

NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

ALERT!

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Calendar of AMS Meetings and Conferences

This calendar lists all meetings and conferences approved prior to the date this issue went to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have been assigned. *Programs* of the meetings will appear in the issues indicated below. *First* and *supplementary* announcements of the meetings will have appeared in earlier issues. **Abstracts of papers** presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the *Notices* which contains the program of the meeting,

insofar as is possible. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. The abstract deadlines listed below should be carefully reviewed since an abstract deadline may expire before publication of a first announcement. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of special sessions.

Meetings

Meeting #	Date	Place	Abstract Deadline	Program Issue
876	* October 30–November 1, 1992	Dayton, Ohio	August 3	October
877	* November 7–November 8, 1992	Los Angeles, California	August 3	October
878	* January 13–16, 1993 (99th Annual Meeting)	San Antonio, Texas	October 8	December
879	* March 26–27, 1993	Knoxville, Tennessee	January 5	March
880	* April 9–10, 1993	Salt Lake City, Utah	January 29	April
881	* April 17–18, 1993	Washington, D.C.	January 29	April
882	* May 21–22, 1993	DeKalb, Illinois	February 26	May–June
883	* August 15–19, 1993 (96th Summer Meeting) (Joint Meeting with the Canadian Mathematical Society)	Vancouver, British Columbia	May 18	July–August
	October 22–23, 1993	College Station, Texas		
	January 12–15, 1994 (100th Annual Meeting)	Cincinnati, Ohio		
	March 18–19, 1994	Lexington, Kentucky		
	March 25–26, 1994	Manhattan, Kansas		
	June 16–18, 1994	Eugene, Oregon		
	October 28–29, 1994	Stillwater, Oklahoma		
	January 25–28, 1995 (101st Annual Meeting)	Denver, Colorado		
	March 24–25, 1995	Chicago, Illinois		
	January 10–13, 1996 (102nd Annual Meeting)	Orlando, Florida		
	March 22–23, 1996	Iowa City, Iowa		

* Please refer to page 614 for listing of Special Sessions.

Conferences

July 26–August 1, 1992: AMS-SIAM Summer Seminar in Applied Mathematics, Exploiting symmetry in applied and numerical analysis, Colorado State University, Fort Collins, Colorado.

January 11–12, 1993: AMS Short Course on Wavelets and Applications, San Antonio, Texas.

Deadlines

	October Issue	November Issue	December Issue	January Issue
Classified Ads*	August 27, 1992	October 1, 1992	November 13, 1992	December 10, 1993
News Items	August 13, 1992	September 21, 1992	October 29, 1992	December 2, 1993
Meeting Announcements**	August 17, 1992	September 21, 1992	October 29, 1992	December 2, 1993

* 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.

NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

ARTICLES

- 557 ALERT! Assistance Needed for Mathematical Colleagues in the Former Soviet Union**
Severe economic conditions are causing a rapid deterioration of the mathematical sciences community in the former Soviet Union. The AMS is developing a plan to directly assist mathematical scientists there and calls upon the international mathematical community to help in this important endeavor. This article describes aspects of the AMS plan, and an accompanying display advertisement provides instructions for making contributions. (Also see the "From the Executive Director" column on page 554, which provides further background on this effort.)
- 560 Applying for Jobs: Advice from the Front** *Annalisa Crannell*
This article provides practical advice to jobseekers from one who's been there—and found a job.
- 564 Canada's Fields Institute Opens its Doors**
Allyn Jackson describes the activities of the newly-established Fields Institute and its official opening held in June.
- 567 JPBM Presents Testimony Before Congress**
Phillip Griffiths and I. M. Singer presented testimony on behalf of the Joint Policy Board for Mathematics (JPBM) before Congress in April. Allyn Jackson describes the ensuing informal discussion, and the full text of the testimony is reprinted here.
- 570 Highlights of the 1990 CBMS Survey** *Donald C. Rung*
This article describes some of the main findings in the most recent CBMS Survey of mathematical sciences departments, faculty, and courses.
- 573 1991 Annual AMS-MAA Survey (Second Report)** *Donald E. McClure*
This report includes an update on the number of and the employment status of the 1990–1991 new doctorates, as well as information on enrollments and faculty characteristics.

FEATURE COLUMNS

- 587 Computers and Mathematics** *Keith Devlin*
Three of the four reviews that make up this month's column fall into the category of textbook-software combinations. The other review is of the software development package *Prograph*, by Jon Barwise.
- 597 Inside the AMS**
A brief look at the 1993 AMS Operating Plan, currently under development, as well as a description of the AMS' sponsored membership program.

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OF THE

AMERICAN MATHEMATICAL SOCIETY

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ADVERTISING

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From the Executive Director . . .

A CALL FOR HELP

The AMS is being called upon to assist mathematics and mathematicians in the republics of the former Soviet Union (fSU). Most of the requests for assistance address the need to preserve the vitality of this school of mathematics and the opportunities for new levels of communication and collaboration. Many individual mathematicians and groups of mathematicians are exploring avenues to support fSU mathematics. At the same time, government agencies, Congress, the National Academy of Sciences, private foundations, and numerous professional and scientific societies are initiating programs and activities to assist the various constituencies within the fSU scientific community.

The mathematical community in the fSU has long received world-wide recognition for its creativity and productivity. From this school of mathematics come many of our leading mathematicians and a prolific production of mathematical literature. The character of this mathematics, the educational process, and the style of writing bring a distinctive component to the world's mathematical culture. It is an important world resource to preserve. Within the fSU, mathematics is regarded as one of the leading scientific and intellectual enterprises, and mathematicians are among the most respected academicians. Many mathematicians are among the leaders of change there. It is essential for the transition to an open society and a new economy that the mathematical community in the fSU be supported and sustained.

The AMS is in a unique position to provide leadership and coordinate efforts for assisting mathematics and mathematicians in the fSU. Certainly such an effort needs the collective representation and coordination of many constituencies, and this the Society can provide. The relationship between the Society and mathematicians in the fSU goes back many years. In 1948, the AMS began its translation and publication of Russian mathematical literature into English. Since then, the Society has assisted with communication and travel between fSU mathematicians and the West and has acted on behalf of human rights of mathematicians in the fSU. In recent years, new relationships have developed involving joint ventures among the AMS, the fSU mathematical organizations, and the former Soviet (now Russian) Academy of Sciences. The Society has the capability to assist in fund-raising, publication and distribution of mathematical literature, grant administration, meeting and conference organization, and electronic communications. Also useful is the Society's many years of experience, through its publications program, in dealing with the complexities of financial relationships with individuals and institutions within the fSU.

In response to the calls for assistance, the AMS assembled an Advisory Committee and their recommendations have led to the Executive Committee of the Council and the Board of Trustees approving several actions. The lead article in this issue of the *Notices*, pp. 557–559, and the accompanying display announcement, describe these actions. The AMS will focus on goals and a response it can reasonably and quickly achieve. These activities will help to keep communications open between mathematicians in the fSU and other mathematicians; they will provide a small amount of infrastructure support to mathematics so the community can maintain a level of intellectual activity until a more stable economic and political climate leads to domestic recovery; and they will prepare the groundwork for long-term support to the mathematical enterprise within the fSU.

This is a crucial time where a small amount of support can tip the balance toward continued vitality of fSU mathematics and reaffirm the collegiality and collaboration between the mathematicians of the fSU and other mathematicians throughout the world. This activity needs the support of our community, we hope you will help in this important endeavor.

William Jaco

Letters to the Editor

New Journals, Defunct Journals, and Library Budgets

I am on the University of Wisconsin Library Committee and have had to watch as many serials have been cancelled. Yesterday, I received an announcement of the founding of two more specialized mathematics journals; last week I received a letter asking me to be on the editorial board of a proposed new journal; and a couple of weeks ago read an e-mail message telling about the start of a new section in an existing journal with plans to separate this section to start a new journal in a couple of years.

I replied to the request to be on the editorial board of a new journal that at the present time it was irresponsible to start new journals unless there were compelling reasons, and that I did not see them in this case. A compelling reason might be the existence of a new field where adequate publication is not possible in existing journals, but I do not know of such cases in mathematics at this time.

Please consider carefully the problem of keeping information available for future generations. Journals have ceased publication in the past, and results which appeared there tend to get lost. One instance of this concerns Legendre polynomials. For thirty years, from about 1830 to 1860, there was a result known as the formula of Ivory and Jacobi. About 1860, Hermite noticed that Rodrigues had found this result about 1815, in a journal which only published three volumes. There are many other instances, so I have become very conservative about closing journals. Along with this, I find it necessary to be conservative about starting new journals. If others feel this way, they can say no to invitations to be on editorial boards of journals that are proposed without very good reasons.

After all the cuts we have made in our journal holdings, I can not in good conscience recommend other cuts just

to subscribe to a new journal. Publishers and prospective editors should be aware of these problems, and realize that even major university libraries will not be able to subscribe to the new journals being proposed. These larger libraries, which now attempt comprehensive coverage, are hit with the double effect of rising prices and journal proliferation. Few will be able to keep up with these pressures on an indefinite basis, and collections are likely to become increasingly fragmented. Someone suggested that part of the problem comes from very good younger mathematicians wanting to have more of a hand in the direction mathematics is developing. If this is the case, some senior mathematicians might consider cutting down on the number of editorial boards they are on, to free space for the new generation.

Richard Askey
University of Wisconsin
(Received April 20, 1991)

Federal Funding Priorities

I read with some care the discussion of federal funding for the mathematical sciences which appeared in the April issue of the *Notices*. It was a depressing experience.

The bottom line seems to be that NSF [National Science Foundation] funding for basic research in mathematics will not rise in the next two years. On the other hand, "cross disciplinary research and computational research" will receive a 32% increase, and the Office of Special Projects will get a 10% increase. The Division of Mathematical Sciences will receive, overall, an 8% increase, none of it going to increase funding in disciplinary research. This is a deplorable situation.

Compounding the difficulty is the fact that the new Director of the NSF, Walter Massey, says that his "... highest priority is to increase support to individual investigators through larger grant size, and extended award duration." Given this priority and a flat budget, it is clear that the NSF will be able to fund fewer and fewer people in the coming years. Moreover, with the

competition for scarce resources becoming so intense, it is also clear that many excellent researchers won't be funded at all. This is already happening, and the result is very demoralizing.

What can be done? Since large increases in federal funding are unlikely, it is a question of what to do with what we have.

We simply have to do a better job of explaining to Congress and the public the importance of basic research. The priorities which have come to the fore in the new budget show that basic research is not considered to be as important as applied, interdisciplinary, or computational research. Many mathematicians, myself included, strongly disagree with this assessment, but we have not made an effective case for our point of view. Unless we do better, funding may in fact decline rather than remain stagnant.

Secondly, thought should be given to ways of spreading the research dollar more widely (and wisely). One way to do this is to decrease the amount of money going to summer salary support, especially for senior investigators. Whereas money for travel, consultation, conferences, and graduate students, all contribute directly to research activity, large amounts of money going to senior investigators for summer salary is much harder to justify. Cutting down on this aspect of funding will make more money available for more people. It seems to me that in mathematics this will contribute

Letters to the Editor

Letters submitted for publication in the *Notices* are reviewed by the Editorial Committee.

The *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.

Letters should be typed and in legible form or they will be returned to the sender, possibly resulting in a delay of publication. All published letters must include the name of the author. Letters which have been, or may be, published elsewhere will be considered, but the Managing Editor of the *Notices* should be informed of this fact when the letter is submitted.

The committee reserves the right to edit letters.

Letters should be mailed to the Editor of the *Notices*, American Mathematical Society, P. O. Box 6248, Providence, RI 02940, or sent by email to notices@math.ams.com, and will be acknowledged on receipt.

much more to a healthy and growing research community than bigger grants to fewer people.

Finally, I want to express my opposition to the directed research approach, which is overly evident in the new budgets. The best way to fund research is to give the most talented people the wherewithal to follow their own scientific inclinations. This is a difficult argument to make to the greater public, but I think it is a valid point which should be made as forcefully as possible. Too many of the mathematicians who are quoted in the last [April] issue of the *Notices* seem to assume that the best way to proceed is to make the best of a bad situation. A better response might be to argue against the underlying assumptions of some of the new directions in research funding.

Michael Rosen
Brown University
(Received April 15, 1992)

Bugs

The obituary of G. M. Hopper (April 1992, p. 320) perpetuates an oversimplified account by saying that she “coined the term ‘bug’ after a moth was removed from a computer she was working on at Harvard.” No doubt the experience popularized the term computer workers, but it did not start with her. Her own reminiscence, published in *Ann. Hist. Computing* 3 (1981), 285–6, includes a picture of the logbook: a moth is taped down with the note “Relay #70 Panel F, (moth) in relay. First actual case of bug being found.” The phrase “first actual case” strongly suggests that the metaphorical use of “bug” was already familiar.

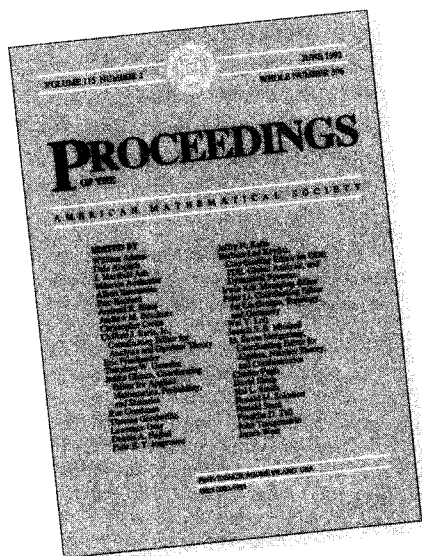
In fact, it is certain that the word was used by engineers before that time. The first printed example found in the *Oxford English Dictionary* (2nd Ed.) is a newspaper report from 1889: “Mr.

Edison, I was informed, had been up the two previous nights discovering a ‘bug’ in his phonograph—an expression for solving a difficulty, and implying that some imaginary insect has secreted itself inside and is causing all the trouble.” J. Lord also found the word used in a private letter by Edison in 1878 (*Ann. Hist. Computing* 6 (1984), 409). Thus the evidence to date indicates that the usage began with Edison.

This fact suggests one question, which others might explore: Did history repeat itself? The relays used in those early computers were the direct descendants of the relays (and sounders) used in telegraphy from the time of Morse. Edison began his career by working with telegraphs. Might he have had the same experience as Admiral Hopper?

William C. Waterhouse
The Pennsylvania State University
(Received April 9, 1992)

Proceedings of the American Mathematical Society



This monthly journal, which began publication in 1950, is devoted entirely to research in pure and applied mathematics, principally to the publication of original papers of moderate length. A section called Shorter Notes was established for the purpose of publishing very short papers of unusually elegant and polished character for which there is normally no other outlet. An author index appears in the last issue of each volume. Starting with the 1972 volumes (31–36), an annual author index is published in the December issue. Volumes 114–116 are the 1992 volumes. Single issues are not available after five years. Call the American Mathematical Society's Customer Services Department for the prices on back volumes.

1993 Subscription Prices—Either paper or microfiche*, List \$538, Inst. mem. \$430, Indiv. mem. \$323, **Paper and Microfiche***, List \$716, Inst. mem. \$572 (ISSN 0002-9939)

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Alert!

Assistance Needed for Mathematical Colleagues in the Former Soviet Union

“Russia is faced with the imminent dissolution of its science and technology infrastructure within the Russian Academy of Sciences, its educational institutions, and its military-industrial complex. We cannot simply allow the talent in this sector of the [former Soviet Union] to disappear. These are the people who are integral to the [former Soviet Union’s] survival. They will educate the future engineers and scientists and they have the skills to address Russia’s current economic problems . . . What they need is a steady source of funding and assistance in building a modern S&T management system to keep them in Russia.”

—Representative George E. Brown, Jr., Chair of the House Committee on Science, Space, and Technology, in a speech at a meeting of the American Association for the Advancement of Science in Chicago, February 8, 1992.

“The Moscow school of mathematics is a unique community of scientists. This school, whose origins go back to the turn of the century, was able, despite serious losses, to survive even the worst period for Russian science. Nonetheless, this school is now in imminent danger of extinction; and its extinction would be an immeasurable tragedy for the mathematicians and mathematically oriented scientists all over the world. On the other hand, given the opportunity, this same endangered school has the potential to become the kernel out of which could grow a new, this time international, community of scholars who would play a central role in the cultural and educational life of the future. But, unfortunately, time is running out: what remains of our once renowned scientific educational system is fast disappearing.”

—V. I. Arnold, chair of the Department of Mathematics of the Independent University of Moscow, in a letter in the Department’s Newsletter, January 1992.

The political turmoil in Eastern Europe over the past several years has resulted in a near-catastrophic situation for scientific and mathematical research in the former Soviet Union. Shortages of journals, lack of communication with colleagues, deteriorating equipment, and even scarcity of food are depleting the strength of this important and productive community. As it embarks on a project to provide direct assistance to mathematical scientists in the former Soviet Union, the AMS calls upon the international mathematical

sciences community to contribute to this urgently needed endeavor.

A Stellar History

The former Soviet Union has a particularly strong tradition in the mathematical sciences, with a history of stellar research accomplishments, distinctive traditions, and important contributions to mathematics education. However, this community could all but disappear as many of its members are compelled by economic circumstances to take jobs outside the mathematical sciences. In addition, economic hardship has forced large numbers of them to seek employment in foreign countries. Over the past few years, there has been a steady stream of such emigrés to the U.S. Although a boon to the U.S., this exodus poses a great risk to the future of mathematical sciences research in the former Soviet Union. In addition, it could seriously damage the former Soviet Union’s unique and fruitful tradition of educating and nurturing mathematically talented students, which ranks as one of the central contributions of the mathematical sciences community there.

The fate of the scientific community in the former Soviet Union has been the subject of numerous discussions within the National Academy of Sciences, Congress, the President’s Council of Scientific Advisers, and federal agencies. Several scientific societies (including the American Association for the Advancement of Science (AAAS), the American Physical Society (APS), the American Chemical Society (ACS), and the American Astronomical Society (AAS)) have recently undertaken efforts to aid their scientific colleagues in the former Soviet Union. For example, AAS and APS have initiated programs to award grants to astronomers and physicists and to supply journals to leading research centers there. AAS has raised \$45,000 in personal donations from the astronomical community, and APS has raised \$30,000 from the physics community. In addition, the APS has received a \$100,000 grant from the Sloan Foundation and has submitted a proposal to the National Science Foundation (NSF) for additional funds. AAAS has prepared a proposal to the MacArthur Foundation to support a program to supply journals to research institutes in the former Soviet Union. The ACS has also instituted a program of free journal subscriptions to the former Soviet Union and to Baltic and former Eastern bloc countries.

The leadership of the AMS believes the Society has a special responsibility to contribute to these efforts by aiding the mathematical sciences community in the former Soviet Union. The AMS has formulated a plan for directly assisting mathematical scientists in the former Soviet Union and is developing a proposal to the Sloan Foundation for funds to support this effort. In addition, the Society has been exploring other avenues of assistance through discussions with the MacArthur Foundation, the international program at the National Science Foundation, and other federal agencies, as well as the Office of Science and Technology Policy, the National Research Council, and the staff of relevant Congressional committees. To build on these efforts, the leadership of the Society urges all members of the mathematical sciences community to contribute generously to this important cause. Contributions of even \$100 can go a long way toward helping scientists there, many of whom subsist on salaries as low as \$200 a year. The full-page advertisement accompanying this article provides information on how to make a contribution.

Various Modes of Support

To try to address the variety of problems facing the mathematical sciences community in the former Soviet Union, the AMS is developing a four-point assistance plan:

- *Sending mathematical literature.* The AMS Executive Committee and Board of Trustees has approved the establishment of an AMS Reading Room in the former Soviet Union that would stock copies of AMS books and journals and provide access to MathSci Disc, the CD-ROM version of *Mathematical Reviews*. Current plans call for the AMS Reading Room to be located in the Moscow Mathematical Institute (more details about this new institute may be found below). In addition, the AMS intends to identify libraries throughout the former Soviet Union to receive current subscriptions of Society journals and may attempt to make arrangements for contributions or discounts by other mathematical publishers.

- *Providing small grants.* Even a grant of as little as \$200 can keep a researcher alive mathematically. Grants would be made to various groups, such as graduate students, young mathematicians, and established scholars. The Society staff has experience in administering grants (it currently handles reviewing for the NSF Mathematical Sciences Postdoctoral Fellowships and the mathematical sciences grants program of the National Security Agency). This aspect of the program would necessitate a reviewing panel that includes representatives from the mathematical sciences community of the former Soviet Union. Details of the distribution mechanism are being developed. In this vein, the AMS publications program's extensive experience with financial arrangements with the former Soviet Union will likely prove useful, as will the experience of organizations like AAS and APS.

- *Developing exchanges and workshops.* An exchange program for researchers can go a long way toward strengthening ties between the mathematical sciences communities of the U.S. and the former Soviet Union. Workshops involving both researchers and graduate students provide a means for much-needed communication and exchange of ideas at a time

when isolation of the former Soviet Union's mathematical sciences community poses one of the greatest risks. The AMS intends to seek funds from the NSF's international program to fund this activity.

- *Supporting development of new centers of mathematical sciences research and education.* In spite of the problems the former Soviet Union faces, various groups in several cities have formed with the purpose of keeping mathematical sciences research alive and providing advanced training for mathematically talented students. Among these are the Moscow Mathematical Institute (MMI) and the Department of Mathematics at the Independent University of Moscow. The MMI, established in 1991, is a small research institute directed by Askold Khovanski. On the governing board are Pierre Deligne of the Institute for Advanced Study, Vladimir Drinfeld of the Institute of Low-Temperature Physics in Kharkov, Ukraine, and Alexander Beilinson and Robert MacPherson of the Massachusetts Institute of Technology. Serving a much-needed role as a gathering place for researchers and students to meet formally and informally, the MMI will have a few permanent members of the highest level of achievement in research, some three-year appointees, and visitors from abroad. The MMI will need international assistance to get off the ground in these troubled economic times.

At present, the Independent University of Moscow is a small institution in which only mathematics and physics are represented. Because the University is independent of the present state-controlled structure that continues to administer education in the former Soviet Union, it cannot draw its budget from the usual state-run sources. The mathematics teaching faculty is presently small and focused at the undergraduate level, but as students progress through graduation, there are plans to add a graduate school. The Scientific Council for the Department contains some of the top names in the mathematical sciences community of the former Soviet Union. As V. I. Arnold points out in his letter in the Department's Newsletter, the University could do a great deal for the conservation and regeneration of the tradition of mathematics in the former Soviet Union, and international support for this effort is badly needed.

A Responsibility to International Colleagues

The U.S. has the most prolific and arguably the best supported mathematical sciences research community in the world. The AMS, in its role as representative of this community, and as one of the world's largest mathematical societies, has a special responsibility to the international community. Therefore, at this time of crisis, it is imperative that the members of the AMS and of the international mathematical sciences community do all they can to help their colleagues in the former Soviet Union to preserve the distinctive and illustrious tradition that has flourished there.

Allyn Jackson
Staff Writer

Please see the accompanying advertisement for information on how to make contributions.

Help!

Please help the American Mathematical Society support mathematics in the former Soviet Union.

The mathematics community in the former Soviet Union (fSU), one of the world's great centers of mathematical research and scholarship, is in danger of collapse! The AMS is involved in developing ways to assist mathematics and mathematicians in the fSU in the following ways:

- Sending mathematical literature to libraries in the fSU.
- Providing small grants to students, young mathematicians, and established scholars.
- Developing exchanges and workshops in both the U.S. and the fSU.
- Supporting the development of the Moscow Mathematics Institute and the Department of Mathematics in the Independent University of Moscow.

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FSU



Applying for Jobs: Advice from the Front

*Annalisa Crannell,
Brown University and
Franklin & Marshall College*

The introduction to the 1985 edition of *Seeking Employment in the Mathematical Sciences* flatly pronounces that “At the present time, job opportunities are somewhat plentiful in mathematics” [1]. Those who are facing the job market nowadays—either from the hiring end, where roughly 400 applications demand attention, careful reading, and sometimes pity, or from the applying end, where the battery of current statistics mingled with inexperience produces a wealth of anxiety—find a mirthless irony in those words. The situation is not easy for anyone: not for the applicants, not for the universities trying to find jobs for their graduating students, and not for the hirers. This article attempts to address, in as humane a way as possible, the issues facing applicants (especially recent graduates), and also to offer advice from one who has already “served time at the front.”

I approach this subject from a personal angle; I have just graduated from Brown University and accepted (very contentedly) a job at Franklin & Marshall College. My knowledge of the application process comes through a variety of avenues: various articles [2–5], my work in Brown’s Center for the Advancement of College Teaching, discussions with employers at the Joint Meetings in Baltimore last January and at my several job interviews, and other experiences. The information you’ll find here is occasionally statistical, occasionally philosophical, and frequently anecdotal.

I will break my discussion into various parts: (1) a brief discussion of the job market; (2) advice for those who will be applying far in the future; (3) general aspects of the job application; and (4) issues of concern to women entering the job market.

What You’ll Be Facing

Few of us have come this far in our careers without hearing the dire stories of the current job market. The reasons for this crisis are varied: the temporary reduction in the number of college-aged Americans, the increasing number of foreign mathematicians making their homes in the U.S., the swell in graduating doctorates, and the recession, which has forced severe budget cuts in state education as well as in smaller private schools. Preliminary reports [6] indicate that the number of advertised jobs is still decreasing (the January 1992 issue of *Employment Information in the Mathematical Sciences* contained 23% fewer positions than the January

1991 issue), and that half the nontenure track jobs are for one year only. The AMS Task Force on Employment will soon be publishing a report which includes more recent and complete statistics.

For a number of reasons, today’s applicants apply to an incredible number of schools. They do so out of convenience—“print merge” has made 140 applications only marginally more difficult than seventy. They do so out of inexperience—many believe that blanketing the market is the most effective strategy for procuring a job. They do so out of terror—who has not heard about the excellent mathematician who applied to 200 places and received no offers? They do so out of pressure from their faculty—I initially applied to “only” sixty places and was urged to double that number. (I eventually applied to eighty, but subsequently withdrew many of those applications.) Finally, they do so out of peer pressure—while nonmathematicians are amazed that I applied to as many places as I did, for us it has become standard.

The sorry state for job applicants has not, however, resulted in a fiesta for employers. There is an incredible amount of work involved in sorting through the multitude of applications. Moreover, having a surplus of applications doesn’t mean that it’s easier to hire “superstars”: the chair of one department told me that the best people are still fought over as fiercely as ever—much to his chagrin.

Long before You Graduate

All job search manuals begin with the timely advice, *Start early*. Unfortunately, the amount of work that is necessary to maintain a graduate existence keeps us from thinking about extraneous affairs before they are directly upon us, and so most people who see the words *Start early* have long since lost the advantage those words could have afforded. I am hardly a conformist, but I also present this advice with the optimistic and perhaps vain hope that it may do somebody, somewhere, some good.

The best way to get an interesting job is to have evidence that you have done interesting things. The best way to have interesting things to do is to have so many options that you can choose the most interesting ones yourself. Even a young, inexperienced graduate student with few connections and no reputation to speak of has a number of ways to open up those options, most of which essentially come down to advertising.

Volunteer. Go to departmental seminars. Go to conferences. Going to a local conference doesn't have to cost you anything—write a polite letter to your deans asking for a grant. They won't mind shelling out fifty or sixty dollars for a good cause. Getting grants, no matter how small, looks very good to employers. Giving talks to undergraduates or high school students is an excellent way to prepare for the bigger talks that follow, and it lets people know that you're out there (it looks good on your CV, too).

Most of all, talk about your interests. For young graduate students, it's often intimidating to talk to the faculty. However, making use of professors' knowledge, experience, and connections is one of the foremost reasons for being in graduate school. An appreciable benefit of talking to faculty outside of class is that, if the faculty know what you're doing, they'll feel much more comfortable writing letters or verbally recommending you to others, sometimes even before you ask them to. The two most exciting opportunities that came my way while I was in graduate school were both passed along by professors who'd received phone calls asking "We need somebody for such-and-such. Do you know anyone who might be interested?" For foreign graduate students, talking to faculty becomes an effective way to increase your command of English—and this will make a *big* difference when it comes time to apply for jobs.

Next, collecting and maintaining evidence of what you've done is of supreme importance. It's a wise idea to have a folder (mine was unabashedly called "Bragging" as long as it stayed in my drawer) where you can dump everything that's going to make you look good some day. You might keep lists of awards and honors you've received, invitations to speak or to teach external classes, brochures from conferences you've attended, copies of transcripts, copies of old CVs or resumes, interesting computer experiences, student evaluations, unsolicited comments from students (letters, notes on exams, etc.), statistics on student retention, letters—especially thank you letters—from faculty or administrators, and so on.

This folder can be used in various ways. You will almost certainly use it to prepare your CV. You can give it to your letter writers, who will be more than happy to have tangible things to say: "I've seen copies of her course syllabi and they're very good" is nicer to write and read than "I've heard she's a well-organized teacher." And finally, you can clean it up and carry it around to show to prospective employers.

Putting Together Your Application

First, figure out what kind of job you want to apply for. You'll have to do it someday, and doing it now will make your applications much more effective. What do you want out of a job? To learn more math? To work with the hot shots in your field? To have access to large computers? To work in a college? Four-year or two-year [7], liberal arts, community, or technical? To get out of academia altogether [8]? To live in a particular geographic area? Your "Career Services Office" or its equivalent probably has copies of books which discuss academic institutions and their various departments. Careful

use of these books is a big help in deciding where to apply and in putting together well thought out applications.

Once you have these things in mind, you can begin to assemble your application. I am most familiar with applying to institutions that place a high emphasis on teaching (and with state budgets being cut, a lot of the hiring is indeed being done at private colleges), but I hope that this advice is generalizable to other institutions.

An application will include many of the following items:

- a curriculum vita, or CV, which is best prepared by looking at other people's CVs and deciding which style best suits your needs;
- a thesis abstract and research proposal;
- reprints or preprints of any articles you've written;
- two copies of your graduate and undergraduate transcripts. (These cost money and take time, so order early. You can send photocopies in your mass mailings, but once places get serious about you, they'll want the originals.)
- four letters of recommendation, one of which addresses only teaching (more on this later);
- a statement of your teaching philosophy (if you're interested in a teaching job); and
- a cover letter that includes the position you're applying for; your name, address, email address, and phone number; the names and addresses of your recommenders; your professional interests and aspirations; the reasons you're applying to that particular place (name people you can work with, programs which interest you, location, reputation, etc.); and the fact that you'll be attending the Employment Register at the Joint AMS-MAA meetings in January (if, in fact, you will be).

Keep the cover letter short. If you want to brag more, do it in . . .

- a follow up letter, in which you brag like crazy and/or respond to questions the school has asked you.

There are a variety of places that advertise job openings, and a fairly complete list of these can be found by looking in [5], an excellent reference.

Here are some general strategies for arranging your application. First, if you are one of the many who have not been able to "start early", now would be the perfect time to invest in a good coffeemaker. When you sit down to put your application together, you must realize that today many schools are getting upwards of 400 applicants, a large number of which are obviously inappropriate (only one school I talked to in January had received as few as 250 applications, but they didn't start advertising until December). Reading hundreds of applications carefully without becoming jaded is strenuous (think about grading your exams), so the first sort merely verifies whether the applicant fits the advertised criteria. If a school advertised for a differential geometer and you're a topologist, you're out. If you apply to a two-year college that wants someone with computer expertise but your letters of recommendation all talk about nothing but your research, you're out. A lot of applicants still believe in the "safety school" approach—they want to do research, but they'll apply to a small college "just in case." Small colleges that advertise for teaching excellence want, believe it or not, teaching

excellence, not researchers. So the first rule of thumb is: don't bother applying to places that are advertising for what you're not. It's a waste of time and money. (Some argue that an application is a form of advertising, of spreading one's name around. I believe there are more straightforward ways of achieving the same result.)

Another consideration to keep in mind is that a person high on one institution's list is likely to be high on another's list, and institutions are fully aware of this. Potential employers have to worry about not only whether the applicant is suitable for that school, but also whether that applicant is likely to accept the job if it's offered. Therefore, it's a good idea to try to convince the places to which you're applying that you know what you're doing. If you're applying to a new geographic area, for example, explain why you're doing so. (Employers are likely to be reluctant to interview people who are too far away—they're expensive to interview and less likely to accept.) Especially if you're applying to small places, pay attention to your cover letter. Larger schools may not pay them much heed, but smaller schools tend to emphasize the individual and read the letter fairly carefully. If you are "print merging" your letters, check them over: employers do not "read merge".

It's not a bad idea—and may even be a good one—to have some part of your application, clearly marked, that goes into depth about something that reflects your own strengths and interests. Your thesis abstract and preprints do this for the research side of you, but there may be another aspect you'd like to emphasize. It doesn't have to be teaching; it could be computers, or integrating music and mathematics, or getting grants for mathematical trips to the Caribbean. But there should be something about your application that makes a school think, "Wow. Wouldn't it be nice to have *this* person here?"

Some schools have started asking for a statement of teaching philosophy (which is why other schools have started seeing them even without such requests). I firmly believe this is a step in the right direction. A school that asks for a statement of teaching philosophy weeds out those not really interested in that job and also gains extra insight into each applicant.

I incorporated my description of my teaching directly into my CV. I kept my CV fairly standard for the first two pages—I was born, I went to various schools, I won awards, I did research, I taught courses, I went to conferences, I joined organizations—but then I added a third page called "Goals and Techniques in the Classroom." It was on this page that I mentioned my work with dyslexics, my use of computers and of writing assignments, the career advice that I give, and what students do after they leave my class.

This idea is based on one of the hottest new items in pedagogical circles, the "Teaching Portfolio," which is in turn modeled after the artist's or architect's portfolio. Teachers across the country are being encouraged to maintain artifacts that document their teaching effectiveness—course syllabi, student projects, external and self-evaluations, and so on. It is more comprehensive than a "4 out of 5" on a student

evaluation, and is being used by institutions such as Stanford, Harvard, and the New Hampshire secondary school system. Those who are interested in more information should see Peter Seldin's *The Teaching Portfolio* [9]. (If your Career Services Office doesn't have a copy, ask them to get one.)

One last tip: Several schools told me that the small number of applications which are completed early get substantially more attention than the hordes that pour in at the deadline. It can also mean the difference in getting an interview during the Joint Meetings in San Antonio next January. So, give your letter writers plenty of time and push them to get things done early, and aim for getting things done early yourself.

Letters of Recommendation

When I talked to employers about the process of reading job applications, their second-largest gripe (next to the sheer quantity of applications) was bad letters of recommendation. Some "writers" can't. Some letters were, for various reasons, offensive. One example of such a complaint prompted a letter to the editor of the *Notices*: "We have seen letters of recommendation for job candidates that suggest anti-female bias on the part of the writer. The technique is subtle: the (female) candidate is compared only with other women; or statements are made such as 'she is the best female graduate student I have seen in the last five years' . . ." [10]. But most often, the letters did not at all take into account the type of institution to which they were being sent. One interviewer complained to me that letters for an applicant to a small, liberal arts college that emphasized teaching above all else often began, "Let G be a semi-abelian variety. . ."

You have more control over your letters than you might think. It is imperative that you tell your writers the kinds of jobs you're applying to, your top choices, as well as which aspects of your career you'd like them to emphasize. It's not unreasonable to ask for two letters, emphasizing different aspects. Neither is it pushy to show them your "bragging" folder—if you think about how hard it is to write letters of recommendations for your own students, you'll realize that your writers will appreciate it. (This is especially true for those writers who don't know you well.) For goodness' sake, give your letter-writers as much information as possible! Tell them your deadlines, both official and personal, and try to give them plenty of time to meet those deadlines.

Sending out letters can often be done through the department or through your Career Services Office. In fact, the folks at Career Services will often maintain a file of letters and other material you want sent out, and will even send them out free-of-charge.

The Interview

When and if you get an interview at a school, make the most of it. Your talk will be better if you've asked beforehand what types of people are going to be in the audience, which upper-level courses are being taught that year, and what kind of knowledge you should assume. If possible, choose a talk

that allows you to highlight your own teaching style (use of computer, lots of pictures, whatever).

Your interview is the time to ask all those questions you thought you wouldn't ask until you accepted the job—Is there child care on campus? How much does it cost to live around here? Does the city have a square dancing club? Can I talk to some of the undergrads today?—as well as those that more carefully define the job—On what decisions is tenure based? What is the salary? What are the benefits? Are there tenure quotas? Do faculty “own” courses? What will I be teaching? You'll probably be meeting about ten different people during the day, most of whom will ask you, “So, er, do you have any questions?” Feel free to ask the same questions over and over; you'll get a lot of different answers anyway.

The kinds of questions that you'll be asked are: What is your research? (This is invariably asked by a dean who hasn't had math since freshman year of college—practice now). What courses would you like to teach? Where's your research going? Um, er, do you have any questions?

You're going to make a much better impression if you are enthusiastic, energetic, and smiling. When you do get to the interview, enjoy it, and drink a lot of coffee.

Women in the Job Market

Graduating students, even in the best of economic times, are prone to bouts of uncertainty and anxiety regarding their futures. A market such as the one we're facing can only further erode their confidence. Many studies have shown that this crisis of confidence disproportionately affects women, who, although they tend to do better than their male counterparts at every stage of mathematical education, consistently undervalue their own skills (see, for example, [11]).

Often, women not only belittle their own accomplishments, but also believe others who belittle their accomplishments for them. I haven't yet met a woman in graduate school who wasn't told at some point (usually by friends) that her gender must have been a big help in getting in. Nor does it stop at graduate school; versions of the “gender boost” are prevalent in the job market.

Although these comments are intended to be encouraging, they further chip at a woman's belief in her own strengths, for they imply that a woman's success is not based on her qualifications alone. Instead, anecdotes and research abound that shows just the opposite: not only must women “make it” on their own merits, but many qualified women are turned away—or turn away—in spite of merits. The “turning away” takes many forms, from applying only for jobs for which she is overqualified, to leaving mathematics altogether.

At such a crucial stage as applying for jobs, it is vital for an applicant to have a realistic and even slightly idealistic view of her or his level of ability. This level may be higher than the applicant thinks, especially if she is a woman. I strongly urge all those who are in a position to advise students that they assure them of their abilities and encourage them to aim high.

To the women who are on the job market this year, I offer the following encouragement: For me, it was too easy

to say, “Well, I've made it this far, but I don't know that I'm really any good.” I learned pretty quickly that employers and colleagues alike believe that making it “this far” is a concrete indication that I *am* good. If the rest of the world is going to think you're amazing for doing all you've done, you might as well think so, too. Aim high.

For those who are interested in a more thorough treatment of this subject than I have space for here, I highly recommend the *Special Issue on Women in Mathematics* that appeared in the September 1991 issue of the *Notices* [12].

Conclusion

When you know how tough the job market is, it's hard not to send applications to every department that's advertising. Yet the sheer quantity of one-size-fits-all applications indicates that tailoring your applications for the jobs you really want is not only more considerate to prospective employers, but also a smart move on your own part. The application that stands out from the crowd is one that is intelligent and well-considered and that reflects the interests and aspirations of the applicant.

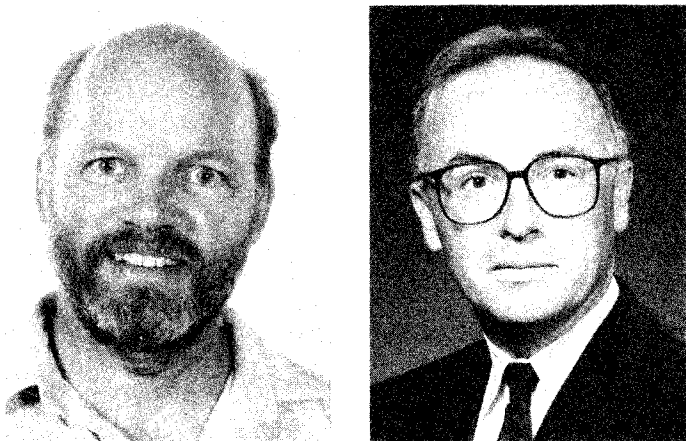
If I had to sum up my own experiences into one sentence of advice, I would say: “Start early, apply to the kinds of institutions where you'd really like to work, and do your best to convince them you're the perfect person for the job.” If I were allowed two sentences, I'd add, “And drink a lot of coffee.”

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Canada's Fields Institute Opens its Doors

A new institute in Canada is aiming for a spot on the growing international roster of research institutes in mathematics. The Fields Institute for Research in Mathematical Sciences began holding workshops and seminars earlier in the year and had its "official opening" on June 11, 1992. Named after John Charles Fields, the Canadian mathematician who established the Fields Medal, and based in Waterloo, Ontario, the Fields Institute aims to promote research and education in the mathematical sciences and to foster connections with other areas of science and with industry. Jerrold E. Marsden of the University of California at Berkeley serves as director, and William F. Shadwick of the University of Waterloo as deputy director. John Chadam of McMaster University is also a key player and one of the major proponents in getting Fields started (he also currently serves on the Fields board of directors). The associate directors are Josef Paldus of Waterloo, Carl Riehm of McMaster, and Paul Selick of the University of Toronto.



The Fields Institute Director, Jerrold Marsden (left), and the Deputy Director, William F. Shadwick.

Many mathematicians and mathematics graduate students end up in the U.S., where top-flight researchers can command larger salaries, and opportunities for graduate students are richer and more varied. Still, Canada has a sizable and active mathematical sciences research community, particularly in such areas as operator theory, combinatorics, and synthetic geometry. In addition, the National Science and Engineering Research Council (NSERC) provides research grants that

don't include summer salary but do provide support for travel, equipment, and other nonsalary costs of doing research. Some believe this system allocates funds better than does the system used by such agencies as the National Science Foundation in the U.S.

The Fields Institute will bring in top experts from all over the world to present lectures and conduct workshops and seminars. In addition, Fields will run short courses for Canadian graduate students—an important addition to mathematical life in Canada. Canadian mathematics faculty also benefit from the Fields Institute activities. Shadwick says the Fields-affiliated universities have agreed to accept reimbursement of no more than 40% of the salaries for faculty visiting Fields—the idea is that Fields will cover only the cost of a teaching replacement for visiting faculty, which is far less expensive than covering the entire salary of tenured faculty. This arrangement means that Fields can bring in many senior faculty from all over the country.

The Fields Institute is supported primarily by the Ministry of Colleges and Universities of Ontario and by NSERC. The NSERC funds of \$750,000 (all figures are in Canadian dollars) came from a program that supports large-scale collaborative research initiatives and is separate from the pool of money going to individual grants for mathematicians. The funds from the province of Ontario of \$1 million (with steady-state funding expected at the level of \$1.3 million) were made through a "centers of excellence" program that promotes science, technology, and connections to industry. In addition, the three sponsoring universities for Fields—the University of Waterloo, the University of Toronto, and McMaster University—make a financial contribution, as do the fourteen university affiliates from across Canada.

An advisory panel runs the scientific side of the Fields Institute, and a board of directors handles administrative aspects and provides liaison with various constituencies, such as mathematical sciences societies, university research administrations, and business and government. There is also a governing council that, in addition to the constituencies on the board, contains representatives from the affiliate universities. Shadwick says he's determined that Fields be run in an efficient and businesslike manner, and he seems serious: the chairman of the board is Peter Nicholson, senior vice president of the Bank of Nova Scotia. (However, there are probably

few bankers with Nicholson's background—he studied with Rudolf Kalman at Stanford University.) In addition, Fields has a very capable and intelligent staff who run things with efficiency and hospitality.

Canada already has a well-known mathematics institute—the Centre de Recherches Mathématiques (CRM) at Université de Montréal. Established in 1968, CRM differs from the Fields Institute in that it has a permanent staff of nine, but in many ways the two are quite similar in their activities—an extensive visitor program, workshops, theme years, and so on. CRM is also initiating a program of formal graduate courses through a new enterprise it calls l'Institut des Sciences Mathématiques (see News and Announcements in this issue of the *Notices*, p. 601, for more information). As with Fields, CRM is funded by the provincial government and by NSERC, and the budgets are comparable. Collaborations between Fields and CRM are planned for the future.

Even before its official opening in June, the Fields Institute has been holding workshops and graduate courses. Since the beginning of the year, there have been activities focusing on various aspects of control theory, especially stabilization, control, and design of flexible structures. During the 1992–1993 academic year, the focus will be on dynamical systems and bifurcation theory, organized by William Langford of University of Guelph, Leon Glass of McGill University, Chadam, Marsden, and Shadwick. In addition, the Fields Distinguished Lecture series will feature Vaughan Jones of the University of California at Berkeley, Michael Berry of Bristol University, and Michael Atiyah of Cambridge University. Other planned activities include a cooperative program with the Mathematical Sciences Research Institute (MSRI) in Berkeley in differential geometry during 1992–1994. (Periodically, news from the Fields Institute will appear in the News and Announcements section of the *Notices*; see the April 1992 issue, page 324, for more details on the 1992–1993 program.)

The Official Opening

The official opening took place at the Fields Institute and on the University of Waterloo campus. Complete with a ribbon cutting and plenty of pomp and circumstance, the opening was attended by 100 to 200 people, most of them Canadian mathematicians. There was even a reception, with champagne and fancy hors d'oeuvres; Fields officials took pains to make it clear the champagne did not come out of the Fields budget, but was donated by two mathematicians who went by the names of Elie Cartan and William Rowan Hamilton.

The opening provided a good opportunity to celebrate some mathematics as well. The Fields Distinguished Lecture series was inaugurated with lectures by Phillip A. Griffiths, director of the Institute for Advanced Study in Princeton, and Stephen Smale of the University of California at Berkeley. Griffiths' lecture focused on some of the fertile analogies between exterior differential systems (EDS) and algebraic geometry. In algebraic geometry, one starts with a polynomial equation; in EDS, one starts with a partial differential equation, which can be thought of as a polynomial whose "variables"

are derivatives. In each case, one is interested in obtaining a geometric understanding of the solutions to the equations. Algebraic geometry is a mature subject, whereas EDS is not, and in fact is somewhere between a theory and a set of techniques for solving special problems. Griffiths noted that there have been developments in the local theory of EDS, but that a global theory has been slower in coming, partly because the topology of the solution manifolds and the analogy to moduli theory in algebraic geometry need to be developed.

