
(65) manifolds of constant curvature.*
David E. Blair, Michigan State University (858-53-01)
- 9:00 a.m. *Actions of loop groups on harmonic maps.
(66)* **Maarten Bergvelt**, University of Georgia, and **Martin Guest***, University of Rochester (858-53-34)
- 9:30 a.m. *Volumes of foliations on spheres. Preliminary report.
(67)* **David L. Johnson*** and **Penny Smith**, Lehigh University (858-53-03)
- 10:00 a.m. *On the number of minimal two-spheres of small area in
(68) manifolds with curvature bounded above. Preliminary report.*
John Douglas Moore, University of California, Santa Barbara (858-53-08)
- 10:30 a.m. *Morse theory on the spinor groups. Preliminary report.
(69)* **Jay A. Wood**, Bowdoin College and Lehigh University (858-57-79)

AMS Special Session on Mathematical Biology, III

8:30 a.m.–10:50 a.m. Sandia Room, Sheraton Old
Town Hotel

- 8:30 a.m. *Population dynamics in a time-varying environment.
(70)* **Richard R. Vance**, University of California, Los Angeles (858-92-76) (Sponsored by Deborah L. Sulsky)
- 9:00 a.m. *Dynamics of competing or cooperating species.
(71)* **Morris W. Hirsch**, University of California, Berkeley (858-99-100)
- 9:30 a.m. *Microbial competition in the gradostat.
(72)* **Hal L. Smith**, Arizona State University (858-99-99)
- 10:00 a.m. Discussion

AMS Special Session on Invariant Embedding and Inverse Problems, III

8:30 a.m.–10:50 a.m. Weaver Room, Sheraton
Old Town Hotel

- 8:30 a.m. *Undetermined coefficient problems for quasilinear
(73) parabolic equations.*
Michael Pilant and **William Rundell***, Texas A & M University, College Station (858-30-02)

- 9:00 a.m. *Wave splitting for some nonhyperbolic time-dependent
(74) PDE's. Preliminary report.*
Curtis R. Vogel, Montana State University (858-35-05)

- 9:30 a.m. *Fast numerical solution of non-linear functional
(75) differential equations pertaining to time domain inverse scattering for a dissipative wave equation.*
David J.N. Wall, University of Canterbury, New Zealand (858-65-14) (Sponsored by Kevin C. O'Meara)

10:00 a.m. Discussion

AMS Special Session on Numerical Solution of Partial Differential Equations, III

8:30 a.m.–10:50 a.m. Jemes Room, Sheraton Old
Town Hotel

- 8:30 a.m. *Discrete variational grid generation.
(76)* **José E. Castillo**, San Diego State University (858-65-52)
- 9:00 a.m. *Parameter estimation for discrete variational grid
(77) generation.*
Daria F. Buonassisi* and **José E. Castillo**, San Diego State University (858-65-50) (Sponsored by Stanly L. Steinberg)
- 9:30 a.m. *Robust grid generation on surfaces of large curvature.
(78)* **Patrick M. Knupp**, Ecodynamics Research Associates, Inc., Albuquerque, New Mexico (858-76-17)
- 10:00 a.m. *Existence and uniqueness of a class of elliptic
(79) differential equations.*
Gordon Liao, University of Texas, Arlington (858-53-62)
- 10:30 a.m. *Mathematical theory of harmonic grid generation.
(80)* **S. S. Sritharan**, University of Southern California (858-35-53)

AMS-SIAM Invited Address

11:00 a.m.–11:50 a.m. Rio Grande Ballroom,
Sheraton Old Town Hotel

- (81) *Solitary waves and their interactions in non-integrable
nonlinear partial differential equations.*
David Campbell, Los Alamos National Laboratory (858-99-97)

AMS-SIAM Invited Address

1:30 p.m.–2:20 p.m. Rio Grande Ballroom, Sheraton
Old Town Hotel

- (82) *Transmission dynamics of HIV/AIDS.*
Robert M. May, University of Oxford, England (858-92-32)

AMS Special Session on Mathematical Biology, IV

2:00 p.m.–5:00 p.m. Sandia Room, Sheraton Old
Town Hotel

- 2:00 p.m. *Latin hypercubes, partial rank correlation coefficients and HIV epidemiology in intravenous drug-using communities.* (83) **Sally Blower***, Imperial College, England, **Hadi Dowlatabadi**, Rockefeller Foundation, **Robert M. May**, Oxford University, England, and **Roy Anderson**, Imperial College, England (858-92-43) (Sponsored by Walter T. Kyner)
- 2:30 p.m. *Modeling HIV transmission and AIDS in the major risk groups.* Preliminary report. (84) **Herbert W. Hethcote**, University of Iowa (858-92-41)
- 3:00 p.m. *Some worst case results for mixing models of AIDS.* (85) **Edward H. Kaplan**, Yale University (858-92-64) (Sponsored by Stanly L. Steinberg)
- 3:30 p.m. *Modeling the spread of HIV in Africa.* (86) **E. Ann Stanley**, Los Alamos National Laboratory (858-92-70) (Sponsored by Walter T. Kyner)
- 4:00 p.m. *Liapunov functions for the stability of equilibria in a model of HIV spread.* Preliminary report. (87) **John Jacquez** and **Carl P. Simon***, University of Michigan, Ann Arbor (858-99-101)
- 4:30 p.m. Discussion

AMS Special Session on Invariant Embedding and Inverse Problems, IV

2:00 p.m.–3:20 p.m. Weaver Room, Sheraton Old
Town Hotel

- 2:00 p.m. *Invariant imbedding and inverse problem of reflection.* (88) **Alan P. Wang**, Arizona State University (858-99-04) (Sponsored by Cecilia Y. Wang)
- 2:30 p.m. *Wave splitting for a class of hyperbolic equations.* (89) **Vaughan H. Weston**, Purdue University, West Lafayette (858-35-07)
- 3:00 p.m. *Inverse problems and the optimization of kernels.* (90) **John D. Zahrt**, Los Alamos National Laboratory (858-45-19) (Sponsored by William A. Beyer)

AMS Special Session on Numerical Solution of Partial Differential Equations, IV

2:30 p.m.–5:30 p.m. Jemes Room, Sheraton Old
Town Hotel

- 2:30 p.m. *Discrete variational grids and solution of elliptic partial differential equations.* (91) **José E. Castillo** and **Lynne A. Tablewski***, San Diego State University (858-65-51) (Sponsored by Stanly L. Steinberg)

- 3:00 p.m. *Surface grid generation and differential geometry.* (92) **Z. U. A. Warsi**, Mississippi State University (858-65-78) (Sponsored by Stanly L. Steinberg)
- 3:30 p.m. *The mixed finite element method.* (93) **Thomas H. Robey**, University of New Mexico (858-35-55)
- 4:00 p.m. *Computation of invariant manifolds on multicomputers.* (94) **Jens Lorenz***, University of New Mexico, and **Eric Van de Velde**, California Institute of Technology (858-65-68)
- 4:30 p.m. *Adaptive grid generation from harmonic maps.* (95) **Arkady S. Dvinsky**, Creare Inc., Hanover, New Hampshire (858-65-93) (Sponsored by Stanly L. Steinberg)
- 5:00 p.m. Discussion

AMS General Session

2:30 p.m.–4:20 p.m. Isleta Room, Sheraton Old
Town Hotel

- 2:30 p.m. *Condition P for real analytic singular differential forms in the plane.* (96) **Abdelhamed Meziani**, Florida International University (858-35-23)
- 2:50 p.m. *Multipliers of Besov spaces on certain groups.* (97) **Hitoshi Ombe**, University of Puerto Rico, Rio Piedras (858-43-24)
- 3:10 p.m. *Completion of a quasi local ring.* Preliminary report. (98) **J. H. Kim**, East Carolina University (858-13-25)
- 3:30 p.m. *Differentiation formulas for generalized Wiener functionals with multiparameter time.* Preliminary report. (99) **Mylan Redfern*** and **David E. Betounes**, University of Southern Mississippi (858-60-26)
- 3:50 p.m. *Two magnetic monopole Julia sets.* Preliminary report. (100) **M. Temple-Raston**, University of Arizona (858-70-27)
- 4:10 p.m. *An optimal control problem in exterior hydrodynamics.* (101) **S. S. Sritharan**, University of Southern California (858-35-59)

Lance W. Small
AMS Associate Secretary
La Jolla, California

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.

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* AMS Special Session Speaker

◦ AMS-SIAM Invited Lecturer

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ALGEBRAIC TOPOLOGY

Mark Mahowald and Stewart Priddy
(Contemporary Mathematics, Volume 96)

This book will provide readers with an overview of some of the major developments in current research in algebraic topology. Representing some of the leading researchers in the field, the book contains the proceedings of the International Conference on Algebraic Topology, held at Northwestern University in March, 1988. Several of the lectures at the conference were expository and will therefore appeal to topologists in a broad range of areas.

The primary emphasis of the book is on homotopy theory and its applications. The topics covered include elliptic cohomology, stable and unstable homotopy theory, classifying spaces, and equivariant homotopy and cohomology. Geometric topics—such as knot theory, divisors and configurations on surfaces, foliations, and Siegel spaces—are also discussed. Researchers wishing to follow current trends in algebraic topology will find this book a valuable resource.

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Invited Speakers and Special Sessions

Invited Speakers 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.

Columbus, OH, August 1990

Joseph G. Conlon	John Morgan
Michael G. Crandall	(Progress in
(Progress in	Mathematics Lecture)
Mathematics Lecture)	Michael E. Taylor
Saunders Mac Lane (AMS-MAA)	

Denton, TX, November 1990

Avner D. Ash	John Leucke
Peter S. Constantin	Clarence W. Wilkerson

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.

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 *Notices* went to the printer. The section below entitled **Information for Organizers** describes the timetable for announcing the existence of Special Sessions.

August 1990 Meeting in Columbus, Ohio

Associate Secretary: W. Wistar Comfort

Deadline for organizers: Expired

Deadline for consideration: April 27, 1990

Eiichi Bannai, Thomas A. Dowling, Dijen Ray-Chaudhuri and Neil Robertson, *Combinatorics*

Susan Jane Colley and Gary Kennedy, *Algebraic geometry*
Zita M. Divis and David Terman, *Dynamics of biological systems*

Richard K. Guy and Richard J. Nowakowski, *Combinatorial games*

S. K. Jain and S. Tariq Rizvi, *Ring theory*

Surinder K. Sehgal and Ronald Solomon, *Group theory*

October 1990 Meeting in Amherst, Massachusetts Eastern Section

Associate Secretary: W. Wistar Comfort

Deadline for organizers: Expired

Deadline for consideration: July 16, 1990

Colin C. Adams, *Hyperbolic manifolds*

Melvyn S. Berger, *Non-linear dynamics in mathematics and science*

Haskell Cohen, *Semigroups*

James E. Humphreys and Ivan Mirković, *Lie groups and algebraic groups*

Chjan C. Lim, *Algebraic graph theory*

V. S. Prasad, *Ergodic theory*

November 1990 Meeting in Denton, Texas Central Section

Associate Secretary: Andy Roy Magid

Deadline for organizers: Expired

Deadline for consideration: July 16, 1990

Avner D. Ash and Mark S. Reeder, *Arithmetic groups*

Elizabeth M. Bator, Russell G. Bilyeu and Paul W. Lewis, *Banach spaces-functional analysis*

Ilya Bakelman, *Geometric inequalities and convex bodies*

Scott T. Chapman and Nick H. Vaughan, *Commutative algebra*

Daniel S. Freed, Robert F. Williams and Michael Wolf, *Texas topology and geometry*

John Leucke and Robert Myers, *Low dimensional topology*

Lisa Mantini and Roger C. Zierau, *Representation theory of Lie groups*

John W. Neuberger and Henry A. Warchall, *Differential equations*

Peter F. Stiller, *Algebraic geometry*

January 1991 Meeting in San Francisco, California

Associate Secretary: Andy Roy Magid

Deadline for organizers: April 16, 1990

Deadline for consideration: September 19, 1990

March 1991 Meeting in South Bend, Indiana

Central Section

Associate Secretary: Andy Roy Magid

Deadline for organizers: June 16, 1990

Deadline for consideration: To be announced

March 1991 Meeting in Tampa, Florida

Southeastern Section

Associate Secretary: Joseph A. Cima

Deadline for organizers: June 22, 1990

Deadline for consideration: To be announced

October 1991 Meeting in Fargo, North Dakota

Central Section

Associate Secretary: Andy Roy Magid

Deadline for organizers: January 25, 1991

Deadline for consideration: To be announced

January 1992 Meeting in Baltimore, Maryland

Associate Secretary: W. Wistar Comfort

Deadline for organizers: April 8, 1991

Deadline for consideration: To be announced

January 1993 Meeting in San Antonio, Texas

Associate Secretary: Lance W. Small

Deadline for organizers: April 13, 1992

Deadline for consideration: To be announced

January 1994 Meeting in Cincinnati, Ohio

Associate Secretary: Joseph A. Cima

Deadline for organizers: April 5, 1993

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 and Editorial Departments 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 Invited Speakers are selected. 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 *Notices*.

Each Invited Speaker 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 well in advance of the meeting and, in any case, 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 *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 *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. They are selected by the Section Program Committee. The processing of proposals for Special Sessions for Sectional Meetings is handled by the Associate Secretary for the Section, who then forwards the proposals to the Section Program Committee, which makes the final selection of the proposals. Each Invited Speaker at a Sectional Meeting is invited to organize a Special Session. Just as for national meetings, 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:

Far Western Section (Pacific and Mountain)

Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
e-mail: g.small@math.ams.com
(Telephone 619-534-3590)

Central Section

Andy Roy Magid, Associate Secretary
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As a general rule, members who anticipate organizing Special Sessions at AMS meetings are advised to seek approval at least nine months prior to the scheduled date of the meeting. No Special Sessions can be approved too late to provide adequate advance notice to members who wish to participate.

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 (Editorial Department, American Mathematical Society, P. O. Box 6248, 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 now available to those who use the T_EX 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 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: Electronic Abstracts, American Mathematical Society, Publications Division, P.O. Box 6248, Providence, RI 02940, USA. When requesting the Abstracts package, users should be sure to specify whether they want the plain T_EX, A_MS-T_EX, or the L^AT_EX 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.

1990 Summer Seminar in Applied Mathematics

Vortex dynamics and vortex methods

University of Washington, Seattle, June 18–29

The twenty-first AMS-SIAM Summer Seminar in Applied Mathematics will be held June 18–29, 1990, at the University of Washington, Seattle. The seminar will be sponsored jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics (SIAM). It is anticipated that the seminar will be supported by a grant from federal agencies. The proceedings of the seminar will be published by the AMS in the *Lectures in Applied Mathematics* series.

The subject of this seminar will be the study of vorticity-dominated fluid motion. Numerical techniques and their applications will be discussed (in particular, there will be several talks about discrete vortex methods). Applied mathematical analysis and laboratory experiments will be additional lecture subjects. A combination of introductory exposition and recent research results will be presented in the lectures. A goal of the seminar is to bring together researchers with different viewpoints in order to suggest new approaches and to facilitate critical evaluations of existing techniques for the study of vorticity-dominated flows.

A partial list of invited speakers includes J. BELL, Lawrence Livermore National Laboratories; T. BUTTKE, Courant Institute of Mathematical Sciences, NYU; R. CAFLISCH, University of California, Los Angeles; A. J. CHORIN, University of California, Berkeley; W. DAHM, University of Michigan; J. FERZIGER, Stanford University; A. GHONIEM, Massachusetts Institute of Technology; R. GLOWINSKY, University of Houston; W. HENSHAW, IBM T.J. Watson Research Center; H. HORNING, California Institute of Technology; T. HOU, Courant Institute of Mathematical Sciences, NYU; S. HUBERSON, ONERA, France; A.K.M.F. HUSSAIN, University of Houston; R. KRASNY, University of Michigan; J. LASHERAS, University of Southern California; A. MAJDA, Princeton University; P. MARCUS, University of California, Berkeley; S. MAS-GALLIC, Ecole Polytechnique, France; E. MEIBURG, Brown University; J. NEU, University of California, Berkeley; S. ORSZAG, Princeton University; J. SETHIAN, University of California, Berkeley; M. SHELLEY, University of Chicago; and G. TRYGGVASON, University of Michigan.

The Organizing Committee consists of CHRISTOPHER R. ANDERSON, University of California, Los Angeles, co-chair; STEPHEN CHILDRESS, Courant Institute of Mathematical Sciences, NYU; GEORGES-HENRI COTTET,

Ecole Polytechnique, Paris; CLAUDE GREENGARD, IBM T.J. Watson Research Center, co-chair; and ANTHONY LEONARD, California Institute of Technology.

A brochure will be available from the AMS office which will include information on accommodations and local information. Participants will be required to pay a \$20 registration fee and a \$25 social fee.

Those interested in attending the seminar should send the following information to the Summer Seminar Conference Coordinator, American Mathematical Society, P.O. Box 6248, Providence, RI 02940; by electronic mail: BAV@MATH.AMS.COM; or by FAX: 401-331-3842 **before March 23, 1990.**

1. Full name;
2. Mailing address;
3. Telephone number and area code for office and home. E-mail address (if applicable);
4. Member of AMS or SIAM? Include customer code if an AMS member;
5. Anticipated arrival and departure dates;
6. Your scientific background relevant to the topic;
7. Financial assistance requested (estimate cost of travel);
8. Indicate if interested in attending if support is not offered. Indicate if support is not required.

Participants who wish to apply for a grant-in-aid should so indicate; however, funds available for the seminar are very limited and individuals who can obtain support from other sources should do so. Graduate students who have completed at least one year of graduate school are encouraged to participate.

Funds may also be available for foreign graduate students under the Short Term Enrichment Program (STEP) of the United States Information Agency (USIA). Students must meet the following eligibility requirements: 1. must be enrolled in full-time graduate studies at a U.S. institution of higher education; 2. are not receiving any U.S. government funds for academic support; 3. are not on refugee, immigrant, or tourist visa status; and 4. have not been awarded STEP grants previously. Those eligible should include the following information when supplying the above eight items: 1. home country; 2. student status; 3. name of institution enrolled; 4. name of an official at the institution who can verify status and financial situation.

1990 Summer Research Institute

Differential Geometry

University of California, Los Angeles, July 8–28

The thirty-eighth Summer Research Institute sponsored by the American Mathematical Society will be devoted to *Differential Geometry* and will take place at the University of California, Los Angeles. Members of the Organizing Committee are: ROBERT BRYANT, Duke University; EUGENIO CALABI, University of Pennsylvania; S. Y. CHENG, University of California, Los Angeles; H. BLAINE LAWSON, State University of New York, Stony Brook; H. WU, University of California, Berkeley; ROBERT E. GREENE, University of California, Los Angeles (co-chair); and S. T. YAU, Harvard University (co-chair).

It is anticipated that the institute will be partially supported by a grant from the National Science Foundation. Proceedings of the institute will be published in the AMS series *Proceedings of Symposia in Pure Mathematics*.

This topic was selected by the 1988 AMS Committee on Summer Institutes and Special Symposia whose members at the time were: STEVEN L. KLEIMAN (chair), HAYNES R. MILLER, RAGHAVAN NARASIMHAN, PAUL H. RABINOWITZ, THOMAS C. SPENCER, and ROBERT B. WARFIELD, JR..

The years since the last AMS Summer Institute on differential geometry, held in 1973, have been a period of explosive growth and exciting research in this subject. Seen in retrospect, the 1973 institute both recounted the accomplishments in geometry in the 1960's and early 1970's and at the same time marked some new directions for the field. Riemannian geometry in the purest sense along with the theory of characteristic classes in geometry were enjoying a triumphant period. The previous decade had seen the quarter-pinching Sphere Theorem, results on complete open manifolds of nonnegative curvature, the use of heat kernel asymptotics in invariant theory, the discovery of new invariants, and the rapid growth of the theory of foliations. The 1973 institute also heralded a new era just beginning: work on prescribed curvature, the renewed interest in the spectrum of the Laplacian, and the beginning of the study of complex manifolds using analytic $\bar{\partial}$ methods. These were all portents of a new growth period which would involve a vast increase in the use of partial differential equations in geometry.

Partial differential equations arise naturally in geometry. The association of curvature tensor to metric is itself a partial differential operator, which could be thought of as the central object of the whole subject.

Many other operators also arise naturally, as the Euler-Lagrange equations for variational problems. Naturally arising variational problems yield the minimal submanifold equations, the equations for harmonic maps, the complex Monge-Ampere equation for the Ricci curvature of a Kähler manifold, and the Yang-Mills equations. Since the early 1970's, significant progress has been made in understanding all these partial differential equations and many others on manifolds. In a virtually unprecedented way, it has become possible to approach the problems of geometry by direct study of the relevant partial differential equations. The results have transformed the subject of differential geometry.

Any reasonably short list of specific theorems will be necessarily partial, so numerous are the results, but some highlights will help to indicate the magnitude of the progress made: the solution of the Calabi Conjecture on the existence of canonical Einstein-Kähler metrics; the related constructions of a canonical complete Einstein-Kähler metric on pseudoconvex domains in C^n ; the solution of the positive mass conjecture of relativity; the classification of manifolds of positive scalar curvature; results on minimal surfaces in 3-manifolds which were instrumental in the proof of the Smith Conjecture; the use of harmonic maps to prove rigidity theorems for complex manifolds; the characterization of C^n by curvature and related results on gap phenomena for Riemannian manifolds; the development of harmonic function theory on manifolds; the construction of surfaces of constant mean curvature; new results on differential systems; the determination of the possible holonomy groups; the solution of the Frankel conjecture on compact Kähler manifolds of nonnegative bisectional curvature; the solution of the Yamabe problem; the deformation of manifolds of positive Ricci curvature to constant positive; and the existence of canonical metrics on stable vector bundles.

Special mention should be made of the spectacular geometric results arising from Yang-Mills theory. Yang-Mills theory is again an example of an extremal problem, in this case in effect the minimization of the square integral of the curvature of a connection on a principal bundle. When the bundle lies over a 4-dimensional manifold, an additional structural feature arises in that the Hodge star takes the curvature 2-form again to a 2-form, so that 2-forms can be symmetrized and

antisymmetrized relative to this operation. Out of this rich geometric structure arises the possibility of proving profound differential topological results on 4-manifolds by geometric methods. The most spectacular of these is perhaps the existence of "exotic" (nonstandard) differentiable structures on topological R^4 .

There have also been revolutionary developments in Riemannian geometry outside the partial differential equations methods. New concepts and methods involving the limiting behavior of metrics and the structure of the space of Riemannian manifolds as a whole have given new life to manifold geometry. Highlights include: the characterization of almost flat manifolds; the bounds on the Betti numbers of manifolds of nonnegative curvature; finiteness and convergence theorems for manifolds satisfying curvature bounds; and a comprehensive theory of manifolds of negative curvature.

The general intention for the 1990 Summer Institute is to cover not only developments in differential geometry itself, but also related topics in other parts of mathematics and in physics. The planned format is to have a number of one hour survey lectures in the morning sessions offering more broadly sketched viewpoints, followed in the afternoons by shorter, more specialized seminar lectures in parallel sessions. For organizational purposes the subject will be divided into eight subdivisions: 1. Riemannian geometry; 2. Minimal submanifolds; 3. Complex geometry and L^2 cohomology; 4. General theory of partial differential equations on manifolds: harmonic functions and mappings, Monge-Ampere equation, differential systems, and isometric embedding; 5. Eigenvalues, heat flow, and index theory; 6. Gauge theory and geometry in mathematical physics; 7. Groups and manifolds, and dynamical systems; 8. Symplectic geometry.

While it is anticipated that seminar activity on all these topics will continue throughout the three weeks of the institute, each week will have a different specific emphasis on two or more of the eight topics. A tentative list of the topics to be addressed follows.

Week One: July 8 - 14: Minimal submanifolds; general theory of partial differential equations on manifolds; eigenvalues, heat flow and index theory.

Week Two: July 15 - 21: Gauge theory and geometry in mathematical physics; symplectic geometry; complex geometry and L^2 cohomology.

Week Three: July 22 - 28: Riemannian geometry; groups and manifolds, and dynamical systems.

A partial list of survey lecturers includes: (week one) S. S. CHERN, Z. GAO, R. HAMILTON, J. JOST, P. LI, R. SCHOEN, W. WEEKS, H. WENTE; (week two) J. BISMUT,

R. BOTT, N. HITCHIN, J. MILLSON, I. SINGER, M. STERN, C. TAUBES, A. WEINSTEIN; (week three) W. BALLMANN, J. CHEEGER, P. EBERLEIN, T. FARRELL, D. GROMOLL, K. GROVE, P. PETERSEN, D. SULLIVAN.

Accommodations will be available in the campus residence halls for participants; cafeteria style meals will be available. All facilities will be accessible to the handicapped.

Information on housing, dining, travel and the local area will be sent to invited participants in the spring. Each participant will pay a registration fee and a social fee to cover the costs of social events scheduled during the institute.

Those interested in receiving an invitation to participate in the institute should send the following information to the Summer Institute Conference Coordinator, American Mathematical Society, Post Office Box 6248, Providence, RI 02940, **prior to April 1, 1990** or through electronic mail: WSD@MATH.AMS.COM, or by FAX: 401-331-3842.

Please type or print the following:

1. Full name;
2. Mailing address;
3. Telephone number and area code for office and home;
4. Which week or weeks you wish to attend;
5. Your scientific background relevant to the institute topic;
6. Financial assistance requested;
7. Indicate if interested in attending if support is not offered. Indicate if support is not required.
8. If member of AMS, give AMS member code.

Funds may also be available for foreign graduate students under the Short Term Enrichment Program (STEP) of the United States Information Agency (USIA). Students must meet the following eligibility requirements: 1. must be enrolled in full-time graduate studies at a U.S. institution of higher education; 2. are not receiving any U.S. government funds for academic support; 3. are not on refugee, immigrant, or tourist visa status; and 4. have not been awarded STEP grants previously. Those eligible should include the following information when supplying the above eight items: 1. home country; 2. student status; 3. name of institution enrolled; 4. name of an official at the institution who can verify status and financial situation.

Requests for invitations will be forwarded to the Organizing Committee for consideration up to the **deadline of April 1**, and applicants selected will receive formal invitations and notification of financial assistance beginning in mid-May.

Symposium on Some Mathematical Questions in Biology

Neural Networks

Vancouver, Canada, August 2-3

The twenty-fourth annual Symposium on Some Mathematical Questions in Biology on *Neural networks* will be held on Thursday and Friday, August 2-3, 1990, during the Congress of the International Union for Pure and Applied Biophysics (IUPAB), July 29-August 3, 1990. 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 consisted of Jack D. Cowan (organizer), Michael C. Mackey, Marc Mangel, Hans G. Othmer, Richard E. Plant (chairman), and John Rinzel.

The theme of the symposium is *Neural networks*. There will be two morning sessions on Thursday and Friday, August 2 and 3, each including three one-hour lectures.

For further information, contact the Symposium Conference Coordinator, AMS, P.O. Box 6248, Providence, RI 02940 or by electronic mail: BAV@MATH.AMS.COM.

Program

Thursday, August 2, 9:30 a.m.

Chairman: Robert Miura, University of British Columbia

Neurodynamics. JACK D. COWAN, University of Chicago

Learning, networks, and approximation theory. T. A. POGGIO, Massachusetts Institute of Technology

Neural networks, information theory and perception, in animals and machines. RALPH LINSKER, IBM T. J. Watson Research Center

Friday, August 3, 9:30 a.m.

Chairman: John Rinzel, National Institutes of Health

Learning and generalization in multi-layered neural networks: A statistical analysis. D. RUMELHART, Stanford University

Growing and pruning neural networks: relation to statistical mechanics. ALAN LAPEDES, Los Alamos National Laboratory

Perspectives in computational neurobiology. TERRENC. J. SEJNOWSKI, Salk Institute

Joint Summer Research Conference in the Mathematical Sciences

University of Massachusetts at Amherst

June 7-13, 1990

Inverse scattering and applications

In previous issues of the *Notices*, the title of this conference was given incorrectly as *Inverse scattering on the line*. The correct title is *Inverse scattering and applications*.

There has been much progress recently on inverse scattering theory in one and two dimensions. This conference will cover recent developments in the field, including inverse scattering theory on the line, Riemann-Hilbert problems, and inverse monodromy problems. Multidimensional problems will be covered, using the so-called $\bar{\partial}$ methods. Applications to the Davey-Stewartson II and KP II equations will be treated. Higher dimensional problems will also be discussed, and one day will be spent on applications of inverse scattering theory and inverse monodromy theory to problems in statistical mechanics.

Members of the Organizing Committee: RONALD R. COIFMAN (Yale University), CRAIG A. TRACY (University of California, Davis) and STEPHANOS VENAKIDES (Duke University).

The deadline for receipt of applications for this conference has been extended to **March 23, 1990**. For more information on the conferences, please refer to the 1989 October and November issues of the *Notices* or contact the Summer Research Coordinator, Meetings Department, American Mathematical Society, Post Office Box 6248, Providence, RI 02940 or by E-Mail: CAK@MATH.AMS.COM on the Internet.

Call For Topics For 1992 Conferences

Suggestions are invited from mathematicians, either singly or in groups, for topics of the various conferences that will be organized by the Society in 1992. The deadlines for receipt of these suggestions, as well as some relevant information about each of the conferences, are given below. An application form to be used when submitting suggested topic(s) for any of these conferences (except the Short Course Series) may be obtained by writing to the Meetings Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940, or telephoning 401-455-4146, or sending E-mail to MEET@MATH.AMS.COM.

Individuals willing to serve as organizers should be aware that the professional meetings staff in the Society's Providence office will provide full support and assistance before, during, and after each of these conferences. Organizers should also note that for all conferences, except Summer Research Conferences, it is required that the proceedings be published by the Society, and that proceedings of Summer Research Conferences are frequently published. A member of the Organizing Committee must be willing to serve as editor of the proceedings.

All suggestions must include (1) the names and affiliations of proposed members and the chairman of the Organizing Committee; (2) a one- to two-page description addressing the focus of the topic including the importance and timeliness of the topic, and estimated attendance; (3) a list of the recent conferences in the same or closely related areas; (4) a tentative list of names and affiliations of the proposed principal speakers; and (5) a list of likely candidates who would be invited to participate and their current affiliations. Any suggestions as to sites and dates should be made as early as possible in order to allow adequate time for planning. However, proposers of conferences should know that, by action of the AMS Board of Trustees, the Meetings Department of the Society is responsible for the final selection of the site for each conference and for all negotiations with the host institution. Individuals submitting suggestions for the conferences listed below are requested to recommend sites or geographic areas which would assist the Meetings Department in their search for an appropriate site. In the case of Joint Summer Research Conferences in the Mathematical Sciences, a one-, two-, or three-week conference may be proposed.

1992 AMS Symposium in Pure Mathematics

The symposium in pure mathematics has traditionally been conducted in the spring of even-numbered years in conjunction with a sectional meeting. The symposium can be held independently of a sectional meeting and serves to honor great accomplishments in mathematics. Proceedings are normally published by the Society as volumes in the series *Proceedings of Symposia in Pure Mathematics*.

Topics in recent years have been:

1984 – *Pseudodifferential operators and Fourier integral operators with applications to partial differential equations*, organized by FRANÇOIS TREVES of Rutgers University

1987 – *The mathematical heritage of Herman Weyl*, organized by R. O. WELLS, JR. of Rice University.

1989 – *Complex geometry and Lie theory*, organized by JAMES CARLSON and C. HERBERT CLEMENS, University of Utah.

Deadline For Suggestions: September 1, 1990

1992 AMS Summer Institute

Summer institutes are intended to provide an understandable presentation of the state of the art in an active field of research in pure mathematics and usually extend over a three-week period. Dates for a summer institute must not overlap those of the Society's summer meeting, which at the time of this printing have not yet been determined. There should be a period of at least one week between them. Proceedings are published by the Society as volumes in the series *Proceedings of Symposia in Pure Mathematics*.

Current and recent topics:

1988 – *Operator theory/Operator algebras and applications*, organized by WILLIAM B. ARVESON of University of California, Berkeley, and RONALD G. DOUGLAS of State University of New York at Stony Brook.

1989 – *Several complex variables and complex geometry*, organized by STEVEN G. KRANTZ of Washington University.

1990 – *Differential geometry*, organized by ROBERT E. GREENE of University of California, Los Angeles, and SHING-TUNG YAU of Harvard University.

Deadline For Suggestions: September 1, 1990

1992 AMS-SIAM-SMB Symposium Some Mathematical Questions in Biology

This one-day symposium, sponsored jointly by the AMS, the Society for Industrial and Applied Mathematics, and the Society for Mathematical Biology, is usually held in conjunction with the annual meeting of a biological society closely associated with the topic. Papers from the symposia are published by the AMS as volumes in the series *Lectures on Mathematics in the Life Sciences*.

Current and recent topics:

1987 – *Models in population biology*, organized by ALAN HASTINGS of the University of California, Davis.

1988 – *Dynamics of excitable media*, organized by HANS G. OTHMER of the University of Utah.

1989 – *Sex allocation and sex change: Experiments and models*, organized by MARC MANGEL of the University of California, Davis.

1990 – *Neural Networks*, organized by JACK D. COWAN of the University of Chicago.

Deadline For Suggestions: September 1, 1990

1992 AMS-SIAM Summer Seminar

The goal of the summer seminar, sponsored jointly by the AMS and the Society for Industrial and Applied Mathematics, is to provide an environment and program in applied mathematics in which experts can exchange the latest ideas and newcomers can learn about the field. Proceedings are published by the AMS as volumes in the series *Lectures in Applied Mathematics*.

Current and recent topics:

1987 – *Computational Aspects of VLSI Design with an Emphasis on Semiconductor Device Simulation*, organized by RANDOLPH BANK of the University of California, San Diego.

1988 – *Computational solution of nonlinear systems of equations*, organized by EUGENE ALLGOWER of Colorado State University.

1989 – *The mathematics of random media*, organized by WERNER KOHLER of Virginia Polytechnic Institute and BENJAMIN WHITE of Exxon Research & Engineering Company.

1990 – *Vortex dynamics and vortex methods*, organized by CLAUDE GREENGARD of IBM T. J. Watson Research Center and CHRISTOPHER R. ANDERSON of University of California, Los Angeles.

Deadline For Suggestions: September 1, 1990

1992 AMS-IMS-SIAM Joint Summer Research Conferences in the Mathematical Sciences

These conferences, jointly sponsored by the AMS, the Institute for Mathematical Statistics, and the Society for Industrial and Applied Mathematics, are similar in structure to those held at Oberwolfach and represent diverse areas of mathematical activity, with emphasis on areas currently especially active. Careful attention is paid to subjects in which there is important interdisciplinary activity at present. Topics for the seventh series of one-week conferences, being held in 1990, are: *Probability models and statistical analysis for ranking data*; *Inverse scattering on the line*; *Deformation theory of algebras and quantization with applications to physics*; *Strategies for sequential search and selection in real time*; *Schottky Problems*; and *Logic, local fields, and subanalytic sets*.

If proceedings are published by the AMS, they will appear as volumes in the series *Contemporary Mathematics*.

Deadline For Suggestions: February 1, 1991

Call for Topics for 1992 AMS Short Course Series

The AMS short courses consist of a series of introductory survey lectures and discussions ordinarily extending over a period of one-and-one-half days starting immediately prior to the Joint Mathematics Meetings held in January and August each year. Each theme is a specific area of applied mathematics or mathematics used in the study of a specific subject or collection of problems in one of the physical, biological, or social sciences, technology, or business.

Current and recent topics:

Combinatorial games (August 1990), *Mathematical questions in robotics* (January 1990), *Cryptology and computational number theory* (August 1989), *Matrix theory and applications* (January 1989), *Chaos and fractals* (August 1988), *Computational Complexity Theory* (January 1988). Proceedings are published by the Society as volumes in the series *Proceedings of Symposia in Applied Mathematics*, with the approval of the Editorial Committee.

Deadline for Suggestions: Suggestions for the January 1992 course should be submitted by July 1, 1990; suggestions for the August 1992 course should be submitted by December 1, 1990.

Submit suggestions to: James W. Maxwell, AMS, P.O. Box 6248, Providence, RI 02940.

Mathematical Sciences

Meetings and Conferences

THIS SECTION contains announcements of meetings and conferences of interest to some segment of the mathematical public, including *ad hoc*, local, or regional meetings, and meetings or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. (Information on meetings of the Society, and on meetings sponsored by the Society, will be found inside the front cover.)

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

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

DEADLINES for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

EFFECTIVE with the 1990 volume of *Notices*, the complete list of Mathematical Sciences Meetings and Conferences will be published only in the September issue. In all other issues, only meetings and conferences for the twelve-month period following the month of that issue will appear. As new information is received for meetings and conferences that will occur later than the twelve-month period, it will be announced at the end of the listing in the next possible issue. That information will not be repeated until the date of the meeting or conference falls within the twelve-month period.

1989–1990. **Academic Year Devoted to Hyperbolic Geometry and Quasiconformal Mappings**, Mittag-Leffler Institute, Djursholm, Sweden. (Dec. 1988, p. 1584)

1989–1990. **Special Year in Geometry**, University of Maryland, College Park, MD. (Dec. 1989, p. 1432)

PROGRAM: The Dept. of Math. of the Univ. of Pisa and the Scuola Normale Superiore will organize in the spring term 1990 a special semester to honour the memory of Aldo Andreotti. The semester will be mainly dedicated to algebraic geometry, complex analysis, analytic geometry and partial differential equations.

INVITED SPEAKERS: W. Barth, A. Beauville, E. Bierstone, J.E. Björk, E. Bombieri, F. Campana, A. Douady, H. D'Souza, T. Frankel, H. Grauert,

P.A. Griffiths, M. Gromov, N. Ivanov, S. Klainerman, J.J. Kohn, D. Laksov, Lê Dũng Tráng, S. Łojasiewicz, B. Malgrange, P. Milman, S. Mizohata, R. Narasimhan, L. Nirenberg, F. Oort, M. Seppälä, M. Shiota, M. Schneider, M. Spivakovsky, W.F. Stoll, G. Van der Geer, S.S.T. Yau, S.T. Yau.

INFORMATION: Semestre Andreotti - M. Galbiati, Dipartimento di Matematica - Università di Pisa, Via Buonarroti, 2 56127 Pisa - Italy; email: galbiati@icnucevm.bitnet.

1990. **IMACS International Workshop on Massively Parallel Methods in Computational Physics**, Boulder, Colorado. (Sep. 1989, p. 914)

1990. **IMACS Conference on Computer Aided Design**, Yugoslavia. (Sep. 1989, p. 914)

1990. **CWI-IMACS Symposia on Parallel Scientific Computing**, Amsterdam, The Netherlands. (Feb. 1990, p. 216)

1990–1991. **Academic Year Devoted to Operator Theory and Complex Analysis**, Mittag-Leffler Institute, Djursholm, Sweden. (Dec. 1989, p. 1432)

March 1990

*19–23. **DIMACS Workshop: Arrangements, Center for Discrete Mathematics and Theoretical Computer Science**, New Brunswick, NJ.

PROGRAM: This is the fourth workshop in the DIMACS Special Year on Discrete and Computational Geometry. The plan is to have a small number of invited and contributed talks, in order to encourage more direct interaction among the participants.

ORGANIZERS: R. Pollack, W. Steiger.

INVITED SPEAKERS: A. Björner, Royal Institute of Technology, Sweden; H. Edelsbrunner, Univ. of Illinois; J.E. Goodman, City Univ. of NY; B. Grünbaum, Univ. of Washington; N. Mnëv, Leningrad State Univ.; P. Orlik, Univ. of Wisconsin; J. Pach, New York Univ.; M. Sharir, Tel Aviv Univ.; P. Shor, AT&T Bell Labs.

INFORMATION: DIMACS, Hill Center, Busch Campus, Rutgers Univ., P.O. Box 1179, Piscataway, NJ 08855; 201-932-5928; toci@dimacs.rutgers.edu.

*28–30. **Sixth British Colloquium for**

* Spring Term 1990. **Aldo Andreotti Special Semester in Pisa**, Pisa, Italy.

Theoretical Computer Science, Univ. of Manchester, Manchester, England.

PROGRAM: The colloquium aims to provide a forum for theoreticians to learn of new developments in areas including logic and semantics of programs, formal methods, term rewriting, specification and verification, logic and functional programming, data structures, algorithms and complexity, computational algebra, cryptography, parallel computation and models of concurrency, formal languages and type theories, and artificial intelligence.

ORGANIZING COMMITTEE: J. Tucker, Swansea; M. Jerrum, Edinburgh; J. Shawe-Taylor, R.H.B.N.C.; D. Rydeheard, Manchester; P. Dunne, Liverpool; M. Paterson, Warwick; B. Thompson, Swansea; A. Gibbons, Warwick; H. Simmons, Aberdeen.

INFORMATION: BCTCS6, Dept. of Comp. Sci., Univ. of Manchester, Manchester M13 9L, U.K. email: JANET: bctcs6@uk.ac.man.cs; BITNET: bctcs6@cs.man.ac.uk; ARPA: bctcs6@cs.man.ac.uk or bctcs%cs.man.ac.uk@nsfnet-relay.ac.uk.

* 30-31. **Sixth Pacific Coast Gravity Meeting**, Univ. of Oregon, Eugene, OR.

INFORMATION: T. Dray (teviaan@math.orst.edu) or J. Isenberg (Institute of Theoretical Science, Univ. of Oregon, Eugene, OR 94703).

* 31. **Thirty-fifth Algebra Day**, Univ. of Ottawa, Ottawa Ontario, Canada.

SPONSORS: Carleton Univ. and Univ. of Ottawa.

INVITED SPEAKERS: G. Benkart, Wisconsin; B. Fine, Fairfield; O. Mathieu, IAS/Paris.

INFORMATION: M. Racine, Dept. of Math., Univ. of Ottawa, Ottawa Ontario K1N 6N5, Canada.

April 1990

1-3. **Low Dimensional Dynamics**, University of Maryland at College Park. (Jan. 1990, p. 54)

1-4. **ENAR Spring Meeting**, Baltimore, MD. (Jul./Aug. 1989, p. 766)

1-7. **Design and Codes**, Oberwolfach, Federal Republic of Germany. (Jul./Aug.

1989, p. 766)

1-14. **NATO Advanced Study Institute on "Generators and Relations in Groups and Geometries"**, Castelveccchio Pascoli (Lucca), Italy. (Sep. 1989, p. 916)

3-4. **Mathematics in a Changing Culture**, Glasgow College, Glasgow, Scotland. (Jan. 1990, p. 54)

3-5. **Forty-second British Mathematical Colloquium**, University of East Anglia, Norwich, Norfolk, England. (Jan. 1990, p. 54)

4-7. **Symposium on Distributions with Given Marginals (In Memory of Giuseppe Pompili)**, Rome, Italy. (Oct. 1989, p. 1095)

5-7. **Twenty-fourth Annual Spring Topology Conference**, Southwest Texas State Univ., San Marcos, TX. (Nov. 1989, p. 1249)

5-8. **Conference on Algebraic K-theory and Algebraic Number Theory**, Johns Hopkins Univ., Baltimore, MD. (Jan. 1990, p. 54)

7-8. **Eastern Section Meeting of the AMS**, Pennsylvania State University, University Park, PA. (Note change in date from Oct. 1989, p. 1095)

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

7-8. **1990 Association for Symbolic Logic Spring Meeting (in conjunction with a Spring meeting of the AMS and a MAMLS meeting)**, Pennsylvania State University, University Park, PA. (Feb. 1990, p. 217)

* 7-9. **History in Mathematics Education**, Univ. of Leicester, Leicester, England.

PROGRAM: The format is a mixture of talks, from teachers in this country and abroad who have developed historical perspectives in their mathematics teaching, and workshop sessions to consolidate and develop the ideas further. The conference is not about teaching the history of mathematics as a school subject, but about using history in mathematics teaching.

INFORMATION: S. Russ, HIMED 90, Dept. of Comp. Sci., Univ. of Warwick, Coventry CV4 7AL; tel (0203) 523681.

* 8-11. **Symposium on the Inverse Galois Problem**, Oxford, England.

PURPOSE: The symposium will be held

to coincide with W. Feit's arrival for a two month visit. The aim of the symposium will be to survey what has been achieved and where future work should be directed on the Inverse Galois Problem.

INVITED SPEAKERS: W. Feit, B.H. Matzat, G. Malle, J.-P. Serre, J.G. Thompson, L.L. Scott, J.A. Green.

INFORMATION: M.J. Collins, Mathematical Institute, Oxford Univ., 24-29 St. Giles', Oxford, OX1 3LB.

8-12. **Gamm-Jahrestagung**, Hannover, Federal Republic of Germany. (Jan. 1990, p. 54)

8-14. **Arbeitsgemeinschaft Mit Aktuellem Thema (wird in den Mitteilungen der DMV Heft 1/1990 bekanntgegeben)**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

9-13. **Fifth Workshop on Mathematical Aspects of Computer Science**, Mägdelsprung, German Democratic Republic. (Nov. 1989, p. 1249)

15-21. **Mathematical Concepts of Dependable Systems**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

16-20. **Using Algebraic Processors in Dynamical Systems**, University of Minnesota, Minneapolis, MN. (Feb. 1990, p. 217)

17-21. **Phenomenes de Stokes et Resurgence**, Marseille, France. (Jan. 1990, p. 54)

17-21. **International Conference on Effective Methods in Algebraic Geometry**, Castiglione (near Pisa), Italy. (Feb. 1990, p. 217)

18-20. **Biological Fluid Dynamics Workshop**, Pittsburgh Supercomputing Center, Pittsburgh, PA. (Feb. 1990, p. 218)

18-21. **Sixty-eighth Annual Meeting of the National Council of Teachers of Mathematics**, Salt Lake City, UT. (Jul./Aug. 1989, p. 766)

19-21. **Fourth National Conference on Undergraduate Research**, Union College, Schenectady, NY. (Nov. 1989, p. 1249)

19-21. **Conference on Function Spaces**, Southern Illinois University, Edwardsville, IL. (Dec. 1989, p. 1435)

19-22. **1990 Far Western Section**, University of New Mexico, Albuquerque, New Mexico.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

22-25. **Directions for the Decade in SUPERcomputing**, University of Florida, Gainesville, FL. (Jan. 1990, p. 54)

22-27. **Tenth Conference on Analytic Functions**, Kozubnik, Poland. (Oct. 1989, p. 1095)

22-28. **Einhollende Algebren und Ringe Von Differentialoperatoren**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

24-26. **Second IMACS/ACM-SIGNUM International Conference on Expert Systems for Numerical Computing**, Purdue University, West Lafayette, Indiana. (Feb. 1990, p. 218)

27-30. **Conference on Geometry and Topology**, Harvard University, Cambridge, MA. (Feb. 1990, p. 218)

28-29. **Symposium on Value Distribution Theory in Several Complex Variables**, Univ. of Notre Dame, Notre Dame, Indiana. (Nov. 1989, p. 1250)

29-May 5. **Gruppentheorie (Pro-Endliche Gruppen)**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

30-May 4. **Mathematiques pour la Robotique**, Marseille, France. (Jan. 1990, p. 54)

May 1990

3-4. **Twenty-first Annual Pittsburgh Conference on Modeling and Simulation**, University of Pittsburgh, Pittsburgh, PA. (Sep. 1989, p. 916)

* 3-4. **Automation and Information Engineering Annual Research Review Conference**, College Park, MD.

SPONSORS: The Systems Research Center of the Univ. of Maryland and Harvard Univ.

CONFERENCE TOPICS: Intelligent servomechanisms, expert systems and parallel architectures, chemical process systems, manufacturing systems, communications and signal processing systems.

INVITED SPEAKER: G. Larrabee.

INFORMATION: Registration Deadline is April 15. S. Dass, Systems Research Center, A.V. Williams Bldg. (115), Univ. of Maryland, College Park, MD 20742; tel 301-454-7986.

* 4. **Second Conference on Mathematical Biology**, Stony Brook, NY.

PURPOSE: The conference is intended to provide workers at the interface of mathematics and biology with an opportunity to discuss issues of common interest.

PROGRAM: In addition to two invited talks by J. Cowan and J. White, there will be a series of short talks morning and afternoon.

INFORMATION: E. Beltrami, Dept. of Applied Math. and Stat., State Univ. of New York at Stony Brook, NY 11794-3600; tel 516-632-8367; email: beltrami@chaos.sunysb.edu.

5-6. **Pacific Northwest Geometry Seminar**, University of Oregon, Eugene, OR. (Jan. 1990, p. 55)

* 5-6. **Midwest Partial Differential Equations Seminar**, Northwestern Univ., Evanston, IL.

INFORMATION: Contact A. Devinatz at the address above.

6-9. **Computer Algebra and Differential Equations (CADE-90)**, Cornell University, Ithaca, NY. (Feb. 1990, p. 218)

6-12. **Geschichte der Mathematik**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

7-9. **1990 IEEE Symposium on Research in Security and Privacy**, Oakland, CA. (Oct. 1989, p. 1095)

* 7-9. **Geometric Modeling and Design**, Wayne State Univ., Detroit, MI.

CONFERENCE TOPICS: Continuity of parametric surface patches, algebraic geometry in geometric modeling and design, NC machining and toolpath planning.

INVITED SPEAKERS: C. Chui, G. Farin, D. Gossard, C. Hoffman, A. Requicha.

INFORMATION: T.C. Sun, Dept. of Mathematics, Wayne State Univ., Detroit, MI 48202; tel 313-577-2499; email: tsun@waynest1.bitnet.

7-10. **SIAM Conference on Applications of Dynamical Systems**, Orlando, FL. (Sep. 1989, p. 916)

7-11. **Recent Advances in Regression**, Montréal, Canada. (Jan. 1990, p. 55)

7-11. **Algorithmes et Programmation**, Marseille, France. (Jan. 1990, p. 55)

7-11. **Statistics Week**, Université de Montréal, Canada. (Feb. 1990, p. 218)

7-June 1. **College on Recent Develop-**

ments and Applications in Mathematics and Computer Science, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 601)

9-12. **Computer Algebra and Parallelism (CAP-90)**, Cornell University, Ithaca, NY. (Feb. 1990, p. 218)

13-19. **Abstrakte Konvexe Analysis**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

* 14-15. **Finite Element Applications in Computational Mechanics**, Champaign, IL.

SPONSOR: The National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign (UIUC).

INFORMATION: I. Dilber, NCSA, 152 Computing Applications Building, 605 East Springfield Ave., Champaign, IL 61820; tel: 217-244-1973; email: idilber@ncsa.uiuc.edu (Internet), 13024@ncsavms (Bitnet).

14-15. **Regional Workshop on Nonlinear Conservation Laws**, Stony Brook, NY. (Jan. 1990, p. 55)

* 14-18. **Conference on Nonlinear Analysis and Partial Differential Equations**, Rutgers University, New Brunswick, NJ. (Please note change from Jul./Aug. 1989, p. 767)

INFORMATION: H.F. Pirrello, Conference on Nonlinear Analysis, Dept. of Math., Hill Center, Rutgers Univ., New Brunswick, NJ 08903; email: pirrello@math.rutgers.edu.

14-18. **Workshop on K-Theory**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1990, p. 55)

14-18. **Singularities et Theorie de Hodge**, Marseille, France. (Jan. 1990, p. 55)

* 14-18. **Surfaces, Submanifolds, and their Applications**, Univ. of Leeds, Leeds, England.

INVITED SPEAKERS: B.-Y. Chen, Michigan; J. Eells, Warwick; H. Karcher, Bonn; K. Nomizu, Brown; U. Pinkall, Berlin; B. Smythe, Notre Dame; L. Verstraeten, Leuven; M. Bloor, Leeds. INFORMATION: A. West, Pure Mathematics Department, Univ. of Leeds, Leeds LS2 9JT; email: pmt6aw@uk.ac.leeds.ucs.cms1; tel (0532) 335154.

17-19. **Interface '90 (formerly Computer**

Science and Statistics: Symposium on Interface, East Lansing, MI. (Sep. 1989, p. 916)

17-19. Colloquium: Computer Graphics in Pure Mathematics, University of Iowa, Iowa City, IA. (Dec. 1989, p. 1435)

18-20. Nineteenth Annual State of Jefferson Mathematics Congress, Whiskeytown, CA. (Feb. 1990, p. 219)

*** 20-23. 1990 International Industrial Engineering Conference**, San Francisco, CA.

PROGRAM: The annual conference will bring together the most successful professionals in the field to share state of the art techniques, methods, and theories. The educational program will feature over 100 education sessions, 8 pre-conference seminars, and 6 evening workshops.