Smale discussed some recent work on Bézout's theorem and complexity theory. Bézout's theorem says that, given a homogeneous polynomial f over C^{m+1} , where $f(z) = (f_1(z), \dots, f_n(z))$, with d_i the degree of the i^{th} term, then the number of solutions is the product of the d_i . Smale presented a constructive, geometric proof of Bézout's theorem that furnishes a fast algorithm for the solution of the polynomial equation. His coworker, Michael Shub of IBM's T.J. Watson Research Center, tested the method on a polynomial that has 2^{10} solutions, and it took two days to get the result; Smale says this is probably a record for the complete solution of a problem of that size.



The Common Room at the Fields Institute.

There were two speakers during the day who came from other mathematical institutes: Avner Friedman, director of the Institute for Mathematics and its Applications in Minneapolis, and Francis Clarke, director of CRM. In addition, David Brillinger of the statistics department at University of California at Berkeley talked about the use of the Fourier transform in analyzing data from a number of different areas of science. Rounding out the program were two half-hour lectures on education. The first, by Stephen Halperin of the University of Toronto, was an eloquent if predictable exhortation to get research mathematicians involved in education. The second, by Beverly West of Cornell University, presented a fascinating look at some state-of-the-art uses of computer technology in the teaching of calculus.

Every such event has to have speakers during meal-times, and the Fields opening was no exception. Cathleen S. Morawetz presented an entertaining set of reminiscences

about her father, J. L. Synge, a mathematician from Ireland who went to the University of Toronto and there built up an excellent applied mathematics department (after he left for Ohio State University in 1943, pure and applied were merged at Toronto). A colleague of John Charles Fields, Synge took care of many of the details of getting the Fields Medal established after Fields' death. During the banquet dinner, Irving Kaplansky, who retired in June as director of MSRI in Berkeley, presented reminiscences about his own Canadian roots and about being director of a major mathematics institute. There was also a speech by Israel Halperin of the University of Toronto, and presentation of a Distinguished Service Award to Heinz Götze of Springer-Verlag.

The day after the official opening, one could observe the Fields Institute in its more usual mode: the seminar room was filled with people attending a special "Mechanics Day" that Marsden had organized. Fields' temporary home, rented quarters in an office building, is spacious and comfortable,

with plenty of office space and, most important, an ample supply of coffee. During the coming year, the board of directors will consider proposals for a permanent site for Fields, and there seems to be some jousting among the three sponsoring universities—Waterloo, McMaster, and Toronto—as to which one will get it. A new building may be built, or Fields may be housed in an existing site.

Wherever the Fields Institute ends up, it seems destined to be a mathematical bright spot for Canada, and a center for research on an international level. "We want [Fields] to be a place where people who love mathematics and its applications—people from diverse places, backgrounds, and points of view—can come together in ways you don't usually find in the narrow confines of a university department," said Marsden in his remarks during on opening day. "The Fields Institute is a fresh and welcome development in the Canadian mathematical community."

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JPBM Presents Testimony Before Congress

On April 29, 1992, testimony on behalf of the Joint Policy Board for Mathematics (JPBM) was presented before the Subcommittee on Veterans Administration, Housing and Urban Development, and Independent Agencies. This Subcommittee of the House Committee on Appropriations holds the purse strings for, among other things, the National Science Foundation (NSF). Presenting the testimony were Phillip A. Griffiths, director of the Institute for Advanced Study in Princeton, and I. M. Singer of the Massachusetts Institute of Technology. The chair of the Subcommittee, Representative Bob Traxler, was not present, so Representative Chester Atkins of Massachusetts served as acting chair during the testimony and discussion.

The testimony centered on the NSF budget request for fiscal year 1993. This request has evoked a great deal of dissatisfaction and concern within the community, for the entire increase requested for the Division of Mathematical Sciences (DMS) is slated for large-scale federal initiatives; there is not even an inflationary increase for core areas of mathematics (see "The National Science Foundation Budget Request for Fiscal Year 1993," *Notices*, April 1992, pages 286–297). The testimony supported the participation of mathematics in the initiatives, but raised concerns about the flat funding of core areas. (The full text of the testimony follows this article.)

Although members of the mathematical sciences community have given testimony to Congress before, this presentation was quite different. Usually, notes Griffiths, "there's some polite interchange afterward, and they go on to the next person. This time they kept us and me for an extended discussion". In addition, he says, there was quite a bit of discussion during the preparation of the testimony about exactly what should be said about the DMS budget—should they simply support the NSF budget without reservations? "It seemed as though that wouldn't be quite fair to the mathematics community," says Griffiths. "Here was an opportunity to make the case for mathematics, why it's important, what the community's trying to do, and so on. It would be misleading to not bring up the difficulties we're having in getting the job done. And so what we tried to do was to give testimony which was constructive yet didn't avoid the issues."

"The general feeling of the Executive Branch is, yes, we want your input, but . . . once we've submitted a budget, don't make waves," says Singer. "This is the first time, I'd say,

that we made waves." The testimony raised concerns over the DMS budget, but did not suggest any specific amount by which it should be increased. However, during the discussion period, Singer presented the following statement that expressed his own views on what ought to be done: "I want to expand on the concern of the level of support for disciplinary research [in mathematics]. The line item in the 1993 NSF budget request is \$48.23 million, which I emphasize is the same as the 1992 amount. I would like to suggest that that amount be increased to \$50 million, an essential cost of living increase, if we are to remain world-class and play an essential role in mathematics education and increasing economic competitiveness."

On the whole, it seemed that the testimony and discussion went well. "Mr. Atkins stated that he was very happy to see us and asked us to come back," says Singer. "He was eager to make contact with mathematicians, it seemed to me . . . He sees mostly provosts and university presidents, and they have their own agenda, and it isn't a 'frontier of research' agenda, and that was one of the reasons he was delighted to see us . . . I think it was profitable in the sense of his getting acquainted with research mathematicians and their needs, which I believe he hadn't heard directly before."

Much of the discussion after the testimony centered on universities, currently a "hot topic" inside the beltway. Griffiths notes that there is a great deal of concern about the financial health of the nation's universities. Says Griffiths, "What I was hearing, though, from Atkins, and from other people in the Congress (not in the Executive Branch) is, okay, we're certainly worried about the health of universities, but we're also very much concerned about their responsibility." Are schools of education contributing to solving the problems of K-12 education? Are schools of public health working on the runaway costs of health care? Are business schools doing anything to help with the nation's economic woes? Atkins is not a "university-basher", Griffiths points out, but "he's also worried that universities have gotten into a position as being seen as a special interest group and are not responsive to the great national problems we're facing".

With regard to university mathematics departments, Griffiths noted that Atkins implicitly raised the question of why the employment picture looks so bad for new Ph.D.s in mathematics, while at the same time 40% of all entry-level mathematics courses in four-year colleges and universities are being taught

by nonfaculty. Atkins asked Griffiths if, as former provost of Duke University, he felt that the mathematics department was getting adequate resources. "One could say yes, it was getting adequate resources as far as its research mission was concerned, but it was not getting adequate resources based on the number of students it's teaching," says Griffiths. "I think this is pretty much universally true for mathematics departments. And we had a rather frank interchange about this . . . This was just one illustration of this mood that, yes, universities are facing problems, but they're also not really meeting their responsibilities."

Atkins expressed surprise that, in all his years on the Subcommittee, this was the first time he had seen mathematicians come in and make their case. "The chemists are in there every year, the physicists are in there every year, Lord knows the biomedical people are in there all the time," Griffiths remarks. He and Singer say they hope that this testimony is the start of a continuing dialogue between Congress and the mathematical sciences community. "Without coherent, collective input from the mathematical sciences community into the allocation of resources across all the agencies, we're going to be in the position in the 'out' years that we found ourselves in this year, where things are 'done to us' and we're in the position of reacting," explains Griffiths. "We need to constructively educate our representatives about the importance of mathematics." But it's up to the mathematical sciences community to take the initiative. "The Congress is not going to call you up and say, we haven't heard from you in the last ten years, what's going on?"

Allyn Jackson
Staff Writer

The following is the text of the testimony prepared by the Joint Policy Board for Mathematics and presented by Phillip A. Griffiths, director of the Institute for Advanced Study. The testimony was given on April 29, 1992 before the Subcommittee on Veterans Administration, Housing and Urban Development, and Independent Agencies of the House Committee on Appropriations. Chester Atkins, Democrat from Massachusetts, served as chair.

Good morning, Mr. Chairman and Members of the Subcommittee. On behalf of the Joint Policy Board for Mathematics (JPBM), I would like to thank you for this opportunity to comment on the FY 1993 budget request for the National Science Foundation (NSF). The JPBM is an executive action and public policy arm of the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics, with a combined membership of over 56,000 mathematical scientists and educators. Here with me today is Isadore Singer of the Massachusetts Institute of Technology, winner of the National Medal of Science and former Chair of the Committee on Science and Public Policy for the National Academy of Sciences.

As the NSF is the only government agency with explicit responsibility for maintaining the strength and progress of the mathematical sciences, the JPBM strongly endorses the President's FY 1993 request for an overall 17.6 percent increase for the budget of the NSF. JPBM especially endorses the 17.9 percent increase requested for the Research and Related Activities component.

NSF covers the broadest range of mathematical fields, which together comprise the intellectual infrastructure necessary for a robust mathematical enterprise, including the education of future scientists and engineers. Approximately half of all federal funding for the mathematical sciences comes from NSF. It provides the critical support needed to ensure not only the continued advance of basic mathematical research, but the ensuing ideas and techniques essential to progress in science and vital to developments in industry, for the ultimate benefit of society.

Let me first speak rather broadly about mathematics. In a 1991 speech, the President's Science Adviser, Allan Bromley, quoted Sir Francis Bacon, who had pointed out that "mathematics is the door and the key to the sciences." While Bacon's statement was made four centuries earlier, Bromley added, "Today that statement is more accurate than ever."

In speaking about the FY 1993 budget request, I will first identify the three primary goals of the American mathematical sciences community: 1) to maintain world leadership in research; 2) to guide the process of education at all levels, including general quantitative proficiency for all students, advanced mathematical skills for students in science and engineering as well as precollege mathematics teachers, and education of the professional mathematical researchers needed in industry, national laboratories, and colleges and universities; and 3) to play a leadership role in the applications of mathematics to problems in science and technology, especially those areas identified as national objectives.

I will briefly comment on each of these goals and then discuss the impact of the budget proposal on the ability of the mathematical sciences community to meet them.

Concerning the third objective, the role of mathematics in facilitating applications, we are particularly pleased that the NSF is supporting the participation of the mathematical sciences in three of the four FCCSET [Federal Coordinating Council on Science, Engineering, and Technology] research initiatives and the two internal NSF initiatives: High Performance Computing and Communications, Advanced Materials and Processing, Biotechnology, Advanced Manufacturing, and Environmental Science. Developing the underlying mathematical foundations and the modeling and computation for these areas of science and technology will enable a more thorough realization of the goals of the initiatives.

These activities are part of a broader NSF effort to stimulate mathematical contributions in key fields of national interest. NSF's newly inaugurated Grand Challenge Applications Groups will utilize the latest high performance computing technologies to facilitate the solution of fundamental problems in science and engineering, including many concerning the state of the global environment. Mathematicians

play important roles in the development of the mathematical models and quantitative techniques required for greater understanding of the complex processes and phenomena that grand challenges entail.

Furthermore, we are proud to be, in Dr. Bromley's words, "at the forefront of science education reform," playing an important role in the Presidential Initiative in Mathematics and Science Education. Dr. Bromley notes that two subjects are fundamental to higher education: mathematics and English. Interestingly enough, a Department of Education study reveals that other than demographic factors, the strongest predictor of earnings nine years after graduation from high school is the number of mathematics courses taken, reflecting the fundamental role of the discipline both in research and education.

The involvement of mathematics in education and applications reaches beyond the core of mathematics, but work in the discipline itself is inextricably intertwined with these roles. The core of mathematics must be strong before mathematics can adequately play its critical roles in education and applications for science and technology. One never knows in advance which areas of basic research will produce the innovative results that lead to solution of important problems and underpin future technologies. This is as true for mathematics as it is for the other sciences, and recent developments in chaotic systems provides an example of the power of mathematics. Mathematicians in this field, which is deeply rooted in core mathematics, have recently demonstrated the ability to control chaotic systems. This in turn provides greater understanding of chemical processes in manufacturing.

In summary, the first goal not only addresses science for its own sake, but recognizes that core mathematics provides much of the well-spring from which future applications will flow. As Vannevar Bush said, "Further progress of industrial development would eventually stagnate if basic scientific research were long neglected."

The budget request for the Division of Mathematical Sciences calls for an eight percent increase, most of which will be used to expand support for cross-disciplinary and computational research in mathematics, but provides no increment for disciplinary mathematics research. Such a budget will enable the community to advance goals concerning applications, but it could have negative consequences on the community's ability to fulfill goals concerning education and maintaining U.S. leadership in mathematics.

While we welcome the opportunity to participate in the initiatives and to contribute to the solution of the nation's problems as represented therein, it must be recognized that the budget request represents a substantial redirection of efforts of NSF-supported researchers. **Despite the emergence of new areas of mathematical research, the number of NSF-supported individual investigators in mathematics is**

lower now than it was in the early 1980s. Moreover, since 1988 NSF support for more than half of the programmatic areas of the mathematical sciences has declined in real terms. As the proposed budget will accelerate this latter trend, it is inconsistent with the goal of U.S. Preeminence in mathematical research.

Concerning education, a level of support which discourages present and future research mathematicians diminishes the enterprise as a whole. Ultimately, this will have an adverse impact on the ability of the community to guide the components of our educational responsibility. From eighth grade through the Ph.D., fully half of those studying mathematics each year cease their studies the following year. This has profound implications not just for mathematics, but for the prospects for a scientifically literate population. University and college mathematicians are, after all, the individuals who teach those who teach our nation's children. Mathematics continues to be responsible for education and development of human resources in the sciences and engineering. The amount of mathematics being taught by part-time instructors across the country is of great concern. The problem is significant at universities and is truly appalling at community colleges, where some forty percent of mathematics instruction is being carried out by part-time instructors. Returning to the education of future mathematical researchers, this is best undertaken and delivered by those trained and engaged in mathematics.

I would like to close with some additional observations. In 1990, the National Research Council produced a report, "Renewing U.S. Mathematics: A Plan for the 1990s," under the aegis of a panel headed by former Science Adviser Edward David. The report emphasized the central role of the mathematical sciences in both the research and education missions of U.S. universities, **yet noted a serious shortfall in federal support for academic mathematical sciences, as compared with other disciplines.** The report, and its precursors, have been highly influential in focusing the mathematical community on establishing goals and setting priorities. It provides a recommended level of support necessary to achieve these goals and also provides prioritized recommendations for the distribution of funding by modes of support. We are actively pursuing a multiagency dialogue concerning the goals of the mathematical sciences and prioritized strategies to meet those goals.

In conclusion, the proposed increase in NSF funding for mathematical research in support of the FCCSET initiatives is very important and should be preserved. However, we are greatly concerned about the lack of even an inflationary increase for disciplinary mathematics for all of the reasons stated above. Again, thank you for allowing us this opportunity to add our views to the record regarding appropriations for the National Science Foundation.

Highlights of the 1990 CBMS Survey

Donald C. Rung,
Pennsylvania State University

The following article presents highlights of the 1990–1991 Conference Board of the Mathematical Sciences (CBMS) Survey and is written by the chair of the CBMS Survey Committee. Published as volume 23 in the *Notes* series of the Mathematical Association of America, the Survey is available for \$20 prepaid (includes shipping and handling). Orders may be sent to: Mathematical Association of America, 1529 Eighteenth Street, NW, Washington, DC 20036. Telephone (202-387-5200) or fax (202-265-2384) may be used for credit card orders.

Every five years since 1965, the CBMS conducts a statistical survey of undergraduate programs and faculty in mathematics, statistics, and computer science. The 1990 survey is now available and contains a wealth of information useful to mathematics faculty in a variety of institutions. Described here are some of the survey's highlights, followed by information about other topics covered in the survey.

Increasing Enrollments

Remedial course enrollment, as well as enrollment in non-remedial courses, has increased substantially over the last twenty years (Table A, see next page). In fall 1990, the total two-year and four-year calculus level enrollment was 777,000. However, calculus and advanced-level enrollment has remained at about 47% of the total mathematics enrollment in four-year institutions during this period. In four-year college and university mathematics departments, enrollment in courses above the precalculus level (including advanced statistics and middle and upper level computer science courses) was 44% of the total mathematics department enrollment; the comparable figure was 36% for statistics departments, and 35% for computer science departments.

Table B (see next page) provides more detailed enrollment information by type of department. Noteworthy are the myriad of courses taught in mathematics departments in which the B.A. is the highest degree awarded. These departments taught substantial proportions of enrollments: 31% of the mathematics, 31% of the statistics, and 22% of the computer science enrollments. The ratio of enrollment to total full-time faculty was 112 in Ph.D. mathematics departments,

107 in M.A. departments, and 84 in B.A. departments. The comparable figure is 60 for both computer science and statistics departments.

Increasing Faculty Size

Since 1985, the number of full-time mathematics faculty in four-year institutions increased almost 9%, while the number of statistics faculty remained level and the number of computer science faculty increased by 48% (Table C). (In all tables in the CBMS Survey, full-time faculty means actual faculty count, not full-time equivalent. The number of part-time faculty is reported separately.) Table C shows that, over the last five years, two-year college mathematics faculty increased by 15%, while Table A shows a 35% increase in enrollments in the same period.

TABLE C: Number of full-time faculty in four-year college and university departments of mathematics, statistics and computer science and in two-year college mathematics programs: fall 1970, 1980, 1985, 1990.

	Number of full-time faculty			
	1970	1980	1985	1990
Four-year colleges and universities				
Math Depts	15655	16022	17849	19411
Stat Depts	700	610	740	735
CS Depts	688	1672	3605	5318
TOTAL	17043	18304	22194	25464
Two-year colleges				
Math Programs	4879	5623	6277	7222
GRAND TOTAL	21922	23927	28471	32686

Using Table A, one finds that the enrollment per full-time faculty member in four-year institutions was 99 in mathematics departments, 61 in statistics departments, and 60 in computer science departments. The corresponding 1970 ratios were 84, 46, and 67, respectively. In two-year colleges, the enrollment per full-time mathematics faculty member was 193 in 1990, compared to 119 in 1970. Again using Table A, one can compute the ratio of enrollments to full-time faculty in

CBMS Survey

TABLE A: Enrollment (thousands) by level in mathematics, statistics and computer science courses in four-year college and university departments of mathematics, statistics and computer science and in two-year college mathematics programs: fall 1970, 1980, 1985, 1990. (Unavailable historical data is indicated by a "-").

Course Level	Fall enrollment (thousands)											
	Four-year colleges and universities								Two-year colleges Mathematics Programs			
	Mathematics Depts				Statistics Depts		CS Depts		1970	1980	1985	1990
	1970	1980	1985	1990	1970	1990	1970	1990	1970	1980	1985	1990
Mathematics Courses												
Remedial	101	242	251	261	0	0	0	0	191	441	482	724
Precalculus	538	602	593	593	0	0	0	0	134	180	188	245
Calculus	414	590	637	647	0	1	0	0	59	86	97	128
Advanced	135	91	138	120	0	1	0	1	0	0	0	0
Other (2-year)									171	218	133	144
TOTAL MATH	1188	1525	1619	1621	0	2	0	1	555	925	900	1241
Statistics Courses												
Elementary	-	-	-	87	-	29	0	3	16	28	36	54
Advanced	-	-	-	38	-	14	0	2	0	0	0	0
TOTAL STAT	60	-	-	125	32	43	0	5	16	28	36	54
CS Courses												
Lower	-	-	-	134	0	0	-	204	13	95	98	98
Middle	-	-	-	12	0	0	-	25	0	0	0	0
Upper	-	-	-	34	0	0	-	82	0	0	0	0
TOTAL CS	60	-	-	180	0	0	46	311	13	95	98	98
GRAND TOTAL	1308	-	-	1926	32	45	46	317	584	1048	1034	1393

TABLE B: Enrollment (thousands) for mathematics, statistics and computer science courses in four-year college and university departments of mathematics, statistics and computer science by level of course and by type of institution. Also full-time faculty: fall 1990.

Course Level	Fall 1990 enrollment (thousands)										TOTAL
	Mathematics Depts			Statistics Depts			CS Depts				
	Univ (PhD)	Univ (MA)	Coll (BA)	Univ (PhD)	Univ (MA)	Coll (BA)	Univ (PhD)	Univ (MA)	Coll (BA)		
Mathematics Courses											
Remedial	68	93	100								261
Precalculus	206	202	185								593
Calculus	337	122	188	1							648
Advanced	58	29	33	1					1		122
TOTAL MATH	669	446	506	2					1		1624
Statistics Courses											
Elementary	14	27	46	25	4					3	119
Advanced	18	12	8	14						2	54
TOTAL STAT	32	39	54	39	4					5	173
CS Courses											
Lower	9	42	83				100	60	44		338
Middle	1	4	7				11	8	6		37
Upper	6	12	16				47	19	16		116
TOTAL CS	16	58	106				158	87	66		491
GRAND TOTAL	717	543	666	41	4		158	87	72		2288
Number of full-time faculty	6427	5058	7926	668	53	14	2746	1408	1164		25464

courses at the level of calculus and above (including statistics and computer science): the figure is 44 for mathematics departments and 21 in both statistics and computer science departments.

The 1990 edition of the *Digest of Educational Statistics* reported that the 1987 total of full-time and part-time higher education faculty with the rank of instructor or above was 793,000. The comparable total from the CBMS Survey for mathematics (including two-year colleges), statistics, and computer science was 54,679, including 21,993 part-time faculty (Table D).

TABLE D: Number of full-time faculty in four-year college and university departments of mathematics by highest degree and in 1990 by teaching responsibility: fall 1970, 1980, 1985, 1990.

Highest degree	1970	1980	1985	1990	1990 totals broken down by teaching responsibility		
					Math/Stat	CS	Math/Stat & CS
Doctoral degree	9744 (62%)	12497 (78%)	13208 (74%)	14963 (77%)	12824	816	1323
Other degree	5911 (38%)	3525 (22%)	4641 (26%)	4448 (23%)	3266	676	506
TOTAL	15655	16022	17849	19411	16090	1492	1829

For the first time in the CBMS Survey, teaching responsibilities are reported for mathematics department faculty. The number of faculty teaching only mathematics courses in Fall 1990 was not significantly higher than the 1970 total (reported in Table C), when presumably all of the teaching was in mathematics and statistics only.

Increasing Percentage of Women Faculty

Over the last ten years, the percent increase of women faculty members in mathematics departments averaged 1% per year (Table E). This is the first CBMS Survey to report the percentage of women among those faculty of age 34 or less. Only in computer science was this figure lower than the percentage women comprise on the faculty overall. (A dash indicates that data were not available.) Other tables in the survey further refine this data and provide information on minority group representation within faculty.

In addition to the information described above, the CBMS Survey also contains data on the number of baccalaureate degrees awarded in 1989–1990, a profile of faculty (including information on part-time faculty), and information about requirements for departmental majors. There is also a compendium of departmental figures that include institutional expenditures on travel and the number of support staff per faculty member. In addition, the report contains a description of the average section size and mode of instruction for beginning courses (including Calculus I and II) in each of the three disciplines, data on mathematical sciences libraries, and a detailed report on two-year college mathematics programs.

TABLE E: Percent women among full-time faculty in four-year college and university departments of mathematics, statistics and computer science and two-year college mathematics programs: fall 1975, 1980, 1985, 1990; percent women among faculty aged less than 35: fall 1990.

Women among full-time faculty	Math depts	Stat depts	CS depts	2-year Math programs
1975	10%	–	–	21%
1980	14%	–	–	25%
1985	15%	10%	13%	31%
1990	20%	14%	16%	34%
Women among faculty aged less than 35, 1990	25%	24%	12%	51%
TOTAL FACULTY 1990	19411	735	5318	7222

The report's ninety-two tables are organized into a "user-friendly" format with explanatory text accompanying each table. There are seven chapters on four-year colleges and universities and two chapters on two-year colleges. The data was obtained from a statistically designed sample of 418 responses (the highest of any CBMS Survey) that were well distributed across the population and sufficient to insure reliable estimates.

CBMS Survey Committee

- Donald J. Albers, Mathematical Association of America (chair)
- Richard D. Anderson, Louisiana State University
- Kim B. Bruce, Williams College
- William G. Bulgren, University of Kansas
- Edward A. Connors, University of Massachusetts, Amherst (vice chair)
- Don O. Loftsgaarden, University of Montana (survey statistician)
- Ingram Olkin, Stanford University
- Donald C. Rung, Pennsylvania State University (executive director)
- Ann E. Watkins, California State University, Northridge (two-year college analyst)

CBMS Member Organizations

- American Mathematical Association of Two-Year Colleges
- American Mathematical Society
- American Statistical Association
- Association for Symbolic Logic
- Association for Women in Mathematics
- Association of State Supervisors of Mathematics
- Institute of Mathematical Statistics
- Mathematical Association of America
- National Council of State Supervisors of Mathematics
- National Council of Teachers of Mathematics
- Operations Research Society of America
- Society of Actuaries
- Society for Industrial and Applied Mathematics
- The Institute of Management Sciences

1991 Annual AMS-MAA Survey

(Second Report)

Enrollments, Faculty Characteristics, and Update on New Doctorates, Fall 1991

Donald E. McClure

Highlights

- The final (spring) count of new doctorates shows a total of 1,125 doctorates in the mathematical sciences awarded by U.S. institutions in the period July 1, 1990 through June 30, 1991. This is the largest number since 1971–72 and is 18% higher than the 1989–90 final count.
- The final count shows 478 U.S. citizens among the 1,089 doctoral recipients whose citizenship status is known. This is the largest number of U.S. citizen new doctorates since 1981–82.
- A total of 611 non-U.S. citizens were awarded doctorates in 1990–91. This is the largest number ever reported and represents an increase of 105% over the number of non-citizen new doctorates ten years earlier.
- Recruitment of new faculty showed a sharp decrease in 1990–91 from the level of the previous year. The doctorate-granting mathematics departments in the U.S. attempted to fill 17% fewer full-time positions in 1990–91 than in 1989–90. The master's and bachelor's degree granting mathematics departments sought 34% and 18% fewer new faculty members, respectively, than the year before.
- Unemployment and underemployment among new doctorates reflected the reduced recruitment and increased numbers of new doctorates. Out of 1,070 new doctorates whose employment status is known, 5% were reported to be unemployed and still seeking employment at the time of the spring count. This is the highest level of unemployment at this time of the year since spring data were first reported in 1977. An additional 5% of the new doctorates took part-time employment.
- In the final count, there were 112 women (23%) among the 478 U.S. citizen new doctorates. Among non-U.S. citizens, women represent 17% of the new doctorates. These percentages are substantially lower than the ones for earlier stages of the mathematics education pipeline. Among all U.S. citizen graduate students in U.S. mathematical sciences departments, women constitute 36% of the total. At the undergraduate level, 43% of junior/senior mathematical sciences majors are women.

This is the second report of the 1991 Survey. A first report appeared in the November 1991 *Notices*, pages 1086–1122. It included a report on the 1990–1991 new doctorates, starting salaries, faculty salaries, and a list of names and thesis titles of the 1990–1991 doctorates. A supplementary list of 1990–1991 doctorates appears in the May/June 1992 issue of the *Notices*.

The 1991 Annual AMS-MAA Survey represents the thirty-fifth in an annual series begun in 1957 by the Society. The 1991 Survey was under the direction of the AMS-MAA Data Committee whose members are: Edward A. Connors, Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Charlotte Lin, Don O. Loftsgaarden, David J. Lutzer, James W. Maxwell (ex officio), Donald E. McClure (chair), and Donald C. Rung. Comments or suggestions regarding the Annual Survey may be directed to members of the AMS-MAA Data Committee.

For these reports, departments are divided into groups according to the highest degree offered in the mathematical sciences:

Groups I and II include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.¹

Group I is composed of 39 departments with scores in the 3.0–5.0 range

Group II is composed of 43 departments with scores in the 2.0–2.9 range.

Group III contains the remaining U.S. departments reporting a doctoral program.

Group IV contains U.S. departments (or programs) of statistics, biostatistics, and biometrics reporting a doctoral program.

Group V contains U.S. departments (or programs) in applied mathematics/applied science, operations research, and management science that report a doctoral program.

Group Va is applied mathematics/applied science; **Group Vb** is operations research and management science.

Group VI contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

Group M contains U.S. departments granting a master's degree as the highest graduate degree.

Group B contains U.S. departments granting a baccalaureate degree only.

¹These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of the *Notices*, pages 257–267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392–393. For a listing of departments in Groups I and II see the April 1988 *Notices*, pages 532–533.

I. Introduction

The Annual AMS-MAA Survey collects information each year about departments, faculties, and students in the mathematical sciences in the United States and Canada. This article reports results from two parts of the 1991 Annual AMS-MAA Survey. First, we update information about new doctorates reported earlier in the November 1991 issue of the *Notices* (see pages 1086–1102). Second, we present results about characteristics of faculties and of instructional programs at the undergraduate and graduate levels.

In the interest of continuity in the analysis and presentation, and to make year-to-year comparisons possible, we report the same kinds of information that were included in last year's Second Report. At the same time, we have added new details to the analysis to highlight data of current interest to the mathematics community about recruitment and the employment market.

Further, in order to present a picture of the current status of academic mathematics, we have used the survey responses to make projections to various statistics of the entire population of mathematical sciences departments. In contrast, the reports of the last three Annual Surveys concentrated on reporting year-to-year changes in statistics instead of their absolute values at the time.

The projections of survey responses to the full population are done within strata defined by the survey Groups. For example (see Table 3A), to obtain the total number of Group I faculty who retired or died between fall 1990 and fall 1991 we multiplied the 37 deaths and retirements reported in the 35 Group I responses by the ratio 39/35 of Group size over number of responding departments. Admittedly, this is not the ideal method of estimating population totals since biases may be introduced because of (i) selection bias of the responding departments and (ii) inhomogeneity of departments within the separate Groups. However, the problems of a possible selection bias are mitigated by the generally high response rates to the Annual Survey. In Groups with a lower response rate (Groups M and B), there is greater potential for biased projections. In the future we intend to use population strata defined by institutional enrollment and control (public or private), as was done in the 1990 CBMS Survey of Undergraduate Programs.

The reader may wish to compare results of the Annual AMS-MAA Survey with summary results reported for the 1990 CBMS Survey elsewhere in this issue of the *Notices*.

II. Update on the 1990–1991 New Doctorates

Information about new doctorates awarded between July 1, 1990 and June 30, 1991 was collected from doctorate-granting departments in late spring 1991 and from a follow-up census of individual degree recipients. The First Report of the 1991 Annual Survey (November 1991 issue of *Notices*, pages 1086–1102) presents the survey results obtained about new doctorates up to the time of that report. Here we update the earlier figures on the basis of more complete returns.

Table 1: New Doctorates, Fall and Spring Counts

	1986–87		1987–88		1988–89		1989–90		1990–91	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
U.S.	779	808	804	828	905	919	933	950	1074	1125
Canada	66	66	52	55	53	62	58	59	68	68
Total	845	874	856	883	958	981	991	1009	1142	1193

The spring count of new doctorates (Table 1) shows a total of 1125 doctorates in mathematical sciences awarded by U.S. institutions and 68 awarded by Canadian institutions. The final count for U.S. institutions is an 18% increase from the previous year and is the highest number reported since 1971–72.

Citizenship status is known for 1089 of the new doctorates awarded by U.S. institutions. The total of 478 U.S. citizens is 17% greater than last year's spring count, and is the highest number reported since 1981–82. The percentage of U.S. citizens (44%) remains near its all-time low of 43%, largely because the increase in non-U.S. citizen new doctorates is keeping pace with the increase of U.S. citizens.

The number of non-U.S. citizen new doctorates has risen steadily since 1978–79. The final spring count shows 611 non-U.S. citizens, an increase of 14% above last year's spring count. Over the last ten years the number of non-U.S. citizen new doctorates has increased 105%. Most of the increase has occurred during the last five years. From 1980–81 to 1985–86 the number of non-U.S. citizen new doctorates increased 25%, based on counts reported in the fall analysis. From 1985–86 to 1990–91, the number of non-U.S. citizens increased by 65%. The most substantial increases are due to the new doctorates who are citizens of eastern Asian countries. Over the ten-year period, this number has increased by 300%, the compound effect of a 61% increase from 1980–81 to 1985–86 and a 148% increase from 1985–86 to 1990–91.

Among the U.S. citizens, the final tally shows 112 women and 366 men. The percentage of women (23%) among the U.S. citizens is substantially higher than the percentage (17%) among non-U.S. citizens.

Employment data for new doctorates, broken down by the field of their thesis research, are updated in Tables 2A and 2B (see next page). The employment matrices report the status of the 1142 new doctorates included in the fall count; employment status is known for 1070. (The employment matrix includes new doctorates from Canadian departments.) Overall, the majority (60%) of new doctorates assumed academic positions in the U.S., the same as the percentage reported last year. The percentage assuming academic positions, regardless of country, is 76%. The proportions assuming academic vs. nonacademic positions vary greatly with the field of thesis. For example, in probability and statistics, which includes 170 doctoral recipients from statistics and biostatistics programs, a greater proportion assume nonacademic positions. The First Report shows

Table 2A: Employment Status of 1990–1991 New Doctorates in the Mathematical Sciences, updated March 1992

Type of Employer	Field of Thesis										TOTAL
	Algebra/ Number Theory	Real or Complex Analysis	Geometry/ Topology	Logic	Probability/ Statistics	Applied Math	Discr. Math/ Combinatorics	Numerical Analysis	Linear or Non-linear Optim.	Other	
Group I	24	21	35	6	5	16	1	2	1	4	115
Group II	5	9	9	1	5	11	2	4	1	2	49
Group III	10	9	16		9	10	4	1	1	3	63
Group IV					37	3					40
Group V					6	7	1	2	1	2	19
Masters	21	13	8		17	11	8	3	2	8	91
Bachelors	20	18	31	2	15	20	6	5	1	18	136
Two-year Colleges	5	4	1		3	7	1			3	24
Other Academic Departments	3	1	1	3	19	16	2	2	2	18	67
Research Institutes	5	3	5		9	3			1	7	33
Government		2	1		9	13	2	1		4	32
Business and Industry	8	5	6	2	55	17	8	6	13	16	136
Canada, Academic	11	4	10		8	13	6	1	1	9	63
Canada, Nonacademic							1	1			2
Foreign, Academic	15	22	11	4	29	14	1	2	5	12	115
Foreign, Nonacademic		2			5	1	1			3	12
Not seeking employment	4	2	2		4		1	2		4	19
Still seeking employment	5	7	8	1	13	9	4	2	1	4	54
Unknown (U.S.)	4	3	5		1	2		1	2	2	20
Unknown (non-U.S.)*	8	11	3	1	12	4	2	5	2	4	52
Total	148	136	152	20	261	177	51	40	34	123	1142

*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".

Table 2B: Employment Status of 1990–1991 New Doctorates in the Mathematical Sciences Females Only, updated March 1992

Type of Employer	Field of Thesis										TOTAL
	Algebra/ Number Theory	Real or Complex Analysis	Geometry/ Topology	Logic	Probability/ Statistics	Applied Math	Discr. Math/ Combinatorics	Numerical Analysis	Linear or Non-linear Optim.	Other	
Group I	3	4	3	2		2				1	15
Group II		3	1		2	3	1	1	1		12
Group III	2		3		2	4					11
Group IV					9						9
Group V					3					1	4
Masters	7	1	2		4	3	2				19
Bachelors	8	5	15		3	4	1	2		3	41
Two-year Colleges	1					2					3
Other Academic Departments	1	1			6	3	1	1	1	7	21
Research Institutes					2					3	5
Government					2		1			2	5
Business and Industry		1			16	3		1	3	3	27
Canada, Academic					1		1		1	1	4
Canada, Nonacademic							1				1
Foreign, Academic	2	4		1	9	3		1		3	23
Foreign, Nonacademic											
Not seeking employment	1		1		1			1		1	5
Still seeking employment	1			1	5		2				9
Unknown (U.S.)		1	3		1						5
Unknown (non-U.S.)*	2	1			4	1					8
Total	28	21	28	4	70	28	10	7	6	25	227

*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".

additional differential patterns of employment depending on the type of department awarding the degree and on the citizenship status of the new doctorate.

The updated matrix shows 54 new doctorates (5%) still seeking employment. This figure does not include non-U.S. citizens who are known to have returned to their country of origin and who may be still seeking employment outside the U.S. At the same time a year ago, 2% of the 1989–90 new doctorates were reported as still seeking employment. As is widely known, the level of unemployment is worse for the 1990–91 cohort of new doctorates than is customary. In fact, the unemployment reported in the spring analysis has never exceeded 3% since the number was first reported in 1977.

The survey responses also reveal other indicators of the difficult employment market that are hidden in Tables 2A and 2B. The proportion of individuals in academic positions that are not tenure-eligible is high. Based on 434 individual responses from holders of academic positions, 50% report that their position is not tenure-eligible. Almost half of the nontenure-eligible positions have contract durations of one or two years. Seventy-two new doctorates (11 from Canadian departments and 61 from U.S. departments) report that they are employed by the same institution that awarded their degree. Table 2A shows 286 new doctorates holding positions in a doctorate-granting department in the U.S. (Groups I–V). Out of these 286 individuals, 45 received their degree from the same institution.

Fifty-two of the jobs tallied in Table 2A are part-time positions.

Individual respondents also provided information about jobs for which they applied. Among 436 new doctorates who reported applying for an academic position, the average number of applications made for academic positions was 57 and the average number of applications made for nonacademic positions was 5.6. Among 159 new doctorates who reported applying for a nonacademic position, the average number of applications made for academic positions was 46 and the average number of applications made for nonacademic positions was 13.5.

Finally, we note that the names of the 1990–91 new doctorates and their thesis titles were published in the *Notices* (November 1991 and a supplemental list in May/June 1992).

III. Faculty Characteristics

Information about faculty and instructional programs was obtained from the Departmental Profile Survey sent to mathematical sciences departments in fall 1991. The First Report contained information collected earlier about faculty salaries.

Table 3A shows attrition due to deaths and retirements of faculty in mathematical sciences. Numbers of retirements tend to fluctuate substantially from year to year. Presumably these rates are sensitive to the effects of early retirement plans, and the attrition rates for a Group as a whole can show the effects of perturbations introduced by only a few institutions. The overall

Table 3A. Faculty Attrition*

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	VI
Number of full-time faculty who retired or died (Group total)	41	25	52	118	16	3	116	132	23
% of full-time faculty in Group	2.0%	1.4%	2.1%	1.9%	1.4%	0.6%	2.0%	1.6%	1.7%
Number of usable responses**	35 (90%)	41 (95%)	80 (91%)	156 (92%)	52 (70%)	22 (59%)	151 (58%)	451 (46%)	20 (65%)

* Number and percentage of full-time faculty who were in the department in fall 1990 but were reported to have retired or died by fall 1991.

** The number of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to faculty size and recruitment data only. All counts are projected from the survey response to the respective Group as a whole.

Table 3B. Faculty Recruitment

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	VI
Number of open positions (Group total)*	181	89	172	441	81	30	316	558	65
Doctoral hires, male	144	68	113	326	47	17	175	308	50
Doctoral hires, female	26	5	18	49	14	2	45	94	8
Nondoctoral hires, male	1	1	3	5	0	0	12	70	0
Nondoctoral hires, female	0	1	3	4	0	0	19	35	0
Number of unfilled positions	9	14	34	57	20	12	66	51	8

* Number of positions under recruitment in 1990–1991 to be filled for 1991–1992.

Subtotals of rounded table values may exhibit rounding errors.

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Table 3C. Faculty Size, Fall 1991, and Percentage Change in Size, Fall 1990 to Fall 1991

	I	II	III	I+II+III	GROUP					VI
					IV	V	M	B		
Total number of full-time faculty (Group total)	2059	1825	2461	6345	1157	572	5813	8214		1367
% change in full-time faculty	-0.0%	0.1%	-2.0%	-0.8%	0.1%	1.5%	-1.4%	0.1%		0.1%
Number of doctoral full-time faculty	2030	1710	2268	6008	1123	563	4444	5550		1280
% change in doctoral full-time faculty	-0.3%	-0.4%	-1.5%	-0.8%	0.1%	1.8%	0.2%	1.7%		2.6%
Number of tenured doctoral full-time faculty	1521	1336	1650	4507	756	372	3241	3687		1015
% change in tenured doctoral full-time faculty	-1.9%	-0.0%	-1.4%	-0.1%	-1.1%	2.8%	2.1%	0.2%		-2.2%
Number of untenured, tenure-eligible doctoral full-time faculty	203	278	521	1002	276	126	1080	1646		167
% change in untenured, tenure-eligible doctoral full-time faculty	-0.4%	-1.1%	-2.2%	-1.3%	2.2%	-0.5%	-1.5%	2.7%		1.9%
Number of untenured, nontenure- eligible doctoral full-time faculty	306	95	97	499	91	66	123	218		98
% change in untenured, nontenure- eligible doctoral full-time faculty	10.9%	8.3%	-18.5%	3.2%	-7.2%	2.6%	-9.0%	-5.7%		57.5%
Number of part-time faculty	113	201	596	910	78	74	1813	3494		53
% change in part-time faculty	3.1%	-18.6%	3.6%	-2.6%	-8.3%	10.0%	-2.7%	3.1%		-15.0%

Table 3D. Women Faculty Size, Fall 1991, and Percentage Change in Size, Fall 1990 to Fall 1991

	I	II	III	I+II+III	GROUP					VI
					IV	V	M	B		
Total number of full-time women faculty (Group total)	134	191	306	630	167	44	1200	1982		105
% change in full-time women faculty	0.0%	2.3%	-5.1%	-1.9%	-0.9%	0.0%	-0.7%	3.7%		-4.2%
Number of doctoral full-time women faculty	126	125	197	448	155	42	595	936		88
% change in doctoral full-time women faculty	4.6%	0.8%	-4.8%	-0.7%	-1.8%	4.2%	0.3%	7.6%		-3.4%
Number of tenured doctoral full-time women faculty	64	70	90	224	53	15	361	503		50
% change in tenured doctoral full-time women faculty	-6.6%	-1.5%	-1.2%	-2.8%	2.8%	0.0%	5.6%	15.1%		3.2%
Number of untenured, tenure-eligible doctoral full-time women faculty	14	37	91	142	77	19	207	378		33
% change in untenured, tenure-eligible doctoral full-time women faculty	-18.8%	2.9%	-5.7%	-5.1%	-1.8%	0.0%	-2.4%	0.0%		-4.6%
Number of untenured, nontenure- eligible doctoral f-t women faculty	48	18	15	81	26	8	26	55		6
% change in untenured, nontenure- eligible doctoral f-t women faculty	38.7%	6.2%	-17.6%	15.6%	-10.0%	25.0%	-31.8%	0.0%		-33.3%
Number of part-time women faculty	37	70	212	319	24	7	729	1455		8
% change in part-time women faculty	-5.7%	-20.2%	3.8%	-3.9%	30.8%	33.3%	-1.9%	5.3%		-50.0%

attrition rate for Group I, for example, nearly doubled from the rate a year ago, and this mainly reflects a number of retirements that more than doubled in Group I. At the same time, the number of retirements from departments in Group B in 1990–91 is approximately half the number of the year before.

Table 3B reports information on the number of full-time faculty positions that departments attempted to fill during 1990–91. Here there is a striking difference from the previous year. In every Group the number of positions recruited is significantly lower than in 1989–90. Overall, Groups I through III (the doctorate-granting mathematics departments) sought 17% fewer new faculty in 1990–91 than in 1989–90. Group III was especially hard hit; in 1990–91 Group III departments recruited 26% fewer new faculty than the year before. Similar cuts affected the other Groups: Group IV recruited 33% fewer new faculty; Group M sought 34% fewer new faculty; and Group B recruitment was down by 18%. We believe that these data indicate the effect of economic conditions on the difficult employment market for doctoral mathematical scientists.

Table 3B also provides information about hiring patterns for doctoral faculty. Among doctoral new hires, 13% of the new hires in Groups I, II, and III combined are women and 22% of the new hires in Groups M and B combined are women. Both of these percentages are marginally lower than last year.

Tables 3C and 3D describe the makeup of faculties by sex, tenure status, and doctoral/nondoctoral degree in the different Groups. These data show that there have not been substantial changes since the previous year in total faculty size. The only significant variations from the 1990 Annual Survey occur among numbers of untenured, nontenure-eligible faculty. Traditionally, among mathematics departments, Groups I and II employ larger numbers of faculty in this category relative to

their total doctoral faculty size, and Groups III, M, and B employ smaller numbers. From 1989–90 to 1990–91, there were very substantial increases in untenured, non tenure-eligible full-time faculty in Groups I and II and similarly substantial decreases within Groups III, M, and B. These changes may also reflect effects of the difficult employment market.

Tables 3C and 3D together show proportions of women faculty in different categories of tenure and employment status. For example, the proportion of women among full-time faculty in mathematics departments (Groups I, II, III, M, and B) is 19% (3812/20372) and the proportion among full-time faculty in statistics departments (Group IV) is 14% (167/1157). These percentages echo the results of the 1990 CBMS Survey summarized elsewhere in this issue of the *Notices*.

IV. Enrollment Profile and Undergraduate Majors

The Departmental Profile Survey collects information about enrollments and distribution of instructional effort in mathematical sciences departments.

Table 4A summarizes enrollment data for undergraduate and graduate courses. Undergraduate enrollments were generally stable and graduate enrollments increased modestly from 1989–90 to 1990–91.