INFORMATION: IIE Registrar, P.O. Box 6150, Norcross, GA 30091-6150; tel 404-449-0460; Fax 404-263-8532.

20-25. NSF/CBMS Conference on Operator Algebras, Texas Christian University, Fort Worth, TX. (Jan. 1990, p. 55)

20-26. The Schrödinger Equation and Its Classical Counterparts, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

21-24. The Simulation of Random Processes and Fields - Mathematics and Applications, Portofino, Italy. (Sep. 1989, p. 916)

21-25. NSF-CBMS Regional Conference on The Interface between Analytic Number Theory and Harmonic Analysis, Manhattan, KS. (Jan. 1990, p. 55)

21-25. Eleventh United States National Congress of Applied Mechanics, Tucson, AZ. (Nov. 1988, p. 1389)

21-25. Nonlinear Analysis, Function Spaces and Applications IV, Czechoslovakia. (Jan. 1990, p. 56)

*** 21-25. DIMACS Workshop: Algebraic Issues in Geometric Computations**, New Brunswick, NJ.

PROGRAM: This is the sixth workshop in the DIMACS Special Year on Discrete and Computational Geometry. The plan is to have a number of invited and contributed talks, in order to encourage more direct interaction among the participants.

ORGANIZERS: R. Pollack, B. Sturmfels.

INVITED SPEAKERS: S. Abhyankar, Pur-

due Univ.; P. Alfeld, Univ. of Utah; D. Arnon, Xerox, Palo Alto; C. Bajaj, Purdue Univ.; D. Bayer, Columbia Univ.; L.J. Billera, Cornell Univ.; B. Buchberger, Linz, Austria; J. Canny, Berkeley; D. Kozen, Cornell Univ.; J. Renegar, Cornell Univ.; M.-F. Roy, Rennes, France; J.-J. Risler, Paris; D. Scott, Carnegie-Mellon Univ.; M. Sharir, Tel Aviv.

INFORMATION: DIMACS, Hill Center, Busch Campus, Rutgers Univ., P.O. Box 1179, Piscataway, NJ 08855; 201-932-5928; toci@dimacs.rutgers.edu.

23-25. 1990 International Symposium on Multiple-Valued Logic, Charlotte, NC. (Apr. 1989, p. 496)

23-25. Workshop on Viscous and Numerical Approximation of Shock Waves, North Carolina State University, Raleigh, NC. (Feb. 1990, p. 219)

23-27. Azumaya Algebras, Group Actions, and Modules: A Conference in Honor of Goro Azumaya's 70th Birthday, Indiana University, Bloomington, IN. (Feb. 1990, p. 219)

24. Second Conference on Lagrange Calculus, Community College of Philadelphia, Philadelphia, PA. (Feb. 1990, p. 219)

24-25. Twelfth Symposium on Mathematical Programming with Data Perturbations, George Washington Univ., Washington, DC. (Nov. 1989, p. 1250)

24-26. Conference on Probability Models in Mathematical Physics, Colorado Springs, CO. (Jan. 1990, p. 56)

25-31. Tenth International Conference on Pattern Recognition, Resorts Hotel, Atlantic City, NJ. (Mar. 1988, p. 466)

27-June 2. Lyapunov-Exponents, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

28-June 1. Twenty-second Annual Conference on Statistics, Tours, France. (Jan. 1990, p. 56)

28-June 1. Tenth International Conference on Distributed Computing Systems, Paris, France. (Jan. 1990, p. 56)

28-June 1. Mecanique Celeste et Systemes Hamiltoniens, Marseille, France. (Jan. 1990, p. 56)

28-June 1. Workshop on Set Theoretic Methods in Algebra, Baylor University, Waco, Texas. (Feb. 1990, p. 219)

28-June 2. Geometry of Complex Projective Varieties, Cetraro, Italy. (Nov. 1989, p. 1250)

29-30. Algebraic Logic Conference in Honour of Professor Don Monk, Boulder, Colorado. (Nov. 1989, p. 1250)

29-31. GAMM/IFIP Workshop: "Stochastic Optimization: Numerical Methods and Technical Applications", Neubiberg, Federal Republic of Germany. (Jan. 1990, p. 56)

29-June 1. Eleventh Annual Conference of the Canadian Applied Mathematics Society, Halifax, Nova Scotia. (Oct. 1989, p. 1096)

29-June 2. Dynamical Theories of Turbulence in Fluid Flows, Minneapolis, MN. (Nov. 1989, p. 1250)

29-June 2. Workshop on Dynamical Systems in Fluid Mechanics, Minneapolis, MN. (Nov. 1989, p. 1251)

30-31. Conference on Algebraic Logic, Boulder, Colorado. (Dec. 1989, p. 1436)

31-June 1. Annual Meeting of the Canadian Society for History and Philosophy of Mathematics, University of Victoria, British Columbia. (Feb. 1990, p. 220)

31-June 3. Percolation Models of Material Failure, Cornell University, Ithaca, NY. (Dec. 1989, p. 1436)

June 1990

June-July 1990. International IMACS Conference on Mathematical Modelling and Applied Mathematics, Vilnius, USSR. (Sep. 1989, p. 917)

1-8. Third International Symposium on Orthogonal Polynomials and Their Applications, Erice-Trapani (Sicily), Italy. (Dec. 1989, p. 1436)

1-10. Fourth Annual Meeting of the International Workshop in Analysis and its Applications, Dubrovnik-Kupari, Yugoslavia. (Oct. 1989, p. 1096)

3-6. 1990 Annual Meeting of the Statistical Society of Canada, St. John's, Newfoundland, Canada. (Sep. 1989, p. 917)

3-6. Symposium on Chaos in Biological and Agricultural Systems, Lincoln, Nebraska. (Jan. 1990, p. 56)

3-9. Graphentheorie, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

4-7. Fifth Annual IEEE Symposium on Logic in Computer Science, Philadelphia, PA. (Sep. 1989, p. 917)

4-8. Workshop on Model Theory, Berkeley, CA. (Sep. 1989, p. 917)

- 4-8. **Nonlinear Phenomena in Atmospheric and Oceanic Sciences**, Minneapolis, MN. (Nov. 1989, p. 1251)
- 4-8. **International Conference on Approximation Interpolation and Summability in Honor of A. Jakimovski**, Tel Aviv, Israel. (Dec. 1989, p. 1436)
- 4-8. **International Conference on Bootstrapping and Related Techniques**, Trier, Federal Republic of Germany. (Jan. 1990, p. 56)
- *4-8. **The Mathematics of Neural Nets**, Salisbury State Univ., Salisbury, MD.
- PURPOSE: To give college teachers a working knowledge of Neural Nets.
- LECTURER: R.J. Scott.
- INFORMATION: B.A. Fusaro, Dept. of Math. Sciences, Salisbury State Univ., Salisbury, MD 21801; 301-543-6470 or 6471.
- 4-12. **Recent Developments in Geometric Topology and Related Topics**, Villa "La Querceta", Montecatini Terme. (Feb. 1990, p. 220)
- 4-15. **Analyse Harmonique sur Les Groupes Reductifs P-Adiques**, Marseille, France. (Jan. 1990, p. 56)
- 4-28. **Supercomputing Program for Undergraduate Research**, Cornell National Supercomputing Facility, Ithaca, NY. (Feb. 1990, p. 220)
- 6-8. **First IFIP Conference on Fractals**, Lisbon, Portugal. (Jan. 1990, p. 57)
- 6-9. **Fifth Annual Conference of the European Consortium for Mathematics in Industry**, Lahti, Finland. (Apr. 1989, p. 496)
- 6-12. **1990 Barcelona Conference on Algebraic Topology**, Centre de Recerca Matematica, Barcelona, Spain. (Sept. 1988, p. 1060)
- 6-15. **Third Logical Biennial (in honour of S.C. Kleene)**, Chaika (near Varna), Bulgaria. (Oct. 1989, p. 1096)
- 7-July 4. **1990 Joint Summer Research Conferences in the Mathematical Sciences**, University of Massachusetts at Amherst, MA.
- INFORMATION: C. Kohanski, AMS, P.O. Box 6248, Providence, RI 02940.
- 10-14. **Sixth Haifa Matrix Conference Technion City**, Haifa, Israel. (Feb. 1990, p. 220)
- 10-16. **Reelle Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)
- 10-16. **Fourth Czechoslovak Symposium on Combinatorics**, Prachtice, Czechoslovakia. (Nov. 1989, p. 1251)
- 11-14. **Fourteenth Rolf Nevanlinna Colloquium**, University of Helsinki, Helsinki, Finland. (Jul./Aug. 1989, p. 767)
- 11-14. **Fifth SIAM Conference on Discrete Mathematics**, Atlanta, GA. (Sep. 1989, p. 917)
- 11-15. **World Organization of Systems and Cybernetics Eighth International Congress**, New York, NY. (Please note date change from Mar. 1989, p. 315)
- 11-15. **Chaotic Processes in the Geological Sciences**, Minneapolis, MN. (Nov. 1989, p. 1251)
- 11-15. **Third International Conference on Hyperbolic Problems**, Uppsala, Sweden. (Jan. 1990, p. 57)
- 11-15. **Rigorous Results in Quantum Dynamics**, Liblice Castle, Czechoslovakia. (May/Jun. 1989, p. 602)
- 11-15. **NSF/CBMS Conference on Wavelets**, University of Lowell, Lowell, MA. (Nov. 1989, p. 1251)
- 11-15. **IMACS First International Conference on Computational Physics**, Boulder, CO. (Jan. 1990, p. 57)
- *11-15. **The Mathematics of Computer Graphics**, Salisbury State Univ., Salisbury, MD.
- PURPOSE: To give college teachers a working knowledge of computer graphics.
- LECTURER: J.W. Weiss.
- INFORMATION: B.A. Fusaro, Dept. of Math. Sciences, Salisbury State University, Salisbury, MD 21801; 301-543-6470 or 6471.
- *11-15. **Undergraduate Faculty Enhancement "Workshop on Computational Number Theory"**, Univ. of Wisconsin-Whitewater, WI.
- LECTURER: Carl Pomerance.
- INFORMATION: R.M. Najar, College of Letters and Sciences, Univ. of Wisconsin-Whitewater, Whitewater, WI 53190; 414-472-1620.
- 12-15. **Ninth International Conference on Analysis and Optimization of Systems**, Antibes, France. (Jan. 1990, p. 57)
- 12-15. **Workshop on Spectral and Scattering Theory of Partial Differential Operators**, Institute of Mathematics, Hebrew Univ., Jerusalem, Israel. (Feb. 1990, p. 220)
- 13-15. **Seventh Annual Quality and Productivity Research Conference**, Madison, WI. (Mar. 1989, p. 315)
- 13-16. **Function Estimation and Statistical Applications**, Cornell University, Ithaca, NY. (Feb. 1990, p. 221)
- 13-22. **Free Boundary Problems: Theory and Applications**, Centre de Recherches Mathématiques, Université de Montréal, Canada. (Jul./Aug. 1989, p. 767)
- 14-16. **Sixth Summer Conference on General Topology and Applications**, Long Island Univ. (C.W. Post Campus), Brookville, NY. (Feb. 1990, p. 221)
- 14-16. **Fifth Southeast Asian Conference on Mathematical Education (SEACME 5)**, Gadong, Brunei Darussalam. (Nov. 1989, p. 1251)
- *14-16. **Function Estimation and Statistical Applications**, Cornell Univ., Ithaca, NY.
- PURPOSE: This workshop will focus on using data to estimate unknown functions.
- ORGANIZERS: D. Ruppert, Cornell Univ. and J.S. Marron, Univ. of North Carolina, Chapel Hill.
- INVITED SPEAKERS: N. Altman, R.J. Carroll, D. Cline, D. Cox, R. Eubank, P. Hall, I. Johnstone, R. Liu, J.S. Marron, D. Nychka, J. Rice, D. Scott, P. Speckman, M. Wells.
- INFORMATION: For scientific content: D. Ruppert, School of Operations Research and Industrial Engineering, Cornell Univ., 343A Upson Hall, Ithaca, NY 14853, 607-255-9136; email: davidr@orie.cornell.edu. To register: V. Styles, Mathematical Sciences Institute, Cornell Univ., 201 Caldwell Hall, Ithaca, NY 14853-2602; 607-255-7740.
- 15-20. **Global Differential Geometry and Global Analysis**, Berlin, Federal Republic of Germany. (Jan. 1990, p. 57)
- 17-23. **Partial Differential Equations in Complex Analysis**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)
- 18-20. **Joint WNAR-IMS Regional Meeting**, Montana State University, Bozeman, MT. (Mar. 1989, p. 315)
- 18-21. **A Conference on Partial Differential Equations, in Honor of Shmuel Agmon**, Inst. of Math., Hebrew Univ.,

Jerusalem, Israel. (Feb. 1990, p. 221)

18-22. **Fourteenth Mathematical Sciences Lecture Series on Partially Ordered Sets**, Johns Hopkins University, Baltimore, Maryland. (Oct. 1989, p. 1096)

18-22. **Approximations Diophantiennes et Nombres Transcendants**, Marseille, France. (Jan. 1990, p. 57)

* 18-23. **The Fifth International Conference on Topology and its Applications**, Dubrovnik, Yugoslavia.

ORGANIZING COMMITTEE: I. Ivanšić (Chairman), D. Adnadević (Vice-chairman), M. Mršević (Secretary), S. Mardešić, J. Vrabec.

CONFERENCE TOPICS: General topology, geometric topology, algebraic topology, differential topology, applications.

INFORMATION: Secretary: M. Mršević, Društvo Matematicara SR Srbije, Knez Mihailova 35/IV, p.p. 791, 11001 Beograd, Yugoslavia.

18-26. **Recent Developments in H_∞ Control Theory**, Villa Olmo, Como. (Feb. 1990, p. 221)

18-29. **Radar/Sonar**, Minneapolis, MN. (Nov. 1989, p. 1251)

18-29. **AMS-SIAM Summer Seminar on Vortex Dynamics and Vortex Methods**, University of Washington, Seattle, WA.

INFORMATION: B. Verducci, AMS, P.O. Box 6248, Providence, RI 02940.

20-22. **Sixteenth International Workshop on Graph-Theoretic Concepts in Computer Science**, Berlin, Federal Republic of Germany. (Jan. 1990, p. 57)

* 20-23. **Second Symposium on Chaotic Dynamical Systems**, Conference Center "Woudschoten" (near Utrecht), The Netherlands.

PURPOSE: The purpose of the symposium is the following: 1). The lectures consist of introductions to some subjects as well as a sketching overview of actual research, i.e. lectures for a broad audience. These lectures will be given by some leading researchers in the field. 2). There must be a sufficient amount of time to discuss with the prominent researchers. This does not only hold for advanced scientists but also for Ph.D. students. 3). The participating Ph.D. students will get the opportunity to present a poster.

INVITED SPEAKERS: M. Misiurewicz, Warsaw Univ.; F. Takens, Univ. of Groningen; T. Tél, Eötvös Univ.; J.A. Yorke, Univ. of Maryland; L.-S. Young, Univ. of Arizona.

INFORMATION: H.E. Nusse, Rijksuniversiteit Groningen, Faculteit der Economische Wetenschappen, WSN-gebouw, Postbus 800, NL-9700 AV Groningen, The Netherlands.

24-30. **Mathematische Probleme in der Nichtlinearen Elastizität**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

25-29. **International Symposium on Fuzzy Approach to Reasoning and Decision Making**, Bochyne, Czechoslovakia. (Oct. 1989, p. 1096)

25-29. **Logique et Informatique**, Marseille, France. (Feb. 1990, p. 221)

25-July 13. **SMS-NATO ASI: Shape Optimization and Free Boundaries**, Université de Montréal, Montréal, Canada. (Dec. 1989, p. 1437)

27-29. **ACM Conference on Lisp and Functional Programming**, Nice, France. (Jan. 1990, p. 58)

27-30. **Fourth International Congress on Algebraic Hyperstructures and Applications**, Xanthi, Greece. (Apr. 1989, p. 496)

July 1990

July 1990. **AMS Summer Research Institute on Differential Geometry**, University of California, Los Angeles, CA.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

1-7. **Modulfunktionen In Mehreren Variablen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

1-15. **International Symposium on Algebraic Topology - Adams Memorial Symposium**, University of Manchester, England. (Sep. 1989, p. 918)

1-18. **Twentieth Summer Session on Probability Theory**, Saint-Flour (Cantal), France. (Mar. 1989, p. 315)

2-6. **Tenth Australian Statistical Conference/Second Pacific Statistical Congress**, Sydney, Australia. (Jul./Aug. 1989, p. 768)

2-6. **The Jónsson Symposium**, Laugarvatn, Iceland. (Sep. 1989, p. 918)

2-6. **Thirty-fourth Annual Meeting of the Australian Mathematical Society**, Townsville, Queensland, Australia. (Oct. 1989, p. 1097)

2-6. **Fifteenth International Biometric Conference**, Budapest, Hungary. (Jan. 1990, p. 58)

2-7. **Groupes Ordonnés et Groupes de Permutation**, Marseille, France. (Jan. 1990, p. 58)

2-10. **Continua with Microstructures**, Villa "La Querceta", Montecatini Terme. (Feb. 1990, p. 222)

2-31. **Time Series**, Minneapolis, MN. (Nov. 1989, p. 1252)

2-August 10. **Représentations des Groupes et des Algèbres de Lie**, Université de Montréal, Canada. (Feb. 1990, p. 222)

3-6. **Eleventh Dundee Conference on Ordinary and Partial Differential Equations**, Dundee, Scotland. (Sep. 1989, p. 918)

5-7. **Lattice Path Combinatorics and Applications**, McMaster University, Hamilton, Ontario, Canada. (Feb. 1990, p. 222)

6-7. **International Colloquium on Applications of Mathematics (on the occasion of the 80th birthday of Lothar Collatz)**, Hamburg, West Germany. (Feb. 1990, p. 222)

8-14. **Variationsrechnung**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

9-11. **"Universita'di Genova - The Ohio State University Joint Conference" on New Trends in Systems Theory**, Genoa, Italy. (Jul./Aug. 1989, p. 768)

9-14. **4ème Colloque International de Theorie des Graphes et de Combinatoire**, Marseille-Luminy, C.I.R.M., France. (Jan. 1990, p. 58)

9-20. **Geometry and Topology of Four-Manifolds**, McMaster University, Hamilton, Ontario, Canada. (May/Jun. 1989, p. 602)

* 15-20. **SIAM Annual Meeting**, Chicago, IL.

ORGANIZER: A. Manitius, George Mason Univ.

INFORMATION: SIAM, Conference Coordinator, Dept. CC0190, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel 215-382-9800; Fax 215-386-7999; email:

siam@wharton.upenn.edu.

- 15-21. **Stochastic Image Models and Algorithms**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)
- 15-22. **1990 European Summer Meeting (Logic Colloquium '90)**, University of Helsinki, Finland. (Feb. 1990, p. 222)
- 15-23. **Colloquium in Honor of Roland Fraisse**, Centre International de Rencontres Mathématiques, Luminy, France. (May/Jun. 1989, p. 602)
- 16-20. **SIAM Annual Meeting**, Chicago, IL. (Nov. 1988, p. 1389)
- 16-20. **Symposium Fraisse**, Marseille, France. (Jan. 1990, p. 58)
- * 16-20. **NSF-CBMS Regional Conference "The Polynomial Identities and Invariants of $n \times m$ Matrices"**, DePaul Univ., Chicago, IL.

INVITED SPEAKERS: E. Formanek (Featured Lecturer), S.A. Amitsur, A. Berele, L. LeBruyn, S. Montgomery, L. Small.

INFORMATION: J. Bergen, Dept. of Math., DePaul Univ., Chicago, IL 60614; tel 312-341-8248; email: matjmb@depaul.bitnet.

- * 16-21. **Design and Analysis of Scientific Experiments**, Cambridge, MA.

INFORMATION: Director of the Summer Session, Room E19-356, MIT, Cambridge, MA 02139.

- * 16-27. **Regional Institute in Dynamical Systems**, Boston Univ., Boston, MA.

PROGRAM: A two week intensive short course on the basic ideas in dynamics, aimed at graduate students and college faculty. Opportunities for interactions with ongoing high school teacher enhancement programs in dynamics. Support from NSF for travel and lodging for participants is anticipated.

CONFERENCE TOPICS: Chaos, complex dynamics, circle and annulus maps, computer experiments in dynamics, and teaching dynamics.

INVITED SPEAKERS: P. Blanchard, R.L. Devaney, D. Fried, G.R. Hall.

INFORMATION: Dynamics Institute, Mathematics Dept., 111 Cummington St., Boston Univ., Boston, MA 02215; email: dynamics-inst@math.bu.edu.

- 22-28. **Konvexgeometrie**, Oberwolfach,

Federal Republic of Germany. (Apr. 1989, p. 497)

23-27. **CADE 10 - Tenth International Conference on Automated Deduction**, West Germany. (Feb. 1990, p. 223)

23-28. **Fourth International Congress on Computational and Applied Mathematics**, Leuven, Belgium. (Jan. 1990, p. 58)

23-August 4. **Third Workshop on Stochastic Analysis**, Silivri, Istanbul-Turkey. (Feb. 1990, p. 223)

26-29. **International Conference on New Trends in Geometric Function Theory and Applications**, University of Madras, Madras, India. (Sep. 1989, p. 918)

29-August 4. **Mechanik Und Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

30-August 4. **The Fourth International Conference on Fibonacci Numbers and their Applications**, Wake Forest University, Winston Salem, NC. (Nov. 1989, p. 1252)

31-August 2. **Dynamics of Numerics and the Numerics of Dynamics**, Bristol, England. (Nov. 1989, p. 1252)

August 1990

- * 2-3. **AMS-SIAM-SMB Symposium on Some Mathematical Questions in Biology, Neural Networks**, Vancouver, Canada.

INFORMATION: Betty Verducci, AMS, P.O. Box 6248, Providence, RI 02940.

5-9. **From Topology to Computation: Unity and Diversity in the Mathematical Sciences (in Honor of Professor Stephen Smale's 60th Birthday)**, Berkeley, CA. (Jan. 1990, p. 58)

5-11. **Mathematical Methods in Tomography**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

5-11. **International Conference on Approximation Theory**, Hungary. (Oct. 1989, p. 1097)

6-7. **AMS Short Course on Combinatorial Games**, Columbus, Ohio.

INFORMATION: M. Foulkes, AMS, P.O. Box 6248, Providence, RI 02940.

6-9. **1990 Joint Statistical Meetings**, Anaheim, CA. (Mar. 1988, p. 466)

6-10. **Singularities**, Honolulu, Hawaii. (Feb. 1990, p. 223)

8-11. **Joint Mathematics Meetings**, Ohio State University, Columbus, OH. (includ-

ing the summer meetings of the AMS, AWM, MAA and PME). This is the 75th Anniversary of the MAA.

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

- * 8-11. **The Fifth KIT Mathematics Workshop**, Korea Institute of Technology, Taejeon, Korea.

PROGRAM: Algebra and topology. The program will consist of a series of lectures by invited speakers, and some one-hour talks.

CALL FOR PAPERS: Papers are solicited in all areas of algebra and topology. Small amounts of financial support will be available to a limited number of talkers.

INFORMATION: Y. Yong Oh, Director, Mathematics Research Center, Korea Institute of Technology, Taejeon 305-701, Korea; fax: (Korea) 42-861-5636.

- * 12-13. **Workshop on Using Technology to Enhance the Teaching and Learning of Calculus and Precalculus Mathematics**, The Ohio State Univ., Columbus, OH.

PROGRAM: Fourth annual summer workshop for college mathematics faculty on the use of graphing calculators and computers in college calculus and precalculus instruction. Immediately after the annual summer AMS/MAA meetings in Columbus, OH.

INFORMATION: F. Demana and B. Waits, 1990 Summer College Workshop, The Ohio State University, Math. Dept., 231 W. 18th Ave., Columbus, OH 43210.

12-18. **Algebraische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

12-18. **Pre-Congress Topology Conference**, University of Hawaii, Honolulu, HI. (Feb. 1990, p. 223)

13-16. **Alaska Conference, Quo Vadis, Graph Theory?**, University of Alaska, Fairbanks, AK. (Oct. 1989, p. 1097)

13-17. **Fifth International Conference on Hadronic Mechanics and Nonpotential Interactions**, University of Northern Iowa, Cedar Falls, Iowa. (Jul./Aug. 1989, p. 768)

13-17. **Eleventh IFAC World Congress**, Tallin, USSR. (Sep. 1989, p. 918)

13-17. **Algebraic Geometry and Analytic Geometry**, Tokyo, Japan. (Sep. 1989,

p. 919)

13-17. **1990 International Conference on Parallel Processing**, Pennsylvania State University, University Park, PA. (Dec. 1989, p. 1438)

* 13-17. **NSF/CBMS Conference on Random Number Generation and Quasi-Monte Carlo Methods**, Univ. of Alaska, Fairbanks, AK.

PROGRAM: H. Niederreiter will give ten lectures emphasizing recent research in the interrelated areas of: quasirandom points and applications to numerical analysis; pseudorandom numbers and applications to Monte Carlo methods; linear complexity for pseudorandom sequences of bits and applications to cryptography. There will also be a few additional lectures by other participants.

INFORMATION: J.P. Lambert, Dept. of Mathematical Sciences, Univ. of Alaska, Fairbanks, AK 99775-1110; email: ffjpl@alaska.bitnet.