Table 4A, together with Table 3C, provides illuminating statistics about the instructional load of mathematical sciences faculty. The CBMS Surveys have reported substantial increases in the number of enrollments per full-time faculty member over the past 20 years. Tables 4A and 3C show results consistent with the 1990 CBMS Survey and they show the variation of instructional load between Groups. The respective ratios by Group of enrollment per full-time faculty member (FTFM) are:

Table 4A. Undergraduate and Graduate Enrollments (thousands), Fall 1991, and Percentage Change in Enrollments, Fall 1990 to Fall 1991

	GROUP							
	I	II	III	IV	V	M	B	VI
Number of undergraduate course enrollments (thousands)	175	177	316	61	21	631	785	161
% change in undergraduate course enrollments	-0.8%	-0.5%	-1.4%	-0.5%	4.8%	0.5%	2.0%	11.0%
Number of graduate course enrollments (thousands)	10	8	12	22	9	20	2	2
% change in graduate course enrollments	0.7%	3.4%	5.7%	3.8%	4.1%	3.3%	-5.6%	78.0%
Number of usable responses	34 (84%)	41 (95%)	79 (90%)	51 (79%)	22 (59%)	149 (57%)	442 (45%)	20 (65%)

* The number of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to Tables 4A through 4C on enrollments and class size only. All counts are projected from the survey response to the respective Group as a whole.

Group I, 89.8 enrollments per FTFM; Group II, 101.4 enrollments per FTFM; Group III, 129.2 enrollments per FTFM; Group IV, 71.7 enrollments per FTFM; Group V, 52.4 enrollments per FTFM; Group M, 112.0 enrollments per FTFM; Group B, 95.8 enrollments per FTFM; and Group VI, 119.2 enrollments per FTFM.

Table 4B provides a summary of the largest components of undergraduate mathematics instruction. There are no striking changes from the 1990 Annual Survey. Table 4C reports average class size by type of course and survey Group.

In every group except Group V (applied mathematics and operations research departments), the number of undergraduate majors increased (Table 4D).

Table 4B. Distribution of Undergraduate Enrollments, Fall 1991

COURSES	GROUP						
	I	II	III	I+II+III	M	B	VI
Remedial mathematics*, %	10.0	7.5	11.0	9.8	16.7	18.4	1.7
Remedial mathematics + precalculus, %	24.2	28.3	38.7	32.1	34.2	33.1	4.6
Remedial mathematics + precalculus + calculus, %	63.8	59.3	62.1	61.8	49.2	47.4	36.6

* Arithmetic, high school algebra, geometry.

Table 4C. Average Class Size, Fall 1991

COURSES	GROUP							
	I	II	III	IV	V	M	B	VI
Remedial mathematics*	36	31	39		23	32	28	46
Traditional precalculus	31	38	44			36	30	76
First-year calculus	35	42	40			32	25	81
Undergraduate statistics	33	39	37	45	55	33	26	44
Undergraduate computer science	36	21	23	26	57	22	19	22
Other undergraduate courses for majors	30	31	28			21	15	32
Other undergraduate courses (not for majors)	35	36	42			33	28	59
Graduate courses	10	10	9	17	18	10	10	4
All courses	30	32	34	31	31	29	24	40

* Arithmetic, high school algebra, geometry.

Table 4D. Undergraduate Junior/Senior Majors (hundreds) and Undergraduate Women Junior/Senior Majors (hundreds), Fall 1991, and Percentage Change in Majors, Fall 1990 to Fall 1991

	GROUP							
	I	II	III	IV	V	M	B	VI
Number of junior/senior majors (hundreds)	55	45	70	17	23	219	279	87
% change in junior/senior majors	0.5%	7.5%	6.4%	1.6%	-6.9%	3.1%	6.2%	2.0%
Number of women junior/senior majors (hundreds)	19	19	32	6	7	100	123	27
% change in women junior/senior majors	-5.6%	10.1%	11.2%	-5.6%	-7.7%	5.3%	7.2%	2.4%
Number of usable responses*	34 (87%)	40 (93%)	72 (82%)	50 (68%)	21 (57%)	125 (48%)	383 (39%)	14 (45%)

* The number of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to undergraduate major data only. All counts are projected from the survey response to the respective Group as a whole.

V. Graduate Student Profile

Tables 5A through 5C summarize tallies of graduate students derived from the 1991 Departmental Profile Survey.

Numbers of first-year graduate students increased by 2.6% overall in the doctorate-granting U.S. mathematics departments. However, the increase was not experienced by all Groups. Group III showed a substantial increase (12.8%), while Group I showed a decrease in the number of first-year students (-6.8%). Last year the direction of these changes was reversed; commonly, Groups that experience a large increase in new students in one year will have a decrease in first-year students the following year. Group M follows this pattern also, with a 5.6% drop in new students in 1991 following a 4.3% increase the previous year.

Table 5B gives the numbers of women graduate students by Group. In the U.S. mathematics departments (Groups I, II, III, and M) 35.2% of the first-year students are women. Table 4D shows that among undergraduate majors in mathematics, 43.8%

are women. It is interesting to note that the pipeline for women in statistics does not narrow in the same way that it does in mathematics. While 38.0% of the junior/senior majors in Group IV departments are women, 45.2% of the first-year graduate students in Group IV are women. Among U.S. citizens, women represent 47.7% of the first-year graduate students in Group IV in 1991.

Table 5C records the numbers of U.S. citizen graduate students by Group. In Groups I, II, III, and M, the proportion of U.S. citizens among first-year students is approximately the same as the proportions reported a year ago for the 1990 Annual Survey. However, in Group IV 57.6% of the first-year students in fall 1991 were U.S. citizens, compared to 51.2% in the previous year.

In all doctorate-granting departments, the percentage of U.S. citizens among graduate students is substantially higher than their percentage among new doctorates.

Table 5A. Full-time Graduate Students, Fall 1991, and Percentage Change in Graduate Students, Fall 1990 to Fall 1991

	GROUP						
	I	II	III	IV	V	M	VI
Total number of full-time graduate students	3751	2635	3440	3085	2134	3285	1353
% change in full-time graduate students	-1.0%	4.8%	2.8%	3.4%	14.8%	-1.3%	6.0%
Number of first-year graduate students	928	771	1172	961	657	1257	416
% change in first-year graduate students	-6.8%	1.7%	12.8%	-0.3%	9.7%	-5.6%	9.9%
Number of usable responses*	35 (90%)	41 (95%)	75 (85%)	51 (69%)	21 (57%)	130 (50%)	19 (61%)

* The number of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to Tables 5A through 5C on graduate student enrollments. All counts are projected from the survey response to the respective Group as a whole.

Table 5B. Women Full-time Graduate Students, Fall 1991, and Percentage Change in Women Graduate Students, Fall 1990 to Fall 1991

	GROUP						
	I	II	III	IV	V	M	VI
Total number of full-time women graduate students	855	770	1143	1149	564	1399	276
% change in full-time women graduate students	-1.5%	6.2%	3.3%	3.7%	20.8%	-0.4%	9.0%
Number of first-year women graduate students	260	264	417	434	204	514	101
% change in first-year women graduate students	-2.9%	7.2%	9.9%	18.2%	13.7%	-7.6%	6.9%

Table 5C. U.S. Citizen Full-time Graduate Students, Fall 1991, and Percentage Change in U.S. Citizen Graduate Students, Fall 1990 to Fall 1991

	GROUP					
	I	II	III	IV	V	M
Total number of full-time U.S. citizen graduate students	1978	1489	2073	1531	1006	2267
% change in full-time U.S. citizen graduate students	1.0%	9.2%	4.1%	7.5%	12.8%	-3.2%
Number of first-year U.S. citizen graduate students	509	491	759	554	317	924
% change in first-year U.S. citizen graduate students	-9.3%	4.0%	14.7%	7.0%	-1.1%	-4.2%

Acknowledgment

The Annual AMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical scene for the use and benefit of the mathematics community. Every year, college and university departments in the United States and doctorate-granting departments in Canada are invited to respond. The Annual Survey relies heavily for the quality of its information on the conscientious efforts of the dedicated staff members of these departments. On behalf of the AMS-MAA Data Committee and the Annual Survey staff, I thank the many secretarial and administrative staff members in the mathematical sciences departments for their cooperation and assistance in responding to the survey questionnaires. Monica Foulkes has made essential contributions to the coordination of the Annual Survey, management of the work of the Data Committee, full computerization of the data analysis, and preparation of the reports. The Data Committee expresses special thanks to her.

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Forum

The Forum section publishes short articles on issues that are of interest to the mathematical community. Articles should be between 1000 and 2500 words long. Readers are invited to submit articles for possible inclusion in Forum to:

Notices Forum Editor
American Mathematical Society
P.O. Box 6248
Providence, RI 02940

or electronically to notices@math.ams.com

The Character of Mathematical Research

Saunders Mac Lane
University of Chicago

Recent government statements about the current National Science Foundation (NSF) budget for the mathematical sciences suggest that it is important that there be better understanding in Washington of the character of research in mathematics.

Research in mathematics has existed for twenty-five centuries and has led to many profound results and to firm traditions which reflect the general experience in these achievements.

Here are some of the traditions.

Mathematics is **Long-Range**. Results found today may not appear effective for many years, until they suddenly appear in unexpected ways. Thus, tensor analysis was an obscure specialty in the late nineteenth century until in 1915 it proved to be essential for general relativity. The Viennese mathematician Radon described integration in terms of slices, in the 1920s; this just recently found application to the analysis of Cat Scans.

Mathematics is **Small Science** par excellence. Mathematicians depend on seminars, conferences, and stimulus from colleagues, but the real research is almost always done by one individual or two working together.

Collaboration is effective but only when two collaborators see that their talents will fit. There are many examples of such long-term collaborations.

Choice of Problems. Mathematicians tackle a problem not just because it is important, but because they have a hunch that their particular ideas might just possibly lead to a solution. For example, perhaps the most famous problem in

mathematics is the Riemann Hypothesis on the Zeta function; it has to do with the distribution of the prime numbers. A correct solution to this conjecture would bring overwhelming fame. However, few mathematicians are currently trying to find a solution; they know that the available approaches have already been explored. This observation means that a potential new problem which has arisen in Washington needs more than this political interest to motivate enthusiastic and effective attack by mathematicians.

Expert Advice is not enough as a motive for starting on a problem. May I offer a personal example? In 1942, S. Eilenberg saw that a calculation by Mac Lane might be used to solve a problem in topology. It did, and thereby we found that our different backgrounds meshed well; a long collaboration ensued. In 1945 we came across some bizarre geometric spaces. We hesitated, and wrote then of these spaces "The calculations involved are rather complex . . . and the final result has less interest." The reigning expert on this subject told us that such spaces were essentially worthless. Nevertheless, we persevered; it took us 9 years; these spaces are now known as Eilenberg-Mac Lane spaces and form a recognized topic in homotopy theory. The conclusion, well born out in many other cases, is that well-intending experts may be wrong. A long mathematical project requires personal confidence and perseverance, not advice from others or instructions from Washington.

Precision. In science, the uses of mathematics are not restricted just to the expected differential equations, geometry, algebra, mathematical models, or other mathematical sciences. The Mathematical community has unusually explicit standards of accuracy and precision, primarily because a mathematician must know when a proof is really flawless. From extensive experience, I know that there are many aspects of science where this training can or could be effective. For example, current science policy is influenced by numerous committee reports—rarely with mathematicians involved. Such reports are not always well done; in my eight years as Chairman of the Report Review Committee of the National Academy of Sciences, I saw first hand how the practice of mathematical precision helped in the vetting of reports from the National Research Council.

Mathematical ideas are **Powerful**. They are real; they arise from examination of the world; they are then gradually

developed, often in abstract form—and then turn out to illuminate different aspects of reality: Consider for example how the abstract notion of a group arose from the study of symmetry and of solution of polynomial equations—and the many ways in which groups and their representation have figured in science.

Mathematics is **Protean**. One and the same mathematical concept (for example, the Laplace equation) may appear in many different scientific contexts. For this reason, mathematical projects often do not comfortably fit under one or another current initiative. For instance, the study of recursive functions by logicians has undoubted connections both to the foundation of mathematics and to the use of algorithms in High Performance Computing—but projects on recursive functions are best judged by the high standards of the community of mathematical logicians.

Judgements of **Future Prospects** can best be made by accomplished mathematicians. For example, about 1960, the late A. Adrian Albert saw that studies of finite group theory by Richard Brauer, John Thompson, and others held great promise. With strong government support, he organized a “group theory year”. The ensuing results led—over a twenty-five year period—to the recent remarkable results classifying ALL the finite simple groups.

New Ideas enter mathematics both from internal developments—as recently with striking ideas in intersection homology—and from applications—as currently with the remarkable interactions between category theory, low dimensional topology and geometry, and quantum field theory. Initiatives from the government cannot anticipate all these new thrusts, and may miss some of the most vital ones.

The National Interest requires both new budgetary initiatives and increased support for disciplinary research by individuals on subjects of their choice. The governmental support of pure science has a firm economic foundation. Basic scientific discoveries can bring extensive societal benefits—which cannot be exploited or patented by the discoverer. This justification of social support applies especially to mathematics. Contributions of mathematics to the national welfare come chiefly in the long run; for this reason their economic value cannot be captured by individuals. This is the underlying reason for the support of mathematical research by the government. Mathematicians should keep the national interest in mind. However, it has been my observation that far too few experienced and senior mathematicians take part in activities in Washington. Their expanded presence there—even at the cost of some of their own research—would support the profession and contribute to the national welfare.

The characteristics of mathematical research, here illustrated by contemporary cases, are in large part permanent. When new governmental initiatives are proposed, it is not suitable that mathematicians be cajoled into cooperation by eloquent statements from Washington or by budgetary devices. Mathematicians should be able to make their own informed decisions as to the best use of their talents. The many contributions of mathematics to the national welfare re-

quire the firm and stable support of the centuries old traditions of deep research in disciplinary mathematics.

Sensitive Nerves

Irwin Kra

If I am not for Mathematics, then what am I for?

If I am only for Mathematics, then what am I?

Serious dialogue concerning important issues facing the membership is actively discouraged by the establishment of the American Mathematical Society (AMS). The question of “large vs. small science” has never been discussed by the Council during my previous seven year (1984–1990) term on it and very rarely in these pages. Whether the newly established Institutes (e.g., the Mathematical Sciences Research Institute (MSRI)) and Science and Technology Centers (e.g., the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS)) are good or bad for the profession is a forbidden topic. The purpose of this note is to discuss another issue that seems to create discomfort among my colleagues: anti-semitism. What I thought started as an effort to oppose anti-semitism in the far away and now defunct Soviet Union, turned out to be an even more important effort to raise sensitivity among my colleagues.

I begin with a review of some recent history. A few years ago rumors reached us of anti-semitic statements credited to I.R. Shafarevich. His eminence as a mathematician dissuaded most of us from believing that there was any substance to these charges. We were wrong to disbelieve. The appearance of his book *Russophobia* [published by the Russischer Nationaler Verein, München, 1989¹; the latest version was published by Sovietskii Pisatel, Moscow, 1991] proved the rumors to be facts. English translations of segments of this manuscript as well as of the entire opus have been circulating privately among American mathematicians for some time.

A number of us thought that a reaction from the mathematical community was needed. Individual attempts to challenge Shafarevich have been frustrating and unsuccessful. The original discussions of what to do started at various AMS meetings. Lenore Blum (ICSI, Berkeley), Lance Small (UC, San Diego), and I were joined subsequently by Eli Stein (Princeton) to form “the gang of four”. We decided that formal action by the AMS was not appropriate, but that a widely publicized Open Letter, signed by a significant number of individuals, would be an appropriate statement. It was our intention to publish this letter in as many places as possible, including particularly the *Notices* of the AMS to which we submitted it on March 8, 1991. To my great surprise, the Letters Editor turned it down, and an appeal to the entire Editorial Committee resulted in a reaffirmation, on July 22, of the earlier mistake. I appealed the *Notices* decision to the Council. In anticipation of a discussion of this issue at the January 1992 Council meeting, President Artin appointed an ad hoc committee to advise the Council on

¹Russischer Nationaler Vereira (RNV) E. V., Theresienstrasse 118–120, 8000 München 2, Germany

this question. The committee recommended that the *Notices* commission an article on anti-semitism—focused more or less on its ubiquity in Russian mathematical circles and on Shafarevich's writings (the wording is mine)—for the Forum section of the journal. As an additional ingredient in a compromise, the committee recommended that the *Notices* print the Open Letter, with all the signatures, as an advertisement AND that the AMS bear the cost of this advertisement. The recommendation alone was inadequate; the recommendation with the compromise was acceptable.

The Open Letter carries the force of a group of individuals speaking out (together) on an important subject. It is much more than an article by an individual on a current political issue. It is a moral statement by an outraged community. The report of the ad hoc committee is careful to note that the *Notices* Editorial Committee (NEC) acted within its rights (I certainly agree), according to established policies (I have some reservations), as well as “thoughtfully and responsibly” (I disagree most emphatically). The Editors of the *Notices* (and indeed all other officers of the Society as well) should encourage free discussion of important issues and not act as censors imposing their taste on the membership of the Society.

This Open Letter, by now signed by more than 400 mathematicians, is about the public writings and public pronouncements of a prominent mathematician who was previously honored by official organs of his profession and who is now being criticized by members of the same profession. Our letter attacks ideas, not personalities. It belongs in mathematical journals, primarily in the *Notices*, the journal of record of the AMS. The Council essentially accepted the recommendations of the ad hoc committee and the Letter appeared in the March 1992 *Notices* as an “advertisement” paid for by the Society.

With this history behind us, I would like to discuss my involvement with what, for want of a better name, I will call the Shafarevich affair, in greater detail. I believe it sheds considerable light on how things work in the AMS, about individual and institutional response to controversy, and about the American mathematical community.

I was shocked several times during my involvement in this affair. The Open Letter is a fairly strongly worded statement. There were those (myself included) who would have preferred an even stronger statement. What amazed me was that so many of my colleagues involved in drafting the Letter would have preferred a much milder statement. (After all, “anti-semitic writing is not the same as anti-semitic action” and “Shafarevich is such a good mathematician” were two common reasons.) My bottom line was that I would sign even a weak attack on anti-semitic polemics, but I would not take the time to work to get signatures and publish a watered down statement. To put it bluntly and to provide some perspective to my view of the Shafarevich affair: I would never invite Shafarevich to my house for dinner or take him out to lunch. But if he were still capable of doing the mathematics that made him famous, I would unhesitatingly appoint him to a position (professorship) in my department. Apparently some of my colleagues feel that only a Jewish mathematician can make such a statement.

We did not launch an elaborate campaign to get signatures to the Open Letter. News of the existence of this Letter spread in a segment of the mathematical community and most of the signatures were the result of this informal activity. I was often startled by private conversations and correspondence with colleagues whose signatures I solicited.²

After some revisions of the original text, most of the signers were enthusiastic about this effort as well as the wording of the Open Letter. As in any letter with multiple authors and with even more signers, we had to declare the letter to be in final form at some point. After that people either signed or did not. Clearly, some of the signers would have preferred different wording. There were two recurrent reasons offered for refusing to sign. The first holds that Shafarevich is part of the new Russian nationalism and needs to write this trash to gain admittance to the proper circles; the second, that Shafarevich's anti-Jewish writings must be viewed in the context of his fundamental Christian outlook. I found it beyond comprehension that such statements came from distinguished, sophisticated American mathematicians. What nonsense! Arguments which accept anti-semitism as legitimate national or religious expression, which I have heard more than once, prove (if proof is needed) that in nonmathematical endeavors mathematicians can be as fallible as anyone else.³

I cannot, nor would if I could, reproduce the discussions among the members of the NEC that led to their decision to refuse to publish the Open Letter. My conversations and electronic mail correspondence with members of the Board are, however, relevant, and I would like to address some of their objections to publishing the Letter that came to my attention during these exchanges.

First, there seems to be an objection to address “political issues” in the *Notices*. The distinction between political and human rights issues totally escapes me. The past record of the *Notices* bears some relevance. The politics question (Which of our activities is totally devoid of political connotation?) is often further confused by equating an attack on ideas (anti-semitic writing) with an attack on an individual (the author of the anti-semitic statements). It is official *Notices* policy not to publish attacks on individuals. In the November 1978 issue of the *Notices*, one finds a letter to the Editor signed by sixteen

²Included in the group whose signatures I thought important are former students of Shafarevich. I was NOT surprised by their comments; on the contrary, I empathized with the difficulty of their situation and was moved by the poignancy of their decision to sign the Letter.

³G.D. Mostow articulated the only valid reason I could accept for not signing this letter: In *Russophobia*, “Shafarevich had run hopelessly amok” and one should not “aggrandize him by according him the attention of a long list of distinguished signers.” There were indeed other reasons given for not signing that I can understand if not accept. A distinguished colleague whom I admire enormously believes that the *Notices* should be devoted only to mathematics. Were this an ideal world, I would agree completely. Unfortunately, we do not live in such a world. After lengthy exchanges of letters we agreed to disagree. *My admiration for my colleague remains unshaken*. Some protest Shafarevich's anti-semitic writing by not buying his mathematics books. I can understand such actions even though I do not approve of them. I do not claim that everyone who did not sign the Open Letter did so because of anti-semitic feelings; unfortunately, for some that was the case.

mathematicians (the alphabetical list of signatories starts with M. Artin and ends with A. Zygmund) that contains a long report on “the Situation in Soviet Mathematics” compiled by a group of former Soviet mathematicians who for obvious reasons wanted to keep their identities secret. A letter signed by six mathematicians (R. Finn, . . . , M. Shinbrot) in the October 1979 *Notices* came to the defense of Soviet science or scientists and concluded by labeling the signers of the first letter as “new cold warriors.” This was not an attack on an individual, but an attack on sixteen individuals.

Politics have often been directly addressed in *Notices* letters. I quote from a February 1979 letter from another apparent defender of the “political policy” of Soviet science: “Since the role of Jews in the vanguard of science is over, the Soviet authorities are now moving to eliminate the accumulated effect of the past, which is presumably conceived as a hindrance to the basic policy of assimilation. Hence, the policy to assimilate the Jews most rapidly through intermarriage, with perhaps 10% of the “hopeless” Jews eliminated through emigration—voluntary, or in some cases perhaps even forced. In particular, since Jewish names in the scientific sphere are a concrete reminder of the past, there is now great pressure being exerted upon the scientifically trained with typically Jewish names to change them.”⁴

Second, I often heard the statement, “The Open Letter should, of course, be published. But is it appropriate for the *Notices*?” My response, “Why not the *Notices*?” had no ready answer.

Third: “If we publish this, we will also have to publish letters with an opposing point of view.” I fail to see the problem. We make judgments about which articles to publish in AMS journals. We make judgments about which advertisements to accept for the *Notices*. We are also capable of making judgments about which letters or Forum pieces are appropriate for this journal. A judgment was made not to publish the Open Letter. I do not object to the NEC making judgments. I object to the judgment in this case because it was wrong. The Society must have an outlet for airing opposing points of view. What more appropriate venue to air differences of opinion within the Society than the Letters section of the *Notices*?

Fourth: “Kra knows that Shafarevich will not change his mind as a result of, nor be influenced by, the Letter.” Of course I do. I do not aspire to influence Shafarevich. He is beyond hope. I do want to influence future would be anti-semites and I hope to educate my colleagues. What I want to accomplish is, however, totally irrelevant to the issue of publication. The Open Letter must and DOES stand on its own. It makes a certain statement. It has over 400 signatories. Each signer had her or his own (valid) reason for making the statement.

⁴I recognize that the *Notices* printed a lot of material on refusniks and in fact it temporarily adopted a policy of *not* publishing such articles in consecutive issues to contravene the Russian censors orders not to distribute journals that dealt with the refusnik question. Reprinting the above selections illustrates that political issues were indeed previously considered by the *Notices* and that vituperative propaganda has appeared before in this journal and will no doubt appear in the future. I am willing to pay this price in the interest of open exchange.

Fifth: “The Open Letter did not explain what was happening in the Soviet Union and did not inform the reader what Shafarevich wrote. Only those on the east coast had any idea about the issues raised in the Letter.” The mathematical community could read about Shafarevich in both “our” journals [e.g., various issues of the *Intelligencer*] or the general press [e.g., *The current digest of the Soviet Press*, volume 46 (1989), *The New Republic* of February 5, 1990, *The San Francisco Chronicle* of March 14, 1990 and Hendrick Smith’s article in *The New Russians*, Random House, New York, 1990].

Sixth and last: “Many of the signers of the Open Letter did not know what they were signing.” I found this comment astounding and simply ask that you consider what it says about its author.

A former student of Shafarevich (and signer of the Open Letter) wrote to me: “He {Shafarevich} never did any damage to our science. I know many more people who did much more damage to it by preventing Jews from doing mathematics. Many of these people (for example, . . . and many others) were often welcome abroad, nobody wrote open letters to them.” I agree, somebody certainly should have.⁵

It took longer to settle the AMS’s involvement in the Shafarevich affair than to break up and reconstitute the Soviet Union. The Editors-in-Chief of the *Intelligencer* (in this respect see the Winter and Spring 1992 issues) and the *American Mathematical Monthly* (March 1992 issue) found ways to address this issue. There is no reason why the Society should not be able to do as well. It must be emphasized that the mathematical managers of the other two journals did not need to be coerced to address this issue, whereas those of the *Notices* did.

It is clear to me that some members of the *Notices* Editorial Board and I do not view the journal or the Society in the same light. I want to encourage dialogue and I expect individuals to act responsibly. The Society is about mathematics. But mathematics cannot be entirely divorced from other human activity. Our journals and committees must be able to address the multiple issues confronting our community. A mathematician who contributes significantly to any area of human endeavor can rightly be honored by the (*Council of the Society*). A mathematician who uses his status as a mathematician to damage humanity can rightly be criticized by the *membership of the Society*.

On a slightly different point, responsibility for decisions (about what to publish) must rest with individuals, NOT committees. Democracy and good judgment requires consultation with members of Editorial Boards, but final decisions on the execution of editorial policy of a journal must rest with the Managing Editor of that journal. Policy making is the responsibility of the entire Board. It is impossible to negotiate with a Committee; it is possible to negotiate only with individuals (the fewer, the easier). Also, at times and for good reasons, a bad decision of an editor should be overruled by an elected

⁵Some mathematicians (L. Bers, R.S. Phillips, and A. Shields among others) did confront, in public and/or private, the issue of anti-semitism in Soviet mathematical circles.

officer of the Society as, for example, the President.

In summary, although I am not unhappy about the overall response of the mathematical community to the Shafarevich affair, I believe more needs to be done to educate my colleagues about prejudice within all of us. I was delighted with the spontaneous offers of help in this matter from colleagues throughout this country. I have very high expectations of my fellow mathematicians. Hence, my strong negative reaction to hints of racism, sexism, or anti-semitism in the actions or pronouncements of a colleague.

Editors' Note: Decisions regarding the publication of Letters and Forum articles are the responsibility of the Letters and Forum editors, respectively. However, appeals of negative

decisions are considered by the entire editorial committee. In the past few years, slightly under 25% of the letters submitted have been rejected.

Excerpts from the report of the ad hoc Committee on the Kra/Blum Open Letter to Shafarevich appear in the May/June 1992 issue of the *Notices*, page 517.

We would like to take this opportunity to advise anyone considering submitting a letter with a long list of signatures to get approval for the letter before signatures are solicited. Had this procedure been followed in the "open letter to Shafarevich," it is likely that revisions, such as the addition of information regarding the foundation of the charge of anti-Semitism against Shafarevich, would have satisfied the concerns both of the authors and of the *Notices*.



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Algebra and Analysis

A. D. Aleksandrov,
O. V. Belegradek, I. A. Bokut',
and Yu. L. Ershov, *Editors*

This collection consists of lectures delivered at the First Siberian Winter School, "Algebra and Analysis," held in March 1987 at a retreat near Kemerovo. The school was organized by Kemerovo State University and the Institute of Mathematics of the Siberian Branch of the Academy of Sciences of the USSR. The conference drew more than 100 participants from Novosibirsk, Kemerovo, Omsk, Moscow, St. Petersburg, and other cities. The papers concern current research on the interface of algebra and analysis.

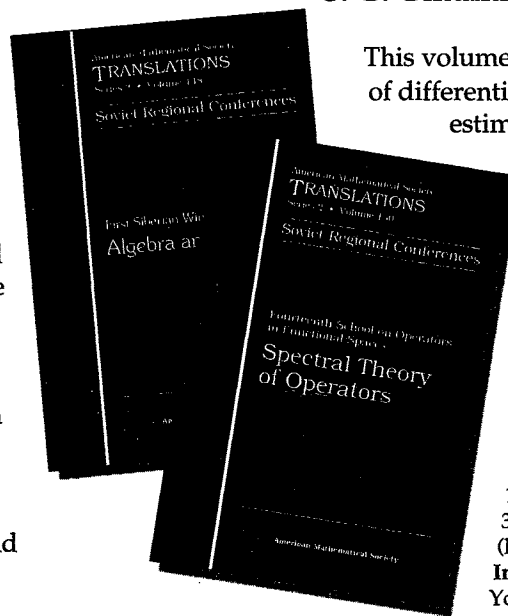
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Spectral Theory of Operators

S. G. Gindikin, *Editor*

This volume focuses on the spectral theory of differential operators. The emphasis is on estimates of the number of negative eigenvalues of elliptic differential operators and on the analysis of asymptotical distribution of eigenvalues. This collection provides an excellent overview of problems in the field, for Gindikin ranks among the leading Soviet specialists in this area of research.

1991 *Mathematics Subject Classification*: 34, 47; 58, ISBN 0-8218-7500-0, 176 pages (hardcover), March 1992
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Computers and Mathematics

Edited by Keith Devlin

This month's column

Textbook-software combinations are becoming increasingly common these days, as book publishers adapt to the changing nature of mathematics education brought about by the growth of the personal computer market. Three of the four reviews that make up this month's column fall into this category.

MacMath, reviewed by Bob Fisch, is a suite of programs designed for use in a course on differential equations. Written by John Hubbard and Beverly West, the package can be used on its own, but the authors' intention is for it to be used in conjunction with their textbook *Differential Equations: A Dynamical Systems Approach*.

Problem Solver, reviewed by Mario Vassallo, accompanies a textbook on finite mathematics and applied calculus.

Exploring Math from Algebra to Calculus with Derive and Calculus and the Derive Program: Experiments with the Computer, both reviewed by Alan Solomon, are books written for use with the well-known computer algebra system *Derive* (last reviewed in this column in January of this year).

Of course, book-software combinations are just one aspect of the use of computers in education. In addition to off-the-shelf packages, many professors find they need to develop their own course software, tailored to the particular needs of their students, and the first of this month's reviews addresses this particular audience. Returning as a much-welcomed contributor to the *Computers and Mathematics* column he founded in the summer of 1988, Jon Barwise reviews the software-development package *Prograph*, a program designed to take a lot of the tedium out of Macintosh programming.

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Reviews of Mathematical Software

Building Stand-Alone Applications for the Macintosh

Reviewed by Jon Barwise*

For several years now, John Etchemendy and I have been developing both research and teaching tools in mathematical logic. What inspired us to do this was the feeling that the graphical abilities of machines like the Macintosh, and the forms of interaction supported through icons and the mouse, were tremendously powerful, both theoretically and pedagogically. One of the programs we have developed, *Turing's World*, allows the student to design complicated Turing machines by drawing the flow diagram on the window of the Macintosh. One can run the program quickly, or in a debug mode, where you watch the machine transitions, to see if it is doing what you expect.

Getting involved with software development has had a rather dramatic impact on our research as well as our teaching. It has led us in completely unexpected directions. But there has been a constant frustration over these years. The very abilities that make the Macintosh so exciting as a tool have also made it very difficult to program. Folklore has it that about 75% of the effort in creating a typical Macintosh application goes into the interface: dealing with windows, menus, mouse clicks, and the like. As a result, it has seemed too daunting to even dream of personally creating a Macintosh application. We had always been dependent on programming help for every tool or change we needed, big or small.

A few years ago the situation was partially alleviated by the development of *Hypercard* and its associated programming language, *Hypertalk*. Etchemendy and I found this an excellent tool for doing mock-ups of the programs we really wanted. But the language is too clumsy for serious programming. For

*Jon Barwise is College of Arts and Sciences Professor at Indiana University. He is a member of the Departments of Mathematics, Computer Science, and Philosophy. He was the founding editor of this column.

that one needed to use C, and to harness it to *Hypercard* by means of “X-commands”.

So why not just learn C or some other serious programming language? Well, for me, at any rate, there is a stumbling block. As a mathematical logician, I have no trouble understanding, at a conceptual level, how to put together a complicated set of algorithms. But doing this in practice, in a language like C, was just too much. Too much coding. Too much syntax. Too many bugs. And much too much frustration! I have better things to do with my life.

Well, if this sounds familiar to you, if you would like to be able to build serious applications for the Macintosh but have a similar distaste for the nitty-gritty of standard Macintosh programming tools, I have good news for you. As they used to say, there is light at the end of the tunnel, folks.

Prograph 2.5

There has been a chasm between the philosophy on which the Macintosh environment is based, and that with which it is programmed. The former makes extensive use of visual elements, in the forms of icons, and motor involvement through the mouse, to draw the user into the Macintosh world, to give them the ability to visualize and manipulate data objects in an intuitive manner, one that takes advantage of a range of cognitive abilities and real world experience. Why not apply this same philosophy to programming the machine?

Around January 1, I started learning to use *Prograph 2.5*. Within a month, I finished my first real stand-alone application for the Macintosh, one with five windows, two menus, a host of buttons, and other Macintosh devices. The program is a logic game for my eight-year-old daughter and her friends. As a computer program goes, it is pretty simple. But I could never have dreamt of creating it before I discovered *Prograph*.

Prograph is a visual programming language based on the object-oriented, data flow model of computation. What this means is that you develop programs by creating graphs of linked icons. (That’s where the name comes from: programming with graphs—*Prograph*.) The nodes of the graphs consist of icons depicting various data objects and methods for dealing with them. The data inputs are at the top of the graph, the data outputs at the bottom. Any such graph can be collapsed into a method of its own and given an icon, to be used within other methods, or even that method itself. (The latter is how you implement recursion.)

Once you have created a program, you can either compile it, or run it in an interpreted mode. If you run it in interpreted mode, the graphs can be observed. You can see the flow and transformation of data over time. In fact, I only compiled my program after it was completely developed and debugged (I hope). The *Prograph* environment lets you develop a program in an incremental way, method by method, watching them work as you go. If something goes wrong, you can stop at any point and examine the data at the nodes of your graph to see what is there and why it is not behaving as you expected. You can modify the data or the method during the middle of a computation. *Prograph* backs up the computation and let’s you try it again, to see if you have got it right.

Prograph also has WYSIWYG editors for dealing with windows, menus, scrolling text fields, buttons—all that sort of stuff. What is lovely about this is that these are represented just like everything else, as data objects, with attributes and methods of their own. So your program can manipulate them in the same way that it deals with the objects and methods you create. In Figure 1, you will see a picture of the different kinds of Macintosh objects available, together with the three needed for my application: **Comments**, **Profile**, and **Round**.

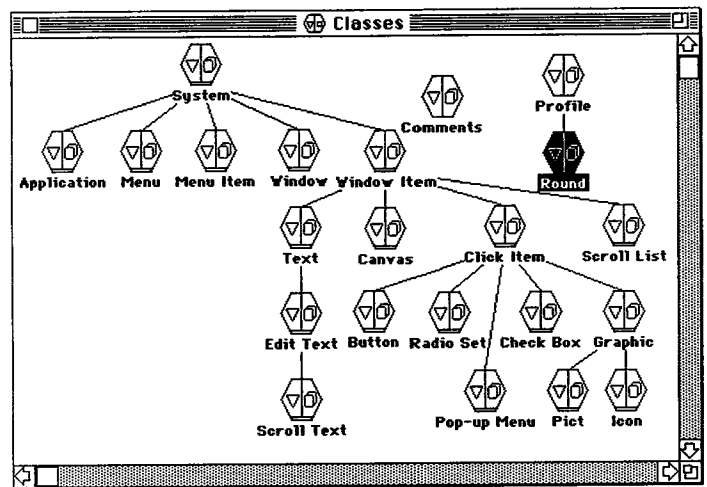


Figure 1.

An example

To give a hint as to how this really works, let me give an example from my application. Figure 2 shows the main window of the program, the one where the child interacts with the program, trying to guess a mystery list of numbers in as few steps as possible, getting information about the accuracy of each guess. (This is an old game called “Cows and Bulls”, “Mastermind”, or “Bagels, Pico, Fermi”.)

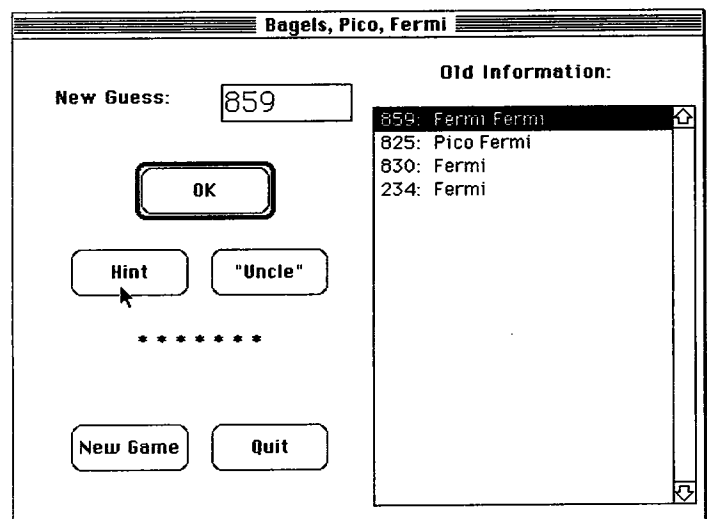


Figure 2.

Each "object" in *Prograph* has various attributes and methods. Some of the attributes of a Round object are shown in Figure 3. One of these is the attribute **Hint?**, which has the value **TRUE** if the child has asked for a hint, otherwise it has the value **FALSE**.

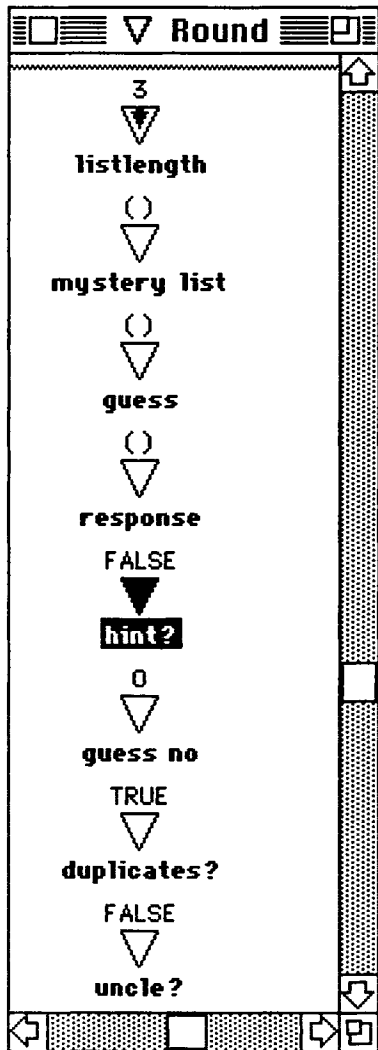


Figure 3.

Figure 4 shows four of the methods associated with Rounds. One of these, the method **hint**, is the method used when the child asks for a hint. The details of this (very simple) method are shown in Figure 5. It is with graphs such as these that the real programming takes place. The method extracts the value of the current mystery list from the current **Round**, extracts one member of this list at random, say 7, and displays the message "One of the digits in my mystery list is 7". It also sets the value of the attribute **Hint?** of the **Round** to **TRUE**.

Rough edges

Prograph is not the only visual programming language around. I investigated a couple and decided to buy this one based largely on the enthusiasm of the people who have created it. I like it a lot, but there are some rough edges.

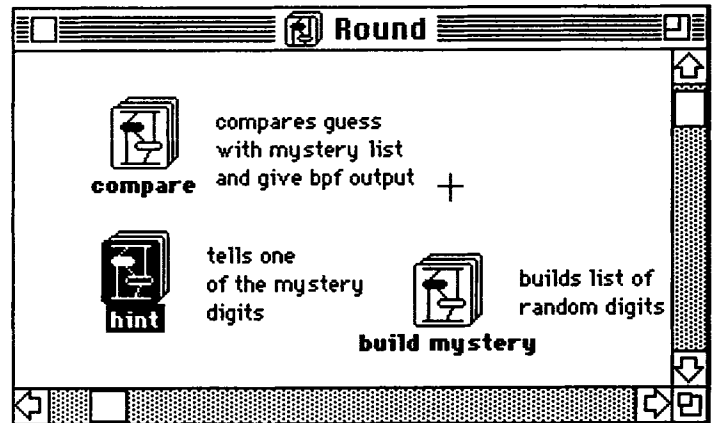


Figure 4.

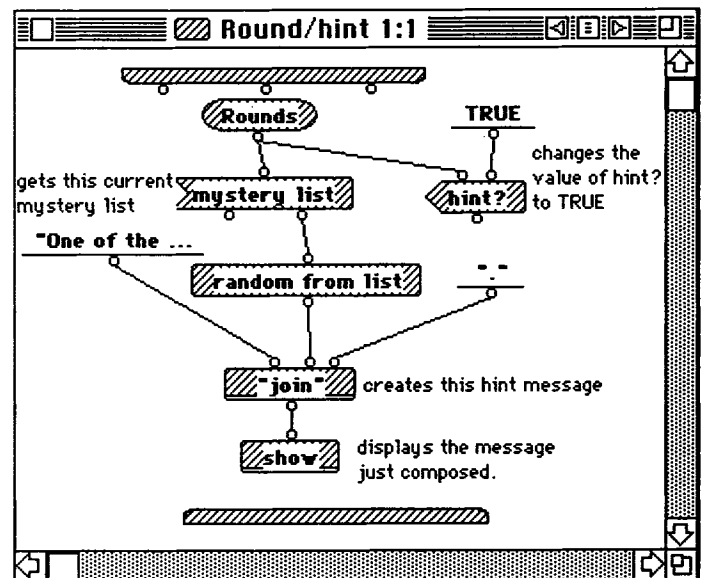


Figure 5.

First, the application builder definitely contains some bugs. If you do some things that it does not expect (and what beginner doesn't), then it crashes quite unceremoniously. So you need to save your work fairly often. For another, the application builder is frustratingly slow. I was running it on a Macintosh IIci with 4 meg of memory. In building a graph, it was not uncommon to have to wait 5 to 10 seconds between a mouse click and the appearance of the resulting icon. Worse, the usual little Macintosh wristwatch does not appear to tell you that anything is happening, so you are not sure if you failed to click properly, or you have not been patient enough.

Prograph 2.5 comes with a useful tutorial and a large reference manual. These are pretty well written. I found it easy enough to go from zero to the stage where I could build simple little methods and objects. However, to build my first real application, I found the tutorial and reference manual to be insufficient. (The index for the manual is definitely less than adequate.) But along with the tutorial are a number of

uncompiled applications that you can explore. So, with no one around for help, I was still able to learn all I needed to know to complete my project successfully.

The visual features of *Prograph* eliminate many of the bugs that would normally come by writing textual code. The icons show the number of input and output arguments of the methods they denote. But I have a complaint even here: the iconic conventions used for “next case” constructions. These are the visual equivalent of the “else” in an “if... then...; else...”. I found them quite contrary to my visual expectations. They probably resulted in a lot of my errors.

Conclusion

Is the visual aspect of *Prograph* a gimmick? It might seem so to an experienced programmer. I don't know. But I think there is a definite need for this kind of tool. Programming, like theorem proving, is a difficult cognitive task. Getting them right is not easy. *Prograph* allows you to see what you are doing and what the computer is doing with what you have created. So, I recommend *Prograph 2.5* to mathematicians who want to be able to build simple, stand-alone Macintosh applications. I am not experienced enough as a programmer to tell whether it is a great programming language. The application I built seems to run very fast and to be very stable. But it is not a very sophisticated program, either. Still, *Prograph* has given me a power I had just about given up on getting, creating my own Macintosh applications.

A couple of caveats to this review. I did not need any mathematical algorithms more sophisticated than a random number generator, which comes with the program. But it does not look to me like there is a very large library of such programs. This would no doubt be a problem for some of you. Second, I have not yet tried to do anything using graphics, so I can't say anything about that. The manual is very terse on graphics, and I have not had the time to dig into sample programs to see how this part of the language works.

Where to get it

Prograph is a product of TGS Systems, in Halifax, Nova Scotia. It costs around \$500, with a 50% academic discount. (There are also a couple of add-on packages that I have not purchased.) For more information, call 902-455-4446 or fax 902-455-2246. Or send email to GUNAKARA@watt.ccs.tuns.ca.

MacMath

Reviewed by Bob Fisch*

This is a review of a software package for Macintosh computers entitled *MacMath*, developed by John Hubbard and Beverly West. *MacMath* consists of twelve programs designed primarily for use in teaching various aspects of differential equations and dynamical systems, but parts of it can be used to teach selected topics in a Calculus or

linear algebra course. It is available from Springer-Verlag; the current price of the entire package is \$49.

My overall impression of the package is that it is terrific! Keep this in mind as you read this review; I do have complaints, which I hope are addressed by the authors in a future release. But with regard to teaching differential equations, the bottom line is: this package gets the point across as to what a differential equation is and what a solution is.

I am currently using *MacMath* in a differential equations course for juniors and seniors. The text for the course, *Differential Equations: A Dynamical Systems Approach, Part I*, is also written by Hubbard and West. The text makes reference to the software, so if one uses this text, then *MacMath* is convenient. But *MacMath* comes with its own 162-page book of documentation and stands alone to be used in any course covering a relevant topic. In fact, the documentation book also includes some discussion of the theory of differential equations and dynamical systems and suggests problems to experiment with.