13-18. **Institute of Mathematical Statistics Fifty-third Annual Meeting**(jointly with the **Second World Congress of the Bernoulli Society**), Uppsala, Sweden. (Sep. 1989, p. 919)

13-18. **Tsukuba International Conference on Representations of Algebras and Related Topics**, University of Tsukuba, Japan. (Nov. 1989, p. 1253)

14-18. **The Asian Mathematical Conference 1990**, Hong Kong, China. (Sep. 1989, p. 919)

14-18. **Harmonic Analysis, Sendai 1990**, Tohoku University, Sendai, Japan. (Feb. 1990, p. 223)

14-18. **Zeta Functions in Geometry**, Tokyo Institute of Technology, Tokyo, Japan. (Feb. 1990, p. 223)

15-19. **International Conference on Knot Theory and Related Topics**, International House, Osaka, Japan. (Apr. 1989, p. 497)

15-19. **International Conference on Commutative Algebra and Combinatorics**, Nagoya University, Nagoya, Japan. (Feb. 1990, p. 224)

15-20. **Conference on Gaussian Random Fields (The Third Nagoya Lévy Seminar)**, Nagoya University, Nagoya, Japan. (Nov. 1989, p. 1253)

16-18. **SIGAL International Symposium on Algorithms**, Tokyo, Japan. (Oct. 1989, p. 1097)

16-19. **Current Topics in Operator Algebras**, Nara Ken-New Public Hall, Nara, Japan. (Feb. 1990, p. 224)

18-22. **The Second International Conference on Graph Theory**, Kanagawa, Japan. (Feb. 1990, p. 224)

19-20. **Inverse Problems in Engineering Sciences**, Osaka Institute of Technology, Osaka, Japan. (Feb. 1990, p. 224)

19-25. **Mathematische Methoden Des VLSI-Entwurfs Und Des Distributed Computings**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

20-24. **Second International joint Conference of the ISSAC-90 and the AAECC-8**, Nihon University, Tokyo, Japan. (Feb. 1990, p. 224)

20-25. **Fifth Conference on Numerical Methods**, Miskolc, Hungary. (Jan. 1990, p. 59)

21-29. **The International Congress of Mathematicians 1990**, Kyoto, Japan. (Nov. 1988, p. 1389)

23-September 1. **Twenty-eighth International Symposium on Functional Equations**, Graz-Mariatrost, Austria. (Dec. 1989, p. 1438)

26-September 1. **Komplexe Analysis**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

27-31. **Eleventh Prague Conference on Information Theory, Statistical Decision Functions and Random Processes**, Praha, Czechoslovakia. (Jan. 1990, p. 59)

28-30. **IMACS European Simulation Meeting on Problem Solving by Simulation**, Esztergom, Hungary. (Mar. 1989, p. 316)

28-31. **Operations Research 1990, International Conference Operations Research**, Vienna, Austria. (Jul./Aug. 1989, p. 768)

29-31. **International Colloquium on Words, Languages, and Combinatorics**, Kyoto Sangyo University, Kyoto, Japan. (Feb. 1990, p. 224)

30-September 1. **International Symposium on the Semigroup Theory and its Related Fields**, Ritsumeikan University, Kyoto, Japan. (Feb. 1990, p. 224)

30-September 2. **International Symposium on Functional Differential Equations and Related Topics**, Kyoto Shigaku Kaikan (YOUANDI), Kyoto, Japan. (Feb. 1990, p. 224)

30-September 4. **International Conference on Potential Theory**, Nagoya, Japan. (May/Jun. 1989, p. 602)

30-September 4. **International Symposium on Computational Mathematics**, Matsuyama, Japan. (Feb. 1990, p. 224)

31-September 1. **Tokyo History of Mathematics Symposium 1990**, University of Tokyo, Tokyo, Japan. (Feb. 1990, p. 224)

31-September 2. **Conference on Representation Theories of Lie Groups and Lie Algebras**, Lake-Kawaguchi, Yamanashi, Japan. (Feb. 1990, p. 224)

31-September 4. **International Symposium on Functional Analysis and Related Topics**, Sapporo, Japan. (Feb. 1990, p. 225)

31-September 4. **General Topology and Geometric Topology Symposium**, University of Tsukuba, Japan. (Feb. 1990, p. 225)

September 1990

September/October 1990. **IMACS-GAMM Conference on Computer Arithmetic, Scientific Computation and Mathematical Modelling**, Bulgaria. (Sep. 1989, p. 919)

IMACS Symposium on Modelling and Simulation of Electrical Machines, ENSEM - Nancy, France. (May/Jun. 1989, p. 602)

2-7. **Twelfth International Conference on Nonlinear Oscillations**, Cracow, Poland. (Sep. 1989, p. 919)

2-7. **International Conference on Integral Equations and Boundary Value Problems**, Yantai University, Shandong, People's Republic of China. (Nov. 1989, p. 1253)

2-8. **Topologie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

3-6. **Fourth Asian Logic Conference**, Tokyo, Japan. (Mar. 1989, p. 316)

3-7. **IMACS Symposium on Intelligent Models in Systems Simulation**, Brussels, Belgium. (Mar. 1989, p. 316)

3-7. **Représentation des Groupes et Analyse Complexe**, Marseille, France. (Jul./Aug. 1989, p. 768)

3-7. **International Conference on Dynamical Systems and Related Topics**, Nagoya University, Nagoya, Japan. (Feb. 1990, p. 225)

* 3-8. **Physical Interpretations of Relativity Theory**, Imperial College, London, England.

PURPOSE: The conference will review the development, status and potential

of the various physical interpretations of the Relativistic Formal Structure. **INFORMATION:** Conference Coordinator, M.C. Duffy, School of Mech. and Manufacturing Engineering, Sunderland Polytechnic, Chester Rd., Sunderland SR1 3SD; tel (091) 5152856.

8-12. **Neuronet-90: IMACS International Symposium on Neural Nets and Neural Computers**, Prague, Czechoslovakia. (Please note change from May/Jun. 1989, p. 602)

9-15. **Surgery and L-Theory**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

* 10-12. **Second International Workshop on Advances in Robot Kinematics**, Linz, Austria. (Please note change in location from Jan. 1990, p. 59)

10-14. **Mathematiker-Kongress**, Dresden, German Democratic Republic. (Jul./Aug. 1989, p. 769)

10-14. **Greco Calcul Formel**, Marseille, France. (Jan. 1990, p. 60)

* 10-14. **Real Analysis and Measure Theory**, Capri, Italy.

SCIENTIFIC COMMITTEE: L. Albano, Univ. di Bari; V. Aversa, Univ. Federico II di Napoli; L. Barone, Univ. di Lecce; B. Bongiorno, Univ. di Palermo; M. Boni, Univ. di Modena; P. de Lucia, Univ. Federico II di Napoli; E. De Pascale, Univ. della Calabria; N.O. Berruti, Univ. di Pavia; M. Puglisi, Univ. di Bari; G. Santagati, Univ. di Catania; C. Vinti, Univ. di Perugia; A. Volčič, Univ. di Trieste; H. Weber, Univ. della Basilicata; C. Zanco, Univ. di Milano.

ORGANIZING COMMITTEE: Univ. Federico II di Napoli: P. de Lucia, V. Aversa, A. Basile, E. Guariglia.

INFORMATION: Dipartimento di Matematica e Applicazioni, Renato Caccioppoli dell'Università di Napoli, via Mezzocannone 8, 80134 Napoli, Italy.

10-October 5. **School on Qualitative Aspects and Applications of Nonlinear Evolution Equations**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 602)

16-22. **Risikotheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

17-21. **Atelier International de Theorie des Ensembles**, Marseille, France. (Jan.

1990, p. 60)

17-22. **DMV-Jahrestagung 1990**, Bremen, Federal Republic of Germany. (Jul./Aug. 1989, p. 769)

23-29. **Random Graphs and Combinatorial Structures**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

24-28. **International Symposium on Mathematical Theories**, San Sebastián, Spain. (Jan. 1990, p. 60)

24-28. **Structure Galoisienne Arithmetique**, Marseille, France. (Jan. 1990, p. 60)

24-28. **IMACS-GAMM International Symposium on Computer Arithmetic, Scientific Computation and Mathematical Modelling - SCAN 1990**, Albena (near Varna), Bulgaria. (Feb. 1990, p. 225)

24-29. **Mathematical Modelling of Industrial Processes**, Tecnopolis, Bari. (Feb. 1990, p. 225)

30-October 6. **Diophantische Approximationen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

October 1990

1-5. **Organisations et Theorie des Jeux**, Marseille, France. (Jan. 1990, p. 60)

* 1-5. **Third Joint Europe/U.S. Short Course in Hypersonics**, RWTH Aachen Univ. of Technology, Federal Republic of Germany.

PROGRAM: Since hypersonic flight requires highly integrated systems the short course not only aims to give in depth analysis of hypersonic research and technology but also tries to broaden the views of attendees to give the ability to understand the complex problem of hypersonic flight. The course should interest post-graduate students, designers and researchers.

ORGANIZING COMMITTEE: J. Ballmann, Univ. of Aachen, FRG; R. Bec, CNES, France; J.J. Bertin, SANDIA National Labs.; M. Borsi, AIT-GAD, Italy; K.-H. Brakhage, Univ. of Aachen, FRG; A. Dervieux, INRIA, France; C. Dujarric, ESA, France; R. Glowinski, Univ. of Houston; W. Goodrich, AGARD/NASA; R. Graves, NASA; H. Grönig, Univ. of Aachen, FRG; E.H. Hirschel, MBB/GAMM, FRG; B. Holmes, NASA; R. Jeltsch, Univ. of Aachen, FRG; G. Koppenwallner, DLR Göttingen, FRG; W. Kordulla, DLR Göttingen, FRG; E. Krause,

Univ. of Aachen, FRG; P. Le Tallec, Univ. of Paris Dauphine, France; B. Monnerie, ONERA and AAF, France; R. Pellat, CNES, France; J. Periaux, Dassault Industries, France; M. Smith, U.S. Air Force Academy; J. Stollery, Cranfield Institute of Technology, UK; J. Wendt, VKI, Belgium. **CONFERENCE TOPICS:** Physical environments, configuration requirements, propulsion systems including airbreathing systems, experimental methods for external and internal flow, theoretical and numerical methods.

INVITED SPEAKERS: J.J. Bertin, SANDIA Nat'l. Labs.; F.S. Billig, Johns Hopkins Univ.; R. Brun, Univ. de Provence, France; J. Cousteix, ONERA-CERT, France; M. Delery, ONERA/OA, France; J.-A. Desideri, INRIA, France; D. Hänel, RWTH Aachen, FRG; E.H. Hirschel, MBB-München, FRG; H. Hornung, California Inst. of Tech.; G. Koppenwallner, DLR, FRG; R.G. Lacau, Aérospatiale, France; C.P. Li, NASA-JSC; M. Mallet, Dassault Industries, France; J.G. Marvin, NASA-ARC; C.G. Miller, III, NASA-LRC; R.D. Neumann, Wright-Patterson Labs; M. Pandolfi, Politecnico di Torino, Italy; P. Perrier, Dassault Industries, France; C.D. Scott, NASA-JSC; J.L. Steger, NASA-ARC; K.F. Stetson, Wright-Patterson Labs; J.L. Stollery, Cranfield Inst. of Tech., UK.

INFORMATION: Conference Office, K.-H. Brakhage, Institut für Geometrie, und Praktische Mathematik, RWTH Aachen, D-5100 Aachen, Fed. Rep. of Germany; tel 49-241-80 3951; email: Earn/Bitnet: ez010pm@dacth11.

5-6. **Math-History Conference**, LaCrosse, WI. (Jan. 1990, p. 60)

* 5-7. **Workshop on Partial Differential Equations**, Cornell Univ., Ithaca, NY.

PROGRAM: The workshop is being held in honor of Lawrence E. Payne's 25 years as a professor in Cornell University's Dept. of Math. It will focus on several topics within the general area of partial differential equations: non well-posed problems, isoperimetric inequalities, and finite time blowup.

INVITED SPEAKERS: C. Bandle, Univ. of Basil; J. Bell, Lawrence Livermore Labs.; J. Cannon, Lamar Univ.; A.

Carasso, National Institute of Standards and Technology; K. Gustafson, Univ. of Colorado; C. Horgan, Univ. of Virginia; R. Knops, Harriot Watt Univ.; H. Levine, Univ. of Iowa; G. Philippin, Laval Univ., Quebec; M. Protter, Berkeley; D. Sather, Univ. of Colorado; B. Straughan, Univ. of Glasgow; H. Weinberger, Stanford Univ.

INFORMATION: A. Schatz, Dept. of Math., Cornell Univ., 303 White Hall, Ithaca, NY 14853; 607-255-2318; schatz@mssun7.msi.cornell.edu.

7-13. **Arbeitsgemeinschaft Mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

8-12. **Congres Franco-Sovietique de Programmation Mathematique**, Marseille, France. (Jan. 1990, p. 60)

14-20. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

15-19. **Modeles pour L'Analyse des Donnees Multidimensionnelles**, Marseille, France. (Jan. 1990, p. 60)

15-19. **Tercer Congreso Nacional de Matemáticas**, San José, Costa Rica. (Feb. 1990, p. 225)

21-22. **Eastern Section**, University of Massachusetts at Amherst, Amherst, MA.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

21-27. **Mathematische Methoden In Der Robotik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

21-27. **Arithmetik der Körper**, Oberwolfach, Federal Republic of Germany. (Oct. 1989, p. 1098)

21-27. **International Functional Analysis Meeting on the Occasion of the Sixtieth Birthday of Professor M. Valdivia**, Peñíscola, Spain. (Oct. 1989, p. 1098)

22-25. **Fifth Jerusalem Conference on Information Technology (JCIT-5)**, Jerusalem, Israel. (Jan. 1990, p. 60)

26-27. **Statistical Mechanics at the 45th Parallel: Fourth Annual Meeting**, Université de Montréal, Canada. (Feb. 1990, p. 226)

28-November 3. **Mathematical Economics**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

29-November 2. **Trieste Conference on Integrable Systems**, Trieste, Italy. (Jan.

1990, p. 61)

29-November 2. **Algorithmes Paralleles et Architectures Nouvelles**, Marseille, France. (Jan. 1990, p. 61)

* 29-November 2. **The International Conference "D-Modules and Microlocal Geometry"**, Lisbon, Portugal.

PROGRAM: The conference is devoted to the study of systems of linear partial differential equations, analytic singularities, microlocal geometry, and related topics.

SCIENTIFIC COMMITTEE: T.M. Fernandes (CMAF and Univ. of Lisbon), M. Kashiwara (RIMS, Univ. of Kyoto), P. Schapira (Univ. of Paris-Nord).

INVITED SPEAKERS: E. Andronikof (Univ. Paris-Nord, France), D. Barlet (Univ. Nancy, France), E. Björk (Univ. Stockholm, Sweden), J.M. Bony (Ecole Polytechnique, Paris, France), F. Castro (Univ. Sevilha, Spain), D'Agnolo (Univ. Paris-Nord, France), L. Hörmander (Univ. Lund, Sweden), Y. St. Laurent (CNRS, Univ. Grenoble, France), G. Lebeau (Univ. Orsay, France), F. Loeser (Univ. Paris VI, France), B. Malgrange (Univ. Grenoble, France), L. Narvaez (Univ. Sevilha, Spain), O. Neto (Univ. Lisboa, Portugal), T. Oshima (Univ. Tokyo, Japan), R. Rodrigues (Univ. Nova, Portugal), C. Sabbah (CNRS, École Polytechnique, Paris, France), M. Saito (Univ. Kyoto, Japan), J.P. Schneiders (Univ. Liège, Belgium), J. Sjöstrand (Univ. Orsay, France), D. Struppa (Univ. George Mason, USA), Trépreau (Univ. Paris VI, France), Van Doom (Univ. Katholieke, Nijmegen, The Netherlands), Van den Essen (Univ. Katholieke, Nijmegen, The Netherlands), M. Vergne (CNRS, École Normale Supérieure, France), J. Zampieri (Univ. Padova, Italy).

INFORMATION: International Conference "D-modules and microlocal geometry", T. M. Fernandes, CMAF, Complexo II, Av. Prof. Gama Pinto, 2, 1699 Lisboa Codex, Portugal; telefax (351 1) 765622; email bitnet: tmf@ptifm; tel 773338/773325.

29-November 16. **Workshop on Mathematical Ecology**, Trieste, Italy. (Jan. 1990, p. 61)

31-November 3. **Latinamerican Seminar on Applications of Mathematics and**

Computer Science to Biology, La Habana, Cuba. (Feb. 1990, p. 226)

November 1990

2-3. **Central Section Meeting of the AMS**, University of North Texas, Denton, TX.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

4-10. **Wahrscheinlichkeitsmaße auf Gruppen**, Oberwolfach, Federal Republic of Germany. (Oct. 1989, p. 1098)

5-7. **Second SIAM Conference on Linear Algebra in Signals, Systems & Controls**, San Francisco, CA. (Sep. 1989, p. 920)

* 9-11. **Third Annual Conference on Technology in Collegiate Mathematics**, The Ohio State Univ., Columbus, OH.

PROGRAM: Conference runs from Friday morning, 11/9/90 through Sunday afternoon, 11/11/90. Advanced registration is advised.

CALL FOR PAPERS: To give a short talk, please contact the organizers and send a one page abstract before September 1, 1990.

INFORMATION: F. Demana and B. Waits, 1990 Technology Conference, The Ohio State Univ., Math. Dept., 231 W. 18th Ave., Columbus, OH 43210.

12-16. **Supercomputing '90**, New York, NY. (Sep. 1989, p. 920)

12-16. **Workshop on Representations of Reductive Groups over Finite Fields**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1990, p. 61)

18-24. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25-December 1. **Stochastische Approximation Und Optimierungsprobleme In Der Statistik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25-December 1. **Lineare Modelle und Multivariate Statistische Verfahren**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 769)

December 1990

2-8. **Multigrid Methods**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

3-5. **First International Symposium on Uncertainty and Analysis: Fuzzy Reasoning, Probabilistic Methods and Risk Management**, College Park, Maryland. (Oct. 1989, p. 1098)

3-7. **Sixteenth Australasian Conference on Combinatorial Mathematics and Combinatorial Computing**, Palmerston North, New Zealand. (Feb. 1990, p. 226)

3-7. **SINO-JAPANESE Joint Seminar on Nonlinear PDEs with Emphasis on Reaction-Diffusion Aspects.**, Taipei, Taiwan. (Jan. 1990, p. 61)

3-7. **Workshop on General Group Representation Theory**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1990, p. 61)

9-15. **Allgemeine Ungleichungen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

16-22. **Mathematische Logik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25-January 1. **Lineare Modelle Und Multivariate Statistische Verfahren**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

* Spring 1991. **IMACS International Symposium on Iterative Methods in Linear Algebra**, Brussels Free Univ., Brussels, Belgium.

INFORMATION: R. Beauwens, Fac. des Sc. Appl., C.P. 165, Univ. Libre de Bruxelles, Ave. F.D. Roosevelt, 50, B-1050 Brussels-BELGIUM; email: r01201@bbrbfu01.bitnet or P. de Groen, Dept. of Math. and Comp. Sci., Vrije Univ. Brussel, Pleinlaan, 2, B-1050 Brussels-BELGIUM; email: z00301@bbrbfu01.bitnet.

January 1991

7-10. **Sixth Caribbean Conference in Combinatorics and Computing**, University of the West Indies, St. Augustine, Trinidad. (Jan. 1990, p. 61)

16-19. **Joint Mathematics Meetings**, San Francisco, CA. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

February 1991

25-March 1. **IEEE Computer Society COMPCON Spring '91**, San Francisco, CA. (Jan. 1990, p. 62)

March 1991

* 21-23. **Sixth S.E.A. Meeting, Southeastern Approximation Theorists Annual Meeting**, Memphis State Univ., Memphis, TN.

INFORMATION: G. Anastassiou, Dept. of Math. Sciences, Memphis State Univ., Memphis, TN 38152.

* 22-23. **Southeastern Section**, University of South Florida, Tampa, FL.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

* 22-24. **Fifth SIAM Conference on Parallel Processing for Scientific Computing**, Houston, TX.

ORGANIZER: D. Sorensen, Rice Univ.
INFORMATION: SIAM, Conference Coordinator, Dept. CC0190, 3600 University City Science Center, Philadelphia, PA 19104-2688; tel 215-382-9800; Fax 215-386-7999; email: siam@wharton.upenn.edu.

May 1991

* May/June 1991. **IMACS Workshop on Decision Support Systems and Qualitative Reasoning**, Toulouse, France.

INFORMATION: L. Trave-Massuyes, Laboratoire d'Automatique et d'Analyse des Systemes (LAAS), 7, Avenue du Colonel Roche, 31077 Toulouse Cedex, FRANCE; tel 61-33-52-00.

* 7-10. **IMACS Symposium on Modelling and Simulation of Control Systems**, Casablanca, Morocco.

CHAIRMEN: P. Borne (Lille, France), A. El Moudni (Casablanca), S. Tzafestas (Athens, Greece).
INFORMATION: A. EL Moudni, Laboratoire d'Automatique, Faculte des Sciences, BP 5366-Maarif, Casablanca, Morocco.

* 13-17. **Conference in Harmonic Analysis in Honor of E.M. Stein**, Princeton

University, Princeton, NJ.

PURPOSE: This conference will honor E.M. Stein on the occasion of his sixtieth birthday. It will focus on topics from harmonic analysis and related areas.

ORGANIZING COMMITTEE: C. Fefferman, R. Fefferman, S. Wainger.

INVITED SPEAKERS: W. Beckner, J. Bourgain, A.P. Calderón, M. Christ, R. Coifman, C. Fefferman, R. Fefferman, D. Jerison, P. Jones, J.L. Journé, C. Kenig, Y. Meyer, A. Nagel, D.H. Phong, S. Wainger, G. Weiss, T. Wolff.

INFORMATION: S. Kenney, Math. Dept., Princeton Univ., Princeton, NJ 08544.

June 1991

* June 1991. **Third IMACS International Symposium on Computational Acoustics**, Harvard Univ., Cambridge, MA.

CHAIRMEN: D. Lee (Naval Underwater Systems Center), A. Robinson (Harvard Univ.), R. Vichnevetsky (Rutgers Univ.).

INFORMATION: D. Lee, Code 3122, Naval Underwater Systems Center, New London, CT 06320; tel 203-440-4438.

* 3-7. **1991 Annual Meeting of the Statistical Society of Canada**, Toronto, Ontario, Canada.

INFORMATION: J.-A. Chapman, Local Arrangements Chairperson, Henrietta Banting Breast Centre, Women's College Hospital, 5th Floor, Burton Hall, 60 Grosvenor Street, Toronto, Ontario M5S 1B2, Canada.

July 1991

* 15-17. **Fifth IFAC/IMACS Symposium on Computer Aided Design in Control and Engineering Systems**, Swansea, UK.

INFORMATION: H.A. Barker, Dept. of Electrical and Electronic Engineering, Univ. College of Swansea, Swansea, UK.

New AMS Publications

COMPUTATIONAL SOLUTION OF NONLINEAR SYSTEMS OF EQUATIONS Eugene L. Allgower and Kurt Georg, Editors (Lectures in Applied Mathematics, Volume 26)

Nonlinear equations arise in essentially every branch of modern science, engineering, and mathematics. However, in only a very few special cases is it possible to obtain useful solutions to nonlinear equations via analytical calculations. As a result, many scientists resort to computational methods.

This book contains the proceedings of the Joint AMS-SIAM Summer Seminar, "Computational Solution of Nonlinear Systems of Equations," held in July 1988 at Colorado State University. The aim of the book is to give a wide-ranging survey of essentially all of the methods which comprise currently active areas of research in the computational solution of systems of nonlinear equations. A number of "entry-level" survey papers were solicited, and a series of test problems has been collected in an appendix. Most of the articles are accessible to students who have had a course in numerical analysis.

Contents

Eugene L. Allgower and Kurt Georg, Numerically stable homotopy methods without an extra dimension; **Giles Auchmuty**, Duality algorithms for smooth unconstrained optimization; **M. S. Berger**, Antidotes for nonintegrability of nonlinear systems: Quasi-periodic motions; **M. S. Berger**, Bifurcation into folds of infinite dimension; **Sharon L. Blish and James H. Curry**, On the geometry of factorization algorithms; **Klaus Böhmer**, Defect corrections and mesh independence principle for operator equations and their discretizations; **Klaus Böhmer and Mei Zhen**, On a numerical Lyapunov-Schmidt method; **A. Castelo, S. De Freitas and G. Tavares**, PL approximation of manifolds and its application to implicit ODEs; **Thomas F. Coleman**, On characterizations of superlinear convergence for constrained optimization; **Jeanne Duvallet**, Computation of solutions of two-point boundary value problems by a simplicial homotopy algorithm; **Richard E. Ewing**, Computational methods for nonlinear systems of partial differential equations arising in contaminant transport in porous media; **R. Fletcher**, Low storage methods for unconstrained optimization; **A. Galantai**, Block ABS methods for nonlinear systems of algebraic equations; **Sylvie Gélinas and Rémi Vaillancourt**, Application of Julia-Fatou iteration theory in dielectric spectroscopy; **Kurt Georg**, An introduction to PL algorithms; **Kurt Georg and David Zachmann**, Nonlinear convection diffusion equations and Newton-like methods; **Ronald B. Guenther and John W. Lee**, Convergence of the Newton-Raphson method for boundary value problems of ordinary differential equations; **Patrick T. Harker and Jong-Shi Pang**, A damped-Newton method for the linear

complementarity problem; **Annegret Hoy and Hubert Schwetlick**, Some superlinearly convergent methods for solving singular nonlinear equations; **John K. Hunter**, Numerical solutions of some nonlinear dispersive wave equations; **H. Th. Jongen**, Parametric optimization: Critical points and local minima; **R. Baker Kearfott**, Interval arithmetic techniques in the computational solution of nonlinear systems of equations: Introduction, examples, and comparisons; **C. T. Kelley**, Operator prolongation methods for nonlinear equations; **Bruce N. Lundberg, Aubrey B. Poore, and Bing Yang**, Smooth penalty functions and continuation methods for constrained optimization; **S. McKay and J. W. Thomas**, Application of the fast adaptive composite grid method to nonlinear partial differential equations; **Raymond Meija**, Interactive program for continuation of solutions of large systems of nonlinear equations; **Hans D. Mittelmann**, Nonlinear parametrized equations: New results for variational problems and inequalities; **Alexander P. Morgan and Andrew J. Sommese**, Generically nonsingular polynomial continuation; **Alexander P. Morgan, Andrew J. Sommese, and Charles W. Wampler**, Polynomial continuation for mechanism design problems; **G. Russo**, A Lagrangian method for collisional kinetic equations; **Renate Schaaf and Klaus Schmitt**, On the number of solutions of semilinear elliptic problems at resonance: Some numerical experiments; **Jürgen Scheurle**, Splitting of separatrices and chaos; **Phillip H. Schmidt**, PL methods for constructing a numerical implicit function; **Hubert Schwetlick**, Nonstandard scaling matrices in trust region methods; **Michael W. Smiley**, Numerical determination of breathers and forced oscillations of nonlinear wave equations; **Min Sun**, Numerical solutions of singular stochastic control problems in bounded intervals; **W. C. Thacker**, Large least-squares problems and the need for automating the generation of adjoint codes; **Homer F. Walker**, Newton-like methods for underdetermined systems; **Y. Yomdin**, Sard's theorem and its improved versions in numerical analysis; **Tjalling J. Ypma**, Finite difference approximation of sparse Jacobian matrices in Newton-like methods; **Jorge J. Moré**, A collection of nonlinear model problems.