My most glowing remark about the package: It is easy to use. This merits repeating: IT IS EASY TO USE! The menus for the twelve programs are standardized, with variations relevant to each particular program. This means that when you learn one program, then you know about 90% of what you need to learn to use any other program. As instructor, you will spend about ten minutes learning how to use any of these programs, without any more than a casual reference to the documentation. If your students are familiar with the Macintosh interface, they can learn how to use the programs you want them to use in one or two class hours (including time spent discussing relevant examples from your course), without ever looking at the documentation book. Of course, times will arise when you need to refer to the documentation, and at these times, you will find it clear, complete, and well organized, including diagrams of actual displays from the package, making it easy to find what you need to know.

The programs in this package allow investigation of many topics. The two most useful programs for my course have been *Analyzer* and *DiffEq*. *Analyzer* is a tool for graphing functions of one variable (up to six of them at once, and in six different colors if you have a color monitor), finding roots, performing numerical integration, and drawing graphical iterates of a function. (See Figure 1, next page.) *DiffEq* displays a slope field for a differential equation of the form $x' = f(t, x)$, and upon the click of a mouse, draws a (numerical) solution through the point you click at. (See Figure 2, next page.) I cannot mention all the features of all the programs, but here is a partial list of topics addressed by the package:

- numerical approximations to solutions of differential equations,
- systems of differential equations involving two or three functions of t ,

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- periodic differential equations of the form $x' = f(t, x)$ where f is periodic in t ,
- a simulation showing bodies exerting gravitational and electromagnetic forces on each other,
- the geometry behind Jacobi's method for finding eigenvalues of 3×3 matrices (there is another program for finding eigenvalues and eigenvectors for matrices as large as 12×12),
- Fourier series approximations to functions,
- orbits achieved under iteration in two dimensions, and
- bifurcation diagrams demonstrating the period-doubling route to chaos.

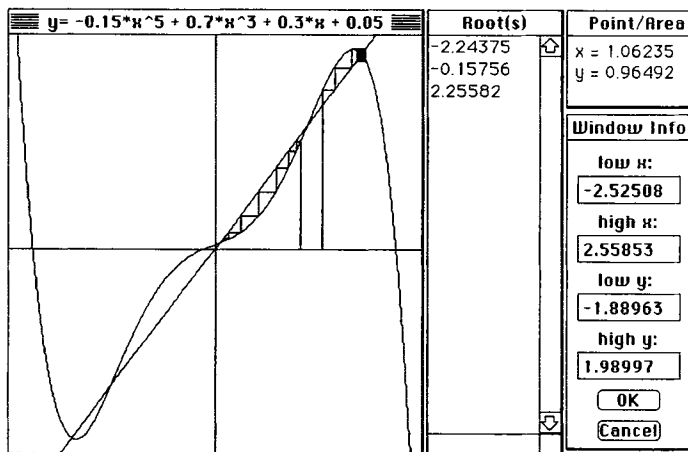


Figure 1. An *Analyzer* graph featuring the graph of the equation $y = -0.15x^5 + 0.7x^3 + 0.3x + 0.05$. The zeros of this equation have been found numerically in the *Root(s)* window. Two graphical iterations of the function are displayed, demonstrating two attracting fixed points and a repelling fixed point.

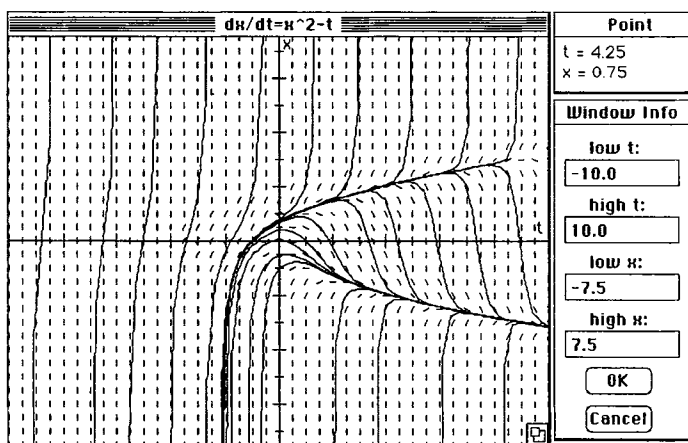


Figure 2. A *DiffEq* graph featuring a slope field and several numerical solutions for the equation $x' = x^2 - t$.

This package does a lot! One common thread is that each program enables a student to learn by understanding the relevant geometry and then experimenting with the parameters of a problem.

Of the 12 programs, I have played with 6 of them, and I decided to teach 4 of them to my students. This choice

has nothing to do with how well these programs work, but merely reflects the focus I have chosen for my course. Instead of trying to review all of these, I will focus on the program *DiffEq*, as it is the program my students have used most frequently. However, these comments are intended to convey the spirit of the overall *MacMath* package.

For the record, the computer on which I have been running *MacMath* is a Mac IIcx running System 6.0.8 with 4 Mb of memory and a high-resolution RGB monitor; this computer is connected to a LaserWriter II printer via an AppleTalk network. My students have an equivalent computing environment available to them in our computer lab.

DiffEq allows a student to investigate differential equations of the form $x' = f(t, x)$. The function f can be constructed out of common functions (trigonometric, exponentiation, logarithm, absolute value, truncation, sign), and both e and π are available for use. Students will need to learn how to input functions—one must type $2 * x$ instead of $2x$, $\sin(t)$ instead of $\sin t$, $(x + t)^2$ instead of $(x + t)^2$, $\exp(x)$ instead of e^x —but my students learned to type these functions without significant difficulty. (See Figure 3.) This is perhaps the hardest part of the user interface, but it is identical across the programs in the package, so one needs to teach this part of the interface only once.

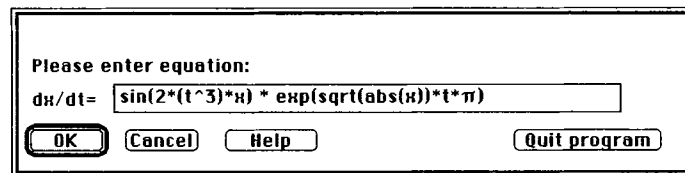


Figure 3. Entering a differential equation into *DiffEq*.

DiffEq allows a student to draw slope marks over the (x, y) -plane so that she can observe how the slope field varies. I find the program to be a bit slow in drawing dense slope marks; times of 15–20 seconds to generate the slope marks for the default graph window size (approximately half as large as the desktop on my 13" monitor) are not uncommon. The user can choose to draw slope marks that are less dense, but I feel that the dense slope marks give a better picture, so I merely tolerate the delay. My guess is that the bottleneck is the speed of updating Macintosh graphics, so this problem can probably only be solved by a faster computer or graphics processor.

To see a particular solution through any point of the plane, the user merely needs to click the mouse on the plane, and a numerical approximation to the solution through that point will be drawn. A window displays the coordinate of the point clicked on to the nearest 0.00001. The user may choose the method (Euler, midpoint Euler, Runge-Kutta) and the corresponding step size to be used in drawing the solution. The default values (Runge-Kutta method with a step size of 0.3) usually generate adequate approximate solutions reasonably fast so that the student first encountering the program need not worry about such matters.

Numerous solutions can be drawn on the same graph, so that one can get a sense of the general nature of the solutions over the entire plane merely by clicking the mouse impulsively. This is perhaps this program's best feature for a differential equations course. I had considered using *Mathematica* for my course, and although *Mathematica* can draw a slope field, my *Mathematica* friends tell me that there is no easy way to emulate this feature of drawing solutions by clicking. This feature is an outstanding way to convey the notion that (under suitable hypotheses that get covered later in the course) an initial condition determines a specific solution, and that a different initial condition (not on the original solution) generates a different solution.

A menu entry allows the user to print out any graph that has been generated. This permits students to compare the behaviors of similar differential equations. The ability to print also enables one to produce graphs of slope fields conveniently. This is useful at the start of a differential equations course when you might want students to draw solutions by hand before the computer takes over this task.

The program displays a window for changing the ranges of the variables represented on the horizontal and vertical axes of the graph window. There is also a "blow up" feature that permits the user to identify a region to magnify by clicking and dragging to outline the rectangle of interest. Another option is to resize the graph window, which does not change the ranges of the axes but instead provides more or less detail (depending on whether the resized window is larger or smaller) for the slope field. Although a menu item allows you to restore the default ranges for the axes, there is no convenient way to restore the default size for the graph window. Such a feature would be handy for printing graphs out, so that one could insure that two different graphs were drawn to the same scale.

Now that I have mentioned the most important features of *DiffEq*, let me suggest ideas of how it can be effectively used in a differential equations course. *DiffEq* creates a framework for talking about solutions to differential equations outside the context of formulas. The authors state in their textbook that a prime motivation for writing this book and this software was the difficulty they found in convincing students that a differential equation has solutions, even when one cannot write a formula, such as $x = t + 1 + Ce^t$, to represent them. In fact, I started my course by having students "solve" equations with *DiffEq*, and only after several weeks did they learn how to manipulate certain types of differential equations to find formulas for solutions.

DiffEq does not compute actual solutions, but merely computes numerical approximations to solutions. When the numerical method breaks down due to numerical instabilities, the program does nothing to help, but blithely computes and draws its numerical solution. This is not a criticism; in fact, it is a key virtue! By demonstrating what can go wrong, one can more emphatically justify the need for mathematical proof of observed phenomena (such as asymptotic values for large t , solutions that blow up in finite time, or even existence and uniqueness) for the actual solutions to the differential equation.

My favorite use of *DiffEq* is in conjunction with *Analyzer*. Given a differential equation for which a formula for solutions can be found, one can ask students to use *DiffEq* to print out a graph of the solution through a particular initial point, and then use *Analyzer* to print out a graph of the function determined to be the solution to the differential equation through that point. The two printouts, when aligned and held up to the light, should show the two functions coinciding. Thus the differential equation, which does not "know" the formula for the solution, is still able to draw the graph of this function. In this way, one can convey the idea that the differential equation and the initial condition together define such a function.

With regard to this use, one major flaw in the package is that one must fiddle with parameters to be able to compare graphs from *DiffEq* and *Analyzer*. The default values for the two programs draw graphs to different scales. If the default ranges for the axes in *DiffEq* are used, then the ranges of the axes in *Analyzer* must be changed (to a range of -7.5 to 7.5 in both directions) in order to make the scales match up. But this still gives a smaller picture for the *Analyzer* graph than for the *DiffEq* graph (where the default horizontal axis ranges from -10 to 10), because the *Analyzer* graph window is smaller. Since there is no precise way to control the sizes of the graph windows, it is best to leave them alone when creating printouts of graphs to be aligned and compared. I would really appreciate an update of the software to attend to this problem; it would save me the trouble of training my students to work around this flaw.

Another problem in using *DiffEq* and *Analyzer* is in the choice of variable names used for defining functions in these programs. Each program rigidly specifies what variables may be used. In *DiffEq*, the independent variable must be t , and the dependent variable must be x . In *Analyzer*, the independent variable must be x , and the dependent variable must be y . Although I understand that there is a history behind our choices of variables, and I also appreciate the problems of parsing the expression that makes up the function typed into any of these programs, I still consider it a nuisance because of the potential confusion to students. I would like to see some feature that allows the user, by clicking on a button perhaps, to choose the names of the independent and dependent variables, even if from a limited set of choices.

There is one major bug I have discovered. (Before going on, though, the reader must promise to go back and reread the second paragraph of this review.) When using *Analyzer* to print out a graph, if the axes have been drawn by selecting the tickmark option (to indicate integers along the axes), my Macintosh generates a system bus error, and bombs, and the printer then needs to be reset. Printing works fine without the tickmarks, and this problem has not occurred in any of the other programs I have used. I do not mention this to condemn the program; instead, I mention this to serve as a caveat for those considering the package for future use. Expect this package to be a bit rough at the edges. For the most part, it will serve you fine, but you will find a few annoying items. One example is when editing a formula defining a function, the text to be edited offsets itself by a pixel or two as you

start to type. Nothing disastrous, but annoying nonetheless. However, the package has so much to offer that it is worth your while to work around these problems, and hopefully a future version will fix all the bugs.

There is one last problem I cannot omit. The documentation states that "problems may occur if these programs are used with MultiFinder, especially in printing and color applications". (The problems mentioned in the previous paragraph occur even when MultiFinder is disabled.) I have frequently used programs from the *MacMath* package while MultiFinder was enabled and while other programs (word processor, spreadsheet, etc.) have been initiated, although I always take care to save documents before initiating a *MacMath* program. I have never had trouble with either printing or with the features that use color under these circumstances. Yet the warning is there, in two different places in the documentation. I do not consider this particularly troubling in situations where you can disable MultiFinder. But System 7 operates in MultiFinder mode; there is no MultiFinder to turn off. I would be quite distressed if *MacMath* fell into disuse for this reason; I hope the authors can address the problems they have encountered with MultiFinder.

In summary, I highly recommend *MacMath* for anyone teaching a differential equations or dynamical systems course. Play with it for two hours, and you will be convinced. The occasional bug you encounter may sometimes be infuriating, but you will never second guess your decision to use it in your course.

Problem Solver

Reviewed by Mario Vassallo*

1. Overview

Problem Solver is a computer program that accompanies the book *Problem Solver for FINITE MATHEMATICS and CALCULUS* written by Kenneth L. Wiggins for PWS-Kent Publishing Company. The package is primarily intended for students of finite mathematics and applied calculus. It could also be used effectively as a supplement to a standard textbook to provide the students with a variety of computer activities. The following is a list of topics covered: Functions, Models, Graphs, Limits, Derivatives, Integrals, Matrices, Probability, and Statistics.

To run the software, you need an IBM or IBM-compatible computer with 512K of RAM and either two floppy disk-drives or a hard disk and a floppy disk-drive. The software is intended to remove the burden of long and tedious calculations. To help the student learn how to use *Problem Solver*, the book includes a considerable variety of examples. Each example is a tutorial, giving step-by-step instructions for using the

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program to help the user solve problems. An extensive on-line help system is available while using the program.

2. User Interface

2.1 Description

Problem Solver is a menu-driven program in which menu options are displayed within windows. If a user has to select a succession of options, the menu windows will overlap each other in stack form. An option can be selected by moving a pointer, using arrow keys, or pressing the highlighted character in the option. Pressing the Esc key removes the current window of options and activates the previous window.

The help facility may be accessed at almost any point in the program by pressing the F1 function key. This system thus works in a very similar way as the one used by other software packages such as *Lotus 1-2-3*. When help is requested, a full screen of information is displayed based on what window is active at that particular time.

Besides viewing the output on the video screen, *Problem Solver* allows the user to direct the output to a printer or a text file.

The program includes a handy Calculator option. This mode accepts mathematical expressions typed in by the user and outputs their result. In entering an expression, the user may enter any one of *Problem Solver's* built-in functions.

2.2 Examples

A. Solving Equations

I used *Problem Solver* to solve the equation $x^3 - 2x^2 - x + 1$ for $x \in [0, 2]$ by the bisection method. The following is the output obtained:

```
Equation: x^3 -2*x^2 -x+1 = 0
Algorithm used: The bisection method.
Initial guess: 0 2
```

iter	x1	x2	f(x)
1	0	2	-1
2	0	1	0.125
3	0.5	1	-0.453125
4	0.5	0.75	-0.162109
5	0.5	0.625	-0.017334
6	0.5	0.5625	0.0542297
7	0.53125	0.5625	0.0185356
8	0.546875	0.5625	0.000621
9	0.554688	0.5625	-0.00835139
10	0.554688	0.558594	-0.00386377
11	0.554688	0.556641	-0.00162091
12	0.554688	0.555664	-0.0005
13	0.554688	0.555176	6.08e-05
14	0.554932	0.555176	-0.000219
15	0.554932	0.555054	-7.93e-05
16	0.554932	0.554993	-9.24e-06
17	0.554932	0.554962	2.58e-05
18	0.554947	0.554962	8.27e-06
19	0.554955	0.554962	-4.85e-07

Number of iterations: 19
 Solution: 0.554958343505859
 Error bound: 3.814697265625e-06
 Estimated relative error: 6.87384433492119e-06
 Residual error: 4.85395075688899e-07

In the table above, $[x_1, x_2]$ is the interval and x is the midpoint of the interval.

B. Linear Programming

I also used *Problem Solver* to find the maximum of the objective function $Z = 2x + 3y$ subject to the constraints

$$\begin{aligned}x + y &\leq 5 \\x + 2y &\leq 8 \\x \geq 0, y &\geq 0\end{aligned}$$

The following is the output obtained:

Linear programming model:

Maximize $Z = 2.000x[1] + 3.000x[2]$

Subject to the constraints:

$$1.000x[1] + 1.000x[2] < 5.000$$

$$1.000x[1] + 2.000x[2] < 8.000$$

All decision variables are nonnegative.

Decision Variables: $x[1] \dots x[2]$

Slack Variables: $x[3] \dots x[4]$

Iteration 1

BV	x[1]	x[2]	x[3]	x[4]	RS
Z	-2.000	-3.000	0.000	0.000	0.000
x[3]	1.000	1.000	1.000	0.000	5.000
x[4]	1.000	2.000	0.000	1.000	8.000

Current basic solution:

0.000 0.000 5.000 8.000

Entering variable: $x[2]$

Leaving variable: $x[4]$

Iteration 2

BV	x[1]	x[2]	x[3]	x[4]	RS
Z	-0.500	0.000	0.000	1.500	12.000
x[3]	0.500	0.000	1.000	-0.500	1.000
x[2]	0.500	1.000	0.000	0.500	4.000

Current basic solution:

0.000 4.000 1.000 0.000

Entering variable: $x[1]$

Leaving variable: $x[3]$

Iteration 3

BV	x[1]	x[2]	x[3]	x[4]	RS
Z	0.000	0.000	1.000	1.000	13.000
x[1]	1.000	0.000	2.000	-1.000	2.000
x[2]	0.000	1.000	-1.000	1.000	3.000

Current basic solution:

2.000 3.000 0.000 0.000

No entering variable -- solution optimal.

Maximum value of the objective function:

$Z = 13$

Optimal values of the decision variables:

$x[1] = 2$

$x[2] = 3$

2.3 Comments

Since it is claimed that no experience in the usage of computers is required, interaction should be very simple and, above all, consistent. I found the program to have a good foundation. The software has a good help facility. It contains an Intermediate Calculations option which allows the problem solution to be displayed in a step-by-step sequence (as shown in the above examples). I found this to be a very useful feature. However, I would like to make the following suggestions for possible improvement:

- Some options in certain menu windows do not have any highlighted character. This problem can easily be fixed.
- In the first chapter, the book describes how to install the software on a hard disk. A subdirectory TPS has to be created to store all the program files. The book should include a step describing how to create a subdirectory in TPS, called DATA, where all data files will be stored. *Problem Solver* should consider the subdirectory C:\TPS\DATA as the default directory. The book describes this directory as the default directory, but, when testing the program, I found out that it is not. The program should have a command that specifically allows the user to change directories.
- The user may load a file in different parts of the program (in particular, under the Functions and Matrices applications). When the load command is selected, *Problem Solver* displays a listing of **all** the files in the subdirectory. It should only display the files that are relevant to the application. I suggest that when the load command is selected under Functions, the program should only display the filenames with a .FUN extension. Similarly, only the filenames with a .MAT extension should be displayed when the load command is selected under Matrices. For this to be possible, the program should automatically add the relevant extension to a filename when entered by the user for saving. If a file already exists and the user had previously loaded and edited it, the name of the file, by default, should appear in the filename window. The user should be informed about the limited number of characters in a file name.
- When the program expects the user to enter a numerical input, the program should be able to freeze all inappropriate keys. This is more convenient than getting an error message for an illegal entry.
- Problem Solver* should have a General Reset option. This option should reset all values set during an application and would prevent a mix-up of values coming from different applications.
- The Functions Window Menu contains an option whereby the user could possibly change the name of the function variable. If the user decides to change the variable name, the headings in the window showing the Intermediate Calculations and other references to the function name should change accordingly.

2.4 Bugs

While testing *Problem Solver*, I encountered a number of bugs. The following are two of the major problems:

- a. In the Matrix Operations Window Menu, there are two options that have the same character, R, highlighted. The two options are Remove Matrix and `PROD <- A * PROD`. When you hit the R key, the option Remove Matrix is selected.
- b. I selected the Limits option under Functions to find the limit of $x^2 + 2x - 1$. I used an estimate of -1 for the limit. I followed all the required steps. Everything worked fine until I finally selected the Graph $y = f(x)$ option. The program tried to plot the graph of $y = x^2 + 2x - 1$ but crashed. The run-time error *Floating point error: Divide by zero* was returned.

3. Conclusion

This software package contains a number of attractive features. The *Help* and *Intermediate Calculations* facilities are very useful. The ability to store output into an external file and the *Calculator* feature are handy tools to have. However, I am concerned about the bugs and other details that need to be corrected, introduced, or improved. If these problems are taken care of in the next version of *Problem Solver*, then I will be ready to consider the software for use in my Calculus courses.

Exploring Math from Algebra to Calculus with *Derive*: A Mathematical Assistant by Jerry Glynn and

Calculus and the *Derive* Program: Experiments with the Computer by L. Gilligan and J. Marquardt

Reviewed by Alan Solomon*

Derive is an excellent mathematics package for the PC. As such, it finds integrals (both numerically and symbolically), evaluates series, differentiates, draws in two and three dimensions, responds to relatively simple instruction sequences, and is very fondly and favorably regarded by the reviewer. Each of these books presents the reader with a variety of exercises in the calculus using *Derive*. The areas chosen by each are reasonably broad and can aid the calculus student in his/her efforts to master the use of *Derive* in solving some of the standard problems of a calculus course. I personally would be happy to recommend either or both to the *Derive* user as an aid to more effective use of this package.

* Alan Solomon was born in New York, received a B.S. in Math from CCNY in 1959, an M.S. and Ph.D. from NYU (Courant Institute) in 1960 and

Having said the “obvious”, this reviewer feels compelled to address the pedagogical aspects of these books, which go beyond the simple question of whether they correctly describe the buttons to be pressed to graph a polynomial or find an integral.

Calculus is a meld of concepts and techniques. Strength in each requires skill and knowledge of the other. I have never seen calculus students who were confused by the statement that “continuity” means that the chalk cannot be raised from the blackboard while the curve is being drawn. On the other hand, I have seldom seen students who would immediately equate this to the “epsilon-delta” definition of limit and continuity, unless the teacher was particularly skillful and the blackboard sufficiently clean. Just how we learn the meanings of concepts and what form this learning takes is a subject about which most mathematicians can only conjecture. The process surely involves mental exercise by solving problems and seeing examples. Whether pushing a button is better than using lots of paper and pencils is not clear to me.

The book by Glynn presents *Derive* in the light of a means to awake interest in the calculus and related concepts for people of all ages. The enthusiasm of the author about this particular math package comes through clearly, and I am certain reflects his enthusiasm about teaching mathematics by any means. As such, he has produced a very good book for students who are motivated and interested in computers and mathematics. I do not share the author’s enthusiasm about *Derive* itself as a learning and motivating tool, but together with this book, the interested and already motivated student will be helped to learn more.

The book by Gilligan and Marquardt made this reviewer somewhat uneasy. The preface opens with the statement that in 1989 an experiment was begun, which was “teaching calculus with a laboratory component”, and that “The experiment was successful”. I am afraid that in the context of calculus teaching (and indeed mathematics in general) I am unsure what we mean by “laboratory component”. When a complex physical process is being simulated on the computer (e.g., biodegradation of a chemical in heterogeneous soil) a computer simulation may be the only way to gain some intuitive insight (if that) into what is happening. However, this is far from the case when we are teaching a student about the concept of a limit. Here a few simple examples illustrated with chalk and blackboard and explained by a good teacher to a class willing to learn, combined with hours of serious study with pencil and paper are the recipe to understanding. As a consultant, I have often been confronted with problems for which large amounts of computer time were wasted in lieu of some simple calculus

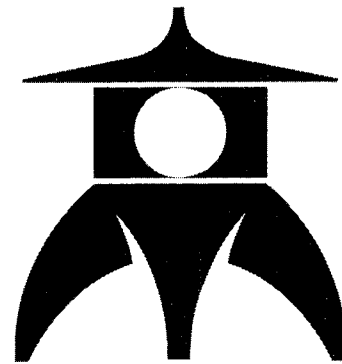
1963. He taught at NYU for four years before moving to Israel and taking the position of Senior Lecturer at Tel Aviv University. From 1970–1976 he was at Ben Gurion University in Beersheva, eventually serving as chairman of the mathematics department. In 1976, he joined the Mathematics Section of the Oak Ridge National Laboratory (ORNL), where he served as Group leader of the Mathematics Group and Senior Research Scientist. He left ORNL in 1987 to return to Israel as a private consultant. He presently consults for companies in Israel and the States, mostly in applied mathematics, simulation, etc. He is also an adjunct professor of mathematics at the University of Tennessee. He can be reached by email at solomon@msr.EPM.ORNL.GOV.

manipulation that the client never learned or did not properly understand. It is not clear to me that the kind of "laboratory" described by this book would be of help in overcoming the common lacks in understanding basic manipulations and theory. I am afraid that the "laboratory" element of a calculus course must be made up of more than the presentation of some obvious and basically simple technical steps (e.g., finding a derivative) using a more or less standard mathematical package that does some calculus and draws some figures. The

form of this laboratory would depend on the students and their directions of study. The objective of the laboratory would have to be better defined. Would it be to find anti-derivatives using the various standard techniques? Would it be to apply calculus to physical problems? Would it be to teach concepts—in which case more would be needed than simple exercises. Since no such philosophy appears in this book, I feel that its principal purpose would be as an aid to a general user of *Derive* rather than as a useful classroom or "laboratory" tool.

Proceedings of the
**International Congress
of Mathematicians**
Kyoto, 1990

Ichiro Satake, *Editor*



Held every four years, the ICM features the frontier mathematics of the day. Each Congress is a historic event: a time for taking stock of current results in the development of the field, a time for lauding the mathematical stars of the day, and a time for camaraderie within the international mathematical community.

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Inside the AMS

AMS Operating Plan for 1993

Since the AMS began its strategic planning activities in early 1991, the *Notices* has presented a number of progress reports to Society membership. The 1993 Operating Plan, now under development, differs in some important ways from that for 1992. The various AMS policymaking bodies involved in the development of the Operating Plan welcome the suggestions and input of the membership as they chart the course for the Society's future.

Differences from 1992 Plan

The 1992 Operating plan was organized around the six goals set forth in the Society's Strategic Planning Task Force (SPTF) report (see "AMS Planning Update: The Operational Plan," *Notices*, March 1992, pages 192-195). For each goal in the strategic plan, an Operational Planning Group of staff and Society members formulated specific plans centered on that goal. The SPTF report will continue to provide direction to the 1993 Operating Plan. However, the focus will shift from being a specific response to the report to a comprehensive, annual process that involves Society leadership and senior management and that evolves over time to fulfill the Society's mission. Therefore, the planning units for the 1993 Operating Plan will be centered on the AMS staff executives' areas of responsibility. This will allow the planning to encompass all Society activities and to fit more easily into the Society's managerial structure. In addition, the 1993 Plan will provide a progress report on the strategies identified for implementation in the 1992 Plan.

Ten Planning Units have been convened for development of the 1993 Operating Plan. These consist of unit leaders drawn from AMS staff, Board of Trustees (BT) liaisons, and Council liaisons. As with the 1992 Plan, the volunteers will provide input on strategies pertaining to the Planning Units. In addition, the conveners of each planning unit will seek input from relevant AMS committees. Following is a list of the Planning Units.

Publications, including acquisitions, translations, electronic publishing, production and publishing of AMS books and journals, and publications-related marketing. *Leaders:* Gary Brownell, Samuel Rankin (convener), William Woolf, Jeremy Soldevilla. *BT Liaisons:* Maria Klawe, John Polking, Paul Sally. *Council Liaisons:* Carl Cowen, Elliott Lieb.

Mathematical Reviews, including production and publishing of *MR* and *Current Mathematical Publications*, and electronic delivery of the *MR* database. *Leaders:* Gerald Janusz, Donald Babbitt (conveners), Jane Kister. *BT Liaisons:* Steve Armentrout, B. A. Taylor. *Council Liaisons:* Chandler Davis, David Cox.

Meetings, including all current and future meetings, symposia, and conferences sponsored by the AMS. *Leader:* Hope Daly. *BT Liaison:* Susan Montgomery. *Council Liaison:* Ruth Williams.

Marketing, including public relations, promotions, database services, membership, customer services, and distribution. *Leader:* Jeremy Soldevilla. *BT Liaison:* Frederick Gehring. *Council Liaisons:* Sheldon Axler, Ruth Charney.

Computer Services, support of the AMS computer system, including programming and analysis, computer operations, and user training and support. *Leader:* William Woolf. *BT Liaison:* Maria Klawe. *Council Liaisons:* John Franks, Gunther Uhlmann.

Public and Government Affairs, including the AMS "Washington presence"; communication with federal agencies, the U.S. Congress, and the White House; and increasing public understanding of the benefits of mathematics. *Leaders:* Spud Bradley (convener), William Jaco. *BT Liaisons:* Michael Artin, John Polking. *Council Liaisons:* Linda Keen, Carl Pomerance.

Executive Director's Office, including administration and management of the Society governance, committees on the status of the profession (including the Committee on Education and the Committee on Science Policy), joint committees having staff as ex-officio members (such as the Data Committee and the Committee on Employment Opportunities), and international activities. *Leaders:* William Jaco (convener), James Maxwell. *BT Liaison:* Michael Artin. *Council Liaisons:* Frank Gilfeather, Rebecca Herb.

Development, including federal, corporate, and foundation grants; individual and planned giving; and corporate membership. *Leader:* Timothy Goggins. *BT Liaisons:* Michael Artin, Franklin Peterson. *Council Liaisons:* S.-T. Yau, Arthur Jaffe.

Fiscal, Finance, and Facility Services, including accounting and financial functions, purchasing, building operations, upkeep, and maintenance. *Leader:* Gary Brownell. *BT*

Liaison: Franklin Peterson. *Council Liaison:* Hugo Rossi.

Human Resources, including staff personnel matters and employee training. *Leader:* James Maxwell. *BT Liaison:* Susan Montgomery. *Council Liaison:* Lenore Blum.

Input from Committees

AMS committees will play an important role in the development of the 1993 Operating Plan by contributing ideas and strategic directions. Three committees have been specifically charged with developing strategies to direct the planning process in various areas. The Committee on Science Policy, chaired by Frank Warner of the University of Pennsylvania, has been charged with developing a "science strategy" for the AMS. Task forces have been appointed in four areas: federal support and public awareness of mathematics; academic support of mathematics and connections between research and education; corporate support and connections between research and uses of mathematics; and science policy aspects of core AMS activities, such as meetings and publications. (For a more detailed discussion of current activities of this Committee, see "Support for Mathematics Departments and Federal Funding: AMS Committee on Science Policy Examines Issues Confronting the Community," *Notices*, May/June 1992, pages 419–421.)

Similarly, the Committee on Education, chaired by Ramesh Gangolli of the University of Washington at Seattle, has convened four task forces to develop an "education strategy" for the Society. The task forces will focus on: undergraduate mathematics education, graduate and postdoctoral education (including professional development), promoting communication among mathematicians and others involved in mathematics education, and connections among mathematics research, mathematics education, and the uses of mathematics. After meeting in the late summer, these two Committees are scheduled to present reports to the Executive Committee and Board of Trustees (ECBT) in November 1992.

The third committee with a direct responsibility in the planning activities is the Society's Long Range Planning Committee (LRPC), chaired by M. Salah Baouendi of the University of California at San Diego. The LRPC has principal responsibility for input on the overarching themes in the strategic planning process and insuring that the operating plan reflects the Society's mission. In addition, the LRPC has been specifically charged with the task of assessing the Society's current and potential international role.

The LRPC has identified two issues that cut across the planning process. The first is participation: encouraging members to participate and contribute to Society activities and to the improvement of the profession, increasing the participation of international members of the AMS, and enhancing the participation of groups traditionally underrepresented in mathematics. The second issue concerns making student activities an integral part of such AMS core activities as meetings, publications, and membership services. The LRPC has charged the various committees and planning units to take these issues into account in all of their planning activities.

Timetable

The 1993 Operating Plan will be presented to the ECBT for endorsement at its meeting in November 1992. At that time, the ECBT will consider specific action items stemming from the Plan. In addition, a status report on the Plan will be presented to the Council at its meeting in September 1992, and the final version of the Plan will be discussed at the Council meeting in January 1993. The membership is invited to provide comments and suggestions to members of the Council, the ECBT, and the various committees involved in the 1993 planning process. For more information, contact Timothy Goggins, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248; telephone 401-455-4110; email: tjg@math.ams.com.

Sponsored Membership Program

The American Mathematical Society has a sponsored membership program which allows individuals and organizations to "sponsor" eligible mathematicians for membership in the Society by paying their membership dues. This program enables individuals who may not otherwise be able to pay the dues to be members of the Society. Eligibility for sponsorship is limited to individuals residing in countries with currency restrictions or in developing countries. The individual being sponsored need not be a current member of the Society. For 1993 the sponsored member dues rate will be \$27.

If you know an individual whose membership you would like to sponsor or if you would like to learn more about the program, please contact Carol-Ann Blackwood, Membership Manager, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248 or via email to cmr@math.ams.com or amsmem@math.ams.com.

News and Announcements

Ellis Kolchin 1916–1991

Ellis Robert Kolchin (April 18, 1916 – October 30, 1991) died at his home near Columbia University after a summer-long struggle with pancreatic cancer. Until that summer he continued his research and active participation in the seminar that he founded twenty-five years ago.

Except for service in naval intelligence during WWII, Kolchin spent virtually his entire career at Columbia University, where he attended college and earned a Ph.D. in 1941, working with J. F. Ritt. He chaired the Department of Mathematics from 1963 to 1968 and retired as the Adrain Professor of Mathematics in 1986. As Adrain Professor Emeritus, he continued vigorous research and his characteristic devotion to his research students. His Differential Algebra Seminar, the longest ongoing mathematics seminar at Columbia, continues to this day. His two books, *Differential Algebra and Algebraic Groups* (1973), and *Differential Algebraic Groups* (1985), the latter the subject of his 1975 AMS Colloquium Lectures, are definitive reference works in this field.

Kolchin was a Guggenheim Fellow (in Paris) during 1954–1955, and again in 1961–1962. His fluency in Russian facilitated his efforts to foster contacts with Soviet scientists. As early as 1965, he was an Exchange Lecturer in the USSR, jointly sponsored by the U.S. and Soviet Academies of Science. He has held visiting positions at the Institute for Advanced Study in Princeton, the University of Paris, the Tata Institute in Bombay, the Kyoto Mathematics

Institute, and at Rutgers and Bucknell Universities. He was a Fellow of the American Academy of Arts and Sciences and of the American Association for the Advancement of Science.

Kolchin's mathematical work, like his life, is remarkable for its integrity. He devoted almost his entire career to differential algebra, a subject that he christened and nurtured. Differential algebra is the study of algebraic differential equations by algebraic methods. It was founded in the work of Kolchin's mentor, J. F. Ritt, and built into the imposing edifice that it has become mainly by Kolchin and his students.

The early work of Ritt and Kolchin was concrete and computationally effective, introducing methods resembling the Grobner bases and other tools of modern computational algebraic geometry. Kolchin belonged more to the post-Emmy Noether era. Influenced strongly by Weil and Chevalley (then Kolchin's colleague at Columbia), Kolchin recast the subject in the style of modern algebraic geometry, with the additional presence of derivation operators.

For ordinary differential equations, he thus first developed the Galois theory of differential fields, a theory that encompassed and made rigorous the 19th century work of Picard and Vessiot. Here the finite Galois groups of nondifferential algebra become instead finite dimensional algebraic groups. At the time of this work, there was no general theory of algebraic groups, the only recourse being to treat them as special cases of Lie groups. Kolchin was thus led to inaugurate a proper general theory of algebraic groups, over any field, work from which we inherit the Lie-

Kolchin theorem. This theory was later consummated in the hands of Chevalley and Borel. Kolchin's early focus was on solvable groups, in connection with the differential analogue of solvability by radicals, namely solvability by adjunction of algebraic functions, integrals, and exponentials of integrals, a condition characterized by solvability of the differential Galois group. These so called Liouvillian extensions have been further studied by Rosenlicht, M. Singer, and Risch.

In addition to the lifetime enterprise of extending the foundations of algebraic geometry and of the theory of algebraic groups to the differential algebraic setting, Kolchin showed an interest also in questions of a more arithmetic nature. For example, the differential analogue of the Thue-Siegel-Roth Theorem asks about rational (function) approximation to a solution of an algebraic differential equation with rational coefficients. In this connection, Kolchin showed that the appropriate differential analogue of the degree of a polynomial is the "denomination" of a differential polynomial $f(y_1, \dots, y_n)$, which he defined to be the least integer d such that $y_0^d f(y_1/y_0, \dots, y_n/y_0)$ is a differential polynomial. The differential polynomials in n variables of denomination at most d form a vector space over the coefficient field of dimension, say, $\text{den}(n, d)$. In connection with Kolchin's work, W. Schmidt showed that $\text{den}(n, d) \geq (n+1)^d$. It is not even known in general if $\text{den}(n, d)$ is finite. A draft manuscript left by Kolchin at his death contains preliminary efforts toward showing that $\text{den}(n, d) = (n+1)^d$.

Those who had the good fortune to know Ellis Kolchin personally will remember a man of extraordinary kindness, sensitivity, and generous and loyal friendship. His research students benefited from his insights, his technical power, his patient and supportive mentoring, and his unceasing personal concern for their well being. He was a man of rare charm and virtue. Countless mathematicians and friends enjoyed the rich hospitality of the Kolchins (Ellis and his wife Kate) at their Riverside Drive apartment.

In Kolchin's memory, a lecture fund is being established at Columbia University.

Hyman Bass, Columbia University
Phyllis Cassidy, Smith College

Elections to the National Academy

The National Academy of Sciences has announced the election of fifty-nine new members and fourteen foreign associates in recognition of their distinguished and continuing achievements in original research. There were several appointments made that are likely to be of interest to the mathematical sciences community: DONALD L. BURKHOLDER, professor of mathematics and statistics, University of Illinois at Urbana-Champaign; MELVIN HOCHSTER, R. L. Wilder Professor of Mathematics, University of Michigan; GEORGE LUSZTIG, professor of mathematics, Massachusetts Institute of Technology; ROBERT MACPHERSON, professor of mathematics, Massachusetts Institute of Technology; and HARRY L. SWINNEY, Tull Centennial Professor and director, Center for Nonlinear Dynamics, University of Texas at Austin. Elected as foreign associates were STEPHEN W. HAWKING, Lucasian Professor of Mathematics, department of applied mathematics and theoretical physics, Cambridge University; and JACQUES TITS, professor of mathematics, Collège de France.

Prizes of the Mathematical Society of Japan

A number of prizes have been awarded by the Mathematical Society of Japan.

The 1992 Spring Prize was awarded to HARUZO HIDA of the University of

California at Los Angeles, for his outstanding contribution to the theory of p -adic Hecke algebras, representations of Galois groups, and p -adic L -functions of automorphic forms.

The 1992 Geometry Prize was awarded jointly to AKIRA FUJIKI of Kyoto University, for his outstanding contribution to the theory of moduli spaces of Kähler manifolds; and to NORIHITO KOISO of the University of Osaka Prefecture, for his outstanding contribution to the deformation theory of Einstein metrics.

The 1992 Asahi Prize was awarded to GORO SHIMURA of Princeton University for his outstanding contribution to number theory. The annual Asahi Prize is given by the Asahi Shimbun to a certain number of individuals and groups for distinction in arts, sciences, and other areas. The Asahi Shimbun is one of the major Japanese newspaper companies.

National Science Board Appointment

John Hopcroft, professor of computer science at Cornell University and chair of the Board of Trustees for the Society for Industrial and Applied Mathematics, has been appointed to the National Science Board. The twenty-five-member board sets policy for the National Science Foundation. Phillip A. Griffiths of the Institute for Advanced Study and Jaime Oaxaca of Coronado Communications Corporation also sit on the Board.

AMS Awards Prizes at the International Science and Engineering Fair

The American Mathematical Society presented Karl Menger Memorial awards to seven high school students at the 43rd International Science and Engineering Fair (ISEF), held May 10–16, 1992, in Nashville, Tennessee.

Each of the 753 invited projects had already won regional prizes in the states, territories, and other countries. There were only 26 entries in mathematics this year, about half the number entered in mathematics from last year's fair. In addition, 16 exhibits from other science categories were judged by the

10 mathematics judges representing the AMS.

The cash awards and certificates were accompanied by a booklet about Karl Menger and also the book *Stories about Maxima and Minima* (Mathematical World, Volume 1). The cash prizes given by the AMS were more than double those given by any of the other 61 professional societies giving awards and, as a result, interest was very keen among the 2,000 or so students and families at the awards ceremony.



Back row: Yen-Hsiang Li, Jonobie Dale Baker, John A. Kelingos, Joshua Brody, and Robert Jordan Pollack. Front Row: Mahesh Kalyana, Mahanthappa, Andrew Olstrom Dittmer, and Harrison Kwei Tsai. (Photo courtesy of *FocusOne*.)

First prize (\$1,000) went to MAHESH KALYANA MAHANTHAPPA, Fairview High School, Boulder, CO, for "On the Diophantine Equation $X^3 + 3 = 4^n$ ".

Two second prizes of \$500 each went to HARRISON KWEI TSAI, Loomis Chaffee School, Windsor, CT, for "Chaos in Lanchestrian Combat Models," and to ANDREW OLSTROM DITTMER, Thomas Jefferson High School for Science and Technology, Alexandria, VA, for "Abelian Rings: Wherein Every Zero Divisor is Nilpotent".

Four third place prizes of \$250 each went to JONOBIE DALE BAKER, Theodore Roosevelt High School, Kent, OH, for "Designing and Implementing a Four-Dimensional Graphics Language"; to JOSHUA BRODY, Paul D. Schrieber High School, Port Washington, NY, for "Restrictions in the Number/Size of Parts in Composition Theory"; to YEN-HSIANG LI, Provincial Chia-Yi Senior High School, Republic of China, for "Length Properties in a Regular Polygon"; and to ROBERT JORDAN POLLACK, Bronx High School of Science, Bronx, NY, for "An Analysis of Continued

Fractions over a Polynomial Ring”.

The judges were Bettye Anne Case and Jack Quine from Florida State University, John Kelingos (chair), Denise Kirschner, and Steven Tschantz from Vanderbilt University, Kenneth Stephenson from the University of Tennessee, Ralph Faudree from Memphis State University, Teresa Edwards from Spellman College, Horacio Porta from the University of Illinois, and Thomas Potter with TCS Management Group in Nashville, TN.

The Society's participation in the ISEF is supported, in part, by income from the Karl Menger Fund, which was established by the family of the late Karl Menger. Individuals interested in supporting the Society's participation in this program may send their contributions to the Karl Menger Fund, AMS, Box 1572, Annex Station, Providence, RI, 02901-1571.

John A. Kelingos
Vanderbilt University

Small Businesses Receive Grants

The National Science Foundation (NSF) has announced 200 awards made in Phase I of its Small Business Innovation Research program, which funds high technology research conducted by small businesses. Under Phase I of the program, the NSF awarded up to \$50,000 to each firm, selected from 1500 proposals submitted in June 1991. Upon completion of Phase I research, awardees are encouraged to submit proposals for Phase II research programs, which receive grants of up to \$300,000 for up to two years. Private investors fund Phase III, which includes product development, manufacturing, and marketing.

Funded in this round of Phase I awards were six projects in the mathematical sciences. The names of the businesses, their locations, and their project titles are: Applied Mathematics, Inc., Gales Ferry, CT, *Dynamics of fluid mixing in time-dependent viscous wakes, jets, and shear layers*; Daat Research, Lyme, NH, *A new method for adaptive grid generation*; Dynaflow, Inc., Fulton, MD, *Bubble nuclei measurement via an inverse acoustic scattering technique*; MO-SCI Corporation, Rolla, MO, *Computational de-*

velopment of order restricted statistical inference; OLTech Corporation, Cleveland, OH, *Computer modeling of stochastic groundwater flow*; and Weidlinger Associates, Los Altos, CA, *Parallel, asynchronous global optimization techniques for medium and large inversion problems*.

1992 BMS Chairs' Colloquium

The 1992 Mathematical Sciences Department Chairs Colloquium, sponsored by the Board on Mathematical Sciences of the National Research Council, will be held October 16–17, 1992 in Arlington, VA.

The theme of the 1992 Colloquium is “Chairing the Changing Mathematical Sciences Department of the 1990s.” The keynote speaker will be D. Allan Bromley, Assistant to the President for Science and Technology. Speakers and panel members will include chairs of mathematical sciences departments, university administrators who come from the mathematical sciences community, staff from the House Science Subcommittee, representatives of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), and representatives of federal research and education programs.

The goal of the Colloquium is to provide department chairs and candidates for appointment as chairs with current information on the changing interaction among research and education in core mathematics, applied mathematics, statistics, and operations research, as well as news about trends in Washington that affect mathematical sciences departments.

Don't miss this important and informative annual event. For more information, contact: Board on Mathematical Sciences, National Research Council, NAS 312, 2101 Constitution Avenue, NW, Washington, DC 20418; telephone 202-334-2421; fax 202-334-1597; email bms@nas.edu or bms@nas.bitnet.

New Czech Mathematics Journal

A new mathematical journal, *Acta Mathematica et Informatica Universitatis Ostraviensis*, will be established by the department of mathematics at the Uni-

versity of Ostrava. The journal will be devoted to new results in all areas of pure mathematics and theoretical aspects of computer science. The first issue will appear in early 1993. For more information, or to submit a paper, contact the editor, Prof. Dr. Jiří Močkoř, Department of Mathematics, University of Ostrava, Bráfova 7, 701 00 Ostrava, Czechoslovakia.

New Mathematics Institute Formed in Québec

Montréal is fortunate in having five departments of the mathematical sciences in close proximity to each other, in fact served by a common subway system. It has been a long-cherished ambition to combine these resources in order to make better use of them. An important step in this direction has now been accomplished with the creation of l'Institut des Sciences Mathématiques (ISM). The Institute's primary goal is to offer certain high-quality programs of graduate study in mathematics by coordinating the faculty and the course offerings of its five member institutions: Concordia University, McGill University, l'Université de Montréal, l'Ecole Polytechnique, l'Université du Québec à Montréal. The ISM is funded by its five member institutions and by the province of Québec (Ministère de l'Enseignement Supérieur et de la Science). The Institute will provide financial support to students, and will initiate postdoctoral and distinguished-visitor programs in the coming year. Longer-range plans include an international program of faculty/student visits. These will be linked in many cases to the thematic years and other research activities of le Centre de Recherches Mathématiques (CRM), with whom ISM has formal ties. ISM activities will be phased in over a two-year period beginning in the fall of 1992.

The responsibility for the day-to-day functioning of ISM resides with its Steering Committee, composed of the heads and other faculty members of the five departments involved, and with its director. The founding director of ISM is Francis Clarke. ISM's Advisory Panel consists of Sir Michael Atiyah, Jean-Pierre Bourguignon, Pierre Cartier, Adriano M. Garcia, Ronald Graham,

Peter Hilton, Philip Holmes, Dusa McDuff, Louis Nirenberg, R. Tyrell Rockafellar, and Gilbert Strang.

The following is a list of ISM's programs, in which approximately 130 faculty members are involved: 1). Algebra and number theory; 2). Analysis and applications; 3). Combinatorics, algebraic computation, and algorithms; 4). Nonlinear dynamics; 5). Geometry and topology; 6). Mathematics of computing and applications; 7). Mathematical physics; 8). Probability: theory and applications; 9). Decision theory and mathematical statistics; 10). Category theory and applications.

For more information, contact the ISM coordinator at ISM, Université de Montréal, Box 6128-A, Montréal (QC) H3C 3J7; Fax: 514-343-2254; ism@ere.umontreal.ca.

**News from the
Center for Discrete Mathematics
and Theoretical Computer Science
Princeton, New Jersey**

As the national NSF science and technology center in discrete mathematics and theoretical computer science, DIMACS—a consortium of Princeton and Rutgers Universities, AT&T Bell Laboratories, and Bellcore—is seeking suggestions for topics for either individual workshops or special year programs for the academic years 1993 and beyond.

Each year DIMACS runs a special year program in some important area with a national organizing committee. Each program includes 5 or 6 workshops, many short-term visitors, and a few Postdoctoral fellows. Special years to date have been devoted to Discrete and Computational Geometry (1989–1990), Complexity Theory of Interactive Computation (1990–1991), Graphs and Algorithms (1991–1992); and those scheduled for (1992–1993) and (1993–1994) are Combinatorial Optimization and Massively Parallel Computation.

In addition, DIMACS holds three or four several-day workshops on topics of interest outside the special year (a selected list of workshops that have already occurred or will be held in the future are: Polyhedral Combinatorics (1989–1990), Computer Aided Verification (1990–1991), Groups and

Computation (1991–1992), Coding and Quantization (1992–1993), and Algebraic Combinatorics (1993–1994).

Please send your suggestions to Daniel Gorenstein, Director, DIMACS Center, Rutgers University, P.O. Box 1179, Piscataway, NJ 08855-1179; email center@dimacs.rutgers.edu. Suggestions should contain sufficient information to explain what you have in mind (at most one page in length).

Suggestions received will be discussed by the DIMACS Executive Committee at its regular meetings. The committee, which consists of members from the four participating institutions, has the responsibility for determining DIMACS scientific programs and activities.

If the Executive Committee decides it wishes to follow up on your suggestion, a DIMACS member will be in contact with you.

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

The Institute for Mathematics and its Applications (IMA) 1992–1993 academic year program is **Control Theory and its Applications**. The program Coordinators are H.J. Sussmann (Chairman), W.H. Fleming, P.P. Khargonekar, P.R. Kumar, D.L. Russell, and S.E. Shreve. The Advisory Committee is J.S. Baras, A. Bensoussan, R.W. Brockett, C. Foias, R.V. Kohn, H.J. Kushner, A.J. Laub, J.L. Lions, A.Z. Manitius, J.E. Marsden, S.K. Mitter, R.T. Rockafellar, E.D. Sontag, G. Stein, P.P. Varaiya, and J.C. Willems. The year is divided into three parts (corresponding to fall, winter, and spring quarters) although it is expected that there will be considerable fluidity between the various parts.

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

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

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

The fall program will begin with a **Tutorial**, September 8–11, 1992, organized by P.P. Khargonekar and D.L. Russell. The tutorial will include intro-

ductions to linear multivariable control, optimal design, and parameter estimation.

On September 17–19 the **SIAM Conference on Control and its Applications** will be held at the Radisson Hotel Metrodome, University of Minnesota. It is not an IMA workshop but will cover the themes of the Control year.

The workshop **Robust Control Theory**, organized by B.A. Francis and P. P. Khargonekar, will be held September 21–25. Robust control deals with the stabilization and performance optimization of systems with modelling uncertainty. This workshop will feature talks and discussions on topics of current active research on parametric robust stability theory, structured singular values, and \mathcal{H}_∞ and \mathcal{L}_∞ optimization, mathematical techniques developed for robust control system analysis.

The topics of the September workshop will be continued in the workshop **Control Systems Design for Advanced Engineering Systems: Complexity, Uncertainty, Information, and Organization**, October 12–16. The organizers are D. Enns, M. Morari, and C. N. Nett. The most natural and appropriate control system design paradigm for advanced engineering systems is: *Minimize control system complexity subject to the achievement of a specified accuracy in the face of system/environmental uncertainty*. Though academic control research has made much progress in addressing those aspects of the above paradigm related to the issue of uncertainty, in doing so those aspects of the paradigm related to the issue of complexity have been almost completely ignored. The workshop will highlight *complexity and uncertainty* as the key issues in control system design for advanced engineering systems, with emphasis on the issue of complexity, since it has received far less attention in past research. In addition, *organization of information* will be highlighted as a principal means for reducing the effects of uncertainty with a control system of low complexity. Covered topics will include Control-Oriented Modelling and System Identification; Control Configuration Design; Linear and Nonlinear

Control Law Analysis and Design; and Control Law Implementation.

On November 9–13 J. E. Lagnese, D. L. Russell, and L. White are organizing the workshop **Control and Optimal Design of Distributed Parameter Systems**. The workshop will deal with current control, stability and optimal control problems for nonlinear partial differential equations, and with questions of optimal design as they relate to partial differential equations, variational inequalities, etc. In addition to the control speakers, the organizers expect to enlist an audience consisting largely of researchers whose current efforts are mainly expended in specialized areas of the control theory of linear systems; individuals who may be influenced in a positive way by exposure to accounts of new work in nonlinear areas. Similarly, speakers will describe their optimal design research to an audience composed of other researchers active in parameter identification problems, again with the goal of encouraging greater interest in the special features and problems of optimal design studies. Extensive opportunities will be provided, both formally and informally, for questions, discussions, and other information exchanges.

During November 16–20 Max Gunzburger will run a period of concentration on **Flow Control**. The ability to control fluid flows is crucial to the design and performance of processes in a wide variety of technological applications. The objectives in flow control problems can often be cast in the form of an extremal problem for a functional of the state (velocity, pressure, vorticity, temperature, etc.) and the control variables. The mathematics of flow control involves a wide variety of skills and expertise. Traditional and novel techniques of optimization and the calculus of variations, in the setting of modern theories for partial differential equations, are used to determine and analyze mathematical models that serve to determine the optimal states and controls. In particular, the great body of work on the Navier-Stokes equations provide a starting point for the analysis of flow control problems. The development and analysis of discretization algorithms, such as those based on finite element methods, and of tech-

niques for the solution of the formidable nonlinear system of the discrete equations that result from discretization, also require novel approaches.

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

News from the Mathematical Sciences Institute Cornell University

A monthlong workshop, Patch Dynamics II, cosponsored by the Mathematical Sciences Institute's (MSI) Center for Stochastic Analysis and Cornell's Center for Applied Mathematics, will meet at Cornell's Theory Center from June 22–July 17. Immediately following, on July 17 and 18, the Center for Stochastic Analysis will host a workshop on Stochastic Partial Differential Equations at the University of Rochester, organized by Carl Mueller.

Later that same month, from July 20–24, MSI Director Anil Nerode will be program chair at the symposium on Logical Foundations of Computer Science to meet at Tver University, Russia. MSI Center Director Moss Sweedler is an organizer for the International Symposium on Symbolic and Algebraic Computation (ISSAC 92) to meet in Berkeley, CA from July 27–29, 1992. Contact J. Chiment at jjc@cornell.cit.cornell.edu for information on these events.

From September 13–15, 1992 M. Cranston of the University of Rochester will organize a workshop on Stochastic Analysis to meet at MSI in Ithaca, New York. For information, contact MSI Center Director Richard Durrett at rtd@cornell.cit.cornell.edu.

Andre Scedrov, University of Pennsylvania (andre@saul.cis.upenn.edu) and MSI's Anil Nerode are hosts for Jumelage 92 to meet in Ithaca from October 15–17, 1992. From October 21–23, A. Brown, Xerox (abrown.wbst128@xerox.com) and H. Blair, Syracuse University (blair@top.cis.syr.edu) will orga-

nize a workshop on Documents, Computation, and Preference to meet in Washington, DC. MSI is a cosponsor. Contact conference organizers for information.

Andre Scedrov will also organize an international meeting on Linear Logic to meet at Cornell University from June 14–18, 1993. Contact Scedrov at the above address or MSI for information.

Harry Kesten of Cornell and Ronald Getoor of UCSD will organize a workshop to acknowledge the contributions to the field by Cornell's Eugene Dynkin. The workshop will meet at MSI from May 22–24, 1994.

New Association for Educators of Teachers

The Association of Mathematics Teacher Educators (AMTE) has been formed to promote the discussion of issues related to the professional development of pre-service mathematics teachers and continuing education of mathematics teachers. AMTE will facilitate the professional growth and development of its members. The Association is initiating a number of activities:

- Special AMTE sessions at annual meetings of the National Council of Supervisors of Mathematics and the National Council of Teachers of Mathematics.

- Planning for sessions at future meetings of the Mathematical Association of America and of the American Mathematical Association of Two-year Colleges.

- Regional or state mathematics teacher education forums and sessions.

- Newsletter, directory, and other membership services.

The formation of AMTE is the culmination of activity and interest over many years to help meet the needs of those who educate mathematics teachers in two- and four-year colleges. The officers of AMTE are: Mark Spikell, George Mason University, President; Francis Fennell, Western Maryland College, Vice President; Judith Jacobs, California State Polytechnic University, Treasurer; and Don Balka, St. Mary's College, Secretary.

For information on joining AMTE, contact Judith Jacobs, Director of the Center for Science and Mathematics

Education, California State Polytechnic University, Pomona, CA 91768.

Group on Propositional Logics

An Interest Group on Propositional Logics has been formed to serve as a research and information clearinghouse. The group currently comprises about eighty members all over the world. The main activities include exchanging information about research problems, references, and other items of common interest; helping to obtain photocopies of papers to colleagues, especially those in Eastern Europe; supplying review copies of books through the journals in which group members are editors; helping Eastern European colleagues with visits to the West; and editing and distributing a Newsletter.

For more information or to join the group, send email with your name and address to: dg@doc.imperial.ac.uk (Dov M. Gabbay, Imperial College, London). Names will not be distributed beyond the interest group and group members will not receive junk mail.

Erratum

Graduate Education in Transition

"Graduate Education in Transition," a report of the Conference Board of the Mathematical Sciences (CBMS), was reprinted in the May/June 1992 issue of *Notices*, pages 398-403. The report is based on a conference held in May,

1991. The list of participants, keynote speakers, and CBMS staff was inadvertently omitted from the article and appears below.

List of Participants Joseph A. Applebaum, Representative, Society of Actuaries; Michael Artin, President, AMS; Lida K. Barrett, Past-President, Mathematical Association of America; Michael H. Clapp, Associate Executive Director, Mathematical Sciences Education Board; Shirley M. Frye, CBMS Executive Committee; Ramesh A. Gangolli, Chair, AMS, Committee on Education; Deborah Tepper Haimo, President, Mathematical Association of America; Carl M. Harris, Past-President, Operations Research Society of America; Kenneth M. Hoffman, Associate Executive Officer for Education, NRC; William H. Jaco, Executive Director, AMS; Henry S. Kepner, Jr., President, National Council of Supervisors of Mathematics; James R. C. Leitzel, Chair, MAA Committee on the Mathematical Education of Teachers; Donald J. Lewis, Board on Mathematical Sciences Committee on Doctoral and Postdoctoral Study in the Mathematical Sciences; Donald W. Marquardt, Representative, American Statistical Association; Rogers J. Newman, President, National Association of Mathematicians; Robert E. O'Malley, Jr., President, Society for Industrial and Applied Mathematics; Nozer Singpurwalla, Representative, Institute for Mathematical Statis-

tics; Karen T. Sharp, President, American Mathematical Association of Two-Year Colleges; Karl J. Smith, CBMS Executive Committee; Ivar Stakgold, CBMS Chair; Lynn A. Steen, CBMS Past-Chair; Marcia P. Sward, Executive Director, Mathematical Association of America; James A. Voytuk, BMS Staff Project Director for the Committee on Doctoral and Postdoctoral Study in the Mathematical Sciences; and Carol S. Wood, President, Association for Women in Mathematics.

Keynote Speakers Calvin C. Moore, Associate Vice President for Academic Affairs, University of California at Berkeley; and Luther S. Williams, Assistant Director for Education and Human Resources, National Science Foundation.

CBMS Staff Ronald C. Rosier, CBMS Administrative Officer; and Lisa R. Kolbe, CBMS Administrative Assistant.

San Antonio Meeting

In the article about Special Sessions and Contributed Paper Sessions at the Joint Mathematics Meetings in San Antonio that appeared in the May/June issue, the dates given for the meeting are in error. The incorrect dates also appeared in the Table of Contents. The correct dates for the San Antonio meeting are January 13-16, 1993. These are the dates that appear on the inside front cover. We regret the error.

Funding Information for the Mathematical Sciences

AMS Centennial Fellowships Invitation for Applications, 1993–1994

Deadline December 1, 1992

These fellowships are intended to provide enhanced research opportunities to mathematicians who are several years past the Ph.D., who have a strong research record, but who have not had extensive postdoctoral research support in the past. Applicants should have received the Ph.D. degree between January 1, 1981, and December 31, 1986, and should not have had the equivalent of more than two years of full-time post-doctoral support.

The stipend for fellowships awarded for 1993–1994 has been set by the Trustees of the Society at \$41,500 for nine months. In addition, there will be an expense allowance of \$1,350. Applicants must be citizens or permanent residents of a country in North America. The fellowship may be combined with other stipends and/or part-time teaching; this option can be used to extend the award to cover a period of up to two years. For further information about the acceptability of such arrangements, contact the Secretary of the Society.

The number of fellowships to be awarded is small and depends on the amount of money contributed to the program. The Trustees have arranged a matching program from general funds in such fashion that funds for at least one fellowship are guaranteed. Because of the generosity of the AMS membership, it has been possible to award two or three fellowships a year for the past six years.

The deadline for receipt of applications is **December 1, 1992**. Awards

will be announced in February 1993, or earlier if possible.

For application forms, write to the Executive Director, American Mathematical Society, P.O. Box 6248, Providence, RI 02940. (It should be noted that completed application and reference forms should **NOT** be sent to this address, but to the address given on the forms.)

Mathematical Sciences Postdoctoral Research Fellowships

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

The fellowships will be offered only to persons who 1. are citizens, nationals, or lawfully admitted permanent resident aliens of the United States as of January 1, 1993; 2. will have earned, by the beginning of their fellowship tenure, a doctoral degree in one of the mathematical sciences; 3. will have held the doctorate for no more than five years as of January 1, 1993; and 4. will not previously have held any other NSF postdoctoral fellowship. It is expected that in FY 1993, thirty to forty awards will be made. The evaluation of applicants will be based, in part, on ability as evidenced by past research work and letters of recommendation, likely impact on the future scientific development of

the applicant, and scientific quality of the research likely to emerge. Applicants' qualifications will be evaluated by a panel of mathematical scientists.

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

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

NSA Grants and Sabbatical Programs

The National Security Agency (NSA) provides grants for research in a number of areas of the mathematical sciences: algebra, discrete mathematics, number theory, probability, and statistics, as well as cryptology. Grants may cover some summer salary, travel, partial support of graduate students, partial support of conferences, and so on. Except for the area of cryptology, where proposals are reviewed internally by NSA, each proposal is rated by a panel appointed by the AMS after the panel first obtains scientific evaluations from reviewers selected by the panel members. Grants for young investigators (before tenure) and for senior investigators are available. The deadline for proposals is **October 15, 1992**.

NSA also has a program supporting sabbaticals for academic mathematical scientists to visit NSA, usually for nine

or twelve months. In addition to a supplement to the university's stipend to bring the visitor's salary up to his or her regular monthly salary, a choice is offered of either an allowance for moving expenses or a housing supplement. American citizenship for the applicant and all immediate family members is required. Because a complete background investigation is required, there is an early deadline, which this year was conservatively set at **August 1, 1992** for a sabbatical at NSA in 1993-1994. Although applications received after this date will be considered, those applying late should bear in mind that offers may already have been made to those who applied by the deadline. In addition, those who have received an offer but who had applied late may not always get their first choice of starting date.

For more information on the grants program or the sabbatical program, contact: Charles F. Osgood, Director, NSA Mathematical Sciences Program, National Security Agency, Attention R51A, Ft. George G. Meade, MD 20755-6000; telephone 410-859-6659 (after approximately September 1 the number will change to 301-688-0400); email: msp@titan1.math.umbc.edu.

Support for Hosting Soviet Scientists

The National Research Council (NRC) has initiated a program by which American scientists and engineers can host colleagues from the newly independent states of the former Soviet Union for one academic year (up to nine months) to carry out joint research in U.S. universities and private research institutions. The foreign specialists may also present guest lectures, teach seminars, and consult with other organizations.

Funded by the U.S. Agency for International Development, the program is intended to allow scientists and engineers from the former Soviet Union who have worked in defense-related research to apply their skills to civilian activities. Those with a strong potential to contribute to the development of the private sector in their home countries will receive special consideration, so placement in U.S. university labora-

tories with strong industrial ties is of particular interest.

All visits must commence in the calendar years 1992 or 1993. All application materials must be filled out by the American host, who also has responsibility for making logistical and administrative arrangements for the visit and for obtaining J-1 visas for the visitor(s).

Proposals will be considered in the following fields: applied mathematics/statistics, control theory, computer science, aeronautics, applied physics, materials science, nuclear science, electronics, chemistry, microbiology, virology, and all branches of engineering.

There are two upcoming deadlines, **September 14, 1992** and **March 1, 1993**. For more information and applications, contact: Office for Central Europe and Eurasia, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418; telephone 202-334-3680; fax 202-334-2614.

Research Experiences for Undergraduates

The Division of Mathematical Sciences of the National Science Foundation (NSF) has for the past few years supported the Research Experiences for Undergraduates (REU) program, which gives undergraduate students the opportunity to engage in hands-on research activities. The REU Sites component supports intensive, residential summer programs. The REU Supplements component provides supplements to existing research grants to support undergraduate research activities; REU Supplements may be requested at any time.

Budget requests for REU Site proposals should average \$5,000 per student (bottom line) with an average of \$2,500 budgeted for each student's stipend. For academic year support on REU Supplements, a rate—often the campus rate for undergraduate support—should be arranged by consulting with the appropriate program director. Indirect cost is 25% of student stipends. No other indirect cost should be requested.

REU Sites should involve at least six students, and they ordinarily do not exceed twelve. After student stipends and indirect costs have been calculated,

faculty salary may be charged to REU Site grants, keeping in mind the \$5,000 limitation.

Applications for REU Sites should arrive at NSF by **October 1, 1992**. Information and guidelines are available from: John Ryff, REU Coordinator, Division of Mathematical Sciences, Room 339, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-3456; fax 202-357-3699; email jryff@nsf.gov (Internet) or jryff@nsf (Bitnet).

Mittag-Leffler Stipends for Young Researchers

Stipends for young researchers in mathematical physics and partial differential equations are available for visits to the Mittag-Leffler Institute during the spring of 1993. The National Science Foundation has provided support for young researchers to attend the U.S.-Sweden Workshop in Spectral Methods in Mathematical Physics, which will coincide with the second half of a special year at Mittag-Leffler devoted to the same topic. The Workshop will cover the quantum mechanical many-body problem, problems in solid state physics, and asymptotic methods.

Applications are solicited from advanced graduate students and new doctorates (within five years of the degree) who would like to participate in the workshop for at least two months in the period from January to May, 1993. The stipends will include round trip airfare and living expenses while at Mittag-Leffler (approximately \$2500 per month). Applicants must hold a position at a U.S. institution. The selection committee for the stipends consists of: Ira Herbst, University of Virginia; Peter Hislop, University of Kentucky; Jim Ralston, University of California at Los Angeles; Mary Beth Ruskai, University of Lowell; and Barry Simon, California Institute of Technology.

Requests for more information may be directed to: Peter Hislop, Mathematics Department, University of Kentucky, Lexington, KY 40506-0027. To apply, send a letter of interest, curriculum vitae, publication list, and at least two letters of recommendation to Hislop by **October 1, 1992**.

For Your Information

Women Faculty in Top Departments

In an article that was widely read in the mathematical sciences community, *Science* magazine reported on the tenure suit that mathematician Jenny Harrison has brought against the University of California at Berkeley (*Science*, vol. 252, 28 June 1991, pages 1781–1783). Part of the article focused on the fact that there are very few women in what *Science* called the “Top Ten” mathematics departments: Berkeley, California Institute of Technology, University of Chicago, Columbia University, Harvard University, Massachusetts Institute of Technology, University of Michigan, Princeton University, Stanford University, and Yale University.

The article reported that, out of 303 tenured faculty in these departments, there were only four women, and that, out of 86 untenured faculty, there was only one woman. After a *Notices* article quoted these figures (September 1991, page 735) one of the ten institutions contacted the *Notices* to say that the figures *Science* published for untenured faculty may not be accurate. Part of the problem likely stems from the fact that there are many different kinds of untenured positions in mathematics departments. The *Science* article did not make clear exactly what kinds of untenured positions were counted.

To help clarify the picture, it was decided to report here data from the 1991 Annual AMS-MAA Survey on the number of women in the ten departments. Although the numbers here differ from those reported in *Science*, the basic picture—that of underrepresentation of women in top mathematics departments—remains the same. In addition, the figures in *Science* appear to refer to the 1990–1991 academic year, whereas the AMS-MAA Survey figures were collected at the start of the 1991–1992 academic year.

Because departments’ participation in the AMS-MAA Survey is based on the assurance that data on individual departments will not be released, the *Notices* is at liberty to present here only aggregate figures. In addition, the data for the AMS-MAA Survey is complete for only eight of the ten departments. In the case of one of the departments, the data came through personal communication, not through the Survey.

Number of Full-Time Faculty in Nine Mathematics Departments in 1991

Total Tenured Faculty	275
Women Tenured Faculty	5
Total Nontenured	180
Women Nontenured	20

In a related matter, a different article in the September 1991 issue of the *Notices* focused on the mathematics departments that produce the most women doctorates. The article contained a table listing the departments that are “top producers” in terms of percentage of women among doctorates produced between 1980 and 1990 (Table 2, “Leading U.S. doctorate-granting departments of mathematics by percentage of women doctorates, from academic year 1980–1981 to 1989–1990,” page 716). The data in this table came from the AMS-MAA Annual Survey. Since the appearance of the article, it was brought to the attention of the *Notices* that the data submitted to the Survey for Louisiana State University undercounted the number of women mathematics doctorates produced by that institution. The Survey data indicated that women comprised 23% of the doctorates granted by that department between 1980 and 1990; however, the correct figure is 28%. Therefore, Louisiana State should have been listed in Table 2.

Houston Fetes Lions and Marchuk

In May of this year, the University of Houston awarded honorary doctorates to J.-L. Lions and G. I. Marchuk and held a symposium encompassing a wide range of scientific areas reflecting the research interests of these two mathematicians.

Lions and Marchuk have both received international acclaim for their contributions to science and mathematics. Their work has had a major impact on the theory and computation of solutions to systems of partial differential equations and the application of these systems in science and engineering. Lions serves as the president of both the Centre National d’Etudes Spatiales (the French equivalent of NASA) and the International Mathematical Union. He received the Japan Prize in 1991 and delivered the von Neumann Lecture of the Society for Industrial and Applied Mathematics in 1986. Marchuk is currently director of the Institute of Numerical

Mathematics of the Russian Academy of Sciences in Moscow. He served as the last president of the Soviet Academy of Science. His other honors include the Lenin Prize and an honorary doctorate from Tel Aviv University.

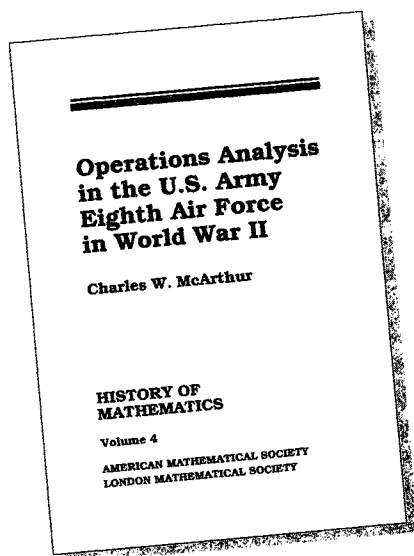
In recent years, Lions has focused on mathematical problems related to space and the environment. Marchuk has worked on mathematical immunological questions, as well as on questions relating to space and the environment. To reflect these combined interests, the mathematics department

at the University of Houston held a three-day symposium on the environment, space, and immunology, organized by faculty members Roland Glowinski and Garret Etgen. Fourteen speakers spanned a range of areas, from medical specialties, to the energy industry, to the academic disciplines of mathematics, biology, chemistry, physics, and engineering. Approximately 250 people attended the symposium, which included a speech by Hans Mark, chancellor of the University of Texas System, on space exploration and its social impact.

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1991 *Mathematics Subject Classification*: 01
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1992 AMS Elections

Council Nominations

Vice President, Members-at-Large, Trustee

One vice-president, five members-at-large of the Council, and one trustee will be elected by the Society in a contested election in the fall of 1992.

The vice-president will serve for a term of three years effective February 1, 1993. The Council has nominated two candidates for the position, namely:

Melvin Hochster Anil Nerode

The five members-at-large will serve for a term of three years. The Council nominated ten candidates, namely:

James H. Curry Peter Li
Gloria C. Hewitt Kenneth A. Ribet
Svetlana R. Katok Philip D. Wagreich
Steven George Krantz Jonathan M. Wahl
James I. Lepowsky Susan Gayle Williams

The trustee will serve for a term of five years. The Council nominated two candidates, namely:

Roy L. Adler Richard W. Beals

President's Candidates

Nominating Committee for 1992 and 1993

Three members of the Nominating Committee are to be elected in the fall of 1992. Continuing members are: Michael Aschbacher, Daniel M. Burns, Jr., Jerry L. Kazdan, Joseph Lipman, Walter David Neumann, Carol S. Wood. President Michael Artin has named six candidates for the other three positions:

Jerome A. Goldstein Louise A. Raphael
Vaughan F. R. Jones Yum Tong Siu
Brian J. Parshall Nancy K. Stanton

Editorial Boards Committee

Two members of the Editorial Boards committee are to be elected in the fall of 1992. Continuing members are: Richard James Milgram, Bhama Srinivasan, Nolan R. Wallach, Robert J. Zimmer. President Michael Artin has named four candidates for the other two places:

Bryan J. Birch Paul H. Rabinowitz
Fan R. K. Chung Masamichi Takesaki

Robert M. Fossum
Secretary
Urbana, Illinois

Dayton, Ohio
Wright State University
October 30–31, 1992

First Announcement

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

Invited Addresses

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

Martin Golubitsky, University of Houston, *title to be announced*.

Jonathan I. Hall, Michigan State University, *title to be announced*.

Louis H. Kauffman, University of Illinois at Chicago, *From knots to topological quantum field theory and back*.

J. Toby Stafford, University of Michigan, *title to be announced*.

Special Sessions

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

Hyperbolic manifolds, **Colin C. Adams**, Williams College, and **Ara S. Basmajian**, University of Oklahoma.

Quantum groups and regular algebras, **Carolyn A. Dean**, University of Michigan, **Timothy J. Hodges**, University of Cincinnati, and **J. Toby Stafford**, University of Michigan.

Operator theory and operator algebras, **Joanne M. Domrowski** and **Richard Mercer**, Wright State University.

Combinatorics and graph theory, **Anthony B. Evans** and **Terry A. McKee**, Wright State University.

Groups and geometries, **Daniel E. Frohardt**, Wayne State University.

Control theory and partial differential equations, **Lop Fat Ho**, Wright State University, **Srdjan D. Stojanovic**, University of Cincinnati, and **Thomas Svobody**, Wright State University.

Differential and integral equations, **Muhammad N. Islam**, University of Dayton, and **Lawrence Turyn**, Wright State University.

Knots and topological quantum field theory, **Louis H. Kauffman**.

Riccatti equations and transport theory, **Hendrik J. Kuiper**, Arizona State University, and **Tapas Mazumdar**, Wright State University.

Topology of affine hypersurfaces and related number theory, **Anatoly S. Libgober**, University of Illinois at Chicago, and **Stephen Sperber**, University of Minnesota.

Set-theoretic topology, **Joe D. Mashburn**, University of Dayton.

Function theory, **C. David Minda**, University of Cincinnati.

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

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in Departments of Mathematics. Abstracts should be sent to the Abstracts Coordinator, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, Rhode Island 02940, so as to arrive before the **August 3, 1992 abstract deadline**. Participants are reminded that a charge of \$16 is imposed for retyping abstracts that are not in camera-ready form. Late papers will not be accommodated.

Electronic Submission of Abstracts

This service is available to those who use the \TeX typesetting system and can be used with abstracts of papers to be presented at the sectional meetings of the AMS. Requests to obtain the package of files may be sent electronically on Internet to **absrequest@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: Abstracts Coordinator, Meetings Department, American Mathematical Society, P.O. Box 6887, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain \TeX , \AMS-TeX , or the \L\ATeX package.

Registration

The meeting registration desk will be located in the Russ Engineering Center, in the lobby on the first floor. The registration desk will be open from 10:00 a.m. to 5:00 p.m. on Friday, October 30, 8:00 a.m. to 5:00 p.m. on Saturday, October 31, and 8:00 a.m. to 10:00 a.m. on Sunday, November 1. The registration fees are \$30 for members of the AMS, \$45 for nonmembers, and \$10 for students or unemployed mathematicians.

Accommodations

Rooms have been blocked for participants at three lodgings adjacent to the Wright State Campus: the Holiday Inn (Fairborn I-165 location), Homewood Suites, and the Red Roof Inn (Fairborn location). Rooms have also been blocked at two lodgings in central Fairborn: the Ramada Inn (Fairborn location), and the Comfort Inn Wright-Patterson. Participants should make their own arrangements with the hotel of their choice and ask for the AMS conference rate.

Fairborn is a suburb of Dayton and most lodgings are chains with other locations in the metropolitan Dayton area. Thus, participants are advised to verify the street address of the lodging when making reservations. All rates are subject to a twelve percent tax. **The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.**

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

616 North Broad Street, Fairborn, OH 45324

Telephone: 513-879-7666 or 800-245-3127

The deadline for reservations is October 16, 1992.

Single \$39 Double \$43

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

2800 Presidential Drive, Fairborn, OH 45324

Telephone: 513-426-7800 or 800-465-4329

The deadline for reservations is October 9, 1992.

Flat rate \$44 up to four occupants

Hollywood Suites (0.5 miles from Russ Engineering Center)

2750 Presidential Drive Fairborn, OH 45324

Telephone: 513-429-0600 or 800-225-5466

The deadline for reservations is October 9, 1992.

Flat rate \$69 suite with king bed, sleeper sofa (up to four occupants)

Ramada Inn (5 miles from Russ Engineering Center)

800 North Broad Street, Fairborn, OH 45324

Telephone: 513-879-3920 or 800-272-6232

The deadline for reservations is October 16, 1992.

Single or double occupancy \$42

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

2580 Colonel Glenn Highway, Fairborn, OH 45324

Telephone: 513-426-6116 or 800-874-9000

The deadline for reservations is October 20, 1992

Single \$35.99 Double \$42.99 Triple \$45.99

Food Service

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

Parking

Free on-campus parking in selected lots will be available to participants. Details regarding location will be announced in subsequent issues of the *Notices*.

Weather

The average temperatures in Dayton for November 1 are 57-58°F (high) and 38-39°F (low). The closest local attraction is the United States Air Force Museum, approximately a ten-minute drive from campus. This is the largest military aviation museum in the world. Admission is free. The museum is open from 9:00 a.m. to 5:00 p.m. every day. Exhibits include about two hundred aircraft and missiles, many other displays of related historical artifacts, and free documentary films. For a \$4 admission, one can also view films in the huge-screen IMAX Theater. Rounding out the facility are a book shop, gift store, and cafe.

Andy R. Magid

Associate Secretary

Norman, Oklahoma

Los Angeles, California
University of Southern California
November 7–8, 1992

First Announcement

The eight-hundred-and-seventy-seventh meeting of the American Mathematical Society (AMS) will be held at the University of Southern California (USC) on Saturday, November 7, and Sunday, November 8, 1992. This meeting will take place concurrently with a meeting of the Southern California section of the Mathematical Association of America (MAA). The invited addresses will be held in the Seeley G. Mudd Building, one block east of the Denny Building, and most other sessions will be held in Kaprielian Hall, north across 36th Place from the Denny Building.

Invited Addresses

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

Robert L. Lazarsfeld, University of California, Los Angeles, *title to be announced*.

Tomasz S. Mrowka, California Institute of Technology, *title to be announced*.

Thomas C. Sideris, University of California, Santa Barbara, *title to be announced*.

Special Sessions

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

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

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

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

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

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

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

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

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in Departments of Mathematics. Abstracts should be sent to the Abstracts Coordinator, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, Rhode Island 02940, so as to arrive before the **August 3, 1992 abstract deadline**. Participants are reminded that a charge of \$16 is imposed for retyping abstracts that are not in camera-ready form. Late papers will not be accommodated.

Electronic Submission of Abstracts

This service is available to those who use the \TeX typesetting system and can be used with abstracts of papers to be presented at the sectional meetings of the AMS. Requests to obtain the package of files may be sent electronically on Internet to **absrequest@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: Abstracts Coordinator, Meetings Department, American Mathematical Society, P.O. Box 6887, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain \TeX , $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\text{\TeX}$, or the \LaTeX package.

Registration

The meeting registration desk will be located in the lobby of the Denny Research Center, on the southeast corner of Vermont Avenue and 36th Place, and will be open on Saturday, November 7, from 7:30 a.m. to 5:00 p.m. and on Sunday, November 8, from 7:30 a.m. to noon. The registration

Meetings

fees are \$30 for members of the AMS, \$45 for nonmembers, and \$10 for students or unemployed mathematicians.

Accommodations

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

University Hilton

3540 South Fuguroa Street
Los Angeles, CA 90007
Telephone: 213-748-4141

800-244-7331 (within California)

800-872-1104 (outside California)

Single \$70

Double \$75

Food Service

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

Parking

Parking permits are required and cost \$5 per day. Participants should park in Parking Structure A and note that the west end of Structure A is closest to the registration area. There are

stairwells at each corner of the building, although the only elevator in Structure A is at the northeast corner.

Travel

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

Weather and Local Information

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

Lance W. Small
Associate Secretary
La Jolla, California

Invited Addresses and Special Sessions

Invited Addresses at AMS Meetings

The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings, the list of speakers is incomplete.

Dayton, OH, October 1992

Please see the first announcement of this meeting elsewhere in this issue.

Los Angeles, CA, November 1992

Please see the first announcement of this meeting elsewhere in this issue.

San Antonio, TX, January 1993

George E. Andrews (AMS-MAA)	Wu-Yi Hsiang
Richard A. Brualdi (AMS-MAA)	Charles S. Peskin (Gibbs Lecture)
Luis A. Caffarelli (Colloquium Lectures)	Bernd Sturmfels
Jim Douglas, Jr.	Leon Takhtajan
Carolyn S. Gordon	Alexander Varchenko
	Mary F. Wheeler (AMS-MAA)

Knoxville, TN, March 1993

Paul R. Blanchard	Richard A. Tapia
Olav Kallenberg	Michelle L. Wachs

Washington, DC, April 1993

Fan R. K. Chung	Joel Spruck
Leopold Flatto	A. Zamolodchikov

Vancouver, British Columbia, Canada

August 1993

Louis Nirenberg (AMS-CMS) Jill Pipher (AMS-CMS)

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

October 1992 Meeting in Dayton, Ohio

Central Section

Associate Secretary: Andy R. Magid

Deadline for organizers: Expired

Deadline for consideration: Expired

Please see the first announcement of this meeting elsewhere in this issue.

November 1992 Meeting in Los Angeles, California

Western Section

Associate Secretary: Lance W. Small

Deadline for organizers: Expired

Deadline for consideration: Expired

Please see the first announcement of this meeting elsewhere in this issue.

January 1993 Meeting in San Antonio, Texas

Associate Secretary: W. Wistar Comfort

Deadline for organizers: Expired

Deadline for consideration: September 17, 1992

Kathleen T. Allgood and Judy A. Kennedy, *Continuum theory and dynamical systems*

Thomas Archibald and Victor Katz, *History of mathematics*

Alvaro Arias, *Banach space theory*

Charles E. Aull, *History of general topology*

Melvyn S. Berger and Daniel Goroff, *Small divisor problems in nonlinear analysis*

Scott T. Chapman, *Commutative algebra*

William J. Coles and B. A. Fusaro, *Environmental modeling*

David Cox and Bernd Sturmfels, *Combinatorial methods in computational algebraic geometry*

- Raúl E. Curto and David R. Larson, *Operator theory and triangular operator algebras*
 Michael R. Darnel, *Ordered algebraic structures*
 Robert S. Doran, *C*-algebras: 1943-1993 (a 50-year celebration)*
 Ed Dubinsky, *The state of research in undergraduate mathematics education: problems and prospects* (AMS-MAA)
 Krishan L. Duggal, *Differential geometry*
 Saber N. Elaydi, John R. Graef, and William F. Trench, *Stability and asymptotic behavior of difference equations*
 Dennis R. Estes and Donald James, *Quadratic forms*
 Naomi Fisher, Harvey B. Keynes, and Philip D. Wagreich, *Mathematics and education reform* (AMS-MAA)
 Robin Forman and John E. Luecke, *Topology and geometry*
 Dennis DeTurck and Carolyn S. Gordon, *Eigenvalues in Riemannian geometry*
 Morris W. Hirsch and Halbert White, *Dynamics and computation in neural networks*
 Hans A. Koch, Rafael de la Llave, and Charles Radin, *Dynamics of systems with infinitely many degrees of freedom*
 Xinzhi Liu and Seenith Sivasundaram, *Integro-differential equations: stability and control*
 David E. Marker and Philip H. Scowcroft, *Model theory and algebra*
 John E. McCarthy, *Holomorphic spaces*
 Alec Norton and Mary Lou Zeeman, *Low dimensional geometric dynamical systems*
 L. Alayne Parson and Mark Sheingorn, *Modular forms and related topics*
 Nikolay Reshetikhin, Leon Takhtajan, and Alexander Varchenko, *Quantum groups*

March 1993 Meeting in Knoxville, Tennessee

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

April 1993 Meeting in Salt Lake City, Utah

- Western Section
 Associate Secretary: Lance W. Small
 Deadline for organizers: Expired
 Deadline for consideration: January 6, 1993

April 1993 Meeting in Washington, DC

- Eastern Section
 Associate Secretary:
 W. Wistar Comfort (until 1/31/93)
 Lesley M. Sibner (after 1/31/93)
 Deadline for organizers: Expired
 Deadline for consideration: January 6, 1993
 Roy L. Adler and Leopold Flatto, *Geodesic flows, hyperbolic geometry, and symbolic dynamics*
 Joseph A. Ball and Cora S. Sadosky, *Dilation and interpolation: operator theoretic methods*
 John J. Benedetto and Rodney B. Kerby, *Wavelets in sampling theory and signal processing*
 Joseph E. Bonin, *Geometric methods in combinatorics*
 Nathaniel Dean, *Graph theory*
 Edward Frenkel, *Mathematical physics*
 Anant P. Godbole and Gary J. Sherman, *Undergraduate research in applied mathematics*
 Anant P. Godbole and Gary J. Sherman, *Undergraduate research in pure mathematics*
 Valentina S. Harizanov and James C. Owings, *Pure and applied recursion theory*
 Kevin G. Hockett and E. Arthur Robinson, *Ergodic theory, dynamical systems, and applications*
 Yongwu Rong, *Low dimensional topology*
 Joel Spruck, *Nonlinear elliptic problems in geometry and physics*

May 1993 Meeting in DeKalb, Illinois

- Central Section
 Associate Secretary: Andy R. Magid
 Deadline for organizers: August 21, 1992
 Deadline for consideration: February 3, 1993
 Michael A. Filaseta, *Number theory*
 Susan J. Friedlander, *Mathematical topics in fluid dynamics*
 Zoltan Furedi, *Combinatorics*
 Andrew J. Granville, *Analytic number theory*
 Frank Harary, *Beautiful graph theory*
 Steffen Lempp, *Recursion theory*
 Mohsen Pourahmadi, *Stochastic processes*
 Linda R. Sons, *Function theory*
 Joel H. Spencer, *Probabilistic methods*
 Peter Weaterman, *Discrete groups*

August 1993 Meeting in Vancouver,

- British Columbia, Canada**
 Associate Secretary: Lance W. Small
 Deadline for organizers: November 11, 1992
 Deadline for consideration: April 27, 1993

October 1993 Meeting in College Station, Texas

- Central Section
 Associate Secretary: Andy R. Magid
 Deadline for organizers: January 22, 1993
 Deadline for consideration: July 14, 1993
 Randall K. Campbell-Wright, Carl C. Cowen, Barbara D. MacCluer, *Composition operators on spaces of analytic functions*

January 1994 Meeting in Cincinnati, Ohio

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

March 1994 Meeting in Lexington, Kentucky

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

March 1994 Meeting in Manhattan, Kansas

Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 25, 1993
Deadline for consideration: To be announced

June 1994 Meeting in Eugene, Oregon

Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: September 7, 1993
Deadline for consideration: To be announced

October 1992 Meeting in Stillwater, OK

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

January 1995 Meeting in Denver, Colorado

Associate Secretary: Andy R. Magid
Deadline for organizers: April 20, 1994
Deadline for consideration: To be announced

March 1995 Meeting in Chicago, Illinois

Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 24, 1994
Deadline for consideration: To be announced

January 1996 Meeting in Orlando, Florida

Associate Secretary: Lance W. Small
Deadline for organizers: April 12, 1995
Deadline for consideration: To be announced

March 1996 Meeting in Iowa City, Iowa

Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 22, 1995
Deadline for consideration: To be announced

Information for Organizers

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

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

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

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

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

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

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

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

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

Western Section

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

Central Section

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

Eastern Section

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

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

Southeastern Section

Joseph A. Cima, Associate Secretary (until January 31, 1993)
Department of Mathematics
University of North Carolina, Chapel Hill
Chapel Hill, NC 27599-3902
Electronic mail: g_cima@math.ams.com
(Telephone 919-962-1050)

Robert J. Daverman, Associate Secretary (beginning February 1, 1993)
Department of Mathematics
University of Tennessee
Knoxville, TN 37996-1300
(Telephone 615-974-6577)

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

Electronic submission of abstracts is available to those who use the TEX typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to absrequest@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, Meetings Department, P.O. Box 6887, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain TEX , $\text{A}\text{M}\text{S}\text{-T}\text{E}\text{X}$, or the $\text{L}\text{A}\text{T}\text{E}\text{X}$ 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.

Call For Topics For 1994 Conferences

Suggestions are invited from mathematicians, either singly or in groups, for topics for the various conferences that will be organized by the Society in 1994. The deadlines for receipt of these suggestions are given below, as well as some relevant information about each of the conferences. 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 6887, Providence, RI 02940; or by telephone: 401-455-4146; FAX 401-455-4004; email: 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, thereby relieving the organizers of most of the administrative detail. Organizers should also note that for all conferences, except Summer Research Conferences, it is required that the proceedings be published by the AMS 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 chair 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. Individuals submitting conference suggestions are requested to recommend sites or geographic areas which would assist the Meetings staff in their selection of an appropriate site.

1994 von Neumann Symposium

Through a bequest from Carroll V. Newson to memorialize the late John von Neumann and his accomplishments, the Society has established a new quadrennial symposium called the von Neumann Symposium. This new conference series will focus on concepts in the forefront of mathematics, and it is intended that they occupy a position of importance in the evolution of mathematical thought. Subjects of these one-week symposia are to be topics of emerging significance, expected to underlie future mathematical development. Ideas expressed and shared at these Symposia, and the new understandings embodied

in the von Neumann proceedings, will, it is hoped, reflect exceptional mathematical leadership.

Deadline For Suggestions: September 1, 1992

1994 AMS Summer Research 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 is scheduled for August. There should be a period of at least two weeks between them. Proceedings are published by the AMS as volumes in the series *Proceedings of Symposia in Pure Mathematics*.

Current and recent topics:

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

1990 – *Differential geometry*, organized by **Robert E. Greene** of the University of California, Los Angeles, and **Shing-Tung Yau** of Harvard University.

1991 – *Algebraic groups and their generalizations*, organized by **William Haboush**, University of Illinois, Urbana-Champaign.