1980 Mathematics Subject Classifications: 65H10, 65K05, 65K10, 65N10, 65N20, 65N25, 65N30, 90C30
ISBN 0-8218-1131-2, LC 90-27, ISSN 0075-8485
784 pages (hardcover), March 1990
Individual member \$129, List price \$215,
Institutional member \$172
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GEOMETRIC AND TOPOLOGICAL INVARIANTS FOR ELLIPTIC OPERATORS Jerome Kaminker, Editor (Contemporary Mathematics, Volume 105)

This volume contains the proceedings of the AMS-IMS-SIAM Summer Research Conference on "Geometric and

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Topological Invariants of Elliptic Operators," held in August 1988 at Bowdoin College. Some of the themes covered at the conference and appearing in the articles are: the use of more sophisticated asymptotic methods to obtain index theorems, the study of the η invariant and analytic torsion, and index theory on open manifolds and foliated manifolds. The current state of noncommutative differential geometry, as well as operator algebraic and K -theoretic methods, are also presented in several of the articles.

This book will be useful to researchers in index theory, operator algebras, foliations, and mathematical physics. Topologists and geometers are also likely to find useful the view the book provides of recent work in this area. In addition, because of the expository nature of several of the articles, it will be useful to graduate students interested in working in these areas.

Contents

Jeff Fox and Jonathan Bloch, *Asymptotic pseudodifferential operators and index theory*; **James Heitsch and Conner Lazarov**, *A Lefschetz theorem on open manifolds*; **Steven Hurder**, *Eta invariants and the odd index theorem for coverings*; **Conner Lazarov and James Heitsch**, *The Lefschetz fixed point theorem for foliated manifolds*; **Varghese Mathai and Alan L. Carey**, *L^2 -acyclicity and L^2 -torsion invariants*; **Hitoshi Moriyoshi**, *Secondary characteristic numbers and locally free S^1 actions*; **Werner Müller**, *L^2 -index theory, eta invariants and values of L -functions*; **Marc Rieffel**, *Non-commutative tori—A case study of non-commutative differentiable manifolds*; **Mel Rothenberg**, *Analytic and combinatorial torsion*; **Michael Taylor**, *Pseudodifferential operators and K -homology, II*; **Phillipe Tondeur and Jesús A. Álvarez López**, *The heat flow along the leaves of a Riemannian foliation*; **Shmuel Weinberger**, *Aspects of the Novikov conjecture*.

1980 *Mathematics Subject Classifications*: 46L80, 58G12
ISBN 0-8218-5112-8, LC 89-18660, ISSN 0271-4132
312 pages (softcover), March 1990
Individual member \$22, List price \$37,
Institutional member \$30
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PROCEEDINGS OF THE WORKSHOP ON LOGIC AND COMPUTATION

Wilfried Sieg, Editor

(Contemporary Mathematics, Volume 106)

This volume contains the proceedings of the Workshop on Logic and Computation, held in July 1987 at Carnegie-Mellon University. The focus of the workshop was the refined interaction between mathematics and computation theory, one of the most fascinating and potentially fruitful developments in logic. The importance of this interaction lies not only in the emergence of the computer as a powerful tool in mathematics research, but also in the various attempts to carry out significant parts of mathematics in computationally informative ways.

The proceedings pursue three complementary aims: to develop parts of mathematics under minimal set-theoretic assumptions; to provide formal frameworks suitable for computer implementation; and to extract, from formal proofs, mathematical and computational information. Aimed at logicians, mathematicians, and computer scientists, this

volume is rich in results and replete with mathematical, logical, and computational problems.

Contents

Michael Beeson, *Some theories conservative over intuitionistic arithmetic*; **Gianluigi Bellin**, *Ramsey interpreted: A parametric version of Ramsey's theorem*; **Douglas K. Brown**, *Notions of closed subsets of a complete separable metric space in weak subsystems of second order arithmetic*; **Wilfried Buchholz and Wilfried Sieg**, *A note on polynomial time computable arithmetic*; **Samuel R. Buss**, *Axiomatizations and conservation results for fragments of bounded arithmetic*; **Peter G. Clote**, *A smash-based hierarchy between PTIME and PSPACE*; **Solomon Feferman**, *Polymorphic typed lambda-calculi in a type-free axiomatic framework*; **Fernando Ferreira**, *Polynomial time computable arithmetic*; **Chris Goad**, *Metaprogramming in SIL*; **Kostas Hatzikiriakou and Stephen G. Simpson**, *WKL_0 and orderings of countable Abelian groups*; **Jeffrey L. Hirst**, *Marriage theorems and reverse mathematics*; **Daniel Leivant**, *Computationally based set existence principles*; **Ken McAloon**, *Hierarchy results for MIXED-TIME*; **A. Nerode and J. B. Remmel**, *Polynomial time equivalence types*; **Frank Pfenning**, *Program development through proof transformation*; **Rick Statman**, *Some models of Scott's theory LCF based on a notion of rate of convergence*; **Gaisi Takeuti**, *Sharply bounded arithmetic and the function $a-1$* ; **Xiaokang Yu**, *Radon-Nikodym Theorem is equivalent to arithmetical comprehension*.

1980 *Mathematics Subject Classifications*: 03, 68
ISBN 0-8218-5110-1, LC 90-40, ISSN 0271-4132
312 pages (softcover), March 1990
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POINTS DE NASH DES ENSEMBLES SOUS-ANALYTIQUES

Wiesław Pawłucki

(Memoirs of the AMS, Number 425)

Directed at researchers in analytic geometry, this book focuses on the geometry of subanalytic sets. By definition, a subanalytic set on a real manifold is the image of a relatively compact semianalytic set under an analytic map; a semianalytic set is one which can be locally described by analytic equalities and inequalities. The author's main result is that, given a subanalytic set, the points at which the set is not semianalytic forms a subanalytic set. In fact, the author also establishes the more general result of the subanalyticity of the set of Nash points of the original set. The proof involves such classical tools as triangulation, Puiseux parametrization, a Bertini theorem, as well as some less standard techniques.

Contents

Théorèmes principaux; Réduction au cas d'une hypersurface; Modifications des théorèmes principaux dans le cas d'une hypersurface; Ω -variétés spéciales et leurs éclatements; Théorèmes de Gabrielov; Achèvement de la démonstration.

1980 *Mathematics Subject Classifications*: 32B20; 32B30, 32C40, 32D20, 32C45
ISBN 0-8218-2430-9, LC 89-18471, ISSN 0065-9266
84 pages (softcover), March 1990
Individual member \$10, List price \$16,
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A LATTICE OF CHAPTERS OF MATHEMATICS: INTERPRETATIONS BETWEEN THEOREMS

Jan Mycielski, Pavel Pudlák, and Alan S. Stern

(Memoirs of the AMS, Number 426)

Directed at mathematical logicians and philosophers, this book will provide readers with a theory of a relationship of interpretability between theories. The authors define chapters of mathematics to be equivalence classes of first order theories relative to interpretability of finite parts of one theory onto the other, and vice versa. This relation induces the structure of a distributive algebraic lattice in the set of those chapters. Some properties of theories, such as finite axiomatizability, completeness, and a new property called connectedness, correspond to natural algebraic properties of their chapters in this lattice. Those properties and the structure of the lattice are the main topics of the book. One of the useful aspects of the concept of a chapter is that it is closer to mathematical practice than the classical concept of first order theory.

Contents

Definitions and generalities; Elementary results about LC; The most significant theorems about LC; Cardinalities, chains and antichains; General results and the structure of LC; Results about special theories; Proof of Theorem 6.12.

1980 *Mathematics Subject Classifications*: 03B10; 03C07
ISBN 0-8218-2488-0, LC 89-18632, ISSN 0065-9266
76 pages (softcover), March 1990
Individual member \$10, List price \$16,
Institutional member \$13
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DERIVATIVES OF LINKS: MILNOR'S CONCORDANCE INVARIANTS AND MASSEY'S PRODUCTS

Tim D. Cochran

(Memoirs of the AMS, Number 427)

The equivalence relation of concordance on the set of links of circles in 3-space arises naturally in attempts to resolve singularities of immersed 2-spheres in a 4-dimensional manifold. In fact, certain unsolved link concordance problems are exactly the obstructions to successfully performing surgery on 4-manifolds as the higher-dimensional theory predicts.

Directed at low-dimensional topologists and knot theorists, this book investigates and clarifies higher-order cohomology operations (Massey products) on the complements of links. These concordance invariants are essentially equivalent to Milnor's $\bar{\mu}$ -invariants, which detect whether or not the longitudes of a link lie in the n^{th} term of the lower-central series of the fundamental group of the link complement. The

author defines geometric derivatives on the set of links and uses these to define higher-order linking numbers, which are seen to be "pieces" of Massey products and to have more geometric content.

His investigation leads to algorithmic realization results, calculational methods, and many new examples, including the first examples with trivial $\bar{\mu}$ -invariants which are not concordant to boundary links, as well as the first examples with trivial Alexander's module but non-trivial $\bar{\mu}$ -invariants. There are also new connections with geometric equivalence relations and with K. Orr's homotopy invariants.

Contents

Higher-order linking numbers; Derived links, derived linkings, and surface systems; Derived links and the lower central series; Computing G/G_n : The Geometric Rewrite; Calculating Milnor's $\bar{\mu}$ -invariants using the Geometric Rewrite; Formal Massey products and surface systems; Antiderivatives and the realization theorem; The effect of Bing-doubling and band-summing on the $\bar{\mu}$ -invariants; Relations to cobordism and Orr's invariants; Cobordism classification and realization; Questions and problems.

1980 *Mathematics Subject Classifications*: 57M25; 55S30, 57Q45, 20F14, 20F32
ISBN 0-8218-2489-9, LC 89-18593, ISSN 0065-9266
88 pages (softcover), March 1990
Individual member \$10, List price \$16,
Institutional member \$13
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ELEMENTS OF THE THEORY OF ELLIPTIC FUNCTIONS

N. I. Akhiezer

(Translations of Mathematical Monographs, Volume 79)

This book contains a systematic presentation of the theory of elliptic functions and some of its applications. A translation from the Russian, this book is intended primarily for engineers who work with elliptic functions. It should be accessible to those with background in the elements of mathematical analysis and the theory of functions contained in approximately the first two years of mathematics and physics courses at the college level.

Contents

Chapter I. General theorems about elliptic functions; **Chapter II.** Modular functions; **Chapter III.** The Weierstrass functions; **Chapter IV.** Theta functions; **Chapter V.** The Jacobi functions; **Chapter VI.** Transformation of elliptic functions; **Chapter VII.** Additional facts about elliptic integrals; **Chapter VIII.** Some conformal mappings; **Chapter IX.** Extremal properties of fractions to which a transformation of elliptic functions reduces; **Chapter X.** Generalization of Tchebycheff polynomials; **Chapter XI.** Various supplements and applications.

1980 *Mathematics Subject Classifications*: 33-01, 33A25; 11F03, 14K20, 30C20, 14K07, 33A30, 32H25, 33A65, 65A05
ISBN 0-8218-4532-2, LC 89-18452, ISSN 0065-9282
248 pages (hardcover), March 1990
Individual member \$56, List price \$93,
Institutional member \$74
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THEORY AND APPLICATIONS OF DIFFERENTIABLE FUNCTIONS OF SEVERAL VARIABLES. XII

S. M. Nikol'skii, Editor

(Proceedings of the Steklov Institute, Volume 181)

This collection of papers is devoted to various problems in the theory of differentiable functions of several variables and their application to partial differential equations.

Among the topics addressed are: imbeddings and equivalent normings of various spaces of smooth functions of several variables defined on subsets of Euclidean spaces; constructive properties of various spaces of differentiable functions; convergence of multiple Fourier series; estimates of bilinear approximations of periodic functions and estimates of widths; variational problems on intervals and solutions of the hydrodynamic system for a viscous fluid; high precision algorithms for approximate conformal mappings of simply connected and doubly connected regions.

Contents

O. V. Besov, *Imbeddings of an anisotropic Sobolev space for a domain with the flexible horn condition*; **Ya. S. Bugrov**, *Imbedding theorems and convergence of multiple Fourier series*; **V. I. Burenkov**, *A theorem on iterated norms for Nikol'skii-Besov spaces, and its application*; **E. A. Volkov**, *High-precision practical results in conformal mappings of simply connected and doubly connected domains by the block method*; **M. L. Gol'dman**, *Imbedding with different metrics for spaces of Calderón type*; **G. A. Kalyabin**, *A characterization of spaces of Besov-Lizorkin-Triebel type with the help of generalized differences*; **V. I. Kolyada**, *On relations between moduli of continuity in different metrics*; **L. D. Kudryavtsev**, *Variational problems with free endpoints on bounded and unbounded intervals*; **G. G. Magaril-Ilyayev**, *Trigonometric widths of Sobolev classes of functions on \mathbb{R}^n* ; **V. N. Maslennikova and A. V. Glushko**, *Localization theorems of Tauberian type and the rate of decay of a solution of the system for the hydrodynamics of a viscous compressible fluid*; **N. V. Miroshin**, *On the maximal space of Vekua and spaces close to it*; **K. T. Mynbaev**, *The anisotropic Strichartz seminorm and capacities*; **S. M. Nikol'skii and P. I. Lizorkin**, *A new approach to the theory of the function spaces $B_{p,\theta}^r$ on the sphere*; **Yu. S. Nikol'skii**, *Integral estimates of differentiable functions in weighted anisotropic spaces on unbounded domains*; **M. O. Otelbaev**, *On coercive estimates of solutions of difference equations*; **V. N. Temlyakov**, *Estimates of best bilinear approximations of periodic functions*.

1980 *Mathematics Subject Classifications*: 30C20, 30C30, 30G20, 31B15, 39A12, 41A30, 41A46, 42B05, 45E35, 46E30, 46E35, 49C05, 76N10, 76U05; 26B05, 34B25, 34E99, 35A22, 35A35, 35A40, 35B40, 35B65, 35E99, 35J05, 42A10, 42A20, 45E05, 47B39, 65E05
ISBN 0-8218-3131-3, LC 68-1677, ISSN 0081-5438
304 pages (hardcover), March 1990
Individual member \$85, List price \$141,
Institutional member \$113
To order, please specify STEKLO/181N

The following publication originally appeared in the December *Notices*. It is being reprinted here with the correct title.

THE MEROMORPHIC CONTINUATION AND FUNCTIONAL EQUATIONS OF CUSPIDAL EISENSTEIN SERIES FOR MAXIMAL CUSPIDAL SUBGROUPS

Shek-Tung Wong

(Memoirs of the AMS, Number 423)

Eisenstein series are fundamental objects in the theory of automorphic forms, which has important applications in analytic number theory. There are a number of approaches for establishing the meromorphic continuation and functional equations of Eisenstein series, with the ideas of Selberg being especially influential.

This book presents a development, based on an idea of Selberg, of the analytic continuation of Eisenstein series by means of integral operators. Starting with a brief account of the role of Eisenstein series in the theory of automorphic forms, the author obtains the meromorphic continuation and functional equations of cuspidal Eisenstein series for the maximal cuspidal subgroups of a reductive real algebraic group with an arithmetic subgroup. The book's most significant contribution is the way it lays out the formalism for Selberg's approach in the context of an algebraic group and an arithmetic subgroup. The main line of argument requires only knowledge of elementary functional analysis and complex analysis.

Contents

The definition and basic properties of the Eisenstein series
The compact operators
Fredholm equations
Analytic continuation
Functional equations
The general case of several cusps

1980 *Mathematics Subject Classification*: 11
ISBN 0-8218-2486-4, LC 89-28399, ISSN 0065-9266
224 pages (softcover), January 1990
Individual member \$15, List price \$25,
Institutional member \$20
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AMS Reports and Communications

Recent Appointments

Committee members' terms of office on standing committees expire on December 31 of the year given in parentheses following their names, unless otherwise specified.

The following ad hoc committees have been discharged by the Council with thanks:

Committee to Review Procedures of the Council in Considering Issues, Committee on AMS Publications in Applied Mathematics, Committee on Election Scheduling, Committee on Electronic Exchange of Information (CEEI), Committee on Vending Software, Committee on Applied Mathematics, Committee on Fellowship Policy, Committee on NCTM Standards, Committee to Recommend Winners of Prizes for Automatic Theorem Proving.

The following individuals have been elected by the Council upon recommendation of the Editorial Boards Committee:

- M. Salah Baouendi (1992) as the Society's Representatives to the *American Journal of Mathematics*; the continuing member of the committee is David Gieseker (1991);

- Richard S. Palais (1992) to the *Bulletin Editorial Committee*; continuing members of the committee are Roger E. Howe (1990), and Murray H. Protter (1991), chair;

- H. Jerome Keisler (1992) to the *Colloquium Editorial Committee*; continuing members of the committee are Raoul H. Bott (1990), and Charles L. Fefferman (1991);

- Jon Barwise (1992), and Judy Green (1992) to the *Committee to*

Monitor Problems in Communication; continuing members of the committee are Nancy Gubman, consultant, William H. Jaco (ex officio), Arthur M. Jaffe (1991), Richard G. Larson (1990), Paul G. Nevai (1991), and Richard S. Palais (1990);

- Craig Huneke (1992), and Linda Preiss Rothschild (1992), to the *Contemporary Mathematics Editorial Committee*; continuing members of the committee are Richard W. Beals (1991), Sylvain E. Cappell (1991), Jonathan Goodman (1990), Jan Mycielski (1990), and Michael E. Taylor (1991);

- B. A. Taylor (1992) to the *Mathematical Reviews Editorial Committee*; he will also serve as chair. Continuing members of the committee are Leonard D. Berkovitz (1991), John L. Selfridge (1991), and Hans F. Weinberger (1990);

- Victor W. Guillemin (1992) and Marc A. Rieffel (1991), to the *Mathematical Surveys and Monographs Editorial Committee*; continuing members of the committee are David S. Kinderlehrer (1991) and M. Susan Montgomery (1990), chair;

- Walter Gautschi (1992) to the *Mathematics of Computation Editorial Committee*; continuing members of the committee are Donald Goldfarb (1990) and Andrew M. Odlyzko (1991);

- Lawrence F. Gray (1993), Jeff Kahn (1993), and Franklin D. Tall (1993) to the *Proceedings Editorial Committee*; continuing members of the committee are William W. Adams (1992), J. Marshall Ash (1992), Maurice Auslander (1992), Andreas Blass (1992), Frederick R. Cohen (1991), William J. Davis (1991), chair, Clifford J. Earle, Jr. (1992), Palle E.

T. Jorgensen (1992), Barbara Lee Keyfitz (1991), Kenneth R. Meyer (1991), Paul S. Muhly (1990), George C. Papanicolaou (1991), Louis J. Ratliff, Jr. (1991), Jonathan M. Rosenberg (1991), James E. West (1991), and Warren J. Wong (1991);

- Ronald L. Graham (1992) to the *Proceedings of Symposia in Applied Mathematics Editorial Committee*; continuing members of the committee are Alexandre Chorin (1992), chair, and Björn E. J. Dahlberg (1991);

- Avner D. Ash (1990), James W. Cannon (1993), Burgess Davis (1992), Judith D. Sally (1993), and Masamichi Takesaki (1993) to the *Transactions and Memoirs Editorial Committee*; David J. Saltman (1990) has been appointed chair. Continuing members of the committee are James E. Baumgartner (1991), Ralph L. Cohen (1990), Eugene B. Fabes (1992), Jerry L. Kazdan (1990), Roger D. Nussbaum (1991), Carl Pomerance (1991), and Audrey A. Terras (1991).

M. Susan Montgomery, then chair of the Board of Trustees, has appointed Frederick W. Gehring (ex officio) to the *Investment Committee*. Continuing members of the committee are Steve Armentrout (ex officio), and Franklin P. Peterson (ex officio), chair.

President William Browder has appointed the following individuals:

- Frederick J. Almgren, Jr., Jerry L. Bona, Hermann Flaschka, Barbara Keyfitz, David Mumford, Ivar Stakgold, and Hans F. Weinberger to an ad hoc *Committee on Applications of Mathematics*; Professor Bona will serve as chair;

- Louis Nirenberg (1991) to the *Committee on National Awards and*

Public Representation; continuing members of the committee are Michael Artin (ex officio), William Browder (ex officio), chair, and Robert Fossum (ex officio);

- Nicholas Katz (1993), and Francois Treves (1993) to the *Committee on Summer Institutes and Special Symposia*; Raghavan Narasimhan (1991) has been appointed chair. Continuing members of the committee are Barbara Lee Keyfitz (1992), Haynes R. Miller (1991), and Brian Parshall (1992). Terms expire on February 28;

- Sue Goodman (AMS, 1992) to the AMS-ASA-IMS-MAA-NCTM-SIAM *Committee on Women in the Mathematical Sciences*; other members of the committee are Marsha J. Berger (SIAM, 1992), Grace M. Burton (NCTM, 1990), Marjorie M. Enneking (NCTM, 1989), Nancy Flournoy (IMS, 1992), Susan Geller (AMS, 1991), chair, Mary Hesselgrave (MAA, 1991), Patricia A. Jacobs (IMS, 1990), Patricia Kenschaft (AWM), Jeanne W. Kerr (AMS, 1992), Betty K. Lichtenberg (NCTM, 1989), Edith Luchins (MAA, 1991), Joyce R. McLaughlin (SIAM, 1990), Anne Parkhurst (ASA), Magda Peli-grad (IMS, 1991), Linda R. Petzold (SIAM, 1992), Frances Rosamond (MAA, 1992), M. Beth Ruskai (AMS, 1992), and Alice T. Schafer (MAA, 1991). NCTM members' terms expire on April 1 of the year given.

Presidents Lida K. Barrett (MAA) and William Browder (AMS) have appointed:

- Newman Fisher to the AMS-MAA *Arrangements Committee for the San Francisco Meeting* and as chair. Other members of the committee are Gerald Alexanderson (ex officio), William H. Jaco (ex officio), and Andy Roy Magid (ex officio).

- Leonard Gillman, Uta C. Merzbach, Everett Pitcher, and Sanford L. Segal to the AMS-MAA *Joint Archives Committee*.

Presidents Ivar Stakgold (SIAM) and William Browder (AMS) have

appointed Joel Spencer (1992) to the AMS-SIAM *Committee on Applied Mathematics*. Other members of the committee are James M. Hyman (1990), Lawrence A. Shepp (1991), Gilbert Strang (1991), and Robert F. Warming (1990).

Presidents Ivar Stakgold (SIAM), Stuart Kauffman (SMB), and William Browder (AMS) have appointed James W. Curran (1993), Marcus W. Feldman (1991), and Eric S. Lander (1993) to the AMS-SIAM-SMB *Committee on Mathematics in the Life Sciences*. Marc Mangel (1992) has been appointed chair. Continuing members of the committee are Jack D. Cowan (1991) and James Murray (1992).

The Council Meeting in Louisville

The Council met at 2:00 p.m. on 16 January 1990 in the Grand Ballroom North of the Hyatt Regency Louisville Hotel. President Browder presided.

The Council received the report of the Tellers for the 1989 Election. (See the following announcement in this section.) It received the report of the Teller for the Election to the Nominating Committee and for the Election to the Editorial Boards Committee. The new members of the Nominating Committee are:

Barbara Lee Keyfitz
Ray Kunze
Robert F. Williams

The new members of the Editorial Boards Committee are:

Linda Keen
Barry Simon

The Council received reports from many committees of the Society, most of them in written form.

It elected members to several editorial boards upon recommendation from its Editorial Boards Committee. These elections are reported in the "Recent Appointments" section. It agreed with the Board of Trustees to establish a new book series "Graduate Texts".

The Council continued to consider election matters. It agreed to send to the membership in the next (Fall 1990) election an amendment to the Bylaws that changes the term of office for the Vice-Presidents from two to three years. Another effect of this proposed amendment is that there will be only one Vice-President elected each year. It agreed to consider at its April 1990 meeting a proposed amendment that would limit to five the number of consecutive two year terms a Treasurer or Associate Treasurer could serve. It asked that biographical information and statements of candidates appear in *Notices* at least two weeks before ballots are mailed. Regarding this, the Council has suggested that a "Nominator" be selected for each candidate for President(-Elect) to write an article for *Notices* about the candidate. It also raised to 200 words the "limit" on statements by candidates.

The Council once again considered the policy of publishing responses to book reviews in the *Bulletin*. A policy proposed by the Editorial Boards Committee was returned to the committee for reconsideration.

The Council gratefully accepted a contribution from Professor Joan Birman, the income from which will be used to fund a biennial award to honor the memory of Ruth Lyttle Satter. The prize is to be for an outstanding contribution to research in mathematics during the past five years and is to be awarded to a woman mathematician.

The Council agreed to recommend a Bylaw amendment that would allow Emeritus Members to receive the *Bulletin* as a privilege of membership.

Finally, the Council passed two resolutions of congratulations, one to the Mathematische Gesellschaft in Hamburg on the occasion of its 300th Anniversary and one to the Deutsche Mathematiker Vereinigung on the occasion of its 100th Anniversary.

The Council adjourned at 7:06 p.m.

Robert M. Fossum
Secretary
Urbana, Illinois

Election Results of 1989

The newly elected Vice-Presidents of the Society are Lenore Blum and Dennis P. Sullivan. The newly elected Members-at-Large of the Council are Sheldon Axler, Shing-Tung Yau, Joan S. Birman, Carl Pomerance, and Charles Herbert Clemens. The newly elected Trustee is John C. Polking.

All candidates in noncontested elections were elected to their respective offices.

The candidates elected to the Nominating Committee for 1990 are Barbara Lee Keyfitz, Ray A. Kunze, and Robert F. Williams.