1992 – *Quadratic forms and division algebras: Connections with algebraic K-theory and algebraic geometry*, organized by **William Jacob** and **Alex Rosenberg**, University of California, Santa Barbara.

1993 – *Stochastic analysis*, organized by **Michael Cranston**, University of Rochester; **Richard T. Durrett**, Cornell University; and **Mark A. Pinsky**, Northwestern University.

Deadline For Suggestions: September 1, 1992

1994 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 (SIAM), and the Society for Mathematical Biology (SMB), 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:

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.

1991 – *Theoretical approaches for predicting spatial effects in ecological systems*, organized by **Robert H. Gardner**, Oak Ridge National Laboratories.

1992 – *Mathematical models in cell biology*, organized by **Byron Goldstein**, Los Alamos National Laboratory, and **Carla Wofsy**, University of New Mexico.

1993 – Proposal not yet selected.

Deadline For Suggestions: September 1, 1992

1994 AMS-SIAM Summer Seminar in Applied Mathematics

The goal of the Summer Seminar, sponsored jointly by the AMS and the Society for Industrial and Applied Mathematics (SIAM), 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:

1989 – *The mathematics of random media*, organized by **Werner Kohler** of Virginia Polytechnic Institute and State University 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 the University of California, Los Angeles.

1991 – No seminar held.

1992 – *Exploiting symmetry in applied and numerical analysis*, organized by **Eugene L. Allgower**, **Kurt Georg**, and **Rick Miranda**, Colorado State University.

1993 – *The mathematics of tomography, impedance imaging, and integral geometry*, organized by **Eric Todd Quinto**, Tufts University.

Deadline For Suggestions: September 1, 1992

1994 AMS-IMS-SIAM Joint Summer Research Conferences in the Mathematical Sciences

These conferences, jointly sponsored by the AMS, the Institute for Mathematical Statistics (IMS), and the Society for Industrial and Applied Mathematics (SIAM), emulate the scientific structure of those held at Oberwolfach and represent diverse areas of mathematical activity, with emphasis on areas cur-

rently especially active. Careful attention is paid to subjects in which there is important interdisciplinary activity at present. A one-week or two-week conference may be proposed. Topics for the eleventh series of one-week conferences being held in 1992 are: *Conformal field theory, topological field theory, and quantum groups; Cohomology, representations, and actions of finite groups; Nielsen theory and dynamical systems; The Penrose transform and analytic cohomology in representation theory; Wavelets and applications; Commutative algebra: syzygies, multiplicities and birational algebra; Change-point problems; Control and identification of partial differential equations; and Adaptive designs.*

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

Deadline For Suggestions: February 1, 1993

Call for Topics for 1994 AMS Short Course Series

The AMS Short Courses consist of a series of introductory survey lectures and discussions which take place over a period of two days prior to and during 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:

Wavelets and applications (January 1993), *New scientific applications of geometry and topology* (January 1992), *Unreasonable effectiveness of number theory* (August 1991), *Probabilistic combinatorics and its applications* (January 1991), *Combinatorial games* (August 1990), *Mathematical questions in robotics* (January 1990), *Cryptology and computational number theory* (August 1989), and *Matrix theory and applications* (January 1989). 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 should be submitted by **December 1, 1992**.

Submit suggestions to: AMS Meetings Department, P.O. Box 6887, Providence, RI 02940; FAX: 401-455-4004; email: MEET@MATH.AMS.COM.

Joint Mathematics Meetings in San Antonio

AMS Special Sessions and Contributed Papers

MAA Contributed Papers

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

AMS Special Sessions

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

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

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

AMS Contributed Paper Sessions

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

Electronic Submission of AMS Abstracts

This service is available to those who use the \TeX typesetting system and can be used for abstracts of papers to be presented at this meeting in AMS sessions only. Requests to obtain the package of files may be sent by electronic mail on the Internet to abs-request@math.ams.com. Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or

Macintosh diskettes, available free of charge by writing to: Director of Meetings, American Mathematical Society, P.O. Box 6887, Providence, RI 02940. When requesting the abstracts package, users should be sure to specify whether they want the plain \TeX , \AMS-TeX , or the \L\ATeX package. Only abstracts should be sent to abs-submit@math.ams.com. Questions regarding an abstract should be addressed to abs-misc@math.ams.com. Questions regarding meetings should be addressed to meet@math.ams.com.

MAA Contributed Papers

Contributed papers are being accepted on several topics in collegiate mathematics for presentation in contributed paper sessions at the meeting. The organizers listed below solicit contributed papers pertinent to their sessions' interests and concerns; material should be sent to the organizer whose name is followed by an asterisk (*). Please note that any days scheduled for any session are tentative. The topics, organizers, and their affiliations are:

- *Assessment programs for the undergraduate major*, Friday morning and Saturday afternoon

Charles F. Peltier*
Department of Mathematics
Saint Mary's College
Notre Dame, IN 46556
email: cpeltier@bach.helios.nd.edu
fax: 219-284-4492

James W. Stepp, University of Houston

This session sponsored by the CUPM Subcommittee on Assessment, seeks papers on use of assessment of student achievement in evaluation of undergraduate programs in mathematics. Contributors may address program evaluation (as related to assessment of student achievement), methods of assessment of individual student achievement, development of goals and criteria for assessment, or the effects of assessment on the development of programs. Contributions addressing methods of assessment or describing experience with programs for assessment are particularly encouraged.

- *"Capstone" courses for senior mathematics majors*, Wednesday and Thursday mornings

Christopher E. Barat and Pamela Crawford*
Department of Mathematics
Randolph-Macon College
Ashland, VA 23005

In recent years, there has been a dramatic increase in the number and variety of “capstone” courses designed to provide senior mathematics majors with a “summation” of their undergraduate experiences and to sharpen fundamental skills such as reading and writing mathematics, problem solving, and research techniques. This session welcomes papers describing courses of this type, as well as those discussing how such courses might be developed. Topics may include the choice of a “capstone” theme, course organization, innovative student assignments, evaluation of student performance, and the integration of “capstone” courses into existing major sequences.

- *Empowering the mathematical community*, Wednesday morning and Thursday afternoon

Gloria F. Gilmer*

Math-Tech, Inc.
9155 N. 70 St.
Milwaukee, WI 53223

Marilyn Frankenstein, University of Massachusetts, Boston

Patricia C. Kenschaft, Montclair State College

Alvin M. White, Harvey Mudd College

This session is organized by the Joint AMS-MAA-AAAS Committee on Opportunities in Mathematics for Underrepresented Minorities (COMUM) in cooperation with the MAA Committee on the Participation of Women, The Critical Math Network, and the Humanistic Math Network.

Student empowerment refers to an internal state in which students see themselves as responsible for, in control of, or the source of their own learning. When students control few elements in the learning environment, their empowerment is low; when they control many elements, it is high. Mathematically **powerful** students think and communicate, drawing on mathematical ideas and using mathematical tools and techniques. Mathematically powerful work is purposeful. Thus, papers are sought which respond to questions such as the following: What are we doing to empower students? What must the profession do to empower others at all educational levels and interests? What must the profession do to empower others at all educational levels and interests? Why are some instructional models more empowering for students than others?

- *Impact of non-traditional instructional methods on testing and evaluation*, Wednesday and Thursday afternoons

Linda H. Boyd*

Mathematics Department
DeKalb College
555 North Indian Creek Dr.
Clarkston, GA 30021

Elizabeth Teles, Montgomery College, Maryland

The session is organized by the Committee on Two-Year Colleges. Papers are requested describing the impact of non-traditional methods of instruction on testing and evaluation. These methods include but are not limited to laboratory exercises or experiments, group projects, and student presentations.

- *Interactive learning environments*, Wednesday and Thursday mornings

Katherine Pedersen*

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

Sandra Z. Keith, St. Cloud State University

Interactive learning environments in undergraduate mathematics have been a topic of growing interest in the last few years. Interactive modes of teaching include collaborative learning and cooperative learning as well as teaching/learning strategies that enable students to interact not only with each other and the instructor but with materials and technology. Typically, the student interactions are structured by the instructor for maximum benefit to the students. Technology often plays a role as group study and group assignments have been a natural outgrowth of environments that use computers and calculators. Papers for this session, sponsored by the Committee on Computers in Mathematics Education, will not be limited to those using technology. Preference will be given to papers describing, with appropriate data, the author’s own experiences in promoting interactive learning environments, especially collaborative learning and cooperative learning.

- *Linear algebra*, Wednesday and Friday afternoons, and Thursday evening

Donald R. LaTorre*

Department of Mathematical Sciences
Clemson University
Clemson, SC 29634-1907

Steven J. Leon, University of Massachusetts, Dartmouth

A. Duane Porter (for the LACSG), University of Wyoming

This session invites papers on innovations in teaching linear algebra, including: (1) the use of computer algebra systems, supercalculators, or computer software; (2) experiences with materials from the ATLAST summer workshops; (3) experiences with the Core Curriculum recommended by the Linear Algebra Curriculum Study Group; and (4) “Gems” of exposition in linear algebra; and (5) other innovative teaching or curriculum ideas in linear algebra.

- *Mathematics and the arts*, Thursday afternoon and Saturday morning

JoAnne S. Growney*

Department of Mathematics and Computer Science
Bloomsburg University
Bloomsburg, PA 17815

This session invites submissions on the following themes: (1) Application of mathematical methods of thought and design to another art form. (2) Examination of artworks/artforms in which mathematics is included in the content or in the construction. (3) Strategies/examples for teaching and learning mathematics by exploring its links with other arts.

- *Recreational mathematical computing*, Friday morning and Saturday afternoon

Dr. Michael W. Ecker*

Editor/Publisher
Recreational & Educational Computing
909 Violet Terrace
Clarks Summit, PA 18411

This session plans to present diverse recreations in which computer programming plays a supplementary but essential role. Though the computer languages and topics are open, some preference will be given to recreations and/or recreational problem-solving with widest appeal for maximum accessibility. Thus papers at a more elementary or intermediate level are particularly sought, perhaps using BASIC, QuickBASIC, or Pascal. Papers presenting recreations off the beaten path or that unify seemingly diverse themes are also most welcome. Utility software for aiding such investigations will be welcome, but more so to the extent that it is connected to particular problems. Since it is impossible to anticipate the range of topics and papers of interest, all proposals and suggestions are encouraged and will be given serious consideration.

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

Marcelle Bessman*
328 Braddock, #212
Frostberg, MD 21532
email: R2NKBES@FRE.TOWSON.EDU
fax: 813-872-9342
(May 10 – Aug. 20, mailing address will be 644 Geneva Place,
Tampa, FL 33606)

This session, sponsored by the Committee on Participation of Women in Mathematics, is a sequel to the 1987 contributed paper session "Recruitment and Retention of Women in Mathematics", which focused on the factors affecting the participation of women in mathematics. Since that time the Committee on Participation of Women in Mathematics was formed to assess the problem and develop or encourage projects designed to improve recruitment and retention of women. One such project is the recent committee publication "Winning Women into Mathematics." The purpose of this session is to learn about projects undertaken at educational institutions and agencies that employ mathematicians to encourage participation of women in mathematics. Of particular interest are presentations that describe such a project, the obstacles encountered, proposed or accomplished solutions, and projections for the future.

- *Teaching mathematics to multicultural and multilingual students*, Friday morning and afternoon

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

Demographic changes have meant that educators are now required to teach mathematics to students from a wide variety of multicultural and multilingual backgrounds. This session

welcomes papers which describe research on student learning as well as methods of teaching mathematics to these students. Descriptions of courses taught should address how these students learn mathematics, teaching methods used, and the effectiveness of these methods.

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

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

James R. King, University of Washington

This session, organized by the Committee on Computers in Mathematics Education, invites presentations that illustrate the use of visualization in mathematics teaching. Authors should send an abstract which includes a description of how visualization will be used in the presentation. In particular, if the use of computers or other technology is contemplated, include a very precise description of what is needed (it is expected that a MacIntosh and an MS-DOS-PC with overhead projection panels will be available).

- *Using data and computers in teaching statistics*, Wednesday morning and Thursday afternoon

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

George Cobb, Mount Holyoke College

The MAA/ASA Joint Committee on Undergraduate Statistics organized this session to explore the use of data and computers in undergraduate statistics courses. Contributions are specifically invited which discuss how the use of data and/or computer simulations can be used to strengthen the teaching of important concepts, to emphasize statistical thinking, and to foster active learning. Papers on upper division mathematical statistics courses are welcome as well as papers on more elementary courses.

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

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

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

along with the summary.

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

1992 Symposium on Some Mathematical Questions in Biology

Cell Biology

Denver, Colorado, November 1992

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

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

There will be sessions on Monday and Tuesday afternoons, November 16 and 17, each including three invited lectures on mathematical and biophysical approaches to problems in cell biology. The speakers and their topics are: **Micah Dembo** (Los Alamos National Laboratory), *Modeling cell adhesion*; **Elliot Elson** (Washington University School of Medicine, St. Louis), *Interpretation of measurements of cellular deformability*; **Byron Goldstein** (Los Alamos National Laboratory), *Cell activation through the aggregation of cell surface receptors*;

Jennifer Linderman (University of Michigan, Ann Arbor), *Cell-cell interactions and the activation of T cells in an immune response*; **George Oster** (University of California, Berkeley), *The dynamics of single-motor molecules*; and **Michael Reed** (Duke University), *The transport of organelles in axons*.

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

The SMB has funds for partial support of graduate students attending the symposium. Those interested in requesting support should have contacted John Rinzel, Chief, Mathematical Research Branch, NIADDKD, Bldg. 31, Room 4B-54, NIH, Bethesda, MD 20892, by June 15, 1992. The application should have included a one-page research summary and one letter from a faculty sponsor.

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

For further information on the symposium, contact the Symposium Conference Coordinator, AMS, P.O. Box 6887, Providence, RI 02940, or DLS@MATH.AMS.COM by electronic mail.

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 the *Notices* if it contains a call for papers, and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in 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 the *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 the *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

EFFECTIVE with the 1990 volume of the *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.

1992

1992. **IMACS Symposium on Symbolic Computation in Engineering Design**, IDN, Lille, France. (Jul./Aug. 1990, p. 746)

1992. **IMACS International Conference on Computational Physics**, University of Colorado, Boulder, CO. (Oct. 1990, p. 1141)

July 1992

22–25. **AT LAST: An NSF-ILAS Project to Augment the Teaching of Linear Algebra through the use of Software Tools**, University

of Maryland, College Park, MD. (Feb. 1992, p. 145)

Last week of July. **The Ninth Latin American Symposium of Mathematical Logic**, Universidad Nacional del Sur, Bahia Blanca, Argentina. (Mar. 1992, p. 246)

24–25. **Workshop on Matrix Theory**, University Bielefeld, Germany. (May/Jun. 1992, p. 490)

26–30. **Dynamics, Competition, and Neural Networks**, Dynamical Systems Institute, Boston University, Boston, MA. (Feb. 1992, p. 145)

26–31. **Eighteenth International Symposium on Rarefied Gas Dynamics (RGD18)**, University of British Columbia, Vancouver, Canada. (May/Jun. 1991, p. 477)

26–August 1. **Variationsrechnung**, Oberwolfach, Germany. (Feb. 1991, p. 147)

26–August 1. **AMS-SIAM Summer Seminar on Exploiting Symmetry in Applied and Numerical Analysis**, Colorado State University, Fort Collins, CO.

INFORMATION: D.L. Salter, AMS, P.O. Box 6887, Providence, RI 02940.

26–August 15. **SIMS Tutorial: Mathematical Sciences in Genomic Analysis**, Rutgers University. (May/Jun. 1992, p. 490)

27–29. **International Symposium on Symbolic and Algebraic Computation**, Berkeley, CA. (May/Jun. 1992, p. 490)

27–31. **Mathematical Physics of Disordered Systems**, Marseille, France. (Jan. 1992, p. 52)

27–31. **Algorithms for Approximation**, Cranfield Institute of Technology, Oxford. (Feb. 1992, p. 145)

27–August 1. **Workshop on Computational Linear Algebra in Algebraic and Related Problems**, Essen, Federal Republic of Germany. (Jan. 1992, p. 52)

27–August 1. **Interactive Mathematics Text Project: Maple for Windows**, University of Pennsylvania. (May/Jun. 1992, p. 490)

30–August 1. **The State of Matter: Conference on Mathematical Physics, Celebrating the Sixtieth Birthday of E.H. Lieb.**, Copenhagen, Denmark. (Dec. 1991, p. 1339)

August 1992

August 1992. **The International Conference Lobachevsky and Modern Geometry devoted to the 200th Anniversary of Lobachevsky's birthday**, Kazan, USSR. (Feb. 1991, p. 147)

August 1992. **Kinetics of Phase Transitions**, International Centre for Mathematical Sciences, Edinburgh, Scotland. (Oct. 1991, p. 1010)

August 1992–May 1993. **Special Year in Nonlinear PDEs and Dynamical Systems**, Brigham Young University, Provo, UT. (May/Jun. 1992, p. 490)

2–8. **Algebraische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

2–8. **Conference on Algebra and its Applications**, Middlesbrough, UK. (May/Jun. 1992, p. 490)

3–6. **Conference on Artificial Intelligence and Symbolic Mathematical Computations**, Karlsruhe, Germany. (Mar. 1992, p. 247)

3–7. **Sixth Workshop on Lie-Admissible Formulations**, Clearwater, FL. (Mar. 1991, p. 244)

3–7. **Fifth International Meeting of Statistics in the Basque Country**, San Sebastian, Spain.

(Jul./Aug. 1991, p. 646)

3-7. **Second Meeting of the International Linear Algebra Society (ILAS)**, University of Lisbon, Portugal. (Mar. 1992, p. 247)

3-8. **Ninth Latin American Symposium on Mathematical Logic**, Bahia Blanca, Argentina. (Jan. 1992, p. 52)

3-8. **Twelfth Brazilian Algebra Meeting**, Diamantina, Minas Gerais, Brazil. (May/Jun. 1992, p. 490)

3-8. **Forty-fourth International Meeting of the ICSIMT**, University of Illinois at Chicago, Illinois. (May/Jun. 1992, p. 490)

3-8. **Interactive Mathematics Text Project: Maple for Windows**, University of Pennsylvania. (May/Jun. 1992, p. 491)

3-14. **NATO Advanced Study Institute: Linear Algebra for Large Scale and Real-Time Applications**, Leuven, Belgium. (Feb. 1992, p. 145)

3-28. **IMA Summer Program for Graduate Students: Mathematical Modeling**, University of Minnesota, Minneapolis, MN. (Dec. 1991, p. 1339)

4-7. **Chaos and its Applications**, Trieste, Italy. (Jan. 1992, p. 52)

5-9. **Topology**, University of Georgia, Athens, GA. (Apr. 1992, p. 346)

7-10. **Twelfth International Symposium on Forecasting (ISF-92)**, Wellington, New Zealand. (May/Jun. 1992, p. 491)

9-12. **The Twelfth Annual International Conference on Critical Thinking and Educational Reform**, Sonoma State University, California. (Mar. 1992, p. 247)

9-13. **Joint Statistical Meetings**, Boston, MA. (May/Jun. 1992, p. 491)

9-15. **Jordan-Algebren**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

9-16. **1992 ASL European Summer Meeting (Logic Colloquium '92)**, Budapest, Hungary. (Mar. 1992, p. 247)

10-14. **Kinetics of Phase Transitions**, Edinburgh, Scotland. (Jan. 1992, p. 52)

10-14. **Summer School in the Model Theory of Fields—the Field of Real Numbers with Exponentiation**, University of Crete, Greece. (Mar. 1992, p. 247)

10-14. **NSF-CBMS Regional Conference: Hopf Algebras and Their Actions on Rings**, DePaul University, Chicago, IL. (Mar. 1992, p. 247)

10-15. **A Workshop on Numerical Ranges and Numerical Radii**, The College of William and Mary, Williamsburg, VA. (Apr. 1992, p. 347)

10-15. **Interactive Mathematics Text Project: Mathcad 3.1**, University of Pennsylvania. (May/Jun. 1992, p. 491)

10-18. **Canadian Mathematical Society Annual Seminar on Representations of Alge-**

bras and Related Topics, Carleton University, Ottawa, Canada. (May/Jun. 1992, p. 491)

11-15. **The Seventh KAIST Mathematics Workshop**, Korea Advanced Institute of Science and Technology, Taejon, Korea. (Feb. 1992, p. 146)

13-17. **First Colloquium on Numerical Analysis**, Plovdiv, Bulgaria. (Oct. 1991, p. 1011)

15-19. **International Conference on Associative Rings**, Irkutsk, USSR. (Feb. 1992, p. 146)

16-20. **CRYPTO '92**, University of California, Santa Barbara. (Mar. 1992, p. 248)

16-22. **Reelle Analysis**, Oberwolfach, Germany. (Jul./Aug. 1991, p. 646)

16-29. **1992 NATO Advanced Study Institute: Wavelets and their Applications**, Tuscany, Italy. (Feb. 1992, p. 146)

17-19. **Algebraic Computing in Geometry**, Linz, Austria. (Feb. 1992, p. 146)

* 17-20. **Second International Conference on Statistical Data Analysis Based on the L1-Norm and Related Methods**, Neuchatel, Switzerland.

INFORMATION: Y. Dodge, Conference Organizer, University of Neuchatel, Groupe de Statistique, Pierre-a-Mazel 7, CH-2000 Neuchatel.

17-21. **The Sixth International Conference on Boundary and Interior Layers—Computational and Asymptotic Methods (BAIL VI)**, Summit County, Colorado. (Nov. 1991, p. 1170)

17-21. **The Alan Day Conference on Lattices and Algebras**, McMaster University, Hamilton, Ontario, Canada. (Nov. 1991, p. 1171)

* 17-21. **Industrial Mathematics Week**, Trondheim, Norway.

INFORMATION: H.E. Krogstad, Div. of Math. Sci., Norwegian Institute of Technology, N-7034 Trondheim NTH.

* 17-21. **Thirteenth International Meeting on Clinical Biostatistics**, Copenhagen, Denmark.

INFORMATION: K. Schmidt, Spadille Biostatistik ApS, P.O. Box 25, N.W.Gadesvej 4, DK-3480 Fredensborg.

17-22. **Interactive Mathematics Text Project: Mathcad 3.1**, University of Pennsylvania. (May/Jun. 1992, p. 491)

17-23. **Seventh International Congress on Mathematical Education (ICME-7)**, Université Laval, Québec, Canada. (Sep. 1991, p. 839)

17-28. **Fourth European Summer School in Logic, Language, and Information**, University of Essex, Colchester, England. (May/Jun. 1992, p. 491)

18-22. **Third Colloquium on Differential**

Equations, Plovdiv, Bulgaria. (Oct. 1991, p. 1011)

19-22. **Sixth International Conference on Representations of Algebras (ICRA VI)**, Carleton University, Ottawa, Canada. (May/Jun. 1992, p. 491)

19-26. **World Congress of Nonlinear Analysts**, Melbourne, FL. (Nov. 1991, p. 1171)

22-28. **Eighteenth International Congress of Theoretical and Applied Mechanics**, Technion-Israel Institute of Technology, Haifa, Israel. (Jan. 1991, p. 52)

23-29. **Mathematical Finance**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

23-29. **Web Geometry**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 53)

24-28. **Tenth Symposium on Computational Statistics (COMPSTAT)**, Neuchatel, Switzerland. (May/Jun. 1992, p. 492)

* 24-September 4. **European School of Group Theory**, Twente Enschede, The Netherlands.

INFORMATION: European School of Group Theory, attn. Mrs. N. Mitrovic, CWI, P.O. Box 4079, NL-1009 AB Amsterdam.

25-29. **Sixth School of Algebra and Analysis**, Irkutsk, USSR. (Feb. 1992, p. 146)

25-29. **Third Islamic Countries Conference on Statistical Sciences**, Rabat, Morocco. (May/Jun. 1992, p. 492)

26-28. **IMACS RM2S '92 Kobe**, Kobe University, Kobi, Japan. (May/Jun. 1991, p. 477)

30-September 5. **Komplexe Analysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 147)

* 30-September 5. **Seventy-five Years of Radon Transform**, Universitaet Wien, Wien, Austria. (Please note update to Apr. 1992, p. 347)

INVITED SPEAKERS: *Revised and Preliminary*: A. Cormack, L. Ehrenpreis, S. Gindikin, A. Goncharov, S. Helgason, G. Henkin, F. Natterer, E. Stein, Sh. Sternberg, J. Wolf.

WORKSHOPS: Integral geometry on homogeneous manifolds; Curved and singular Radon transforms; and Mathematical problems of tomography.

30-September 5. **International Congress on Nonlinear Analysis; Variational and Topological Methods**, Xalapa, Veracruz, Mexico. (Apr. 1992, p. 347)

31-September 2. **Fourth International Workshop on Generalized Convexity**, Pécs, Hungary. (Jan. 1992, p. 53)

31-September 4. **Large Scale Scientific Computation**, Universität Bielefeld. (Feb. 1992, p. 146)

31-September 4. **International Symposium on Numerical Analysis-ISNA '92**, Prague, Czechoslovakia. (May/Jun. 1992, p. 492)

31–September 11. **Arithmetic Algebraic Geometry (Advanced Workshop)**, Trieste, Italy. (Jan. 1992, p. 53)

September 1992

September 1992. **IMACS 2nd International Conference on System Simulation and Scientific Computing-BICSC '92**, Beijing, China. (May/Jun. 1991, p. 477)

September 1992. **Workshop on Topics in Probability and Lie Groups—Boundary Theory**, Centre de Recherches Mathématiques, Université de Montréal, Montréal Quebec, Canada. (Apr. 1992, p. 347)

Academic Year 1992–1993. **Real Closed Fields**, Cornell University, Ithaca, NY. (May/Jun. 1992, p. 492)

* 1–3. **Pedometrics '92, Developments in Spatial Statistics for Soil Science**, Wageningen, The Netherlands.

INFORMATION: J.J. de Gruijter, Winand Staring Centre, P.O. Box 125, NL-6700 AAC Wageningen.

* 1–5. **International Conference on Computation of Differential Equations and Dynamical Systems**, Beijing, China.

PROGRAM: The conference will provide a forum to bring together pure and applied mathematicians, numerical analysts, physicists, and engineers to communicate related research contributions, and to explore common interests and prospective interplay across disciplines.

ORGANIZING COMMITTEE: K.Z. Chen, J.Z. Chui, X.Y. Li, Z.C. Shi (Chair), D.L. Wang, H.M. Wu (Secretary), L.B. Zhang.

CONFERENCE TOPICS: Numerical algorithms and the related theoretical analysis for differential equations and dynamical systems with applications in various physical and engineering areas, such as fluid dynamics, solid mechanics, electrodynamics, celestial mechanics, nonlinear waves, optimal control, etc.

INFORMATION: W. Huamo, Conference Secretary, Academia Sinica Computing Center, P.O. Box 2719, Beijing 100080, China; email: bmaacc@ica.beijing.canet.cn.

2–4. **Ninth IFAC Workshop on Control Applications of Optimization**, Munich, Germany. (Apr. 1992, p. 348)

* 2–4. **Quantum Information Theory and its Applications**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, M. Ohya, Faculty of Science and Technology, Science Univ. of Tokyo, Shinjuku-ku Tokyo 162, Japan.

* 2–4. **International Conference on Con-**

trol: Modeling, Computation, Information, Manchester, U.K.

INFORMATION: The Conference Officer, The Institute of Mathematics and its Applications, 16 Nelson St., Southend-On-Sea, Essex, SS1 1EF, U.K.

4–9. **Homotopy Theory**, Lake of Garda, Italy. (Apr. 1992, p. 348)

6–12. **Topologie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

* 7–10. **Third European Workshop on Logics in Artificial Intelligence**, Berlin, Federal Republic of Germany.

INFORMATION: G. Wagner, LWI Inst. für Philosophie, Freie Univ. Berlin, Habelschwerdter Allee 30, W-1000 Berlin, Germany.

7–11. **Réseaux**, Marseille, France. (Jan. 1992, p. 53)

* 7–11. **First European Conference on Numerical Methods in Engineering**, Brussels, Belgium.

INFORMATION: The Conference Officer, The Inst. of Mathematics and its Applications, 16 Nelson St., Southend-on-Sea, Essex, SS1 1EF, U.K.

7–14. **IMACS Conference on Innovative Methods in Numerical Analysis**, Padova University at Bressanone, Italy. (Jan. 1992, p. 53)

8–11. **IMA Tutorial: Introduction to Linear Multivariable Control, Optimal Design, and Parameter Estimation**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 839)

9–10. **Symposium on High Performance Distributed Computing, HPDC-1**, Syracuse, NY. (May/Jun. 1992, p. 492)

9–11. **Royal Statistical Society Full Conference**, Sheffield, UK. (Nov. 1991, p. 1171)

* 10–12. **Fourier and Radon Transformations of Symmetric Space in Honor of the 65th Birthday of S. Helgason**, Roskilde, Denmark.

ORGANIZING COMMITTEE: M. Flensted-Jensen, G. Ólafsson.

PARTICIPANTS: J.-P. Anker (Nancy), E. van den Ban (Utrecht), J. Faraut (Paris), F.B. Gonzalez (Tufts), S. Helgason (MIT), K.D. Johnson (Georgia), T. Kobayashi (Princeton), T.H. Koornwinder (Amsterdam), A. Korányi (CUNY), and B. Ørsted (Odense).

INFORMATION: G. Ólafsson, Mathematical Institut, Univ. Roskilde, P.O. Box 260, DK-4000 Roskilde, email: gestur@fatou.ruc.dk.

13–15. **MSI Workshop on Stochastic Analysis**, Cornell University. (May/Jun. 1992, p. 492)

* 13–16. **Sup'Eur 92, Umea**, Umea, Sweden.

PROGRAM: The main objective of Sup'Eur is to provide an open forum for the European supercomputer and high performance com-

puting user community to exchange ideas, experiences, and solutions to problems.

CONFERENCE TOPICS: High performance computing (HPC): The future; algorithm design and high performance computing libraries; tools, environments, and languages; clustered workstations and cooperative processing; and scientific visualization.

INFORMATION: T. Johansson, SDCN, Univ. of Umea, S-901 87 Umea, Sweden; tel: +46 90 166585; Fax: +46 90 158405; email: supeur92@cs.umu.se; or B. Kagstrom, Inst. of Information Processing, Univ. of Umea, email: bokg@cs.umu.se.

13–18. **Sixth International Conference on Stochastic Programming**, Udine, Italy. (May/Jun. 1992, p. 492)

13–19. **4-Dimensional Manifolds**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

13–19. **DMV-Jahrestagung**, Berlin, Federal Republic of Germany. (Jan. 1992, p. 53)

13–19. **Symposium on Analytic and Geometric Aspects of Hyperbolic Geometry: Instructional Conference**, University of Warwick, Coventry, UK. (Mar. 1992, p. 248)

* 14–16. **Mathematics of Surfaces V**, Edinburgh, Scotland.

INFORMATION: The Conference Officer, The Inst. of Mathematics and its Applications, 16 Nelson St., Southend-on-Sea, Essex, SS11EF, U.K.

14–18. **Twentieth European Meeting of Statisticians**, Bath, UK. (Nov. 1991, p. 1171)

14–18. **Second Atelier International de Théorie des Ensembles**, Marseille, France. (Jan. 1992, p. 53)

* 14–25. **Workshop on Commutative Algebra**, Trieste, Italy. (Please note name change from Jan. 1992, p. 53)

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

16–20. **IMACS/SICE International Symposium on Robotics, Mechatronics and Manufacturing Systems**, Kobe, Japan. (Jan. 1992, p. 53)

17–19. **International Conference on Group Theory**, University of Timisoara, Romania. (Jul./Aug. 1991, p. 646)

17–19. **SIAM Conference on Control and its Applications**, Minneapolis, MN. (Mar. 1992, p. 248)

20–26. **Funktionalgleichungen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

21–23. **Seventh International Conference on Multivariate Analysis in Memory of Ronald A. Fisher**, Barcelona, Spain. (Jan. 1992, p. 53)

21–23. **Workshop on Algebraic Cycles**,

Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 53)

- * 21–23. **SIAM Workshop on Evolution of Phase Boundaries and Microstructure**, Leesburg, VA.

ORGANIZER: R.V. Kohn, Courant Inst., NYU.

INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; 215-382-9800; Fax: 215-386-7999; meetings@siam.org.

- * 21–24. **Colloque de Probabilités**, Marseille, France.

CHAIRMEN: J. Azema, M. Yor, Paris.

INFORMATION: CIRM, Luminy Case 916, F-133288 Marseille Cedex 9.

21–25. **IMA Workshop on Robust Control Theory**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 839)

- * 21–25. **Sixth Seminar "NUMDIFF" on Numerical Solution of Differential Equations and Applications**, Halle, Federal Republic of Germany.

CHAIRMEN: K. Strehmel, P.J. van der Houwen, Amsterdam.

INFORMATION: R. Weiner, Inst. für Numerische Math., Fachbereich Math und Inform., Martin-Luther-Univ., Halle-Wittenberg, Postfach, 0-4010 Halle (Saale), Germany.

- * 22–26. **International Conference on Interval and Stochastic Methods in Science and Engineering (INTERVAL '92)**, Moscow, Russia.

PROGRAM: The aim of the conference is to present recent advances in the field of interval and stochastic methods, their computer implementation and applications in science and engineering. Sessions will include panel discussions, paper sessions, and a round-table discussion on interval statistics. The official languages are Russian and English.

INFORMATION: A.P. Voschinin, Moscow, Power Engineering Inst., Krasnokasarmennaya 14, 105835 Moscow, E-250, Russia; tel: (095) 362-78-16; Fax: (095) 361-16-20; email: apv@mei.msk.su.

26–27. **Thirty-second Midwest Partial Differential Equations Seminar**, Purdue University, West Lafayette, IN. (May/June 1992, p. 493)

27–October 3. **Darstellungstheorie Endlicher Gruppen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

- * 28–October 2. **Sixth Workshop on Computer Science Logic**, San Miniato, Italy.

CHAIRMAN: E. Börger, Pisa.

INFORMATION: E. Börger, Dept. di Informatica, Univ. di Pisa, Corso Italia 40, I-56125 Pisa.

- * 29–October 2. **Theorie Analytique des Nombres**, Marseille, France.

CHAIRMEN: M. Car, Marseille; M. Balazard, Bordeaux.

INFORMATION: CIRM, Luminy Case 916, F-133288 Marseille Cedex 9.

30–October 2. **Thirtieth Annual Allerton Conference on Communication, Control, and Computing**, University of Illinois, IL. (Feb. 1992, p. 147)

31–October 4. **Third International Conference on Function Spaces**, Institute of Mathematics, Adam Mickiewicz University, Poznan, Poland. (Feb. 1992, p. 147)

October 1992

October 1992. **Workshop on Superprocesses and Interacting Systems**, Centre de Recherches Mathématiques, Université de Montréal, Montréal, Quebec, Canada. (Apr. 1992, p. 348)

2–3. **Fourth Midwest Conference on the History of Mathematics**, Miami University, Oxford, OH. (Mar. 1992, p. 249)

4–10. **Funktionalanalysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

- * 5–9. **Option: Journées Thematiques Médicis**, Marseille, France.

CHAIRMAN: MM. Chardin, Ollivier, Palaiseau.

INFORMATION: CIRM, Luminy Case 916, F-133288 Marseille Cedex 9.

9–10. **Developments from the Stone Age**, University of Chicago, Chicago, IL. (May/June 1992, p. 493)

11–17. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

- * 12–14. **Mathematical Topics in Biology**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, M. Mimura, Dept. of Math., Faculty of Science, Hiroshima Univ., Naka-ku Hiroshima 730, Japan.

12–16. **IMA Workshop on Control Systems Design for Advanced Engineering Systems: Complexity, Uncertainty, Information, and Organization**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)

12–16. **Workshop on Visualization of Geometric Structures**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)

12–16. **International Conference on Polynomial Automorphisms and Related Topics**, CIRM, Luminy, France. (Jan. 1992, p. 54)

14–20. **First African Conference on Research in Computer Science**, Yaounde, Cameroon. (Feb. 1992, p. 147)

- * 15–16. **Fuzzy Logic: Entwicklungsmethoden und Werkzeuge**, Bonn, Federal Republic of Germany.

CHAIRMAN: M. Reinfrank.

INFORMATION: Deutsche Informatik Akademie, Wissenschaftszentrum, Ahrstraße 45, W-5300 Bonn 2, Germany.

15–17. **Jumelage 92**, Mathematical Sciences Institute, Ithaca, NY. (Apr. 1992, p. 348)

- * 15–17. **Interface and Layer Dynamics**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, T. Ohta, Faculty of Science, Ochanomizu Univ., Binkyo-ku Tokyo 112, Japan.

15–19. **SIAM Conference on Applications of Dynamical Systems**, Salt Lake City, UT. (Mar. 1992, p. 249)

17. **Three Decades of Numerical Linear Algebra at Berkeley: A Conference in Honor of the Sixtieth Birthdays of Beresford Parlett and William Kahan**, University of California, Berkeley. (Mar. 1992, p. 249)

18–24. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

19–21. **The Fourth Symposium on the Frontiers of Massively Parallel Computation**, McLean, VA. (Dec. 1991, p. 1340)

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

19–23. **Fourth International Symposium on Orthogonal Polynomials and their Applications**, Evian, France. (Feb. 1992, p. 148)

20–23. **Second Beijing International Conference on System Simulation and Scientific Computing-BICSC '92**, Beijing, China. (Jan. 1992, p. 54)

21–23. **Documents, Computation, and Preference**, Washington, DC. (Apr. 1992, p. 349)

- * 21–25. **Workshop on Conservative Systems and Quantum Chaos**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario.

PROGRAM: The workshop will focus on bifurcation and integrability problems in Hamiltonian systems. Nonlinear normal modes and normal form theory in classical and quantum contexts will be considered. Furthermore, the classical-quantum correspondence in nonintegrable Hamiltonian systems will be explored by means of the Gutzwiller trace formula and its extensions, including dynamical zeta functions. During the workshop M. Berry will present

three lectures as part of the Fields Institute Distinguished Lecture Series.

PARTICIPANTS: M. Berry, T. Bridges, P. Brumer, P. Cvitanovic, M. Gutzwiller, M. Kummer, E. Lacombe, E. Lerman, D. Lewis, J. Marsden, J. Montaldi, K. Meyer, D. Offin, G. Patrick, J. Roberts, R. Sjamaar, B. Sleeman, I. Stewart, J.-C. Van der Meer, and S. Wiggins.

INFORMATION: The Fields Institute for Research in Mathematical Sciences, 185 Columbia Street West, Waterloo, Ontario, Canada N2L 5Z5; 519-725-0096; Fax: 519-725-0704; chaos@fields.waterloo.edu or the organizers David Goodings (goodings@physun.physics.mcmaster.ca) or David Rod (rod@acs.ualgary.ca).

- * 22–24. **General and Geometric Topology and Related Problems**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, T. Hoshina, Inst. of Math., Univ. of Tsukuba, Tennodai Tsukuba 305, Japan.

- * 22–24. **Mathematical Analysis of Phenomena in Fluid and Plasma Dynamics**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, S. Ukai, Dept. of Information Sciences, Tokyo Inst. of Technology, Meguro-ku Tokyo 152, Japan.

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

- 22–30. **Forty-sixth Conference and Congress of the International Federation for Information and Documentation**, Madrid, Spain. (May/June 1991, p. 477)

- 25–31. **Stochastische Analysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

- * 26–30. **Holomorphic Mappings and Diofantine Geometry**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, J. Noguchi, Tokyo Inst. of Technology, Meguro-ku Tokyo 152, Japan.

- 27–31. **International Workshop on Modern Group Analysis: Advanced Analytic and Computational Methods in Mathematical Physics**, Acireale (Catania), Italy. (May/June 1992, p. 493)

- * 30–31. **Seventh Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference**, St. Norbert College, DePere, WI.

INVITED SPEAKER: J. Kasum, Cardinal Stritch College.

INFORMATION: R. Poss, St. Norbert College, DePere, WI 54115-2099; 414-337-3198; email: poss@sncac.snc.edu.

- 30–November 1. **Central Section**, Wright State University, Dayton, OH.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

31. **Differential Geometry Day**, Eastern Illinois University, Charleston, IL. (May/June 1992, p. 493)

November 1992

- November 1992. **The International Lie-Lobachevsky Colloquium Dedicated to the Anniversaries of Sophus Lie's 150 birthday and Nikolai Lobachevski's 200 birthday**, Tartu (Estonia). (Feb. 1992, p. 148)

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

- 1–6. **The First Pan American Conference on Pre-Columbia Mathematics, Astronomy, and Modes of Thought**, Univ. Francisco Marroquín, Guatemala City and Tikal. (Dec. 1991, p. 1340)

- 1–7. **Kombinatorik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

- * 2–4. **Colloque Mathématique-Informatique**, Marseille, France.

CHAIRMAN: B. Vallée, Caen.

INFORMATION: CIRM, Luminy Case 916, F-13288 Marseille Cedex 9.

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

- * 2–20. **Fourth Autumn Course on Mathematical Ecology**, Trieste, Italy.

CHAIRMEN: L.J. Gross, T.G. Hallam, S.A. Levin, Trieste.

INFORMATION: International Centre for Theor. Physics, Second Autumn Workshop on Mathematical Ecology, P.O. Box 586, I-34100 Trieste.

- * 4–6. **Mathematical Methods for Wave Phenomena in Fluids and Their Application**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, M. Oikawa, Research Inst. for Applied Math., Kyushu Univ., Higashi-ku Fukuoka 812, Japan.

- * 4–6. **Fundamental Technologies in Numerical Computation**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, M. Iri, Dept. of Math. Engineering, Univ. of Tokyo, Bunkyo-ku Tokyo 113, Japan.

- * 4–6. **Structure of Solutions of Partial Differential Equations**, Research Institute for

Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, S. Matuura, Research Institute for the Mathematical Sciences, Kyoto Univ., Sakyo-ku Kyoto 606-01, Japan.

- * 5–8. **Eighteenth Annual Conference of the American Mathematical Association of Two Year Colleges**, Indianapolis, IN.

PROGAM: Workshops, minicourses, and sessions will be presented addressing developmental mathematics and the first two years of college mathematics.

INFORMATION: Lucreda Hutton, Chair, 317-274-6929.

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

- 8–14. **Numerische Integration**, Oberwolfach, Federal Republic of Germany. (February 1991, p. 148)

- 8–14. **Third Austrian Symposium on the History of Mathematics**, Neuhofen an der Ybbs (Lower Austria). (Mar. 1992, p. 249)

- * 9–11. **Fundamental Problems in Quantum Field Theory**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, I. Ojima, Research Institute for the Mathematical Sciences, Kyoto Univ., Sakyo-ku Kyoto 606-01, Japan.

- 9–13. **IMA Workshop on Control and Optimal Design of Distributed Parameter Systems**, Institute for Mathematics and its Applications, University of Minnesota. (Nov. 1991, p. 1171)

- * 10–13. **Interdisciplinary Studies on Number Theory**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, S. Kanwmitu, Kinki Univ. in Kyushu, Iizuka Hukuoka 820, Japan.

- 13–15. **Second Joint Meeting of the Midwest Conference on Ordinary Differential Equations and the Southeastern-Atlantic Regional Conference on Differential Equations**, University of Kentucky, Lexington, KY. (Apr. 1992, p. 349)

- 14–16. **The Third Biennial Conference of the Allahabad Mathematical Society**, Allahabad, India. (May/June 1991, p. 477)

- 15–20. **An Applications Symposium on Optics, Electro-Optics, and Lasers in Industry**, Boston, MA. (Feb. 1992, p. 148)

- 15–21. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

- 16–18. **Workshop on Higher Dimensional Geometry**, Mathematical Sciences Research

Institute, Berkeley, CA. (Jan. 1992, p. 54)
 * 16–18. **Hardy Spaces and Uniform Algebras**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, T. Nakazi, Faculty of Science, Hokkaido Univ., Sapporo Hokkaido 060, Japan.

16–20. **International Congress on Numerical Methods in Engineering and Applied Sciences**, University of Concepción, Concepción, Chile. (Jul./Aug. 1991, p. 646)

16–20. **IMA Period of Concentration: Flow Control**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)

16–20. **The Fifth Annual High Performance Computing and Communication Conference-Supercomputing 92**, Minneapolis, MN. (May/Jun. 1992, p. 494)

* 16–20. **Automorphic Forms and L-functions**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, T. Ibukiyama, College of General Education, Osaka Univ., Toyonaka Osaka 560, Japan.

16–22. **Workshop on Normal Forms, Homoclinic Bifurcations and Chaos**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 350)

* 18–20. **Mathematical Optimization and its Applications**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, S. Iwamoto, Faculty of Economics, Kyushu Univ., Higashi-ku Fukuoka 812, Japan.

20–22. **Academic Knowledge and Power**, University of Maryland, College Park, MD. (May/Jun. 1992, p. 494)

23–25. **European Symposium on Research in Computer Security**, Toulouse, France. (Feb. 1992, p. 148)

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

* 24–26. **Spectral and Scattering Theory for Differential Equations**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, M. Ikawa, Dept. of Math., Osaka Univ., Toyonaka Osaka 560, Japan.

* 24–26. **Theory and Applications in Computer Algebra**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, N. Niki, Faculty of Science, Kyushu Univ., Higashi-ku Fukuoka 812, Japan.

29–December 5. **Theory of Large Deviations**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

* 30–December 2. **Algorithm, Fractal, and Dynamical Systems**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Y. Takahashi, College of Arts and Science, Univ. of Tokyo, Meguro-ku Tokyo 153, Japan.

December 1992

2–4. **Workshop on Curves, Abelian Varieties, and their Moduli**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)

4–5. **International Workshop on Matrix Methods for Statistics**, University of Auckland, Auckland, New Zealand. (Feb. 1992, p. 148)

6–12. **Theory and Numerical Methods for Initial-Boundary Value Problems**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

7–11. **IMACS Symposium on Scientific Computing and Mathematical Modelling**, Bangalore, India. (May/Jun. 1991, p. 477)

* 7–11. **Algebraic Number Theory—Recent Developments and Their Backgrounds**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, K. Horie, Faculty of Science, Nara Women's Univ., Kita-Uoya Nara 630, Japan.