The candidates elected to the Editorial Boards Committee for 1990 are Linda Keen and Barry Simon.

The composition of the Council for 1990 follows.

Council for 1990

President:
William Browder
President-Elect:
Michael Artin
Vice-Presidents:
Lenore Blum
Sun-Yung Alice Chang
Dennis P. Sullivan
Secretary:
Robert M. Fossum
Former Secretary:
Everett Pitcher
Associate Secretaries:*
Joseph A. Cima
W. Wistar Comfort

Andy Roy Magid
Lance W. Small
Treasurer:
Franklin P. Peterson
Associate Treasurer:
Steve Armentrout

*One of these four is a voting member at each meeting.

Members-at-Large:
Jonathan L. Alperin
Sheldon Axler
Joan S. Birman
Fan R. K. Chung
Charles Herbert Clemens
Lawrence J. Corwin
Richard K. Guy
Rhonda J. Hughes
Robion C. Kirby
Irwin Kra
Albert Marden
Carl Pomerance
Michael C. Reed
Hugo Rossi
Harold M. Stark
William P. Thurston
Shing-Tung Yau

Representatives of Committees

Bulletin Editorial Committee
Murray H. Protter, Chair
Colloquium Editorial Committee
Raoul H. Bott, Chair
Committee to Monitor Problems in Communication
To be elected, Chair
Journal of the AMS
Michael Artin, Chair
Mathematical Reviews Editorial Committee
B. A. Taylor, Chair
Mathematical Surveys Editorial Committee
M. Susan Montgomery, Chair
Mathematics of Computation Editorial Committee
Walter Gautschi, Chair

Proceedings Editorial Committee
William J. Davis, Chair
Representative, Board of Editors of American Journal of Mathematics
M. Salah Baouendi
Science Policy Committee
Michael C. Reed, Chair
Transactions and Memoirs Editorial Committee
David J. Saltman, Chair

Trustees for 1990

Steve Armentrout
William Browder
Frederick W. Gehring
Ronald L. Graham
M. Susan Montgomery
Franklin P. Peterson
John C. Polking
Paul Sally, Jr.

The Business Meeting in Louisville

The Business Meeting of 19 January 1990 began about 4:55 and followed immediately upon the award of the 1990 Cole Prize in Algebra and the 1990 Award for Distinguished Public Service. President Browder presided.

The Secretary reported that the Society had about 27,000 members at the end of 1989, that the financial picture was bright, and that the Council met and had acted upon various items (see second announcement in this section). The Secretary requested and received unanimous approval of a resolution of thanks for the the Local Arrangements Committee. The meeting adjourned at about 5:10 p.m.

After the business meeting, a panel discussed the role the Society should take in educational matters.

Robert M. Fossum
Secretary
Urbana, Illinois

Miscellaneous

Personal Items

Eliot W. Collins has been promoted to Information Management Specialist at AT&T in Piscataway, NJ. He is also a Visiting Lecturer in Mathematics at Rutgers University.

Paul R. Halmos, of Santa Clara University, has been awarded an honorary Doctor of Mathematics from the University of Waterloo and has been invited to give the Convocation address at that Institution's Spring Convocation for Mathematics.

K. Brooks Reid has been appointed Founding Faculty member and Professor of the new, twentieth campus of California State University, CSU San Marcos.

William H. Reid, Professor Emeritus of The University of Chicago, is now a professor in the Department of Mathematical Sciences at Indiana-Purdue University at Indianapolis.

Deaths

Arthur Bernhart, Retired Professor of the University of Oklahoma, died

on October 16, 1989, at the age of 81. He was a member of the Society for 43 years.

Morris H. DeGroot, of Carnegie-Mellon University, died on November 2, 1989, at the age of 58. He was a member of the Society for 31 years. (See the News and Announcements section of this issue of *Notices*.)

Hubert W. Ellis, Retired Professor of Queen's University, died on January 1, 1990, at the age of 71. He was a member of the Society for 43 years.

Herbert Gross, of the University of Zürich, died on October 29, 1989, at the age of 53. He was a member of the Society for 27 years.

Mark G. Krein, of Odessa, U.S.S.R., died on October 17, 1989, at the age of 82. He was a member of the Society for 17 years. (See the News and Announcements section of this issue of *Notices*.)

Edwin N. Lassettre, Professor Emeritus of Carnegie-Mellon University, died on January 16, 1990, at

the age of 78. He was a member of the Society for 2 years.

Dis Maly, of Troy, NY, died on July 31, 1989, at the age of 78. He was a member of the Society for 43 years.

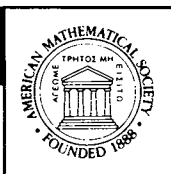
Adrienne S. Rayl, of New Orleans, LA, died on November 27, 1989, at the age of 91. She was a member of the Society for 51 years.

D. Wexler, of the Faculté Universitaire Notre-Dame de la Paix, died on May 27, 1989, at the age of 57. He was a member of the Society for 12 years.

Frantisek Wolf, Professor Emeritus of the University of California at Berkeley, died on August 12, 1989, at the age of 84. He was a member of the Society for 48 years.

Visiting Mathematicians

Boris N. Apanasov (Novosibirsk, U.S.S.R.), Ohio State University, February 1990 to April 1990, low dimensional topology and geometry.



GROUP ACTIONS AND INVARIANT THEORY

A. Bialynicki-Birula, J. Carrell, P. Russell, and D. Snow, Editors
(Conference Proceedings, Canadian Mathematical Society, Volume 10)

This volume contains the proceedings of a conference, sponsored by the Canadian Mathematical Society, on Group Actions and Invariant Theory, held in August, 1988 in Montreal. The conference was the third in a series bringing together researchers from North America and Europe (particularly Poland). The papers collected here will provide an overview of the state of the art of research in this area. The conference was primarily concerned with the geometric side of invariant theory, including explorations of the linearization problem for reductive group actions on affine spaces (with a counterexample given recently by J. Schwarz), spherical and complete symmetric varieties, reductive quotients, automorphisms of affine varieties, and homogeneous vector bundles.

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Backlog of Mathematics Research Journals

Backlog. Information on the backlog of papers for research journals, primarily those published in North America, is reported to the Providence Office by those editorial boards which elect to participate. The figures are an estimate of the number of printed pages which have been accepted, but are in excess of the number required to maintain copy editing and printing schedules.

Observed Waiting Time. The quartiles give a measure of normal dispersion. They do not include extremes which may be misleading. Waiting times are measured in months from receipt of manuscript in final form to publication of the issue. When a paper is revised, the waiting time between an editor's receipt of the final

revision and its publication may be much shorter than is the case otherwise, so these figures are low to that extent.

The observations are made from the latest issue published, before the deadline for this issue of *Notices*, from journals that have actually been received by a subscriber in the Providence, Rhode Island, area; in some cases this may be two months later than publication abroad. If the waiting time as defined above is not given in the journal, if no new issue has been received since the last survey, or if the latest issue is for some reason obviously not typical, no times are given in this report and such cases are marked NA (not available or not applicable).

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages		Editor's Estimated Time for Paper Submitted Currently to be Published (in Months)	Observed Waiting Time in Latest Published Issue (in Months)		
			12/31/89	6/30/89		Q ₁	M	Q ₃
Acta Inform.	8	800	0	0	5	5	6	7
Aequationes Math.	6	640	193	100	NR	7	9	13
Alg. Groups Geom.	4	500	0	0	6	8	9	17
Algorithmica	4	576	103	120	16	21	23	28
Amer. J. Math.	6	1200		0	12-18	13	14	15
Ann. of Math.	6	1200	500	700	9	18	18	19
Ann. Probab.	4	1650	500	300	12-18	14	15	16
Ann. Sci. École Norm. Sup.	4	650	0	47	15	9	10	11
Ann. Statist.	4	1750	650	225	18	12	13	15
Appl. Math. Letters	4	400	50	0	3		*	
Appl. Math. Optim.	6	672		180	11	10	11**	12
Arch. Hist. Exact Scis.	4	400	0	0	11	9	NA	12
Arch. Math. Logic	4	300	0	0	8	7	9	11
Arch. Rational Mech. Anal.	20	2000	0	0	10	10	12	13
Bull. Austral. Math. Soc.	6	1000	400	400	12		NA	
Canad. J. Math.	6	1152	200	0	8-10	9	14	14
Canad. Math. Bull.	4	512	512	614	18	14	17	19
Circuits Systems Signal Proc.	4	512	0	0	10	9	10	13
Comm. Algebra	12	3600	2123	1602	10	10	13	18
Comm. Math. Phys.	24	5184	0	0	8	8	9	11
Comm. Partial Diff. Equations	12	1600	NR	200	NR	4	4	10
Comp. Math. Appl.	24	2400	NR	1000	NR	12	12	13
Computing	8	768	180	280	8	9	10	12
Constr. Approx.	4	448	0	100	13	12	14	14

Research Journals Backlog

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages		Editor's Estimated Time for Paper Submitted Currently to be Published (in Months)	Observed Waiting Time in Latest Published Issue (in Months)		
			12/31/89	6/30/89		Q ₁	M	Q ₃
Discrete Comput. Geom.	6	600	350	375	14	28	32	36
Duke Math. J.	6	1500	100	150	9	5	8	9
Houston J. Math.	4	600	NR	600	NR		***	
Illinois J. Math.	4	704	NR	897	NR	26	27†	29
IMA J. Appl. Math.	6	510	0	0	14	8	10	10
IMA J. Math. Appl. Med. Biol.	4	350	80	0	6		NA	
IMA J. Math. Control Inform.	4	350-400	NR	NR	NR	8	12	13
IMA J. Numer. Anal.	4	600	100	100	8-16	9	11	13
Indiana Univ. Math. J.	4	1000	NR	80	NR	9	10	15
Inst. Hautes Études Sci. Publ. Math.	2	400	0	0	15	12	15	18
Internat. J. Math. Math. Sci.	4	832	145	100	NR	16	19	26
Invent. Math.	12	2688	0	0	8	7	8	9
Israel J. Math.	12	1500	600	350	8	8	10	12
J. Algorithms	4	600	NR	NR	NR	14	22	26
J. Amer. Math. Soc.	4	1000	0	0	0	6	7	8
J. Amer. Statist. Assoc.	4	1200	0	NA	9	7	8	9
J. Appl. Math. Simulation	4	80	200	180	5-6		NA	
J. Assoc. Comput. Mach.	4	1000	NR	300	NR	9	11	13
J. Austral. Math. Soc. Ser. A	6	1100	500	600	18	19	21	24
J. Austral. Math. Soc. Ser. B	4	512	0	256	NR	10	12	13
J. Classification	2	300	NR	0	NR		NA	
J. Complexity	4	500	150	NA	9-12		NA	
J. Comput. System Sci.	6	1200	50	200	12-16		NA	
J. Differential Geom.	6	1800	1600	1300	10-12	17	18	22
J. Integral Equations Appl.	4	600	0	0	8		*	
J. Math. Biol.	6	720	0	0	7	6	6	9
J. Math. Phys.	12	3200	0	0	5	4	4**	5
J. Nigerian Math. Soc.	1	100	NR	NR	NR		NA	
J. Operator Theory	4	800	100	0	15	17	19	21
J. Symbolic Logic	4	1344	0	100	15	13	15	17
Linear Algebra Appl.	16	4800	600	600	12	12	14**	14
Manuscripta Math.	16	1792	0	0	6	5	6	9
Math. Ann.	12	2304	0	0	12-13	8	10	11
Math. Comput. Modelling	16	1600	NR	500	NR	7	8**	9
Math. Comp.	4	1500	240	260	12	11	13	15
Math. Control Signals Sys.	4	400	NR	1000	NR		NA	
Math. Oper. Res.	4	800	600	360	18	16	17	18
Math. Programming Ser. A	6	720	240	240	15	21	21	28
Math. Social Sci.	6	600	0	180	12		*	
Math. Systems Theory	4	256	0	0	9	6	NA	8
Math. Z.	12	1824	0	0	13-14	12	13	15
Mem. Amer. Math. Soc.	6	2800	0	0	4	7	16	18
Michigan Math. J.	3	480	100	130	18	10	15	16
Monatsh. Math.	8	704	0	0	6	7	8	10
Numer. Funct. Anal. Optim.	10	1250	0	0	5	6	8	9
Numer. Math.	16	1664	0	0	5	8	9	11
Oper. Res.	6	1008	NR	420	NR	12	17	19
Pacific J. Math.	10††	2000††	NR	NR	14	14	23	24
Probab. Theor. Relat. Fields	12	1920	0	0	11	8	9	15
Proc. Amer. Math. Soc.	12	3432	0	572	10-12	11	12	16
Proc. London Math. Soc.	6	1250	250	NR	16-18	11	13	15
Quart. Appl. Math.	4	800	400	200	12	11	13	15

Research Journals Backlog

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages		Editor's Estimated Time for Paper Submitted Currently to be Published (in Months)	Observed Waiting Time in Latest Published Issue (in Months)		
			12/31/89	6/30/89		Q ₁	M	Q ₃
Quart. J. Math. Oxford Ser. (2)	4	512	128	96	12	17	21	23
Quart. J. Mech. Appl. Math.	4	625	0	0	13	11	12	14
Results Math.	4	768	0	0	8	4	7	13
Rocky Mountain J. Math.	4	1000†††	1700		32		***	
Semigroup Forum	6	768	0	200	9	11	11	12
SIAM J. Appl. Math.	6	1845	129	500	10**	12	12**	15
SIAM J. Comput.	6	1280	0	200	8**	10	11**	12
SIAM J. Control Optim.	6	1480	196	350	9**	9	10**	11
SIAM J. Discrete Math.	4	600	112	50	9	8	9**	10
SIAM J. Math. Anal.	6	1500	456	430	11**	10	11**	12
SIAM J. Matrix Anal. Appl.	4	600	338	150	11**	9	10**	10
SIAM J. Numer. Anal.	6	1550	257	550	10**		NA	
SIAM J. Sci. Statist. Comput.	6	1200	447	400	13**	13	14**	15
SIAM Rev.	4	725	0	0	9**	5	6**	7
Topology Appl.	12*	1320	1430	500	13	16	17	18
Trans. Amer. Math. Soc.	12	5000	200	200	16	20	20	28

NR means no response received.

NA means not available or not applicable.

* Date of receipt or acceptance of manuscript not given.

** From date accepted.

*** This journal recently ended a moratorium on the acceptance of new papers; latest issue consists of pre-moratorium papers.

† Dates of revisions not indicated.

†† For 1990: 12 issues and 2400 pages per year.

††† Publication will increase by 60% by 1991.

UNIMODAL LOG-CONCAVE AND PÓLYA FREQUENCY SEQUENCES IN COMBINATORICS

Francesco Brenti

(Memoirs of the AMS, Number 413)

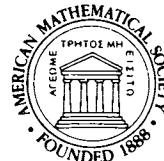
In recent years, considerable research has focused on unimodal or log-concave sequences that are of combinatorial interest. Although these two properties have simple definitions, proving that a sequence is unimodal or log-concave is often a difficult task requiring refined and sophisticated mathematical tools from such areas as representation theory, algebraic geometry, or classical analysis.

The main purpose of this book is to show the theory of total positivity can be very useful in studying this area. In the first part of the book, after discussing some combinatorial motivations, the author studies some of the fundamental linear transformations that preserve the log-concavity or Pólya frequency properties of a sequence. This part forms the theoretical core of the work and may be read independently from the rest. In fact, this rich and powerful theory can be

applied to any situation in which log-concavity and unimodality questions arise. The second part of the book is devoted to applications to several combinatorial situations, yielding many new results and solutions to some problems that had resisted attack with other techniques. Both parts of the book point to many conjectures, open problems, and directions for further study.

1980 *Mathematics Subject Classifications*: 05A20; 05A15, 05A10, 05C20, 06A10, 11B73, 15A04, 26C10, 30C15
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Barbara Anne Shipman	C Irma Lopez	José W Melgarejo	Alejandra Folguera
George Sochos	Shawnee L McMurran	Kevin M Peterson	Gary Kalmanovich
Martin F Staley	Brynn Allison Mundahl	Yannan Shen	Jennifer Lee Kearns
Adam M Stinchcombe	Nancy J Parham	Kevin L Summers	Bradford J Kline
Kebenesh Wondimagegnehu	Tin Quach	Wolfgang A Tomé	Ki-Ho Kwon
Zhiyun Xie	Jeanelle K Repique	Antonia H Yoon	Thomas L La Framboise
<i>University of Calgary</i>	Kenneth M Sill	<i>University of Georgia</i>	Niels Lauritzen
Karoly Boroczky	Deborah Jane Smith	Anitha Srinivasan	Lenore Levine
Seema Kay Keroack	Lynn T Tan	<i>University of Hawaii</i>	Hang-Yeh Lin
Tomaz Kosir	Kazuchika Alex Ushijima	James E Bennett	Changwen Liu
Wayne Nelson	Timothy D Watson	Xiang-Xia Huang	Joy P Magalit
Jun Wang	<i>University of California, Santa</i>	Robert C Rogers	John D Massman
Boll Wu	<i>Barbara</i>	Zhiyuan Tang	Dushan Glen Monchilouich
Shijun Zhou	John Z Bahura	Michael Tischendorf	Eugenia Movshovich
Xuding Zhu	Juan M Estrada	Adrienne S J Young	Kayuan Nasser-Ghods
<i>University of California, Irvine</i>	Maciej J Kocan	<i>University of Houston-University</i>	Teri Jo O'Brien
Lonnie H Hudgins	Ji Ma	<i>Park</i>	Matthew D Pestle
Yong H Kim	Lydia Catherine Matthews	Suzanne C Brower	Georg Martin Reinhart
Gizelle M Marcotte	John E McCarthy	Martha Maureen Carey	Walter J Schreiner
Michael Lind O'Leary	Heidi Mills	Yoon S Cho	Ging-Tzu Shih
Norbert O Schumacher	Curtis A Patton	Jessicia Emily Cole	Lih-Jue Shih
Christopher J Thompson	Jacob Neal Sarvela	Lawrence C Cowsar	Zhi Yi Song
Victor N Tran	Dino Sola	Deborah Doggett	Peijian Sun
<i>University of California, Los</i>	Andrzej Janusz Swiech	John R Elam	Hajime Takagie
<i>Angeles</i>	John St Clair Werth	Sarah Helen Ferguson	Shih-Chun Tou
Clifford Bruce Abe	Chien-ning Yeh	Christopher Gilbert	Todd G Will
Barna L Bihari	Fuzhen Zhang	Lei Guo	Arthur A Woerheide
Mark Cassorla	<i>University of Chicago</i>	Randal M Hall	Shaojie Xu
Hsia-Yen Chen	David Jonathan Chase	Virginia Leigh Hollyer	<i>University of Kansas</i>
	Michael L Earnest		Eric J Barth

New Members of the AMS

Mitchell J Blackburn	Robert J Kelnhofer	<i>University of Missouri, Columbia</i>	Jretai Yu
Delisa Kayleen Drewes	Daniel L Kern	Melinda A Abel	<i>University of Oregon</i>
Rui Guo	Mitchell L Kotler	Joyce A Colvin	Kuei-Fang Chang
Robert H Karkafi	Pui-Keung Law	Bofeng Fu	Cynthia A Gibson
Richard T Lawner	Nicolas A Minutillo	Roger S Offermann	Catherine Ann Miner
Michael E Martin	Simon E Stern	<i>University of Missouri, St Louis</i>	Wendelle L Rawlinson
Elke Mittendorf	Decheng Wang	Ling Cao	Karen Louise White
Roy Osawa	Kenneth J Wilder	Joseph B Dence	Nanping Yang
Leann M Rajewski	Xiao-Peng Xu	Tiegang Li	<i>University of Ottawa</i>
Chris E Stehno	Weiqian Yu	Matthew K Lundberg	Youjian Fang
Mohamad A Tfaili	<i>University of Michigan</i>	Mark A Schneider	Thomas Patrick McLeister
<i>University of Kentucky</i>	Seth W Allen	Sharon K Spoede	Gilbert Remillard
Jonathan P Evans	Robert Bakula	<i>University of Montana</i>	<i>University of Pennsylvania</i>
Neal O Jett	David M Buchthal	Daniel J Balaguy	Xiuxiong Chen
<i>University of Laval</i>	Cesar A Cardenas	Susann Bradford	Liming Ge
Jean-Francois Bussieres	Yaotsu Chang	John A Bruder	David S Grigoryan
Rémi Cote	John Charles Dean	Don D Gilmore	Wei Qing Gu
Lucie Nadeau	George Delistathis	Young-Do Han	Mogens Lemvig Hansen
<i>University of Louisville</i>	Serge Elnitsky	Hongzhe Li	Lei Hong
Yan Huang	Steven D Fischer	Gopalakrishnan A Narayan	Kjeld Knvosen Jensen
Shellie Y Hudson	Darrin D Frey	Julie A Owings	Megan M Kerr
Kathleen Hancock Lamb	Manouchehr Ghamsari	Sumant P Rao	Seon-In Kwon
David P Miller	Hemar T Godinho	Sangadji	Mehrdad Samadani
<i>University of Lowell</i>	Patrick T Headley	<i>University of N C at Charlotte</i>	James Clark Satterthwaite
Fan-Ling Chen	Denise Michele Lee	Christine N Anderson	Mike Tam
Wenpin Ha	Hyeeun Kim Lee	Hyung-Chun Lee	Gerri Wiegink
Carol A Hay	Tamara R Lefcourt	<i>University of N C at Greensboro</i>	<i>University of Pittsburgh,</i>
Eileen Herlihy	Elizabeth Camp McGuire	Yaprak F Balkan	<i>Pittsburgh</i>
Wen-Ching Hsiao	Kiwon Kim Ryu	Bradley P May	Rachel K Hayes
Scott L Johnson	David B Semmelroth	Ronald Lee Merritt	Hans E Johnston
Edmund F Marks	Douglas T Shapiro	<i>University of Nebraska at Lincoln</i>	Charles J Kicey
Ning-Van A Wang	Daren S Starnes	Nicole Austin Bell	Xuming Lei
<i>University of Maine, Orono</i>	Darin R Stephenson	Patrick Heckenlively	Barbara M Maskal
Olca Akman	Kok-Ming Teo	Paul E Hinrichs	Joseph Edward Paultet
Garrett Bywaters	Jennifer L Thornton	Timothy J Huffman	Thomas J Richards
Woo Lee	Timothy R Wagenmaker	Bao Ping Jia	Lei Tsui
Paul VanSteenberghe	Suzanne Louise Weekes	James Lee Kassebaum	Aiping Wang
<i>University of Maryland Baltimore</i>	Gerald James Wuchter	Aihua Li	Xiaolin Wang
<i>County</i>	Shanshuang Yang	Patrick J Nebel	Chong Xu
Chang G Kim	<i>University of Minnesota-</i>	Dana L Nimic	Lianying Xue
Jeffrey B Nowak	<i>Minneapolis</i>	Kristin A Pfabe	Yue Zhao
Witold W Szczechla	Phillip Abbott	Kristin D Spitler	<i>University of Puerto Rico,</i>
Angela M Walters	Abhoyjiy S Bhown	<i>University of New Mexico</i>	<i>Mayaguez</i>
<i>University of Maryland, College</i>	Scott J Carlson	Paul M Bennett	Eric Aviles
<i>Park</i>	Haesung Cheon	James Patrick DeThomas-	Silvestre Colon
Gang Chen	Brian E Eaton	Shields	Nilsa Cruz
Kamel N Haddad	Huiing Gau	Lisa M Duke	Rene Davila
Christopher Martin Judge	Ko Hayashi	Dean A Jones	Patricia Hernandez
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James Marianne	Philip A Jones	<i>University of North Texas</i>	Flor-Constanza Sanmiguel
Maureen E Rush	Steven R Kleinhenz	Marlene L Atchison	Jose Villalobos
Catherine E Searle	Héctor E Lomeli-Ortega	Shawn W Eagleton	<i>University of Quebec, Chicoutimi</i>
Frederick H Wilhelm Jr	Xiaolong Shih	Bridget A Feneis	Sylvain Boivin
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Jörgen J Berglund	Zhao Yan	R Keith Rogers	Jesus E Gonzalez
Alexander N Brin	Karen Elizabeth Young	Alan D Sauter	Yanjie Kang
Kuan Deng	<i>University of Mississippi</i>	Dayton C Sommons III	Ran Levi
Lena Galaktionova	Margaret Fair Barbour	<i>University of Notre Dame</i>	Changmei Liu
David A Gore	Jeffery Wayne Bates	Zarko Bizaca	Dai Tamaki
Holly E Hake	Camille Elizabeth Calhoun	Mario O M Da Silva	Hezhou Tu
Ruth Huerfano	Terry W Hobbs	Shu Nakamura	Yingzhong Wen
Lu Ji	Marilyn Kay Morgan	Deyun Wu	Kerri Lynne Workman
	Patricia C Treloar		

New Members of the AMS

University of San Francisco

Tristan Needham

University of Southern California

Arif Mohamed Ansari

Lynn Beckett-Lemus

Maha Albert Chabhar

Leonard Y Cho

Aniruddha Datta

Chin-pang Alex Fung

Gary A Gilmore

Paul F Glezen

Cherie L Gragnano

Elke M Hennig

Joseph W Hogan

Marianne Huebner

Paul M Kulesa

Chen-Yao G Lai

Waidong Lee

Weishi Liu

Ho Ming Luk

Subhash R Malakar

Mark Nichols

Andreas P Petrou

Poornima Rajamani

Yegan Satik

Philipp H Stephanus

Chi Chung Tong

Aurelija Trgo

Susanne K Watter

University of Southern Mississippi

Stephanie Renée Blackwood

Joydeep Ghoshal

Ming Ma

Robin Mukherjee

Ni Zhou

University of Southwestern

Louisiana

Liet Anh Do

Chunho Han

Lan Ke

Catherine Pui-Kan Kong

Saiming Lee

University of Texas at El Paso

Jinbao Chen

Roger A King

Chuck Littleton

Zheng Ma

Chengke Sheng

University of Texas-Pan American

Joseph E Chance

University of Toronto

Gary F Baumgartner

Habib E Chahin

Sebastian Esteban Ferrando

Martin Forest

Minh Dzong Ha

Christopher J Halonen

Nilooofar Hodjati

Soheil Homayouni

Tai-Hing Dennis Hui

Andrew J Irwin

Izabella Joanna Laba

Stephen Peter Lee

Dennis Ray Lomas

Dimitrios Loukanidis

David M Neto

Giovanni Panti

Jeffrey David Picka

Ulrich C Schanz

Steve G Sculac

Roger R Singh

Don Stanley

University of Utah

David C Beard

Kristina Ann Bogar

Elizabeth Michael Brown

Alberto Castro

Val A Cummings

John C Dallan

Ha Thi Minh Dang

Ashley Michelle DuLac

Stephen G Kurtz

Lorel M Preston

Robert William Stokes

Endre B Szabó

Yuanhua Tang

Craig C Tingey

University of Vermont

Nathan D Bokil

Theresa E Devlin

Yong Duan

Laurie A Hurley

Douglas W Mace

Angela B Martinek

Leo B Schillinger

University of Victoria

Brian J Beckett

University of Virginia

Gene B Christner

Jacqueline Anderson Hall

Sharon L Laubach

Deirdre Longacher Smeltzer

Todd A Smith

Donald E Spickler Jr

James T Wilmet

University of Western Ontario

Xiaopeng Gao

Tim K L Liu

Jack C Singleton

University of Wisc, La Crosse

Patrick C Ward

University of Wisc, Milwaukee

Kevin E Charlwood

Joshua Y Choo

Shubhangi S Nijasure

Keith M Stafford

University of Wyoming

Dongmei Chunyu

George N Gimias

Paul Gerard Jacobs

Yun Li

Rossen R Parashkevov

Linda K Prior

Zhongde Wang

University of the West Indies

Varalakshmi Duvvuri

Ansari Khayam Mohammed

Junior G Solan

Utah State University

Chris L Bendixen

Joan Leilani Dana

Xiaoli Hu

Keng Lee

Jianhua Shao

Lu Zhou

VPI & SU

Elizabeth A Bonawitz

David B Borisuk

Jiuyi Cheng

Raymond A Conner

Lisa K Cooley

Denise Lynette Davis

Guor-Rong C Duh

Dhananjary R Gokhale

Gitanjali S Gulve

Susan M Hagen

Heath D Hart

Wei Huang

Chun Wai Ip

Rajeev R Joshi

Addison B Jump

Kyehong Kang

Hong-Chul Kim

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G Dennis Sparks

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Ivelina Julianova Velikova

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Scott A Yokim

Mary Jo Zukoski

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D Brian Conley

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Sheri R Jordan

Walter Bruce Kessler

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Villanova University

Scott J Kromis

Nghia V Le

Lisa A Sigler

Washington & Lee University

Harry Todd Pearce

Washington State University

Michael D Brands

Richard Roy Drake

Juan Du

William A Kimball

Dongmei Liu

Dali Luo

Pete B McGill

Allen R Miedema

Nandita Rath

Carolyn M Scharmer

Kwang-sik Song

Washington University

Siqi Fu

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Anita W Pabody

Jianwen Wang

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Ishita Dutta Gupta

Hassan K Hamdan

Song Miao

John C Niss

West Virginia University

Michael J Bennett

Marjorie A Darrah

Leslie Ann Dumire

Timothy Jon Hempleman

James M Sconyers

Ling Zhang

Western Carolina University

Laura C Hannah

Mitchell Lane Helms

Robert Dewey Herring

Western Illinois University

Donald E Swanger

Western Kentucky University

Brian K Anderson

Western Washington University

John H Clifford

Maryann L Firpo

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Samuel J Lightwood

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THE 1990 RATE IS \$50.00 per inch on a single column (one-inch minimum), calculated from the top of the type; \$22 for each additional $\frac{1}{2}$ inch or fraction thereof. No discounts for multiple ads or the same ad in consecutive issues. For an additional \$10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Advertisements in other sections of the classified pages will be set according to the advertisement insertion. Headlines will be centered in boldface at no extra charge. Classified rates are calculated from top of type in headline to bottom of type in body copy, including lines and spaces within. Any fractional text will be charged at the next $\frac{1}{2}$ inch rate. Ads will appear in the language in which they are submitted.