8–11. **International Conference on Computer Science and Control**, Paris, France. (Apr. 1992, p. 350)

11–16. **Workshop on Generalized Inverse-Computational Techniques and Applications**, Indian Statistical Institute, Delhi, India. (Mar. 1992, p. 249)

13–19. **Asymptotische Statistik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

15–17. **Third IMA Conference on Mathematics Signal Processing**, University of Warwick, England. (Feb. 1992, p. 149)

* 17–19. **Algebraic Combinatorics**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, M. Yamada, Dept. of Math., Kyushu Univ., Higashi-ku Fukuoka 812, Japan.

27–31. **Holiday Symposium on Lie Group Representations and Combinatorics**, New Mexico State University, Las Cruces, NM. (Sep. 1991, p. 840)

1993

1992–1993. **Mittag-Leffler Institute's Academic Program for 1992–1993: Special Prob-**

lems in Mathematical Physics, Djursholm, Sweden. (Nov. 1991, p. 1171)

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

1993. **Second IMACS International Conference on Computational Physics**, Univ. of Colorado, Boulder, CO. (Jan. 1992, p. 55)

January 1993

* 1–3. **International Symposium on Statistical Physics**, Salt Lake City, Calcutta, India.

PROGRAM: The purpose of the seminar is to sensitize the academic community, particularly young researchers, with this emerging discipline of mathematical science, currently on the international frontier, with immediate and far-reaching application in almost all branches of science and technology.

CONFERENCE TOPICS: Mathematical foundation; equilibrium statistics; nonequilibrium processes; quantum statistics (with special emphasis on Bose statistics); methodology of statistical physics in social and biological systems; statistical mechanics of dynamical systems and chaos.

INFORMATION: C.G. Chakrabarti, Director, International Symposium on Statistical Physics, S.N. Bose School of Mathematics and Mathematical Sciences, Calcutta Mathematical Society, AE-374, Sector-1, Salt Lake City, Calcutta-700 064, India.

3–7. **International Conference on Scientific Computation and Differential Equations**, Auckland, New Zealand. (May/Jun. 1991, p. 477)

3–9. **Grundlagen der Geometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

3–9. **Extensions of Buildings and Geometries**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

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

10–15. **First Panamerican Workshop in Applied and Computational Mathematics**, Simon Bolivar University, Caracas, Venezuela. (May/Jun. 1992, p. 494)

10–16. **Computational Methods for Non-linear Phenomena**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

* 12–14. **Topology and Field Theory of 3-4 Dimensional Algebras**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, K. Fukaya, Dept. of Math., Faculty of Sciences, Univ. of Tokyo, Bunkyo-ku Tokyo 113, Japan.

13–16. **Joint Mathematics Meetings**, San

Antonio, TX. (including the annual meetings of the AMS, AWM, MAA, and NAM)

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

15–16. **1992–1993 ASL Winter Meeting**, San Antonio, TX. (May/Jun. 1992, p. 495)

*15–17. **International Conference on Complex Analysis and its Applications**, Hong Kong University of Science and Technology, Hong Kong.

PROGRAM: The conference will stress the following areas: 1). value distribution theory, 2). complex dynamical systems and geometric function theory, 3). applications of complex analysis to differential equations, physical and engineering problems.

CALL FOR PAPERS: The program will consist of 45-minute survey lectures, 30-minute and 15-minute presentations. Abstracts for lectures and presentations will be collected before October 1, 1992.

INFORMATION: Y.-K. Kwok, Math. Dept., Hong Kong University of Science and Technology, Clear Water Bay Road, Hong Kong; email: maykwok@usthk.bitnet; Fax: 852-358-1643.

17–22. **1993 IEEE International Symposium on Information Theory**, San Antonio, TX. (Feb. 1992, p. 149)

17–23. **Combinatorial Optimization**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

*18–21. **Numerical Analysis of Partial Differential Equations in Engineering and Related Topics**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, Y. Iso, Research Inst. for Math. Sci., Kyoto Univ., Sakyo-ku Kyoto 606-01, Japan.

*20–22. **Hyperfunctions and Differential Equations**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, K. Kataoka, Dept. of Math., Faculty of Sciences, Univ. of Tokyo, Bunkyo-ku Tokyo 113, Japan.

24–30. **Optimale Steuerung Partieller Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

25–27. **Fourth ACM-SIAM Symposium on Discrete Algorithms (SODA)**, Austin, Texas.

25–29. **IMA Workshop on Robotics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1171)

*26–28. **The Development of Algebraic Topology**, Research Institute for Mathematical Sciences, Kyoto University.

INFORMATION: Organizer, Z. Yosimura, Faculty of Science, Osaka City Univ.,

Sumiyoshi-ku Osaka 558, Japan.

31–February 6. **Asymptotics and Adaptivity in Computational Mechanics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

February 1993

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

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

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

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

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

7–13. **Partielle Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

8–17. **IMA Workshop on Nonsmooth Analysis and Geometric Methods in Deterministic Optimal Control**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Mar. 1992, p. 250)

14–20. **Applicable Algebra**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

16–25. **IMA Workshop on Nonsmooth Analysis and Geometric Methods in Control**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

21–27. **Curves, Images, Massive Computation**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

22–28. **Workshop on Pattern Formation and Symmetry Breaking**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 351)

25–March 1. **A Conference on Numerical Analysis with Automatic Result Verification**, Lafayette, LA. (May/Jun. 1992, p. 495)

28–March 6. **Medical Statistics: Statistical Methods for Risk Assessment**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

March 1993

7–13. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

14–20. **Gewöhnliche Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

15–19. **IMA Workshop on Systems and Control Theory for Power Systems**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

17–20. **Pure and Applied Linear Algebra: The New Generation**, University of West Florida, Pensacola, FL. (May/Jun. 1992, p. 495)

21–24. **Sixth SIAM Conference on Parallel Processing for Scientific Computing**, Norfolk, VA. (Mar. 1992, p. 250)

21–27. **Analysis auf Lokalsymmetrischen Räumen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

22–28. **Workshop on Pattern Formation in Earth Sciences and Biology**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 351)

24–25. **Central Section**, DePaul University, Chicago, IL.

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

28–April 3. **Combinatorial Convexity and Algebraic Geometry**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

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

April 1993

4–10. **Topics in Pseudo-Differential Operators**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

5–9. **IMA Tutorial: Design and Analysis of Adaptive Systems**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

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

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

11–17. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of

Germany. (Jan. 1992, p. 56)

12-16. **IMA Workshop on Adaptive Control, Filtering, and Signal Processing**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

14-16. **Seventh SEFI European Seminar on Mathematics in Engineering Education**, Eindhoven University of Technology, The Netherlands. (Feb. 1992, p. 149)

15-22. **Symposium on Analytic and Geometric Aspects of Hyperbolic Geometry: Research Level Workshop**, University of Warwick, Coventry, UK. (Mar. 1992, p. 250)

18-24. **The Arithmetik of Fields**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

18-24. **Mathematische Grundlagen und Numerische Verfahren bei Transsonischen Strömungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 19-21. **SIAM Conference on Mathematical and Computational Issues in the Geosciences**, Houston, TX.

ORGANIZER: J. Glimm, SUNY at Stony Brook.

CALL FOR PAPERS: October 5, 1992.

INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; 215-382-9800; Fax: 215-386-7999; meetings@siam.org.

25-May 1. **Low Dimensional Dynamics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

May 1993

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

3-9. **Workshop on Ecological Systems**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 352)

9-15. **Reelle Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 9-17. **Jerusalem Combinatorics '93**, Hebrew University of Jerusalem, Israel.

PROGRAM: There will be 30 invited speakers who will give 45-minute lectures in the first six days of the conference. In the last two days of the conference, there will be several half-day workshops (in two parallel sessions) on graphs and hypergraphs, relations between combinatorics and dynamics, topology and geometry, enumeration and algebraic combinatorics, probabilistic

methods, algorithms and optimization.

ORGANIZING COMMITTEE: N. Alon (Tel Aviv), H. Barcelo (Tempe), A. Bjorner (Stockholm), G. Kalai (chair, Jerusalem), and E. Wigderson (Jerusalem).

INVITED SPEAKERS: *Preliminary and partial*: N. Alon, H. Barcelo, M. Bayer, L. Billera, A. Bjorner, M. Bousquet-Melou, L. Butler, P. Edelman, P. Erdos, Z. Furedi, M. Haiman, A. Karlin, J. Kahn, D. Kleitman, N. Linial, K. O'Hara, M. Perles, V. Pless, V. Serganova, R. Simion, V. Sos, R. Stanley, J. Stembridge, S. Sundaram, E. Tardos, M. Wachs, A. Weiss.

CALL FOR PAPERS: Please send (or preferably email) title and a short abstract not later than October 15, 1992.

INFORMATION: G. Kalai, Inst. of Math., Hebrew Univ., Jerusalem, Israel; tel: (02) 584-729; email: kalai@humus.huji.ac.il.

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

10-14. **IMA Workshop on Discrete Event Systems, Manufacturing Systems, and Communication Networks**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

16-22. **Mathematical Problems in Viscoelastic Flows**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

20-23. **International Conference on Approximation Probability and Related Fields**, University of California, Santa Barbara, CA. (May/June 1991, p. 477)

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

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

23-29. **Differentialgeometrie im Grossen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 24-27. **COMPEURO '93**, Paris-Evry, France.

PROGRAM: The general theme is computers in design, manufacturing, and production. CONFERENCE TOPICS: Automated manufacturing systems, CAD/CAM, machine control, integration, industrial products and applications.

CALL FOR PAPERS: Papers, in English and in four copies, will be selected from full texts of 10 pages maximum. Papers must be received by September 15, 1992.

INFORMATION: COMPEURO '93, c/o SEE 48 rue de la Procession F-75724 PARIS CEDEX 15 - France; tel: +33 1 44 49 60 60; Fax: +33 1 44 49 60 44; telex: 200565 F.

* 30-June 1. **Canadian Society for the History and Philosophy of Mathematics**, Carleton

University, Ottawa, Ontario, Canada.

PROGRAM: There will be a special session on the philosophy of mathematics organized by R.S.D. Thomas, Applied Math. Dept., Winnipeg, Manitoba, R3T 2N2, Canada.

INFORMATION: G. R. van Brummelen, The King's College, 10766 9th St., Edmonton, Alberta T5H 2M1, Canada.

30-June 5. **Funktionalanalysis und Nicht-lineare Partielle Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

June 1993

June 1993. **Fourth IMACS International Symposium on Computational Acoustics**, Cambridge, England. (Jan. 1992, p. 56)

6-9. **Annual Meeting of the Statistical Society of Canada**, Wolfville, Nova Scotia, Canada. (Feb. 1992, p. 149)

6-12. **Analysis auf Kompakten Varietäten**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 7-10. **SIAM Conference on Mathematical and Numerical Aspects of Wave Propagation Phenomena**, University of Delaware, Newark, DE.

ORGANIZER: R. Kleinman, Univ. of Delaware.

CALL FOR PAPERS: Abstract deadline: 11/13/92.

INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; 215-382-9800; Fax: 215-386-7999; meetings@siam.org.

7-11. **IMA Tutorial: Mathematical Theory which Has become an Integral Part of Modern Financial Economics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

7-13. **Workshop on Pattern Formation and Cellular Automata**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 352)

13-19. **Differential-Algebraic Equations: Theory and Applications in Technical Simulation**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

14-17. **The Fifth Asian Logic Conference**, National University of Singapore, Singapore. (May/June 1992, p. 496)

14-18. **IMA Workshop on Mathematical Finance**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

14-18. **Linear Logic Workshop**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (May/June 1992, p. 496)

- 15–18. **Third IMACS International Workshop on Qualitative Reasoning and Decision Technologies–QR&DT-3**, Polytechnique of Barcelona, Spain. (Jan. 1992, p. 56)
- 20–26. **Konvexgeometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)
- 23–26. **Convergence in Ergodic Theory and Probability**, Ohio State University, Columbus, OH. (May/Jun. 1992, p. 496)
- 27–July 3. **Algebraische K-Theorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

July 1993

- 4–9. **Fifth International Fuzzy Systems Association World Congress**, Seoul, Korea. (Mar. 1992, p. 250)
- 4–10. **Freie Randwertprobleme**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 6–9. **European Multigrid Conference '93**, Amsterdam, The Netherlands. (May/Jun. 1992, p. 496)
- 11–17. **Nonlinear Evolution Equations, Solutions and the Inverse Scattering Transform**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 12–16. **SIAM Annual Meeting**, Philadelphia, PA. (Mar. 1992, p. 251)
- 12–23. **Conference on Universal Algebra and Category Theory**, Mathematical Sciences Research Institute, Berkeley, CA. (May/Jun. 1992, p. 496)
- 18–24. **Dynamische Systeme**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 21–25. **Twenty-Second Conference on Stochastic Processes and Their Applications**, Amsterdam, The Netherlands. (Jan. 1992, p. 57)
- 25–31. **Geometric Methods in Theoretical and Computational Mechanics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

August 1993

- 1–7. **Abelsche Gruppen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 1–14. **Groups 93 Galway/St. Andrews**, Galway, Ireland. (May/Jun. 1992, p. 496)
- 2–6. **Second Gauss Symposium**, Munich, Germany. (May/Jun. 1992, p. 497)
- 2–13. **Georgia International Topology Conference**, University of Georgia, Athens, GA. (May/Jun. 1992, p. 497)
- *4–6. **SIAM Conference on Simulation and Computational Probability**, San Francisco, CA.

ORGANIZER: P.W. Glynn, Stanford Univ.
 CALL FOR PAPERS: Abstract deadline: 1/22/93.
 INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; 215-382-9800; Fax: 215-386-7999; meetings@siam.org.

- 8–14. **Konstruktive Approximationstheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 9–12. **Joint Statistical Meetings**, San Francisco, CA. (Nov. 1991, p. 1172)
- 13–17. **Second International Colloquium on Numerical Analysis**, Plovdiv, Bulgaria. (Dec. 1991, p. 1341)
- 15–21. **Noncommutative Algebra and Representation Theory**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

- *16–19. **Third SIAM Conference on Linear Algebra in Signals, Systems, and Control**, University of Washington, Seattle, WA.

ORGANIZERS: B.N. Datta, Northern Illinois Univ. and J.G. Lewis, Boeing Computer Services, Inc.
 CALL FOR PAPERS: Abstract deadline: 1/29/93.
 INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; 215-382-9800; Fax: 215-386-7999; meetings@siam.org.

- 17–20. **The Mathematical Heritage of Sir William Rowan Hamilton**, Dublin, Ireland. (May/Jun. 1992, p. 497)
- 18–22. **Fourth International Colloquium on Differential Equations**, Plovdiv, Bulgaria. (Dec. 1991, p. 1341)
- 22–28. **Special Complex Varieties**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 22–29. **Twenty-ninth International Congress of History of Science**, Zaragoza, Spain. (Apr. 1992, p. 352)

- *23–28. **International Conference on Algebra Dedicated to the Memory of M.I. Kargapolov**, Krasnoyarsk, Russia.

CONFERENCE TOPICS: Group theory, ring theory, universal algebra, and model theory.
 INFORMATION: Organizing Committee of the International Conference on Algebra, Inst. of Math., Novosibirsk, 630090, Russia, tel: (383) 35-08-50, 35-08-61; email: algebra@cniit.nsk.su.

- 25–September 3. **Forty-ninth Biennial Session of the International Statistical Institute**, Firenze, Italy. (Nov. 1991, p. 1172)

- 29–September 4. **Random Graphs and Combinatorial Structures**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

September 1993

- *13–17. **Fourth European Software Engineering Conference**, Garmisch, Germany.

PROGRAM: Original papers are invited on any aspect of software engineering on the following topics: Software engineering and CSCW; software engineering for distributed systems; software measurement and experimentation; software maintenance; requirements engineering; critical systems engineering; computer-based systems engineering; comparisons between development methods and paradigms; and report on practical experience with new techniques.

CALL FOR PAPERS: Papers (4 copies) should not be longer than 6000 words and should include a title page with a short abstract and the authors' addresses. Papers due by November 23, 1992. Proposals for high-quality tutorials on any aspect of software engineering are welcome.

INFORMATION: General Chair, M. Paul, Inst. für Informatik, Technische Univ. München, Orleansstr. 34, D-8000 München 80, Germany; Fax: +49-(0)89-48095160; email: esec@informatik.tu-muenchen.de.

The following new announcements will not be repeated until the criteria in the last paragraph in the box at the beginning of this section are met.

October 1993

- *25–29. **Third SIAM Conference on Geometric Design**, Seattle, WA.

ORGANIZERS: R.E. Barnhill, Arizona State Univ.; R.E. Chang, Silicon Graphics Comp. Systems.

CALL FOR PAPERS: Abstract deadline: 3/22/93.

INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; 215-382-9800; Fax: 215-386-7999; meetings@siam.org.

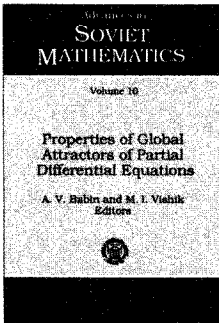
August 1994

- 3–11. **The International Congress of Mathematicians 1994**, Zürich, Switzerland. (Mar. 1992, p. 249)

New Publications Offered by the AMS

ADVANCES IN SOVIET MATHEMATICS

CONTEMPORARY MATHEMATICS



Properties of Global Attractors of Partial Differential Equations

A. V. Babin and M. I. Vishik, Editors
Volume 10

The four papers in this volume examine attractors of partial differential equations, with a focus on investigation of elements of attractors. Unlike the

finite-dimensional case of ordinary differential equations, an element of the attractor of a partial differential equation is itself a function of spatial variables. This dependence on spatial variables is investigated by asymptotic methods. For example, the asymptotics show that the turbulence generated in a tube by a large localized external force does not propagate to infinity along the tube if the flux of the flow is not too large. Another topic considered here is the dependence of attractors on singular perturbations of the equations. The theory of unbounded attractors of equations without bounded attracting sets is also covered. All of the articles are systematic and detailed, furnishing an excellent review of new approaches and techniques developed by the Moscow school.

Contents

A. V. Babin, *Asymptotic expansion at infinity of a strongly perturbed Poiseuille flow*; V. V. Chepyzhov and A. Yu. Goritskii, *Unbounded attractors of evolution equations*; M. Yu. Skvortsov and M. I. Vishik, *Attractors of singularly perturbed parabolic equations, and asymptotic behavior of their elements*; M. Yu. Skvortsov and M. I. Vishik, *The asymptotics of solutions of reaction-diffusion equations with small parameter*.

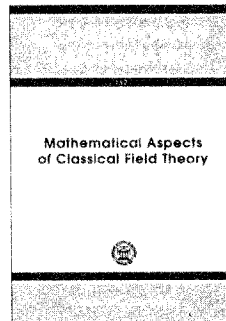
1991 Mathematics Subject Classification: 35B40, 35K22, 35K57, 58F12, 58F39, 76D05; 35G25

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Mathematical Aspects of Classical Field Theory

Mark Gotay, Vincent E. Moncrief, and Jerrold E. Marsden, Editors
Volume 132

Classical field theory has undergone a renaissance in recent years. Symplectic techniques have yielded deep insights into its foundations, as has an improved understanding of the variational calculus. Further impetus for the study of classical fields has come from other areas, such as integrable systems, Poisson geometry, global analysis, and quantum theory.

This book contains the proceedings of the AMS-IMS-SIAM Joint Summer Research Conference on Mathematical Aspects of Classical Field Theory, held in July 1991 at the University of Washington at Seattle. The conference brought together researchers in many of the main areas of classical field theory to present the latest ideas and results. The volume contains thirty refereed papers, both survey and research articles, and is designed to reflect the state of the art as well as chart the future course of the subject. The topics fall into four major categories: global analysis and relativity (cosmic censorship, initial value problem, quantum gravity), geometric methods (symplectic and Poisson structures, momentum mappings, Dirac constraint theory), BRST theory, and the calculus of variations (the variational bicomplex, higher order theories). Also included are related topics with a "classical basis", such as geometric quantization, integrable systems, symmetries, deformation theory, and geometric mechanics.

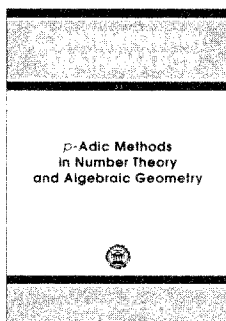
Contents

V. Aldaya, M. M. Navarro, and J. Navarro-Salas, *Hidden symmetry in field theory*; S. C. Anco, *Construction of locally-symmetric Lagrangian field theories from variational identities*; I. M. Anderson, *Introduction to the variational bicomplex*; J. A. de Azcarraga, *Wess-Zumino terms, extended algebras, and anomalies in classical physics*; J. C. Baez, *Scattering and complete integrability in four dimensions*; D. D. W. Bao and T. Stefan Ratiu, *A candidate maximal torus in infinite dimensions*; J. K. Beem and A. Krolak, *Censorship, null geodesics, and strong visibility*; J. D. Brown and J. M. York, *Quasilocal energy in general relativity*; J. Cameron and V. E. Moncrief, *The reduction of Einstein's vacuum equations on spacetimes with spacelike $U(1)$ -isometry groups*; M. Carfora and A. Marzuoli, *Finiteness theorems in Riemannian geometry and lattice quantum gravity*; P. Casati, F. Magri, and M. Pedroni, *Bihamiltonian manifolds and r -function*; P. T. Chrusciel, *On uniqueness in the large of*

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solutions of Einstein's equations ("Strong cosmic censorship"); **M. De Leon, M. J. Mello, and P. R. Rodrigues**, *Reduction of degenerate nonautonomous Lagrangians*; **L. Dickey**, *On exactness of the variational bicomplex*; **C. Duval and J. Elhadad**, *Geometric quantization and localization of relativistic spin systems*; **A. E. Fischer**, *Riemannian maps between Riemannian manifolds*; **M. J. Gotay and J. E. Marsden**, *Stress-energy-momentum tensors and the Belinfante-Rosenfeld formula*; **M. Henneaux**, *On the use of auxiliary fields in classical mechanics and in field theory*; **J. Isenberg**, *Progress on strong cosmic censorship*; **C. J. Isham**, *Loop algebras and canonical quantum gravity*; **T. Kimura**, *Prequantum BRST cohomology*; **Y. Kosmann-Schwarzbach**, *Jacobian quasi-bialgebras and quasi-Poisson Lie groups*; **A. Lichnerowicz**, *Deformations and quantum statistical mechanics*; **R. Loll**, *Canonical and BRST-quantization of constrained systems*; **L. Lusanna**, *Classical observables of Gauge theories from the multitemporal approach*; **J. Monterde and M. J. Masque**, *Variational problems on graded manifolds*; **D. J. Saunders**, *The regularity of variational problems*; **J. D. Stasheff**, *Homological (ghost) approach to constrained Hamiltonian systems*; **C. A. Torre**, *A deformation theory of self-dual Einstein spaces*; **G. M. Tuynman**, *What are the rules of the game called BRST?*; **J. T. Wheeler**, *$SU(3) \times SU(2) \times U(1)$: the residual symmetry of conformal gravity*.

1991 *Mathematics Subject Classification*: 58-xx, 70-xx, 83-xx
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***p*-Adic Methods in Number Theory and Algebraic Geometry**

Alan C. Adolphson, Steven Sperber, and Marvin D. Tretkoff, Editors
 Volume 133

Two meetings of the AMS in the fall of 1989—one at the Stevens Institute of Technology and the other at Ball State

University—included Special Sessions on the role of *p*-adic methods in number theory and algebraic geometry. This volume grew out of these Special Sessions. Drawn from a wide area of mathematics, the articles presented here provide an excellent sampling of the broad range of trends and applications in *p*-adic methods.

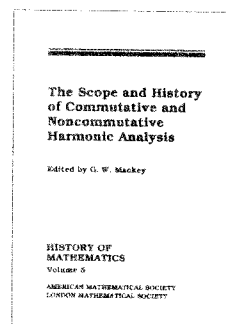
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F. Baldassarri and B. Chiarelotto, *On Christol's theorem. A generalization to systems of PDE's with logarithmic singularities depending upon parameters*; **F. Baldassarri and B. Chiarelotto**, *On Andre's transfer theorem*; **G. Christol and B. Dwork**, *Differential modules of bounded spectral norm*; **R. Crew**, *The *p*-adic monodromy of a generic Abelian scheme in characteristic *p**; **D. R. Dorman**, *Factorization of Drinfeld singular moduli*; **B. Fisher**, *Distinctness of Kloosterman sums*; **R. M. Freije**, *Intersection formulas for Mumford curves*; **D. Goss**, *L-series of Grossencharakteren of type A_0 for function fields*; **G. Kato**, *A *p*-adic cohomological method for the Weierstrass family and its zeta invariants*; **M. Larsen**, *Two-dimensional systems of Galois representations*; **M. M. Robinson**, *Algebraic identities useful in the computation of Igusa local zeta functions*; **A. Silverberg**, *Points of finite order on Abelian varieties*; **P. F. Stiller**, *The arithmetic and geometry of elliptic surfaces*; **P. Van Mulbregt**, *Torsion-points on low dimensional Abelian varieties with complex multiplication*; **M. A. Vitulli**, *Prime-like subsets of a commutative ring*; **D. Wan**, *Newton polygons and congruence decompositions of L-functions over finite fields*.

(continued)

1991 *Mathematics Subject Classification*: 11-06, 14-06
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HISTORY OF MATHEMATICS



The Scope and History of Commutative and Noncommutative Harmonic Analysis **G. W. Mackey, Editor** Volume 5

"When I was invited to speak at the conference on the history of analysis given at Rice University [in 1977], I decided that it might be interesting to

review the history of mathematics and physics in the last three hundred years or so with heavy emphasis on those parts in which harmonic analysis had played a decisive or at least a major role. I was pleased and somewhat astonished to find how much of both subjects could be included under this rubric. . . [Writing up the talks for publication] took several months of full time work but turned out to be an extremely rewarding experience. The picture that gradually emerged as the various details fell into place was one that I found very beautiful, and the process of seeing it do so left me in an almost constant state of euphoria. I would like to believe that others can be led to see this picture by reading my paper, and to facilitate this I have included a large number of short expositions of topics which are not widely understood by non-specialists." —from the Preface

This volume, containing the paper mentioned above as well as five other reprinted papers by Mackey, presents a sweeping view of the importance, utility, and beauty of harmonic analysis and its connections to other areas of mathematics and science. A seventh paper, written exclusively for this volume, attempts to unify certain themes that emerged after major discoveries in 1967 and 1968 in the areas of Lie algebras, strong interaction physics, statistical mechanics, and nonlinear partial differential equations—discoveries that may at first glance appear to be independent, but which are in fact deeply interrelated. This volume is published jointly with the London Mathematical Society.

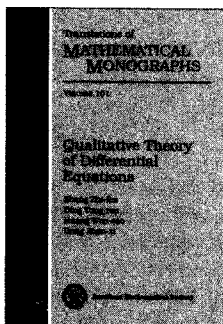
Aimed at mathematicians in all areas as well as to mathematically-oriented theoretical physicists and advanced graduate students, Mackey's book is not directed to specialists but is intended to help specialists learn about fields other than their own and about the relationships among fields. Readers will appreciate this book for its lucid expository presentations and for its wide-ranging treatment of the subject.

Contents

Introduction; Harmonic analysis as the exploitation of symmetry: A historical survey; Herman Weyl and the application of group theory to quantum mechanics; The significance of invariant measures for harmonic analysis; Weyl's program and modern physics; Induced representations and the applications of harmonic analysis; Von Neumann and the early days of ergodic theory; Final remarks.

1991 *Mathematics Subject Classification*: 00B60; 01-02, 11-02, 22D30, 81Q99
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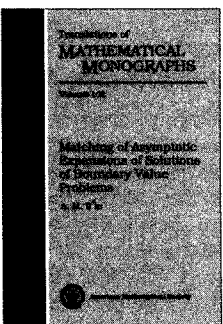
Qualitative Theory of Differential Equations
 Zhang Zhi-fen, Ding Tong-ren, Huang Wen-zao, and Dong Zhen-xi
 (Translated from the Chinese by Anthony Wing-Kwok Leung)
 Volume 101

This book provides an introduction to and a comprehensive study of the qualitative theory of ordinary differential equations. It begins with fundamental theorems on existence, uniqueness, and initial conditions, and discusses basic principles in dynamical systems and Poincaré-Bendixson theory. The authors present a careful analysis of solutions near critical points of linear and nonlinear planar systems and discuss indices of planar critical points. A very thorough study of limit cycles is given, including many results on quadratic systems and recent developments in China. Other topics included are: the critical point at infinity, harmonic solutions for periodic differential equations, systems of ordinary differential equations on the torus, and structural stability for systems on two-dimensional manifolds. This book is accessible to graduate students and advanced undergraduates and is also of interest to researchers in this area. Exercises are included at the end of each chapter.

Contents

Fundamental theorems; Critical points on the plane; Indices of planar critical points; Limit cycles; Critical points at infinity; Harmonic solutions for two-dimensional periodic systems; Systems of ordinary differential equations on the torus; Structural stability.

1991 *Mathematics Subject Classification*: 34; 34A, 34C, 34D
 ISBN 0-8218-4551-9, LC 91-23961, ISSN 0065-9282
 461 pages (hardcover), July 1992
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Matching of Asymptotic Expansions of Solutions of Boundary Value Problems
 A. M. Il'in
 Volume 102

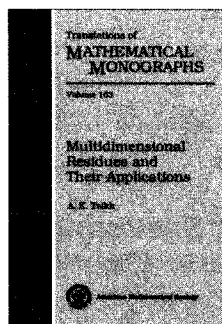
This book deals with the solution of singularly perturbed boundary value problems for differential equations. It presents, for the first time, a detailed and systematic treatment of the version of the matching method developed by the author and his colleagues. A broad class of problems is considered from a unified point of view, and the procedure for constructing asymptotic expansions is discussed in detail. The book covers formal constructions of asymptotic expansions and provides rigorous justifications of these asymptotics. One highlight is a complete asymptotic analysis of Burger's equation with small diffusion in the

neighborhood of the gradient catastrophe point. The book is suitable as a text for graduate study in asymptotic methods in calculus and singularly perturbed equations.

Contents

Boundary layer functions of exponential type; Ordinary differential equations; Singular perturbations of the domain boundary in elliptic boundary value problems; Elliptic equation with small parameter at higher derivatives; Singular perturbation of a hyperbolic system of equations; Cauchy problem for quasilinear parabolic equation with a small parameter.

1991 *Mathematics Subject Classification*: 34-02, 34E15; 41A60
 ISBN 0-8218-4561-6, LC 92-12324, ISSN 0065-9282
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Individual member \$101, List price \$169, Institutional member \$135
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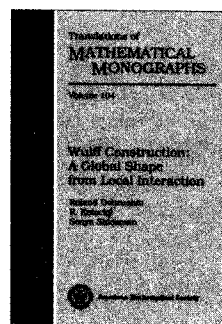
Multidimensional Residues and Their Applications
 A. K. Tsikh
 Volume 103

The technique of residues is known for its many applications in different branches of mathematics. Tsikh's book presents a systematic account of residues associated with holomorphic mappings and indicates many applications. The book begins with preliminaries from the theory of analytic sets, together with material from algebraic topology that is necessary for the integration of differential forms over chains. Tsikh then presents a detailed study of residues associated with mappings that preserve dimension (local residues). Local residues are applied to algebraic geometry and to problems connected with the investigation and calculation of double series and integrals. There is also a treatment of residues associated with mappings that reduce dimension—that is, residues of semimeromorphic forms, connected with integration over tubes around nondiscrete analytic sets.

Contents

Preliminary information; Residues associated with mappings $f: \mathbb{C}^n \rightarrow \mathbb{C}^n$ (local residues); Residues associated with mappings $f: \mathbb{C}^n \rightarrow \mathbb{C}^p$ (residual currents and principal values); Applications to function theory and algebraic geometry; Applications to the calculation of double series and integrals.

1991 *Mathematics Subject Classification*: 32-20; 32A27, 32C30
 ISBN 0-8218-4560-8, LC 92-8368, ISSN 0065-9282
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Wulff Construction: A Global Shape from Local Interaction
 Roland Dobrushin, R. Kotecký, and Senya Shlosman
 Volume 104

A theory of the equilibrium shape of crystal assuming minimal surface free energy was formulated at the beginning of the century by Wulff. Assuming that the anisotropic interfacial free energy (depending on the orientation of the interface with respect to

the crystal axes) is known, the Wulff construction yields the shape of crystal in equilibrium and allows one to understand its main features. This research monograph considers the Wulff construction in the case of a two-dimensional Ising ferromagnet with periodic boundary conditions and at sufficiently low temperatures. Namely, the authors investigate the phenomenon of phase separation in a (small) canonical ensemble characterized by a fixed total spin in a finite volume. Its value is chosen to lie in the interval between the spontaneous magnetizations of pure phases. Heuristically, the main result can be stated this way: a droplet of one phase immersed in the opposite one will be formed with the separation line following with high accuracy the shape yielded by the Wulff construction. The book brings the reader through the entire development of the proof of this result.

Contents

Introduction; Extremal properties of the Wulff functional; Limit theorems; Surface tension; Large contours; Proof of the main results.

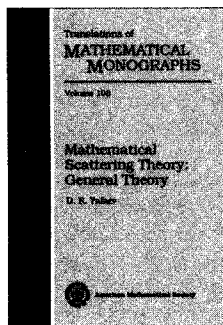
1991 *Mathematics Subject Classification*: 82B05, 85B20; 60K35

ISBN 0-8218-4563-2, LC 92-9200, ISSN 0065-9282

204 pages (hardcover), August 1992

Individual member \$78, List price \$130, Institutional member \$104

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Mathematical Scattering Theory: General Theory

D. R. Yafaev
Volume 105

Scattering theory presents an excellent example of interaction between different mathematical subjects: operator theory, measure theory, the theory of differential operators and equations, mathematical analysis, and applications of these areas to quantum mechanics.

Because of the interplay of these fields, a deep understanding of scattering theory can lead to deep insights into the developing world of modern mathematics.

Yafaev's book provides such an understanding of scattering theory, starting with basic principles and extending to current research. He presents a comprehensive and systematic exposition of the theory, covering different methods (of trace class and smooth perturbations) and approaches (time dependent and stationary) and discussing the relationships among them. Yafaev also fills some gaps in the monographic literature, such as the properties of the scattering matrix and the theory of the spectral shift function. The theory is developed for operators in abstract Hilbert space but is oriented to concrete applications to differential operators (of Schrödinger type). Addressed to graduate students as well as researchers, this book will prove an invaluable reference and research tool.

Contents

Preliminary facts; Basic concepts of scattering theory; Further properties of the WO; Scattering for relatively smooth perturbations; The general setup in stationary scattering theory; Scattering for perturbations of trace class type; Properties of the scattering matrix (SM); The spectral shift function (SSF) and the trace formula.

1991 *Mathematics Subject Classification*: 47A40; 47A55, 81U20

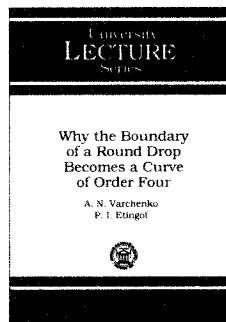
ISBN 0-8218-4558-6, LC 92-803, ISSN 0065-9282

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UNIVERSITY LECTURE SERIES



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

A. N. Varchenko
and P. I. Etingof

Volume 3

This monograph concerns the problem of evolution of a round oil spot surrounded by water when oil is extracted from a well inside the spot. It turns out

that the boundary of the spot remains an algebraic curve of degree four in the course of evolution. This curve is the image of an ellipse under a reflection with respect to a circle. Since the 1940s, work on this problem has led to generalizations of the reflection property and methods for constructing explicit solutions. More recently, the results have been extended to multiply connected domains. This text discusses this topic and other recent work in the theory of fluid flows with a moving boundary. Problems are included at the end of each chapter, and there is a list of open questions at the end of the book.

Contents

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

1991 *Mathematics Subject Classification*: 58F07, 76S05, 31A25, 30C99

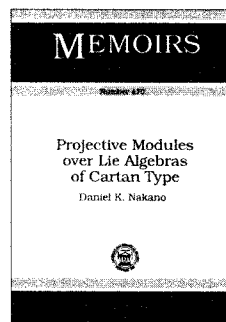
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MEMOIRS OF THE AMS



Projective Modules over Lie Algebras of Cartan Type

Daniel K. Nakano
Volume 98, Number 470

This monograph focuses on extending theorems for the classical Lie algebras in order to determine the structure and representation theory for Lie algebras of Cartan type. More specifically,

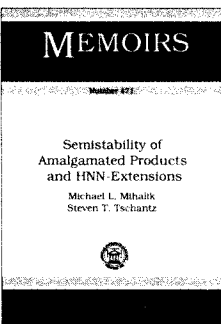
Nakano investigates the block theory for the restricted universal enveloping algebras of the Lie algebras of Cartan type. The first section employs techniques developed by Holmes and Nakano to prove a Brauer-Humphreys reciprocity law for graded restricted Lie algebras and also to find the decompositions for the intermediate (Verma) modules used in the reciprocity law. The second section uses this information to investigate the structure of projective modules for the Lie algebras of types W and K. The restricted enveloping algebras for these Lie algebras are shown to have one block. Furthermore, Nakano provides a procedure for computing the Cartan invariants for Lie algebras of types W and K, given knowledge about the decomposition

of the generalized Verma modules and about the Jantzen matrix of the classical/reductive zero component. Noteworthy for its readability and the continuity of its theme and purpose, this monograph appeals to graduate students and researchers interested in Lie algebras.

Contents

The Brauer-BGG reciprocity theorem; Verma modules over generalized Witt algebras; Cartan invariants for Lie algebras of Cartan type.

1991 *Mathematics Subject Classification:* 17B50; 17B70
 ISBN 0-8218-2530-5, LC 92-12518, ISSN 0065-9266
 84 pages (softcover), July 1992
Individual member \$14, List price \$24, Institutional member \$19
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Semistability of Amalgamated Products and HNN-Extensions
 Michael L. Mihalik and Steven T. Tschantz
 Volume 98, Number 471

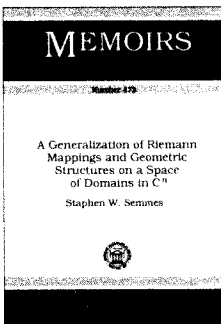
In the study of the proper homotopy theory of finitely presented groups, semistability at infinity is an end invariant of central importance. A finitely presented

group that is semistable at infinity has a well-defined fundamental group at infinity independent of base ray. If G is semistable at infinity, then G has free abelian second cohomology with $\mathbb{Z}G$ coefficients. In this work, the authors show that amalgamated products and HNN-extensions of finitely presented semistable at infinity groups are also semistable at infinity. A major step toward determining whether all finitely presented groups are semistable at infinity, this result easily generalizes to finite graphs of groups. In an early application, this result was used in showing that all one-relator groups are semistable at infinity. The theory of group actions on trees and techniques derived from the proof of Dunwoody's accessibility theorem are key ingredients in this work.

Contents

Geometric preliminaries; Outline of the proof; Dunwoody tracks and relative accessibility; Basic lemmas; Technical lemmas; Proof of the half-space lemma; Proof of Theorem 3.3.

1991 *Mathematics Subject Classification:* 20F32; 20E06, 57M10
 ISBN 0-8218-2531-3, LC 92-10061, ISSN 0065-9266
 86 pages (softcover), July 1992
Individual member \$14, List price \$24, Institutional member \$19
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A Generalization of Riemann Mappings and Geometric Structures on a Space of Domains in C^n
 Stephen W. Semmes
 Volume 98, Number 472

Similar in philosophy to the study of moduli spaces in algebraic geometry, the central theme of this book is that spaces of (pseudoconvex) domains

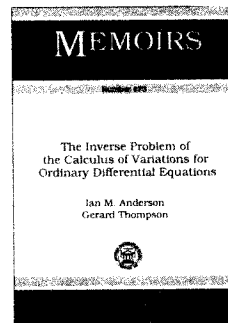
should admit geometrical structures that reflect the complex geometry of the underlying domains in a natural way. Semmes makes two main points in the book. The first is that there is a reasonable analogue of the universal Teichmüller space for domains in C^n , which has a great

deal of interesting geometrical structure, some of which is surprisingly analogous to the classical situation in one complex variable. Second, there is a very natural notion of a Riemann mapping in several complex variables which is a modification of Lempert's, but which is defined in terms of first-order differential equations. In particular, the space of these Riemann mappings has a natural complex structure, which induces interesting geometry on the corresponding space of domains. With its unusual geometric perspective of some topics in several complex variables, this book appeals to those who view much of mathematics in broadly geometrical terms.

Contents

Riemann mappings, Green's functions, and extremal disks; Uniqueness of Riemann mappings, and Riemann mappings onto circled domains; Riemann mappings and the Kobayashi indicatrix; Existence of Riemann mappings whose image is a given smooth, strongly convex domain; Riemann mappings and HCMA, part 1; Riemann mappings and HCMA, part 2; Riemann mappings and liftings to \mathcal{C} ; Spaces of Riemann mappings, spaces of domains; Spaces of Riemann mappings as complex varieties; Homogeneous mappings, completely circled domains, and the Kobayashi indicatrix; A natural action on \mathcal{R} ; The action of \mathcal{H} on domains in C^n ; Riemannian geometry on \mathcal{D}^∞ ; Preliminary discussion; Some basic facts and definitions concerning the metric on \mathcal{D}^∞ ; The metric on \mathcal{D}^∞ , circled domains, and the Kobayashi indicatrix; The Riemannian metric and the action of \mathcal{H} ; The first variation of the energy of a curve in \mathcal{D}^∞ ; Geometry on \mathcal{R}^∞ ; Another approach to Riemannian geometry on \mathcal{R}^∞ ; A few remarks about the Hermitian geometry on \mathcal{R}^∞ .

1991 *Mathematics Subject Classification:* 32H99; 32F07, 32G99
 ISBN 0-8218-2532-1, LC 92-12014, ISSN 0065-9266
 98 pages (softcover), July 1992
Individual member \$15, List price \$25, Institutional member \$20
 To order, please specify MEMO/98/472N



The Inverse Problem of the Calculus of Variations for Ordinary Differential Equations
 Ian M. Anderson and Gerard Thompson
 Volume 98, Number 473

This monograph explores various aspects of the inverse problem of the calculus of variations for systems

of ordinary differential equations. The main problem centers on determining the existence and degree of generality of Lagrangians whose system of Euler-Lagrange equations coincides with a given system of ordinary differential equations. The authors rederive the basic necessary and sufficient conditions of Douglas for second order equations and extend them to equations of higher order using methods of the variational bicomplex of Tulczyjew, Vinogradov, and Tsujishita. What emerges is a fundamental dichotomy between second and higher order systems: the most general Lagrangian for any higher order system can depend only upon finitely many constants. The authors present an algorithm, based upon exterior differential systems techniques, for solving the inverse problem for second order equations. A number of new examples illustrate the effectiveness of this approach. The monograph also contains a study of the inverse problem for a pair of geodesic equations arising from a two dimensional symmetric affine connection. The various possible solutions to the inverse problem for these equations are distinguished by geometric properties of the Ricci tensor.

Contents

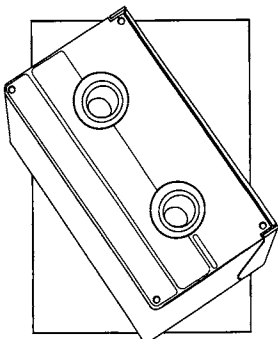
The variational bicomplex for ordinary differential equations; First integrals and the inverse problem for second order ordinary differential equations; The inverse problem for fourth order ordinary differential equations; Exterior differential systems and the inverse problem for second order ordinary differential equations; Examples; The inverse problem for two dimensional sprays.

1991 *Mathematics Subject Classification*: 49N45, 58E30, 58F05
 ISBN 0-8218-2533-X, LC 92-10610, ISSN 0065-9266
 110 pages (softcover), July 1992
Individual member \$16, List price \$26, Institutional member \$21
 To order, please specify MEMO/98/473N

Brunelleschi's famous discovery of linear perspective using mirrors and the Baptistry of the Cathedral in Florence is illustrated with overlays showing the horizon line and the vanishing points. Computer graphics are used to recreate the inclined plane and Tower of Pisa experiments of Galileo. Dauben explains how these experiments allowed Galileo to formulate his revolutionary theory of the behavior of falling bodies and projectile motion. Dauben concludes by showing examples of the influence of Galileo's scientific work on the art of his time.

1991 *Mathematics Subject Classification*: 00, 01
 ISBN 0-8218-8073-X
 NTSC format on 1/2" VHS videotape; approx. 45 minutes, 1991
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VIDEOTAPES

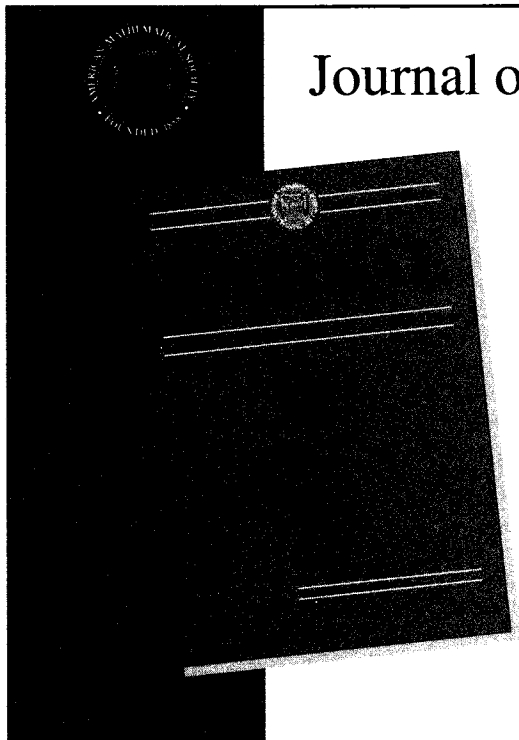


The Art of Renaissance Science: Galileo and Perspective
 Joseph W. Dauben

In this videotape from Science Television; Prof. Joseph W. Dauben discusses the life of Galileo, the origin of perspective drawing and the interaction of art and science in the Renaissance. His presentation includes dozens of examples

from Renaissance painting, sculpture and architectural drawing, including the works of Rembrandt, Michelangelo, and Leonardo DaVinci.