Prepayment is required of individuals but not of institutions. There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified advertising.

DEADLINES are listed on the inside front cover or may be obtained from the AMS Advertising Department.

U. S. LAWS PROHIBIT discrimination in employment on the basis of color, age, sex, race, religion or national origin. "Positions Available" advertisements from institutions outside the U. S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U. S. laws. Details and specific wording may be found near the Classified Advertisements in the February and July/August issues of the *Notices*.

SITUATIONS WANTED ADVERTISEMENTS from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada 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 201 Charles Street, Providence, Rhode Island 02904. Individuals are requested to pay in advance, institutions are not required to do so. AMS FAX 401-331-3842.

POSITIONS AVAILABLE

ALABAMA

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM DEPARTMENT OF MATHEMATICS

Applications are invited for one or more anticipated tenure or tenure-track positions. Preference will be given to strong candidates whose research interests are compatible with those of our current faculty; this includes numerical PDE/Scientific computation, mathematical physics, partial differential equations, nonlinear analysis, dynamical systems, including topological dynamics, and differential geometry. Faculty members have access to the Alabama Super Computer (using a Sun Station and a T-1 line to a Cray X-MP/24). Rank and salary will be subject to qualifications, but applicants for senior positions must have demonstrated excellence in research, while applicants for junior positions must exhibit the promise of excellence. Send as soon as possible a curriculum vita, selected reprints, and three letters of reference (candidates for senior positions may choose to submit a list of references instead) to Search Committee, Department of Mathematics, University of Alabama at Birmingham, Birmingham, AL 35294. UAB is an Affirmative Action/Equal

Opportunity Employer.

CALIFORNIA

CHAFFEY COMMUNITY COLLEGE MATH INSTRUCTOR

The Physical Science Division invites applications for a full-time, tenure-track Math instructor to teach selected Mathematics courses ranging from Arithmetic to Differential Equations.

The ideal candidate will demonstrate a strong commitment to the needs of the diverse academic, socioeconomic, cultural, disability, and ethnic backgrounds of community college students.

Minimum qualifications are Master's degree in Mathematics OR Applied Mathematics; OR Bachelor's degree in either of the above AND Master's degree in Statistics, Physics, or Mathematics Education; OR Master's degree in Teaching Mathematics; OR current California Community College credential that permits full-time service as an instructor of Math; AND teaching experience.

In addition to contributions made in the classroom, this individual will perform professional tasks with an emphasis on student advisement, curriculum design and evaluation, program review, and other affairs of

the department and division. Salary range is 26,107.27–37,023.85.

Submit District application, including a detailed summary of educational preparation, experience, copies of transcripts, and a placement file or three professional reference letters to:

Personnel Services
CHAFFEY COMMUNITY COLLEGE
5885 Haven Avenue
Rancho Cucamonga, CA 91701-3002
AA/EOE

STANFORD UNIVERSITY

Department of Mathematics and Statistics

We invite applications for a tenure-track position in probability at the Assistant Professor level beginning Autumn Quarter 1990 to 1991. The position is a joint appointment in the Department of Mathematics and Statistics. Excellent research potential in probability and stochastic processes, strong interests in applications, and commitment to quality teaching are required. Outstanding candidates at higher ranks will also be considered. Please submit applications, curriculum vitae and letters from three professional references to: Yitzhak Katznelson, Chairman of Search Committee, Department of Mathematics, Stanford University, Stanford, CA 94305-2125, U.S.A.

Stanford University is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

UNIVERSITY OF CALIFORNIA AT BERKELEY

BERKELEY, CA 94720 TEMPORARY POSTDOCTORAL POSITIONS DEPARTMENT OF MATHEMATICS

Several temporary positions beginning in Fall 1990 are anticipated for new and recent Ph.D.'s of any age, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. The terms of these appointments may range from one to three years. Applicants for NSF or other postdoctoral fellowships are encouraged to apply for these positions; combined teaching/research appointments may be made for up to three years. Mathematicians whose research interests are close to those of regular department members will be given some preference. Send by April 1, 1990 a resume, and reprints, preprints, and/or dissertation abstract. Ask three people to send letters of recommendation to Andrew J. Casson, Vice Chair for Faculty Affairs, at the above address. (Applications received for our earlier January 15, 1990 deadline will automatically be con-

sidered for this deadline will automatically be considered for this deadline also.) The University of California is an Equal Opportunity, Affirmative Action Employer.

**UNIVERSITY OF CALIFORNIA
IRVINE
DEPARTMENT OF MATHEMATICS
IRVINE, CA 92717**

The University of California at Irvine has made a significant commitment for the development of the mathematics department. A number of faculty appointments will be made over the next few years. These include:

1. At least five full time positions at any of the tenured professorial levels. The Department is particularly interested in areas of Algebra, Analysis, Applied Mathematics, Geometry, Mathematical Physics, Numerical Analysis-Scientific Computing, Probability, and Topology. Selection will be based on research experience and teaching ability.

2. At least one full time tenure track Assistant Professor position. Candidates must have a Ph.D. and a research record either in Mathematical Physics or Differential Geometry.

Applications must include curriculum vitae, bibliography and three letters of reference. The COMMITTEE ON STAFFING will solicit supplementary letters of reference. Please send applications to the COMMITTEE ON STAFFING at the above address.

UC Irvine is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF CALIFORNIA, SAN DIEGO

An academic research position at the Assistant Research Engineer level is available at the Center of Excellence for Advanced Materials at University of California, San Diego. The Center specializes in high strain-rate deformation of solids and the successful candidate will lead the theoretical aspects of projects that pertain to the motion of dislocations. A Bachelor's degree in mathematics and background in the area of the mathematical treatment of dislocation dynamics in solids (including transient phenomena) are required. (Background can be obtained during educational program.)

Applications with three names of references should be submitted to: Professor S. Nemat-Nasser, Chairman of the Search Committee, the Center of Excellence for Advanced Materials, Department of AMES, R-011, UCSD, La Jolla, CA 92093, before March 31, 1990. Salary is in strict accordance

with University of California pay scales. If non-citizen, state immigration status.

The University of California, San Diego, is an equal opportunity/affirmative action employer.

COLORADO

**UNITED STATES AIR FORCE ACADEMY
DEPARTMENT OF MATHEMATICAL
SCIENCES
VISITING PROFESSOR**

The Department of mathematical Sciences of the United States Air Force Academy invites nominations and applications for a Visiting Professor position. We seek a Professor with extensive experience teaching undergraduate mathematics, statistics or operations research and a strong record of scholarly activity. Duties will include reviewing our academic programs, teaching undergraduate courses and promoting our research programs. Applicants should have a demonstrated commitment to undergraduate research and education. The appointment is usually for one year and will begin in July 1991. Inquiries are welcome for Visiting Professor positions for subsequent years. Salary is commensurate with qualifications. To apply, please send nominations (to include resume and references) by 1 May 1990 to: Chairman, Department of Mathematical Sciences, United States Air Force Academy, CO 80840-5701.

**UNIVERSITY OF COLORADO AT
COLORADO SPRINGS
DEPARTMENT OF MATHEMATICS
COLORADO SPRINGS, CO 80933-7150**

Applications are invited for 1 or 2 possible tenure track Assistant Professor positions for Fall 1990. Prefer areas consistent w/present research interests: algebra, diff. eq., computer vision, harmonic analysis, probability and math physics. Applicants should have significant research accomplishments or exceptional research promise and evidence of good teaching. Ph.D. is required. The average weekly teaching load is 7 1/2 hours. Generous support for faculty development such as travel, teaching off-loads and summer research. Send resume and 3 letters of reference to James E. Daly, Chairman. Screening will begin on Feb. 1, 1990 and continue until all positions are filled. AA/EEO.

DISTRICT OF COLUMBIA

NATIONAL SCIENCE FOUNDATION (NSF)

NSF's Division of Undergraduate Science, Engineering and Mathematics Education (USEME) is seeking candidates for Program Director positions in all NSF disciplines including: biology, chemistry, computer science, engineering, geosciences, mathematics and physics.

USEME was established within the NSF's Science and Engineering Education Directorate to serve as focal point for NSF's mission in undergraduate education. Programs will focus on key areas such as course and curriculum development, instrumentation and laboratory development, faculty enhancement, students, and major initiatives aimed at increasing participation in scientific careers of underrepresented groups such as women, minorities and the disabled.

Program directors in USEME are senior officers who take responsibility for identifying and characterizing national issues in undergraduate education, leading to the design, development and management of leadership activities and high leverage NSF programs. The Foundation relies heavily on program director intellectual capacity and judgement in the final decisions of the proposal and award process. USEME program directors serve as spokespersons for undergraduate education both across the entire Foundation, and to many important national communities.

Individuals are sought who can provide leadership and vision in USEME's mission to strengthen U.S. undergraduate education; who will establish direction to programs and provide technical and educational expertise for guiding the development of projects; and who themselves possess the knowledge and creativity to identify significant solutions to problems both within their disciplines and across the disciplines.

Applicants should have a Ph.D. or equivalent experience and 6 or more years of successful academic experience as a faculty member involved in teaching and research; in addition, academic administrative experience is preferred.

The positions will be filled by August 1990, on a one-or two-year rotational basis. The salary ranges from \$42,601 to \$67,112 per annum.

Applications should be submitted as soon as possible, but not later than April 15, 1990. Applicants should send resume to the National Science Foundation, Room 208, 1800 G Street, NW, Washington, DC 20550. Attn: Catherine Handle. For further information call 202/357-9681. Hearing impaired individuals should call 202/537-7492. For technical information, call Dr. Robert F. Watson, 202/357-9644. NSF is an Equal Opportunity Employer.

FLORIDA

FLORIDA ATLANTIC UNIVERSITY DEPARTMENT OF MATHEMATICS

Senior Position in Mathematics. Candidates should have an established research record and proven ability to attract external research support as well as interest in building a strong research group. Salary is competitive; teaching load does not exceed 2 courses per semester. Areas of research interest in the department include Algebra, Analysis, and Combinatorics. The department instituted a new Ph.D. program in 1988 and anticipates filling several junior positions in the next three years. The new senior person of the Department will be expected to play a major role in this program. Applicants from all fields are invited, but preference will be given to those candidates whose interests would enhance and complement existing research strength. Applications will be accepted until March 31. Send a letter of application and a curriculum vitae with description of research interests, and arrange for at least three letters of recommendation to be sent directly to:

Senior Search Committee Chairman
Department of Mathematics
Florida Atlantic University
Boca Raton, FL 33431

Florida Atlantic University is strongly committed to Affirmative Action and strongly encourages applications from minorities and women.

FLORIDA ATLANTIC UNIVERSITY DEPARTMENT OF MATHEMATICS

Applications are invited for two tenure track positions at the Assistant Professor level commencing August 1990. Candidates must possess a Ph.D., a strong commitment to research, and demonstrated teaching ability. Salary is competitive. Areas of research interest in the department include Algebra, Analysis, and Combinatorics. The department instituted a new Ph.D. program in 1988 and anticipates filling several positions in the next three years. Applicants from all fields are invited, but preference will be given to those candidates whose interests would enhance and complement existing research strength. Applications will be accepted until March 31. Send a letter of application, a detailed resume with description of research, and ask three people to send letters of recommendation to:

Recruiting Committee Chairman
Department of Mathematics
Florida Atlantic University
Boca Raton, FL 33431

Florida Atlantic University is strongly committed to Affirmative Action and strongly encourages applications from minorities and women.

FLORIDA INSTITUTE OF TECHNOLOGY

The Department of Applied Mathematics at Florida Institute of Technology, invites applications for two anticipated regular positions at associate and full professor levels in the area of nonlinear analysis, numerical and computational math, and statistics. Candidates should have a distinguished research record and a strong commitment to teaching. Qualified individuals are invited to send a vita and at least three reference letters to Professor V. Lakshmikantham, Head, Department of Applied Mathematics, Florida Institute of Technology, 150 W. University Blvd., Melbourne, FL 32901-6988. Florida Institute of Technology is an equal opportunity/affirmative action employer.

GEORGIA

VALDOSTA STATE COLLEGE

Two tenure-track positions in mathematics and one tenure-track position in mathematics education at the Asst./Assoc. Prof. level to begin September 1, 1990. Ph.D. required for math positions with special consideration given to applicants in analysis, probability or statistics, applied math and numerical methods. Terminal degree with strong math preparation in geometry required for math education position. A commitment to excellence in teaching and continued scholarly activity required.

Send letter of application and vita to:

John W. Schleusner, Head, Department of Mathematics and Computer Science, Valdosta State College, Valdosta, GA 31698. Application deadline: April 15, 1990, AA/EOE.

ILLINOIS

DEPAUL UNIVERSITY Department of Mathematical Sciences

Applications are invited for a tenure-track position at the assistant professor level beginning in September, 1990. A Ph.D. in Mathematics is required. We will consider strong candidates in any field of research. DePaul University is primarily an undergraduate institution. The Department of Mathematics has graduate programs in Mathematics Education

and Applied Mathematics. Strong commitment to teaching is essential. The official teaching load is nine quarter courses/year, but a reduction to seven quarter course/year for research is possible. Applicants should send a vitae and 3-4 letters of recommendation, at least one of which pertains to teaching, to Hiring Committee, Department of Mathematics, 2219 N. Kenmore, Chicago, IL 60614. Women and minorities are encouraged to apply.

IOWA

IOWA STATE UNIVERSITY

The Department seeks qualified applicants for tenure track positions at the assistant professor level in Discrete Mathematics and in Mathematical Biology and for a tenure track position at the associate or full professor level in Computational Mathematics or Numerical Analysis starting August 21, 1990. The successful applicant for the senior position will be expected to seek outside funding for his or her research and to interact scientifically with colleagues in other campus departments. There will be start up funds available for the successful applicant for each of the three positions.

We will begin the interview process January 15, 1990. However, we shall continue to accept applications after that date until the positions are filled.

A number of visiting positions in diverse areas are expected to be available also and applications for them are also encouraged.

Women and minorities are encouraged to apply. Iowa State University is an Affirmative Action/Equal Opportunity Employer.

Applications should be sent to Howard A. Levine, Chair, Department of Mathematics, Iowa State University, Ames, Iowa 50011.

KANSAS

JOHNSON COUNTY COMMUNITY COLLEGE

JCCC located in suburban Kansas City anticipates two entry level Instructor, Mathematics positions to begin August 1990. Will teach variety of math courses ranging from Fundamentals of Math to Differential Equations. Teaching load will consist of 15 hours per semester. Master's in math or math education with bachelor's in math or equivalent, 2 years teaching experience, and computer skills required. Community college teaching experience and experience teaching math via alternative methods or delivery preferred. Salary will be commensurate with degree and experience. Travel funds for interviewing

not available. Review of applications: April 2, 1990. Send letter of application, transcripts, and vita to Human Resources, JCCC, 12345 College, Overland Park, KS 66210. Non-discrimination employer/EOE.

MARYLAND

FROSTBURG STATE UNIVERSITY Department of Mathematics

Actuarial Science. Full-time, tenure track, Asst./Asso. Prof., Fall 1990. To teach 12 credits undergrad. math per sem., including upper level actuarial math. Give direction to new actuarial science major. Master's degree and undergrad. math teaching exper., exper. in actuarial science, & at least 1 actuarial exam passed, required. Doctorate, Associate Actuary in CAS or SOA, preferred. Rank and salary commensurate with credentials and exper. Teaching exper. & quality of teaching of prime concern. POSITION AVAILABILITY PENDING FINAL APPROVAL BY THE LEGISLATURE OF THE STATE OF MARYLAND. Direct questions to: Dr. Richard Weimer, Department Chair, (301) 689-4377. Send letter of interest, resume, transcripts & 3 letters of recommendation, by 03/31/90, to: Mr. C. Douglas Schmidt, Director of Personnel Services, Frostburg, MD 21532. Women/minorities encouraged to apply. AA/EOE.

MASSACHUSETTS

WORCESTER POLYTECHNIC INSTITUTE

The Department of Mathematical Sciences will have several tenure track positions at all levels for fall of 1990. These positions require a strong research record or potential and evidence of quality teaching. Fields of interest are numerical analysis, computational fluid mechanics, nonlinear PDE, optimization, control theory, optimal design, dynamical systems, applied discrete mathematics, operations research, and statistics/applied probability.

WPI, the nation's third oldest college of science and engineering, offers degrees through the Ph.D. The Mathematical Sciences Department currently offers an undergraduate and master's degree in applied mathematics. Worcester, Massachusetts is the second largest city in New England, approximately 40 miles west of Boston.

Interested applicants should send a curriculum vita to: Samuel M. Rankin, III, Head, Department of Mathematical Sciences, 100 Institute Rd., Worcester, MA 01609. Applications will be accepted until the positions are filled. EOE/AA.

MINNESOTA

UNIVERSITY OF MINNESOTA, DULUTH DEAN—COLLEGE OF SCIENCE AND ENGINEERING

Applications and nominations are invited for the position of the dean of the College of Science and Engineering. Desired starting date is September 1, 1990; however, starting date is negotiable.

THE UNIVERSITY: UMD is a land grant university with 621 full and part-time faculty, 7,391 students, and 650 staff members. It is a coordinate campus of the University of Minnesota located in an urban area of 90,000 on the shores of Lake Superior.

THE COLLEGE: There are eleven departments in the college: aerospace, biology, chemical processing engineering, chemistry, computer engineering, computer science, geology, industrial engineering, mathematics and statistics, military science, and physics. There are 107 full-time and part-time faculty, 1,625 undergraduate and 71 graduate students, and 37 civil service and professional staff members.

THE POSITION: As chief academic officer, the dean reports to the vice chancellor for academic administration and has leadership responsibilities in matters of the curriculum, budget, personnel, resource management, and external relationships.

The dean must be committed to the stated goals of the college:

- excellence in undergraduate education coupled with a positive student experience;
- support for and expansion of faculty scholarship;
- continued growth of graduate programs;
- the service and land-grant mission;
- expansion of cooperative external relationships.

QUALIFICATIONS: Qualified applicants must have an earned doctorate in science, mathematics, or engineering discipline and must present a record of academic and research accomplishment sufficient to warrant tenure in a senior faculty position in the college. Applicants must have administrative experience in higher education at the department head level or above with collegiate administrative experience desirable. Tenured Associate Professor: doctorate plus five years professional experience; professional distinction in research and writing and demonstrated effectiveness in teaching and advising. Tenured Professor: doctorate plus eight years professional experience; national reputation and demonstrated effectiveness in teaching and advising.

The successful candidate shall have demonstrated leadership, team-building, decision-making, and administrative management abilities. The search committee is looking for candidates with a strong record of schol-

arship, commitment to affirmative action and the development of faculty, students and staff, and effective interpersonal and communication skills.

The individual must be eligible for employment in the United States at time of application.

SALARY: Competitive and negotiable

THE APPLICATION: Interested persons are encouraged to write or call for more detailed written information. The application is due on April 10, 1990, and consists of 1) letter of application including a discussion of experiences and accomplishments relevant to this position, 2) a resume, and 3) the names, addresses, and phone numbers of three references.

Applicants, nominations, and inquires are to be sent to:

Dr. Joseph A. Gallian Chair, CSE Dean Search Committee, 420D Darland Administration Bldg., University of Minnesota, Duluth, Duluth, MN 55812, Telephone: (218) 726-6349

The University of Minnesota is an equal opportunity educator and employer and specifically invites and encourages applications from women and minorities.

NEVADA

UNIVERSITY OF NEVADA, LAS VEGAS

The Department of Mathematical Sciences at the University of Nevada, Las Vegas has vacancies for Assistant/Associate/Full Professor in Mathematics/Statistics; three tenure-track positions and one lectureship (renewable one year appointment) to begin Fall 1990. Successful candidates will be expected to participate fully in a research/scholarship program, in undergraduate/graduate teaching, in the continuing development of the graduate program, and in departmental/university service. Lecturers teach 12 credits per semester. Qualifications: tenure-track positions require a Ph.D. in Mathematics, Statistics, or a related field. Areas of recruitment are Statistics, Mathematics (all areas), Applied Mathematics with training in Numerical Analysis, Computer Graphics and dynamical systems, and Computational Mathematics. The lectureship position requires an M.S. or M.A. in Mathematics or a related field. Rank and salary will be commensurate with the candidate's experience and qualifications.

The University of Nevada, Las Vegas is a growing urban university with an enrollment of approximately 16,000 students located in metropolitan Las Vegas. The University will house a supercomputer center funded by DOE beginning May 1990.

Applicants for the 1990 Fall appointments should submit a letter of application, a current resume, photocopies of transcripts, and four

letters of reference to the Search Committee, Department of Mathematical Sciences, University of Nevada, Las Vegas, Las Vegas, Nevada 89154. All files completed by April 15, 1990, will be considered in initial screening. Files completed after the deadline will be reviewed only if positions are not filled up. This advertisement supersedes the previous 1989 ad. Proof of Eligibility for U.S. Employment (under the Immigration Reform and Control Act of 1986) will be required prior to employment. AA/EOE

NEW JERSEY

RUTGERS UNIVERSITY, CAMDEN

The Mathematical Sciences Department seeks highly qualified applicants for an anticipated senior professorship position. Strong research credentials and commitment to teaching are necessities. Send resume, at least three letters of recommendation, and selected reprints to:

Search Committee
Mathematical Sciences Department
Rutgers University
Camden, NJ 08102

AA/EOE

NEW YORK

STATE UNIVERSITY OF NEW YORK AT BINGHAMTON

Department of Mathematical Sciences invites applications at all levels for an unexpected opening. Senior applicants must have an outstanding research record. Junior-applicants must show great research promise. All areas, including statistics and mathematical computer science will be considered. The department has a healthy doctoral program and an attractive future. Vita and letters of recommendation should be sent to: David L. Hanson, Chair, Dept. of Math. Sciences, SUNY-Binghamton, Binghamton, NY 13901. Screening of applications will begin on March 15, 1990. The State University of New York at Binghamton is strongly committed to affirmative action. We offer access to services and recruit students and employees without regard to race, color, sex, religion, age, disability, marital status, sexual orientation or national origin.

STATE UNIVERSITY OF NEW YORK/COLLEGE AT OLD WESTBURY FACULTY POSITION

Specialty in one of following preferred: mathematics education, algebra or statistics. Meaningful computing exper. desirable. Should be committed to excellence in teaching undergraduates & demonstrate research. Ph.D. required. Exper. in multicultural higher educ. institutions desirable. Tenure-track. Rank, salary commens. with exper. Begins Fall 1990. Resumes reviewed upon receipt. Applic. deadline Mar. 10. Send resume & names of 3 references to:

Office of personnel & Affirmative Action
Search Committee MATH
State University of New York/College at
Old Westbury
Old Westbury, NY 11568-0210

Affirmative Action/Equal Opportunity Employer

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE DEPARTMENT OF MATHEMATICS, CHARLOTTE, NC 28223

Two tenure-track and one or more Visiting positions at Asst/Assoc/Full Prof. level in Mathematics and Statistics, and one senior Assoc/Full Prof. level in Math Education. Rank and salary depend on qualifications. A Ph.D. and a serious commitment to teaching and research are required. Preferred specialties are: Algebra, Analysis, Applied Mathematics, Math Education, Statistics, but strong candidates in all areas are encouraged to apply. Also possible are lecturer positions (one or two year renewable; MA/MS required). Send vitae, list of four references, and abstracts of current research to Prof. Hae-Soo Oh at the above address. Closing date: Feb. 2, 1990, but applications will be considered until the positions are filled.

UNCC IS AN AFFIRMATIVE ACTION/
EQUAL OPPORTUNITY EMPLOYER

OHIO

THE OHIO STATE UNIVERSITY AT NEWARK Department of Mathematics

ASSISTANT PROFESSOR, MATHEMATICS—The Ohio State University at Newark is seeking an Assistant Professor for a full-time, tenure track position in the Mathematics Department. DUTIES INCLUDE: Teach undergraduate courses in Mathematics. Ability and willingness to teach elementary statistics course is desirable. Conduct research and render appropriate Campus, Departmental, and University service. QUALIFICATIONS

INCLUDE: Ph.D. in Mathematics. Some experience at the college or university level is preferred. TERMS: Full-time, 9 month tenure track position. STARTING DATE: Autumn Quarter, 1990. STARTING SALARY: \$26,000–\$33,000; comprehensive benefits package. To assure consideration, send vita and three letters of reference written directly to the search committee by March 30, 1990 to Chairperson, Mathematics Search Committee, c/o Coordinator, Human Resources, The Ohio State University at Newark, University Drive, Newark, OH 43055. OSU at Newark is an Equal Opportunity/Affirmative Action Employer.

OKLAHOMA

THE UNIVERSITY OF OKLAHOMA Applied Non-Linear Analysis Applied Mathematics Position (CAPS) Related

The University of Oklahoma seeks a (tenure track) Assistant Professor (or higher) with a specialty in Applied Non-Linear Analysis. A Ph.D. in Mathematics is required. Expertise in fluid dynamics and numerical and computational experience are desirable. Potential for excellence in mathematics teaching and research is required. Competitive Salary.

This position is expected to contribute to the mathematical support of the Center for the Analysis and Prediction of Storms, A Science and Technology Center at the University of Oklahoma funded by the National Science Foundation.

Applicants should send a letter of application, a complete vita, and have three letters of reference sent to: Andy R. Magid, Chair, Applied Analysis Search Committee, Department of Mathematics, University of Oklahoma, 601 Elm, Room 423, Norman, Oklahoma 73019-0315. Closing date for applications is December 20, 1989 and every two weeks thereafter until the position is filled. The University of Oklahoma is an Equal Opportunity/Affirmative Action Employer.

THE UNIVERSITY OF OKLAHOMA Department of Mathematics

Applications are invited for one or more positions at the Assistant Professor level (or higher) in Mathematics beginning Fall 1990. Candidates must have a Ph.D. degree, demonstrated excellence in research, and potential for high-quality teaching. Strong candidates in all areas will be considered, with preference given to research interests compatible with those of our current faculty. Duties include research, normally teaching six credit hours per semester, and Departmental and University service appropriate to rank.

Salary and rank will be commensurate with qualifications and experience. There may also be visiting positions. Applicants should send their vita and have at least three letters of reference sent to Dr. Ruediger Landes, Search Committee Chair, Department of Mathematics, University of Oklahoma, 601 Elm, Room 423, Norman, Oklahoma 73019-0315. Initial screening begins December 15, 1989 and every two weeks thereafter. Applications will be accepted until the position(s) are filled. The University of Oklahoma is an Affirmative Action/Equal Opportunity Employer.

OREGON

SOUTHERN OREGON STATE COLLEGE ASHLAND, OR 97520 DEPARTMENT OF MATHEMATICS

The Mathematics Department anticipates two permanent tenure-track positions (one requiring a specialist in Applied Mth) and two one-year lecturer positions beginning Fall of 1990. A Doctorate in Mathematics is required for the tenure-track positions while a Master's degree is sufficient for the lecturer positions. Applicants must have a strong commitment to teaching undergraduate mathematics and have the equivalent of 1 year of college level teaching experience. Send applications by April 15, 1990, to: Dr. Ronald Steffani, Chairman, at the above address. SOSC is an AA/EEO employer.

PENNSYLVANIA

LAFAYETTE COLLEGE DEPARTMENT OF MATHEMATICS EASTON, PA 18042

One-year visiting position at the rank of Assistant Professor (Ph.D. required) or Instructor beginning in late August, 1990. Teach 3 undergraduate mathematics courses per semester. Lafayette is a small (2000) highly selective private college offering liberal arts and engineering and located near Philadelphia and New York.

Send resume, 3 letters of reference, and telephone numbers (office and home) to Chair, Mathematics Search Committee. Review of applications will begin 3/15/90 and continue until the position is filled. Lafayette College is an Equal Opportunity Employer. Women and minorities are encouraged to apply.

TEXAS

ANGELO STATE UNIVERSITY DEPARTMENT OF MATHEMATICS

Angelo State University is seeking applications for a tenure track position at the Assistant Professor level for Fall, 1990. Candidates must hold the Ph.D. degree in mathematics. Teaching load is twelve hours per semester at a nine-month salary of \$31,300 to \$34,621, depending upon academic qualifications and college teaching experience, plus opportunity for summer teaching at the same monthly salary rate, and other University benefits. Job requirements include ability to communicate effectively with undergraduate students, dedication to excellence in teaching, and strong commitment to high academic and professional standards. Inquiries should be directed to:

Dr. J. M. Bailey, Head
Department of Mathematics
Angelo State University
San Angelo, Texas 76909

Deadline is open but may be closed at any time after April 1, 1990.

Angelo State University has one of the most modern and attractive campuses in the nation and is fully accredited by the Commission on Colleges of the Southern Association of Colleges and Schools. The University student body of over 6,400 ranks first among regional universities and third among all state universities in Texas in the high percentile ranking of entering freshmen in their high school graduating classes. The University offers one of the largest and most distinctive academic scholarship programs in the nation which attracts outstanding students from throughout the world.

Angelo State University is an equal opportunity/affirmative action employer.

LAMAR UNIVERSITY Beaumont, Texas

The Department of Mathematics seeks applications for a tenure-track Assistant/Associate Professor position beginning Fall 1990. Applicants must hold an earned Ph.D., should be active researchers in analysis and/or applied mathematics, and have a strong commitment to teaching.

Lamar is a state supported educational and research institution of approximately 12,000 students. The Department, which is located within the College of Engineering, offers the B.A., B.S., and M.S. degrees in Mathematics and has 16 full-time faculty.

For the approximately 250,000 people in the Beaumont area, there are eight museums, a symphony orchestra, ballet, opera, and other theatrical productions. Other facilities

and events are found in Houston 85 miles west. Nearby outdoor recreational opportunities include two of the largest freshwater lakes in Texas, the Big Thicket National Preserve, four national forests, the Gulf of Mexico, and a large inland saltwater lake.

Salary and rank are commensurate with qualifications and experience. Send a resume and three letters of recommendation to: Dr. John R. Cannon, Chair; Department of Mathematics; Lamar University; P.O. Box 10047; Beaumont, TX 77710. Full consideration will be given to applications received before May 1, 1990. Lamar is an EEO/AA employer.

UNIVERSITY OF TEXAS AT SAN ANTONIO

The Division of Mathematics, Computer Science, and Statistics is accepting applications for a tenure track position at the assistant professor level in mathematics education. Applicants must have at least equivalent of a master's degree in mathematics, and a doctoral degree in mathematics education or a related area. Preference will be given to those candidates with a commitment to research and whose research complements the interests of the current faculty and those with teaching experience at the public elementary or secondary level. Responsibilities include teaching, research, and program development.

Applicants should submit a resume and arrange to have three letters of recommendation sent to:

Chairperson, Search Committee
Division of Mathematics, Computer
Science, and Statistics

The University of Texas at San Antonio
San Antonio, TX 78285-0664

The closing date for this position is March 15, 1990.

UTSA is an Equal Opportunity/Affirmative Action Employer.

VIRGINIA

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY MATHEMATICAL PHYSICS

The Center for Transport Theory and Mathematical Physics at Virginia Tech anticipates a number of openings for visitors during academic year 1990-91. Applications in all areas of mathematical physics are invited for all or any parts of the year. There may also be possibilities of tenure-track appointments. Appointments may be made at any level, from postdoctoral up. Please send a curriculum vitae and a short description of research plans (for visiting positions only) and arrange for three letters of recommendation to be sent directly to Prof. P. F. Zweifel, Virginia

Polytechnic Institute and State University, CTTMP-212A Robeson Hall, Blacksburg, VA 24061-0435, USA. VA Tech is an EO/AA employer. Women and minorities are encouraged to apply.

AUSTRALIA

**THE UNIVERSITY OF ADELAIDE
SOUTH AUSTRALIA**

Invites applications from both women and men for the following position: LECTURER/SENIOR LECTURER IN PURE MATHEMATICS (Tenurable). (Ref: 6963) in the DEPARTMENT OF PURE MATHEMATICS. The Department of Pure Mathematics is engaged in teaching to the Honours degree level and maintains an active Ph.D. programme. The main research and teaching interests of the Department are in discrete mathematics, algebra, finite geometry, number theory, convexity, geometric analysis, differential and algebraic geometry, analysis and applications (including mathematical physics) and mathematics of communication. The Department has recently introduced new graduate certificates in the areas of communications and mathematical education.

Applicants should be effective undergraduate teachers and have proven research capability in Pure Mathematics. Applicants would normally be expected to be holders of a Ph.D. degree.

The position is available from 1 July 1990.

Further information concerning the duties of the position may be obtained from the Chairperson, Dr. D. Parrott, Department of Pure Mathematics, telephone (08) 228 5079.

It is University policy to encourage women to apply for consideration for appointment to tenurable academic appointments. Holders of full-time tenured or tenurable academic appointments have the opportunity to take leave without pay on a half-time basis for a specific period of up to ten years when this is necessary for the care of children.

INFORMATION about the general conditions of appointment and selection criteria may be obtained from the Senior Assistant Registrar (Personnel) at the University.

SALARY per annum: Lecturer: A\$32,197 x 7-A\$41,841; Senior Lecturer: A\$42,703 x 5-A\$49,529

APPLICATIONS, IN DUPLICATE, quoting reference number 6963 and giving full personal particulars (including whether candidates hold Australian permanent residency status), details of academic qualifications and names and addresses of three referees should reach the Senior Assistant Registrar (Personnel) at the University of Adelaide, GPO Box 498, Adelaide, South Australia 5001,

Telex UNIVAD AA 89141, Facsimile (08) 224 0464 not later than 30 April 1990.

The University reserves the right to make enquiries of any person regarding any candidate's suitability for appointment, not to make an appointment or to appoint by invitation.

THE UNIVERSITY OF ADELAIDE IS AN EQUAL OPPORTUNITY EMPLOYER.

CANADA

SIMON FRASER UNIVERSITY

The Department of Mathematics and Statistics of Simon Fraser University invites applications for a tenure track position in Mathematics at the Assistant Professor level starting September 1, 1990 or as soon thereafter as feasible (this position is subject to final budget approval). Applicants will be expected to have completed a Ph.D. degree at the time of appointment and to have demonstrated a strong teaching and research potential. Applicants should have research interests in the areas of Algebra and/or Discrete Mathematics. Applications, including curriculum vitae, should be sent to: Dr. A. R. Freedman, Chair, Department of Mathematics and Statistics, Simon Fraser University, Burnaby, BC V5A 1S6 Canada. Please arrange for three letters of reference to be sent directly from the referees. The deadline for applications is April 30, 1990. In accordance with Canadian immigration requirements, this advertisement is directed in the first instance to Canadian citizens and permanent residents of Canada, however, other qualified persons are encouraged to apply. Applications from women and minority groups are particularly welcome.

THE NETHERLANDS

**UNIVERSITY OF UTRECHT,
THE NETHERLANDS**

The University of Utrecht is looking for a full-time Professor in pure mathematics in the department of mathematics, faculty of mathematics and computer science.

The tasks of the professor will be: - carrying out research in pure mathematics, supervision of PhD students - participation in both the general and specialized teaching duties of the department - contribution to the organizational work of the faculty

Qualifications: The to be appointed professor will be an expert in a central and important part of pure mathematics. The actual area of specialization is less important than general scientific qualities, capacity to stimulate, and the ability to bring different areas of mathematics into contact. Candidates

should have an international reputation and a broad knowledge of recent developments.

Non Dutch-speakers should be prepared to learn this language so that teaching can be done in Dutch within two years. The University of Utrecht would like to employ more women and in the case of otherwise equal suitability a woman will be appointed.

Starting date: This position will become vacant at the retirement of Prof. T.A. Springer. The new professor will take the chair on 1st March 1991.

Salary: According to Dutch civil service scale B for university professors (from fl. 7.783, - to fl. 12.115, - per month gross).

Information: Can be obtained from the chairman of the search committee, Prof. J. J. Duistermaat (tel. -31-30-531513, -31-30-531430); email Duis@math. ruu. nl.

Applications: Should be accompanied by a curriculum vitae and a list of publications and sent within four weeks of the appearance of this advertisement to the vice-dean of the Faculty of Mathematics and Computer Science, Prof. J. van Leeuwen, P.O. Box 80.010, 3508 TA Utrecht; email Duis@math. ruu.nl. Please mention the reference number vac. 478./62013.

Persons who would like to draw the attention of the search committee to possible candidates are warmly invited to write to its chairman.

With equally qualified applicants preference will be given to a woman.

UNITED KINGDOM

**UNIVERSITY OF STIRLING
Division of Computing
Science and Mathematics
Chair in Mathematics and its Applications**

This new Chair is in the School of Accountancy, Business, Computing and Economics. Candidates should be mathematicians who can develop the applications of Mathematics within the School, and within the University generally. Relevant research interests include Applied Combinatorics, Operational Research and Statistics. The successful candidate will provide academic leadership to the mathematicians in the Division, and will promote new growth in mathematics in the University. A new multi-disciplinary programme in Mathematics and its Applications is planned for Autumn 1990, to be supported by further lecturing appointments.

Stirling is a young and active University in Central Scotland, with an attractive campus. The appointment will be on the Professorial salary scale.

Applications in the form of a C.V., to include the names of 3 referees, should be sent to the University Secretary, University

of Stirling, Stirling FK9 4LA, Tel 0786 73171, extension 2250, from whom further particulars are available, by 31 March 1990.

PUBLICATIONS WANTED

Wanted: Mathematical books, journals, reprints, ephemera. Contact R. K. Dennis, Math. Dept., White Hall, Cornell U., Ithaca, NY 14853-7901. Tel: 607-255-4027, FAX: 607-255-7149. e-mail: dennis@mssun7.msi.cornell.edu

SITUATIONS WANTED

TEACHING MATHEMATICIAN. PH.D 1982. AGE 38

Speciality: Differential Equations. 5 published articles. 15 years experience in teaching and research in U.S.A. and abroad. Excellent students and peer evaluations of classes. References and résumé available upon request. Available immediately. M. Abbassi, 500 Tulip Rd., State College, PA 16801

Mathematician with 15 years experience in teaching and research is seeking a (possibly temporary) position. Ph.D. 1978. Analysis and Operator Theory, 20 publications. Available July 1990. Fluent Russian. Respond to applicant, Code 920, Advertising Department, AMS, P.O. Box 6248, Providence, RI 02940.

ARIZONA STATE UNIVERSITY Department of Mathematics

The Department of Mathematics invites applications for tenure-track and visiting faculty positions at all ranks and in all areas of mathematics beginning in August 1990. The Department is in the third year of a major development program intended to build nationally recognized research groups of four to seven faculty members in Computational Mathematics, Differential Equations (including PDE's), Discrete Mathematics, Dynamical Systems, Operator Theory, Algebraic Geometry and Number Theory, Systems and Control and Probability and Statistics. During the past two years, 12 tenure-track or tenured appointments have been made and we anticipate making at least 5 appointments during each of the next three academic years.

For 1990, the majority of the tenure-track appointments will be made at the Assistant Professor level. To be considered for such an appointment, the candidate must demonstrate potential for outstanding research while providing effective teaching at both the undergraduate and graduate levels in a public university environment. For candidates at the Associate Professor level, additional requirements include a proven record of outstanding research accomplishments and versatile and effective teaching. At the Full Professor level, applicants should be recognized nationally for the quality and scope of their research and leadership activities. Salaries are competitive and commensurate with experience and qualifications.

In support of its research and graduate education programs, the Department has installed an Advanced Computing Facility centered around a network of Titan Mini-Super Graphics computers plus a cluster of Work Stations. Research efforts were enhanced by direct access to the University's CRAY XMP-14/se and IBM 3090-500E/VF super computers.

Arizona State University has more than 43,000 students and is located in the rapidly growing Phoenix Metropolitan area—a center of business, finance and high technology. The valley offers a wide range of educational, cultural and recreational opportunities. Pleasant and convenient housing is widely available near the university campus.

Applications should be received by December 1, 1989, and the Department will begin to review applications as of this date. The deadline will be extended on a month-to-month basis until all available positions are filled.

Applicants should send their resumés and arrange for at least three letters of recommendation to be sent to: William T. Trotter, Chair, Department of Mathematics, Arizona State University, Tempe, AZ 85287-1804. AA/EOE

ARIZONA STATE UNIVERSITY



THE CHINESE UNIVERSITY OF HONG KONG

Professor of Mathematics
(Ref. no. 110/509/2/89)

The University

The University offers comprehensive programmes of studies up to PhD level in the Humanities, Business Administration, Science, Medicine, Social Science, Education, Engineering and from 1991 Architecture. The University currently has over 7,700 full-time equivalent students and a major expansion in the next three years is expected. The University is very active in promoting research and development and liaising with industry and the business sector worldwide. Both English and Chinese are used in teaching and administration.

The Professorship

A Professor is at the top of the University teaching profession. By virtue of his/her distinguished scholarship, prominent contributions and invaluable service in the academic discipline concerned, he/she is expected to provide leadership to the teaching and research programmes in his/her field and play a major part in the planning and development of his/her academic discipline. Candidates for the post should have excellent academic qualifications, extensive university teaching and relevant research experience and have published scholarly works of originality and merit.

Remuneration and Benefits

The University offers a competitive remunerative package. Salary will be commensurate with qualifications and experience, with a minimum of HK\$43,210 per month. For superannuable appointment, benefits will include long leave with full-pay at the rate of one-sixth of the period of service, contributory superannuation scheme (University 15%, appointee 5%), medical care, education allowances for children, housing benefit (with appointee contributing 7.5% of salary towards rental) and leave passage benefits for appointee and dependants. Appointment may also be made on a variety of fixed-term contracts with equivalent benefits including a contract-end gratuity. Fringe benefits will be packaged flexibly including cash payment options subject to mutual agreement. Retirement age is 60 but appointment may be extended beyond 60 subject to mutual agreement.

Application Procedure

Application, together with full resume and the names and addresses of three referees, should be forwarded to the Secretary of the University, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong by April 30, 1990. Please quote the reference number and mark 'Recruitment' on cover. Applications submitted after April 30, 1990 may also be considered if the post or comparable posts are available.

The following are the 52 mathematicians who signed the letter which appears on page 263 concerning the June 4, 1989 massacre in Beijing, China.

William B. Arveson	Henry Helson	Richard S. Palais
Michael F. Atiyah	Heisuke Hironaka	Murray H. Protter
Hyman Bass	Wu-chung Hsiang	A. Schatz
Lipman Bers	Wu-yi Hsiang	Michael Schneider
Lenore Blum	Jiunn T. Hwang	Richard M. Schoen
Armand Borel	Victor Kac	Bernard Shiffman
Raoul Bott	Anatole Katok	Katsuhiko Shiohama
James H. Bramble	Jerry L. Kazdan	Yum-Tong Siu
Robert Freeman Brown	Robion C. Kirby	Stephen Smale
Andrew J. Casson	Joseph J. Kohn	Frank L. Spitzer
Sun-Yung Alice Chang	Tsit-Yuen Lam	Elias M. Stein
John P. D'Angelo	Thomas M. Liggett	Chuu-Lian Terng
Peter L. Duren	Saunders Mac Lane	Francois Trèves
Richard T. Durrett	Anil Nerode	Alan D. Weinstein
Edward G. Effros	Junjiro Noguchi	Guido L. Weiss
Doris Fischer-Colbrie	Takushiro Ochiai	Hung-Hsi Wu
Wolfgang H. Fuchs	O. Timothy O'Meara	Paul C. Yang
Ian Graham		

University of Wyoming
Rocky Mountain Mathematics Consortium
Regional Summer School

**ENRICHING DISCRETE MATHEMATICS COURSES
WITH RECENT DEVELOPMENTS**

July 16 – August 3, 1990

The course will address selected important and recent developments in discrete mathematics. The goal is to more quickly incorporate such modern discoveries in this rapidly expanding field into college courses at all grade levels. Many new advances are in fact highly suitable for enriching and modernizing basic courses. Both fundamental theoretical results and contemporary applications will be covered. Some of the topics to be included are: developments on the marriage problem and fair division schemes, Hamiltonian cycles for binary trees (the Catalan numbers), the famous labeling lemmas of Sperner and Tucker with applications to labeling and path following algorithms for finding equilibrium and fixed points, the combinatorial structure for power indices in political science, and combinatorial aspects of polytopes.

PREREQUISITES: Familiarity with basic linear algebra and some exposure to elementary discrete mathematics is desirable.

SPEAKERS: William F. Lucas, The Claremont Graduate School, will lecture during the three weeks. Carl W. Lee, The University of Kentucky, will lecture throughout one week. A few additional lectures will be presented by distinguished experts in the subject.

ADMISSION AND SCHOLARSHIPS: Entry into the summer school is restricted, but is without charge to those who are qualified and are admitted. National Science Foundation funding which consists of a stipend plus living costs is available for selected faculty. A limited number of scholarships, covering living costs, are available for qualified graduate students. For further information and application forms, please write to:

Professor A. Duane Porter – Mathematics Department
Box 3036 – University of Wyoming
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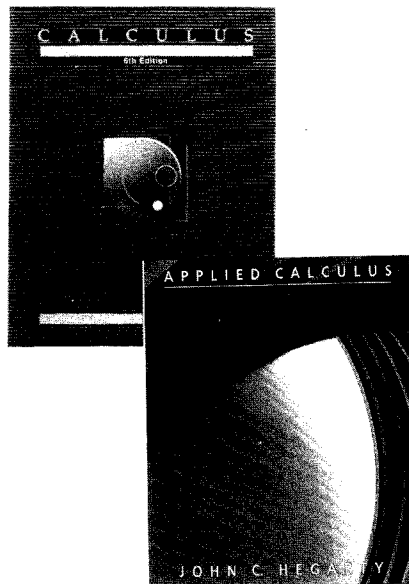
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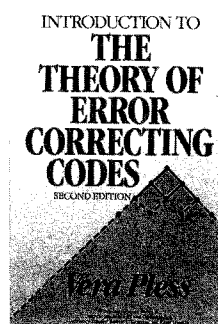
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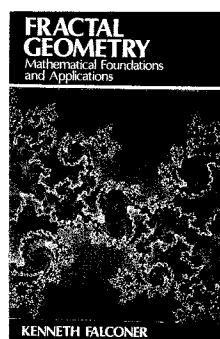
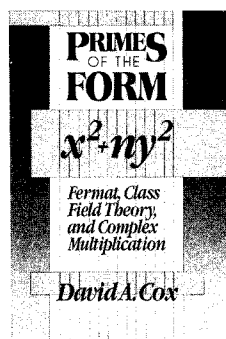
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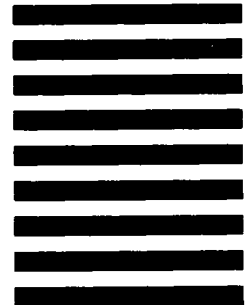
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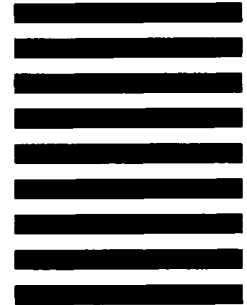
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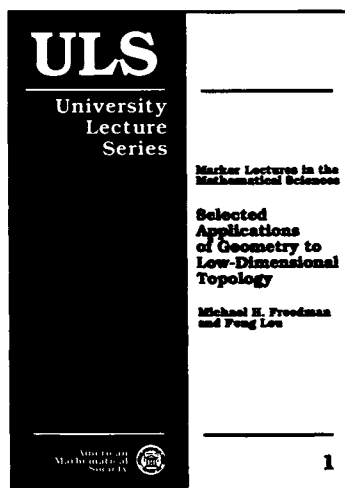
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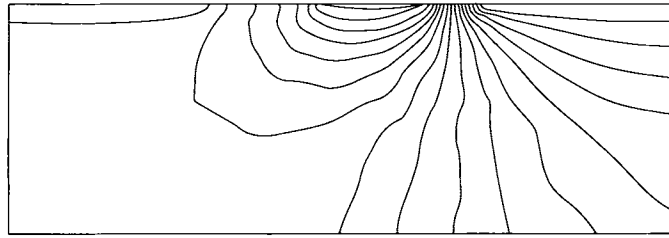
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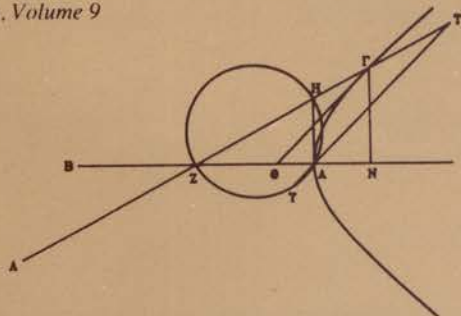
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