Journal of the American Mathematical Society



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

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Miscellaneous

Personals

Timothy Law Snyder, of the Georgetown University department of computer science, has been promoted to the position of Associate Professor at that same institution.

Weiping Yin, of the University of Science and Technology of China, has been appointed an Associate Member of the International Centre for Theoretical Physics from January 1, 1992 until December 31, 1997.

Deaths

Olga Bondareva, of St. Petersburg, Republic of Russia, died on December 9, 1991, at the age of 54. She was a member of the Society for 14 years.

Svetlana Buzasi, of Kossuth Lajos University, died on October 25, 1990, at the age of 52. She was a member of the Society for 1 year.

Landon A. Colquitt, Professor Emeritus of Texas Christian University, died on December 19, 1991, at the age of 72. He was a member of the Society for 44 years.

Zbigniew Gajda, of Silesian University, died on April 6, 1992. He was a member of the Society for 1 year.

Saul Gorn, Professor Emeritus of the University of Pennsylvania, died on February 22, 1992, at the age of 79. He was a member of the Society for 55 years.

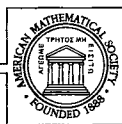
Burrowes Hunt, of Salem, Oregon, died on September 13, 1991, at the age

of 75. He was a member of the Society for 38 years.

Stanley B. Jackson, Professor Emeritus of the University of Maryland, College Park, died on April 19, 1992, at the age of 79. He was a member of the Society for 54 years.

Morris Kline, Professor Emeritus of New York University-Courant Institute, died on June 10, 1992, at the age of 84. He was a member of the Society for 59 years.

Antoni Zygmund, Professor Emeritus of the University of Chicago, died on May 30, 1992, at the age of 91. He was a member of the Society for 52 years. (A more extensive article is being prepared for a future issue of the *Notices*.)



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Visiting Mathematicians

(Supplementary List)

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

American Mathematicians Visiting Abroad

<u>Name and Home Country</u>	<u>Host Institution</u>	<u>Field of Special Interest</u>	<u>Period of Visit</u>
Bellow, Alexandra (U.S.A.)	University of Göttingen, Germany	Ergodic Theory	3/93 - 6/93
Passow, Eli (U.S.A.)	Technion, Israel	Approximation Theory	10/92 - 7/93
Pedit, Franz (U.S.A.)	Technical University of Berlin, Germany	Differential Geometry	9/92 - 5/93
Sakamoto, Kunimochi (U.S.A.)	Hiroshima University, Japan	Dynamical Systems	5/92 - 4/93
Sampson, Paul (U.S.A.)	INRA Biometry Lab., Avignon, France; University of Cape Town, South Africa	Spatial Statistics and Morphometrics	1/93 - 9/93

Visiting Foreign Mathematicians

Abraham, Uri (Israel)	York University	Logic	9/92 - 5/93
Alessandrini, Giovanni (Italy)	Northwestern University	Partial Differential Equations	9/92 - 12/92
Barbe, Phillipe (France)	University of Washington	Extreme Value Theory	6/92 - 8/92
Beirlant, Jan (Belgium)	University of Washington	Nonparametric Statistics, Empirical Processes	6/92 - 8/92
Berkes, Istvan (Hungary)	University of Texas, Austin	Harmonic Analysis	9/92 - 5/93
Börger, Reinhard (Germany)	York University	Category Theory	1/93 - 6/93
Chang, Qianshun (China)	University of Alberta	Applied Math and Scientific Computing	4/92 - 3/93
Eriksson-Bique, Sirkka L. (Finland)	McGill University	Potential Group Theory	8/92 - 7/93
Fan, Liu (China)	Mississippi State University	Operator Theory	9/92 - 4/93
Fomenko, Igor (Russia)	University of Alberta	Oscillatory Phenomena in Biological Systems	1/92 - 12/92
Gardiner, Stephen J. (Ireland)	McGill University	Analysis	6/92 - 12/92
Granovsky, Boris (Israel)	York University	Probability	9/92 - 5/93
Havin, Victor P. (Russia)	McGill University	Analysis	1/93 - 5/93
Henrot, Antoine (France)	Northwestern University	Partial Differential Equations	9/92 - 12/92
Horak, Peter (Czechoslovakia)	Simon Fraser University	Combinatorics	1/93 - 8/93
Itatsu, Seiichi (Japan)	University of Utah	Probability and Statistics	2/93 - 6/93
Jones, Graham (Australia)	Illinois State University	Mathematics Education/Assessment	8/91 - 5/93
Karonski, M. (Poland)	Emory University	Probability Theory	9/92 - 12/92
Kechagias, Epaminondas (Greece)	York University	Algebraic Topology	9/92 - 12/92
Laursen, Kjeld B. (Denmark)	Mississippi State University	Operator Theory	10/92 - 11/92
Makov, Udi (Israel)	York University	Statistics	9/92 - 6/93
Martinyuk, Anatolii (Ukraine)	University of Alberta	Applications to Mechanics	9/92 - 4/93
Merzbach, Ely (Israel)	University of Ottawa	Probability	6/92 - 9/92
Mori, Shigefumi (Japan)	University of Utah	Algebraic Geometry	8/92 - 12/92

Visiting Mathematicians

<u>Name and Home Country</u>	<u>Host Institution</u>	<u>Field of Special Interest</u>	<u>Period of Visit</u>
Muller, Jesper (Denmark)	University of Washington	Spatial Statistics	6/92 - 8/92
Mundruzco, Gyorgy (Hungary)	University of New Hampshire	Statistics	8/92 - 6/94
Perez-Chavela, Ernesto (Mexico)	Northwestern University	Partial Differential Equations	9/92 - 8/93
Reid, Alan (United Kingdom)	University of Texas at Austin	Low-dimensional Topology	9/92 - 5/93
Reid, Miles (United Kingdom)	University of Utah	Algebraic Geometry	8/92 - 12/92
Sheehan, Nuala (Ireland)	University of Washington	Genetical Statistics	7/92 - 8/92
Shereshevsky, Mark (United Kingdom)	University of Texas, Austin	Dynamical Systems	1/93 - 5/93
Spiegel, Hartmut (Germany)	Illinois State University	Mathematics Education/Assessment	8/93 - 12/93
Teng, Zhen-huan (China)	Simon Fraser University	Applied Mathematics	9/92 - 12/92
Uraltseva, N. (Russia)	Emory University	Partial Differential Equations	1/93 - 6/93
Vaananen, Juoko (Finland)	Simon Fraser University	Logic	9/92 - 8/93
Wang, Qi Yun (China)	McGill University	Pattern Formation in Condensed Matters Physics	7/92 - 6/93
Zastawniak, Tomasz (Poland)	University of Alberta	Stochastic Processes and Quantum Mechanics	11/91 - 8/92
Zou, Henghui (China)	Northwestern University	Partial Differential Equations	9/92 - 8/94

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Reciprocity Agreements

The American Mathematical Society has "reciprocity agreements" with a number of mathematical organizations around the world. A current list appears below.

These Reciprocity Agreements provide for reduced dues for members of these organizations who choose to join the AMS and who reside outside of the U.S. and Canada. Reciprocally, members of the AMS who reside in the U.S. or Canada may join these organizations at a reduced rate. Summaries of the privileges available to AMS members who join under the terms of reciprocity agreements are given on the following pages. Members of these organizations who join the AMS as reciprocity members enjoy all the privileges available to ordinary members of the Society. AMS dues for reciprocity members are \$52 for 1992 and \$54 for 1993. Each organization was asked to review and update its listing in the Spring. An asterisk (*) after the name of an organization indicates that no response to this request had been received when the July/August *Notices* went to press. A bullet (●) before the name of an organization indicates that application forms for that organization may be obtained by writing the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940-6248.

Africa

●Nigerian Mathematical Society*

Apply to: Christopher O. Imoru (Secretary), Nigerian Mathematical Society, Department of Mathematics, University of Ife, Ile-Ife, Nigeria.

Dues: \$10; payable to the Treasurer, Nigerian Mathematical Society, Department of Mathematics, University of Benin, Benin City, Nigeria.

Privileges: *Journal of the Nigerian Mathematical Society* at the price normally charged to individual members.

Officers: A. Olubummo (President), J. O. C. Ezeilo (Vice-President), C. O. Nwachuku (Treasurer), C. O. M. Imoru (Secretary), S. A. Ilori (Assistant Secretary), H. O. Tejumola (Editor-in-Chief).

Asia

●Allahabad Mathematical Society*

Apply to: K. K. Azad, Secretary, Allahabad Mathematical Society, 10, C.S.P. Singh Marg, Allahabad-211 001, India.

Dues: US \$20 (annual), US \$150 (life); payable to Allahabad Mathematical Society.

Privileges: *Indian Journal of Mathematics*.

Officers: Pramila Srivastava (President), S. N. Bhalt, A. M. Vaidya (Vice-Presidents), Kavita Srivastava (Treasurer), K. K. Azad (Secretary), G. D. Dikshit (Editor, *Indian Journal of Mathematics*), V. Singh (Librarian).

Calcutta Mathematical Society*

Apply to: U. Basu, Secretary, Calcutta Mathematical Society, 92, Acharya Prafulla Chandra Road, Calcutta 700 009, India.

Dues: \$2; payable to U. Basu, Secretary.

Privileges: *News Bulletin* (free of cost).

Officers: M. Dutta (President), P. C. Vaidya, B. R. Bhonsle, F. Harary, L. Debnath, S. P. Bandyopadhyay, (Vice-Presidents), B. K. Datta, (Treasurer), U. Basu (Secretary).

Indian Mathematical Society

Apply to: S. P. Arya, General Secretary, Indian Mathematical Society, Department of Mathematics, Maitreyi College, Bapu Dham Complex, Chanakyapuri, New Delhi 110 021, India.

Dues: \$20; payable to M. K. Singal, Hon. Treasurer, IMS, Department of Mathematics, Meerut University, Meerut-250 005, India.

Privileges: *Mathematics Student*.

Officers: V. Kannan (President), D. K. Sinha (Immediate Past President), M. K. Singal (Treasurer), S. P. Arya (General Secretary), H. P. Dikshit (Academic Secretary), R. P. Agrawal (Editor of *Journal of Indian Mathematical Society*), V. M. Shah (Editor of *Mathematics Student*), K. S. Padmanabhan (Hony. Librarian).

●Korean Mathematical Society

Apply to: Dohan Kim, 538 Dowha Dong, Mapo Ku, Sung Ji Building, Room 706, Seoul 121-743, Korea.

Dues: \$20; payable to the Korean Mathematical Society.

Privileges: Free receipt of *Bulletin* (two issues per year) and *Journal of the Korean Mathematical Society* (two issues per year), half of membership dues.

Officers: Jongsik Kim (President), Chin-Ku Chu, Moo Ha Woo (Vice-President), Chong-Man Cho (Treasurer), Dohan Kim (Secretary).

Malaysian Mathematical Society

Apply to: Hon. Secretary, Malaysian Mathematical Society, c/o Department of Mathematics, University of Malaya, 59100 Kuala Lumpur, Malaysia.

Dues: \$7.50; payable to Malaysian Mathematical Society.

Privileges: *MMS Newsletter*, *Bulletin of the Malaysian Mathematical Society* (two issues per year), reduced rate for *Menemui Matematik* (three issues per year).

Officers: Sing-Leng Tan (President), Nik Ahmad Kamal, Peng-Choon Wong (Vice-Presidents), Soo-Mei Ee (Treasurer), K. Ratnavelu (Secretary).

•Mathematical Society of Japan

Apply to: Takako Watanabe, Secretary, Mathematical Society of Japan, 25-9-203, Hongo 4-chome, Bunkyo-ku, Tokyo 113, Japan.

Dues: US \$40; payable to Mathematical Society of Japan.

Privileges: *Journal of the Mathematical Society of Japan*; *Sugaku* (in Japanese) for US \$8 additional dues.

Officers: Daisuke Fujiwara (President), Yuko Mizutani (Treasurer), Takako Watanabe (Secretary).

Mathematical Society of the Philippines*

Apply to: Membership Committee, Mathematical Society of the Philippines, Department of Mathematics, Ateneo de Manila University, P.O. Box 154, Manila, Philippines.

Dues: \$5; payable to Mathematical Society of the Philippines.

Privileges: Publications and newsletter of the Mathematical Society of the Philippines.

Officers: Jose Marasigan (President), Rene P. Felix (Vice-President), Aurora Trance (Treasurer), Rolando Ramos (Secretary).

Mathematical Society of the Republic of China*

Apply to: Mathematical Society of the Republic of China, P.O. Box 23-3, Taipei, Taiwan, Republic of China.

Dues: N.T. \$200 (US \$5.00); payable to Mathematical Society of the Republic of China.

Privileges: *Chinese Journal of Mathematics* (two to four issues per year).

Officers: Simon C. Hsieh (President), Jau-D. Chen (Treasurer), Liang-Chi Tsao (Secretary).

Punjab Mathematical Society*

Apply to: Khalid Latif Mir, Secretary, Punjab Mathematical Society, Department of Mathematics, University of the Punjab, Quaid-I-Azam Campus, Lahore 54590, Pakistan.

Dues: US \$25 for life membership; payable to Secretary or Treasurer.

Privileges: Mathematics Forum, Proceedings of the Conferences, Symposia, and Seminars arranged by the Society.

Officers: F. D. Anjum Roomani (President), Khalid Saleem, Maqbool Ahmad Ch. (Vice-Presidents), Muhammad Ashraf Jajja (Treasurer), Khalid Latif Mir (Secretary).

•Ramanujan Mathematical Society

Apply to: Dr. N. Jayasankaran, Secretary, RMS, Bharathidasan Institute of Management, BHEL Complex, Trichi, TamilNadu, India.

Dues: \$15 (annual), \$150 (life); payable to Secretary, Ramanujan Mathematical Society, same address as above.

Privileges: *Journal of Ramanujan Mathematical Society*.

Officers: K. S. Padmanabhan (President), B. K. Lahiri (Vice-President), C. V. Venkatachalam (Treasurer), N. Jayasankaran (Secretary).

Southeast Asian Mathematical Society

Apply to: Southeast Asian Mathematical Society, c/o Department of Mathematics, Chinese University of Hong Kong, Shatin, N.T., Hong Kong.

Dues: US \$10; payable to Southeast Asian Mathematical Society.

Privileges: *SEAMS Newsletter*, *Southeast Asian Bulletin of Mathematics*.

Officers: Mari-Jo P. Ruiz (President), Polly Wee Sy (Treasurer), Luz R. NocheFranca (Secretary).

•Vijnana Parishad of India

Apply to: H. M. Srivastava, Foreign Secretary, VPI, Department of Mathematics, University of Victoria, Victoria, British Columbia, Canada, V8W 2Y2 or R. C. Singh Chandel, Secretary, VPI, Department of Mathematics, D. V. Postgraduate College, Orai-285001, U. P., India.

Dues: US \$12 (annual), US \$120 (life); payable to Vijnana Parishad, c/o Department of Mathematics, D. V. Postgraduate College, Orai-285001, U. P., India.

Privileges: *Jñānābha* (an interdisciplinary mathematical journal currently published once a year); back volumes available at 25% discount.

Officers: J. N. Kapur (President), R. P. Agarwal, M. K. Singal, R.S. Khare (Vice-Presidents), R. C. Singh Chandel (Secretary-Treasurer), H. M. Srivastava (Foreign Secretary).

Europe

Asociación Matemática Española*

Apply to: Miguel de Guzmán, President, Asociación Matemática Española, Facultad de Matemáticas, Universidad Complutense, Madrid 3, Spain.

Dues: US \$15 for members of the American Mathematical Society; payable to Asociación Matemática Española.

Privileges: *Boletín de la Asociación Matemática Española*; *Publicaciones de la Asociación Matemática Española* (at reduced prices).

Officers: Miguel de Guzmán, (President), Ireneo Peral (Treasurer), María T. Carrillo (Secretary).

•Berliner Mathematische Gesellschaft e.V.

Apply to: E.-J. Thiele, Fachbereich 3 - Mathematik -, MA 8 - 1, Straße des 17.Juni 136, D-1000 Berlin 12, Federal Republic of Germany.

Dues: DM 12; payable to G. Preuss, Institut für Mathematik I, FU Berlin, Arnimallee 3, D-1000 Berlin 33, Federal Republic of Germany.

Privileges: One free copy of "Sitzungsberichte der BMG".

Officers: E.-J. Thiele (President), Rolf Sulanke (Vice-President), G. Preuss (Treasurer), H.G.W. Begehr (Secretary).

Dansk Matematisk Forening

Apply to: Mogens Esrom Larsen, Secretary, Dansk Matematisk Forening, Universitetsparken 5, 2100 København Ø, Denmark.

Dues: D.kr. 50; payable to Treasurer.

Privileges: *Mathematica Scandinavica* (D.kr. 183 per volume), *Nord. Mat. Tidss. (Normat)* (N.kr. 130 per volume). (Members of the American Mathematical Society do not have to join Dansk Matematisk Forening to obtain the journals. Subscription orders should be sent directly to the journals: *Normat*, Universitetsforlaget, Avd. for tidsskrifter, Postbox 2959 Tøyen, Oslo 6, Norway; *Mathematica Scandinavica*, Matematisk Institut, Aarhus Universitet, 8000 Aarhus C, Denmark.)

Officers: Kjeld Bagger Laursen (President), Mogens Esrom Larsen (Vice-President), Jesper Michael Møller (Treasurer), Mogens Esrom Larsen (Secretary), Ebbe Thue Poulsen, Sten Markvorsen.

•Deutsche Mathematiker-Vereinigung e.V.

Apply to: Deutsche Mathematiker-Vereinigung e.V., Albertstraße 24, 7800 Freiburg, Federal Republic of Germany.

Dues: DM 40.(for 1992; will change in 1993) - (for reciprocity members); payable to Kreissparkasse Tübingen 16269 (BLZ 641 500 20), Federal Republic of Germany or Postscheckamt Stuttgart 18517-706 (BLZ 600 100 70), Federal Republic of Germany.

Privileges: *Mitteilungen der Deutschen Mathematiker-Vereinigung* (four issues a year), *Jahresbericht der Deutschen Mathematiker-Vereinigung* (four issues a year).

Officers: W. Scharlav (President), K. P. Grotemeyer (Treasurer), N. Schappacher (Secretary).

•Edinburgh Mathematical Society

Apply to: The Honorary Secretary, Edinburgh Mathematical Society, James Clerk Maxwell Building, King's Buildings, Mayfield Road, Edinburgh, EH9 3JZ, Scotland.

Dues: \$10 (preferably £4 sterling); payable to the Honorary Secretary.

Privileges: *Proceedings* at reduced rate of \$17 (preferably £7 sterling) per annum.

Officers: A. C. McBride (President), E. G. Rees (Vice-President), A. D. Sands (Treasurer), J. Martin, C. J. Shaddock (Secretaries).

Gesellschaft für Angewandte Mathematik und Mechanik (GAMM)

Address for mail: Reinhard Mennicken, University of Regensburg, D-8400 Regensburg, Federal Republic of Germany.

Apply to: R. Ansoerge, Institut für Angewandte Mathematik, Universität, Hamburg, Bundesstr. 55, D-2000 Hamburg 13, Federal Republic of Germany.

Dues: 25.-DM; payable to G. Alefeld, Institut für Angewandte Mathematik Universität Karlsruhe, Englerstr. 2, D-7500 Karlsruhe.

Privileges: Regular publications of GAMM and participation in scientific meetings at a reduced rate.

Officers: O. Mahrenholtz (President), W. Walter (Vice-President), G. Alefeld (Treasurer), R. Mennicken (Secretary), R. Ansoerge (Vice-Secretary).

Glasgow Mathematical Association

Apply to: K. A. Lindsay, Glasgow Mathematical Association, Department of Mathematics, University of Glasgow, University Gardens, Glasgow G12 8QW, Scotland.

Dues: £24.50; payable to Glasgow Mathematical Association.

Privileges: *Glasgow Mathematical Journal*.

Officers: M. Hamson (President), D.B. Webber (Vice-President), K. A. Lindsay (Treasurer), I. McFarlane (Secretary).

•Irish Mathematical Society

Apply to: Irish Mathematical Society, G. Ellis, Secretary, Mathematics Department, University College, Galway, Ireland.

Dues: US \$10; payable to D. Tipple, IMS Treasurer, Department of Mathematics, University College, Dublin 4, Ireland.

Privileges: Right to receive the *Bulletin of the Irish Mathematical Society*; right to subscribe to the *Proceedings of the Royal Irish Academy* (Section A) at a reduced rate.

Officers: R. M. Timoney (President), B. Goldsmith (Vice-President), D. Tipple (Treasurer), G. Ellis (Secretary).

Íslenzka stærðfræðafélagið

Apply to: Íslenzka stærðfræðafélagið, Raunvísindastofnun Háskólans, Dunhaga 3, IS-107 Reykjavik, Iceland.

Dues: \$10; payable to Íslenzka stærðfræðafélagið.

Privileges: Reduced subscription rate on *Mathematica Scandinavica* and *Nordisk Matematisk Tidsskrift (Normat)*, subscription orders should be sent directly to the journals.

Officers: Jón R. Stefánsson (President), Kristín H. Jónsdóttir (Treasurer), Sven Sigurðsson (Secretary).

János Bolyai Mathematical Society

Apply to: Vice-Secretary General, Cecilia Szabados, J. Bolyai Mathematical Society, Budapest, Fő utca 68., Hungary H-1027.

Dues: Are voluntary but should minimally cover duplication and mailing costs; Reciprocity members (residing outside Hungary) suggested fee is 1/8 of one percent of the member's net income; sponsoring members pay at least US \$180 or equivalent per year.

Privileges: Upon request—*Matematikai Lapok* (twice a year), *Középiskolai Matematikai Lapok* (monthly). If sufficient interest is expressed, a Bulletin in English will be available. In addition, the JBMS is negotiating to obtain discounts for its reciprocity and sponsoring members on several serial publications and periodicals appearing in Hungary. Contact the JBMS secretary for more information regarding this and other privileges of membership.

Officers: András Hajnal (President), Gyula Katona (Secretary General), Cecilia Szabados (Vice-Secretary General), András Recski (Treasurer).

Jednota Českých Matematiků a Fyziků

Apply to: RNDr. Jirí Rákosník, CSc., Matematický ústav, Žitná 25, 115 67 Praha 1.

Dues: \$20; payable to Komerční banka, pobočka, Na příkopě 28, 110 00 Praha 1, Account no. 34833 - 1200750 - 011.

Privileges: (i) A discount of 20% in the conference fees for conferences, symposia, summer schools, and similar events organized (or coorganized) by the JČMF; (ii) Newsletter. Also, may attend and present letters at meetings.

Officers: F. Nozicka (President), Jirí Rákosník (Vice-President), Miroslav Miler (Treasurer), Štefan Zajac (Secretary).

•London Mathematical Society

Apply to: Miss S.M. Oakes, London Mathematical Society, Burlington House, Piccadilly, London W1V 0NL, United Kingdom.

Dues: £6; payable to London Mathematical Society. (New members should not send payment until elected.)

Privileges: *LMS Newsletter*. Reduced rates for the *Bulletin, Journal, and Proceedings of the LMS; Nonlinearity; Journal of Applied Probability; Mathematical Proceedings of the Cambridge Philosophical Society; Quarterly Journal of Mathematics; LMS Lecture Notes; LMS Student Texts; LMS Monographs; Glasgow Mathematical Journal*. (Please write to the LMS for complete details.)

Officers: J.F.C. Kingman (President), J. M. Howie, P. M. Neumann (Vice-Presidents), J.D.M. Wright (Treasurer), R. Y. Sharp, A. R. Pears (Secretaries), D. A. Brannan (Publications Secretary).

•Norsk Matematisk Forening

Apply to: Åse Wenche Dybvik, Norsk Matematisk Forening, Matematisk Institutt, Postboks 1053 Blindern, N-0316 Oslo 3, Norway.

Dues: N.kr. 50 or N.kr. 500 for permanent membership; payable to Åse Wenche Dybvik, Norsk Matematisk Forening.

Privileges: Reduced subscription rate on *Mathematica Scandinavica* and *NORMAT (Nordisk Matematisk Tidsskrift)*, free monthly information bulletin "Infomat" about the activities of the Society.

Officers: Geir Ellingsrud (President), Tom Lindstrøm (Vice-President), Bjørn Jahren (Treasurer), Jon Reed (Secretary).

•Österreichische Mathematische Gesellschaft*

Apply to: Ludwig Reich, President, Österreichische Mathematische Gesellschaft, Technische Universität Wien, Wiedner Hauptstraße 8-10, A-1040 Wien, Austria.

Dues: öS 150; payable to Inge Troch, Treasurer.

Privileges: *Internationale Mathematische Nachrichten* (IMN).

Officers: Ludwig Reich (President), Werner Kuich (Vice-President), Inge Troch (Treasurer), Hans Reichel (Secretary).

Polskie Towarzystwo Matematyczne*

Apply to: Polskie Towarzystwo Matematyczne, Śniadeczkich 8, 00-950 Warszawa, Poland.

Dues: \$8; payable to Polskie Towarzystwo Matematyczne.

Privileges: Participation in scientific conferences organized by the Polish Mathematical Society and in its scientific sessions; in addition, members receive one of the following five series of the publication *Annales Societatis Mathematicae Polonae: Commentationes Mathematicae* in congress languages, *Wiadomości Matematyczne* (Mathematical News) in Polish, *Matematyka Stosowana* (Applied Mathematics) in Polish, *Fundamenta Informaticae* in congress languages, *Dydaktyka Matematyki* (Didactics of Mathematics) in Polish.

Officers: Andrzej Pelczar (President), Roman Duda, Adam Piskorek (Vice-Presidents), Maciej Bryński (Secretary), Janusz Kowalski (Vice Secretary), Maciej Maczynski (Treasurer).

Real Sociedad Matemática Española*

Apply to: J. Llovet, Secretario General de la Real Sociedad Matemática Española, Dept. Matemáticas, Universidad Alcalá, 28871 Alcalá Henares (Madrid) Spain.

Dues: \$30; payable to Secretario, R. S. M. E.

Privileges: *Gaceta Matemática* and *Revista Matemática Ibero Americana*.

Officers: J. M. Aroca (President), Juan Llovet Verdugo (Secretary).

•Sociedade Portuguesa de Matemática

Apply to: J. F. Rodrigues, Sociedade Portuguesa de Matemática, Av. da República 37 4º, 1000 Lisboa, Portugal.

Dues: 900 Portuguesa Escudos; payable to Sociedade Portuguesa de Matemática.

Privileges: *Boletim da Sociedade Portuguesa de Matemática*, free; discount of 70% in the subscription fees for *Portugaliae Matemática*.

Officers: A. S. Alves (President), A. St' Aubyn, J. F. Rodrigues, A. Martins (Vice-Presidents), A. Autunes (Treasurer), A. Morta (Secretary).

Societat Catalana de Matemàtiques*

Apply to: Secretari de la Societat Catalana de Matemàtiques, Carrer del Carme 47, 08001 Barcelona, Spain.

Dues: 1000 pessetes for members of the AMS, payable to the Societat Catalana de Matemàtiques.

Privileges: *Butlletí de la Societat Catalana de Matemàtiques*, (2 numbers a year).

Officers: J. Girbau (President), Carles Perelló (Secretary), Rubi Corberó (Associated Secretary).

Société Mathématique de Belgique*

Apply to: Guy Hirsch, Secretary, Société Mathématique de Belgique, 317/11, Avenue Charles Woeste, 1090 Brussels, Belgium.

Dues: \$25; payable to Société Mathématique de Belgique, preferably by International Money Order, VISA, MasterCard, or American Express.

Privileges: *Bulletin de la Société Mathématique de Belgique* (6 numbers per year in 1989 and 1990). Series A and Series B, totalling about 800 pages.

Officers: A. Verschoren (President), L. Lemaire (Vice-President), G. Hirsch (Secretary-Treasurer).

Société Mathématique de France

Apply to: Société Mathématique de France, Claire Ropartz, Ecole Normale Supérieure, Tour L, 1 rue Maurice Arnoux, 92120 Montrouge, France.

Dues: \$38; payable to American Mathematical Society or S.M.F.

Privileges: *Officiel* (adresse dans la CEE) \$22, *Officiel* (adresse hors CEE) \$28, *Bulletin* (without *Mémoires*) \$47, *Bulletin & Mémoires* \$76. *Asterique* may be purchased at a discount price. (Members in the U. S., Canada, or Mexico should order their copies from the AMS. See the AMS *Catalogue of Publications*.)

Officers: J. P. Bourguignon (President), J. Detraz, J. M. Lemaire, D. Barlet (Vice-Presidents), F. Gramain (Treasurer), P. Arnoux, J. Faraut (Secretaries).

•Société Mathématique Suisse

Apply to: P. Hess, Secretary SMS, Mathematics Institute, University of Zurich, Rämistrasse 74, CH 8001 Zurich, Switzerland.

Dues: SFr. 25.- for members of the AMS residing outside Switzerland; payable to P. Hess, SMS Secretary, address same as above.

Privileges: *Commentarii Mathematici Helvetici* (reduced price); information concerning activities of SMS.

Officers: H. Holmann (President); F. Sigrist (Vice-President); P. Hess (Treasurer-Secretary).

•Société de Mathématiques Appliquées et Industrielles*

Apply to: Société de Mathématiques Appliquées et Industrielles, Centre de Mathématiques Appliquées, École Polytechnique, 91128 Palaiseau, France.

Dues: US \$25; Société de Mathématiques Appliquées et Industrielles.

Privileges: Free subscription to the *News Bulletin*, reduced rates at conferences organized by SMAI.

Officers: J. C. Nedelec (President), P. Lascaux, J. Periaux (Vice-Presidents), M. Lenoir (Treasurer), G. Meurant (Secretary).

•Suomen matemaattinen yhdistys

Apply to: Heikki Heikkilä, Secretary, Department of Mathematics, University of Helsinki, Hallituskatu 15, SF-00100 Helsinki, Finland.

Dues: 75 FIM; payable to Aatos Lahtinen, Treasurer, Department of Mathematics, University of Helsinki, Hallituskatu 15, SF-00100 Helsinki, Finland.

Privileges: *Arkhimedes* (four issues a year) and *Eukleides* (newsletter).

Officers: Mika Seppälä (President), Sören Illman (Vice-President), Aatos Lahtinen (Treasurer), Heikki Heikkilä (Secretary).

Svenska Matematikersamfundet

Apply to: Peter Kumlin, Chalmers University of Technology, Department of Mathematics, S-412 96 Göteborg, Sweden.

Dues: 40 Skr. payable to Svenska Matematikersamfundet, Stefan Rauch-Wojciechowski, Department of Mathematics, University of Linköping, S-58183 Linköping, Sweden.

Privileges: *Mathematica Scandinavica* and *Nordisk Matematisk Tidskrift* at reduced rate. Information about the meetings of the Society.

Officers: Peter Sjögren (President), Michael Benedicks (Vice-President), Stefan Rauch-Wojciechowski (Treasurer), Peter Kumlin (Secretary).

•Unione Matematica Italiana

Apply to: Enrico Obrecht, Treasurer, Segreteria della Unione Matematica Italiana, Dipartimento di Matematica, Piazza Porta S. Donato, 5, 40127 Bologna, Italy.

Dues: 50,000 lire; payable to Unione Matematica Italiana.

Privileges: Free *Notiziario dell'UMI* (monthly), *Bollettino dell'UMI, ser. A* (3 issues a year), and membership list. Discount of 30,000 Lires for subscriptions to *Bollettino dell'UMI, Ser. B.*

Officers: Alessandro Figà-Talamanca (President), Maurizio Cornalba (Vice-President), Enrico Obrecht (Treasurer), Giuseppe Anichini (Secretary).

Wiskundig Genootschap

Address for mail: Wiskundig Genootschap, Delft University of Technology, Faculty of TWI, P.O. Box 5031, 2600 GA Delft, The Netherlands.

Apply to: Membership Department, Wiskundig Genootschap, University of Utrecht, Postbus 80010, 3508 TA Utrecht, The Netherlands.

Dues: Hfl 55.-; payable to Amro Bank, Utrecht, The Netherlands, Account 45.65.88.167, Penningmeester Wiskundig Genootschap.

Privileges: *Nieuw Archief Voor Wiskunde* (three issues a year containing articles and a problem section), *Mededelingen* (nine issues a year containing announcements and book reviews), *Proceedings of the Royal Academy of Sciences—“Indagationes Mathematicae”* (can be obtained at a reduced subscription rate of Hfl 185.-).

Officers: A. van der Sluis (President), E.G.F. Thomas (Vice-President), J. D. Stegeman (Treasurer), R. W. Goldbach (Secretary).

Latin America

•Sociedad Colombiana de Matemáticas

Apply to: Julia María Cortés, Sociedad Colombiana de Matemáticas, Apartado Aéreo 2521, Bogotá, D.C., Colombia.

Dues: \$16; payable to Sociedad Colombiana de Matemáticas.

Privileges: Either *Revista Colombiana de Matemáticas* (four issues a year) or *Lecturas Matemáticas* (three issues a year).

Officers: Víctor S. Albis (President), J. Hernando Pérez (Vice-President), Leonardo Duarte (Treasurer), Julia María Cortés (Secretary).

Sociedad de Matemática de Chile

Apply to: Secretario, Sociedad de Matemática de Chile, Casilla 16164, Correo 9, Santiago, Chile.

Dues: US \$20; payable to Sociedad de Matemática de Chile.

Privileges: Receive: *Gaceta de la Sociedad, Notas de la Sociedad de Matemática de Chile* (two issues per year).

Officers: Rubí Rodríguez (President), Samuel Navarro (Vice-President), César Burgueno (Treasurer), Rodrigo Barón (Secretary).

Sociedad Matemática de la República Dominicana*

Apply to: Isidro Rodríguez, Sociedad Matemática de la República Dominicana, P. O. Box 797-2, Santo Domingo, Dominican Republic.

Dues: US \$10; payable to Isidro Rodríguez, Sociedad Matemática de la República Dominicana.

Privileges: Right to receive *Notimat* (bimonthly newsletter) and *Revista Matemática Dominicana* (twice a year).

Officers: Amado Reyes (President), David Castillo (Vice-President), Isidro Rodríguez (Treasurer), Luis Leclerk (Secretary).

•Sociedad Matemática Mexicana

Apply to: Sra. Hilda C. de Villa, Apartado Postal 70-450, Mexico 20, D.F. Mexico 04510.

Dues: US \$10; payable to Sociedad Matemática Mexicana.

Privileges: To be a regular member paying half of the regular fee for persons living outside of Mexico.

Officers: José Carlos Gómez-Larrañaga (President), Roberto Martínez (Vice-President), Angel Carrillo (Executive Secretary), Leonardo Salmerón (Treasurer), Margarita Chávez (Secretary), Eduardo Rivera and Gilberto Flores (Associate Secretary).

•Sociedade Brasileira de Matemática

Apply to: Diretoria da SBM, Estrada Dona Castorina - 110, Jardim Botânico, Rio de Janeiro, RJ, Brazil, 22.460.

Dues: US \$20; payable to Sociedade Brasileira de Matemática.

Privileges: *Boletim da SBM* (two issues per year); *Matemática Universitária* (two issues per year) at U.S. \$20; *Ensaio*s and other publications can be purchased at a 25% discount.

Officers: César Camacho (President), Paulo Sad (Vice President), Arualdo Garcia (Treasurer), Abramo Hefez (Secretary).

•Sociedade Brasileira de Matemática Aplicada e Computacional

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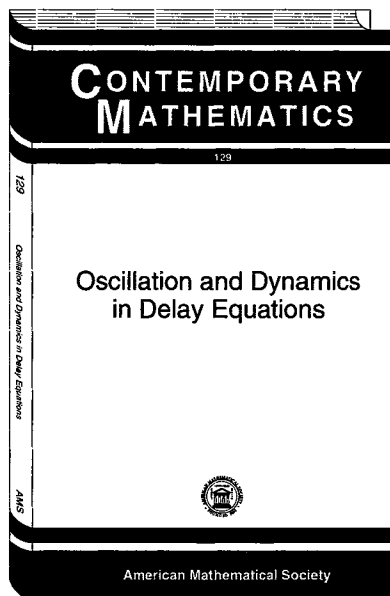
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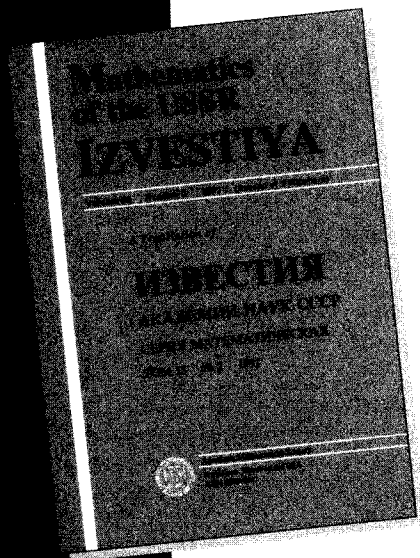
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Mathematics of the USSR—Izvestiya



This journal is a cover-to-cover translation into English of *Izvestiya Akademii Nauk SSSR Seriya Matematicheskaya*, a journal devoted to current areas of pure mathematics research, which is published by the Russian Academy of Sciences. An author index appears in the last issue of each volume. Volumes 40 and 41 are the 1993 volumes.

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The Department solicits applications for a tenure-stream appointment in Analysis. Preference will be given to researchers in the areas of non-linear analysis and geometric analysis. The appointment is at the Erindale campus at the level of Assistant Professor, to begin July 1, 1993. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics. Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should deal with the candidate's teaching. To insure full consideration, this information should be received by October 31, 1992. The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

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SWEDEN

UPPSALA UNIVERSITY Department of Mathematics

The Department invites applications for two full Professorships in Mathematics that will be vacant upon the retirement of Professors Lennart Carleson and Yngve Domar. The starting dates for the appointments are the first of July 1993

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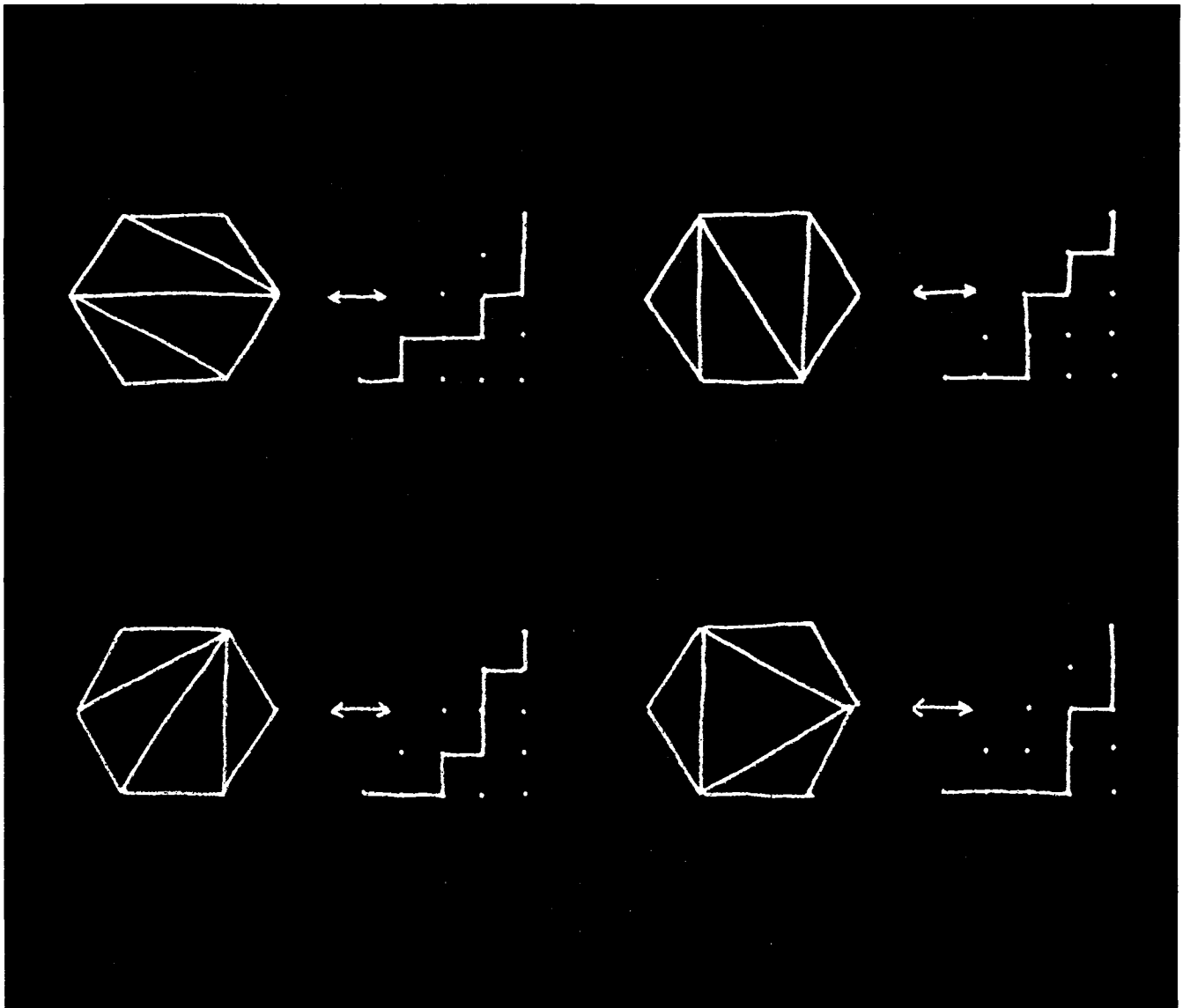
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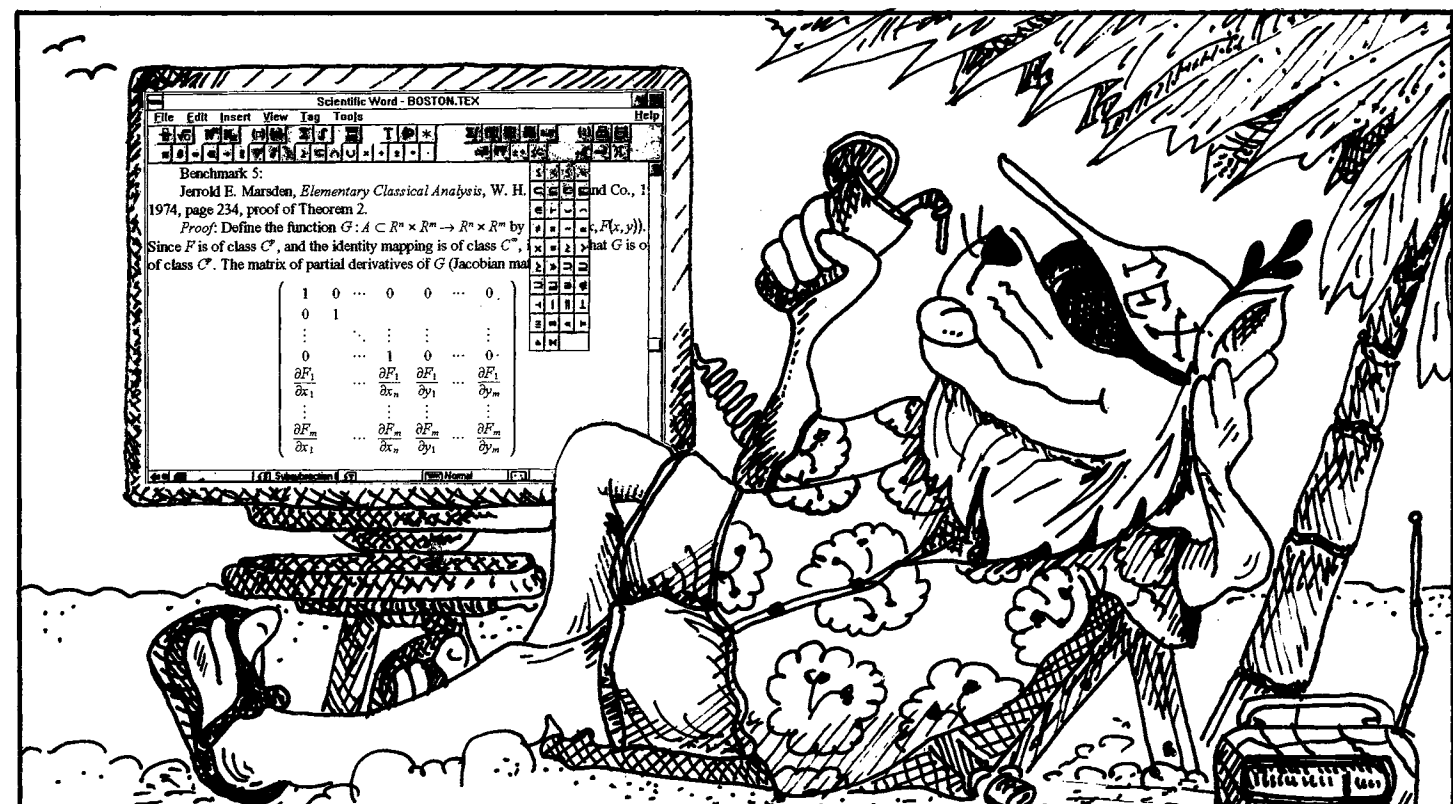
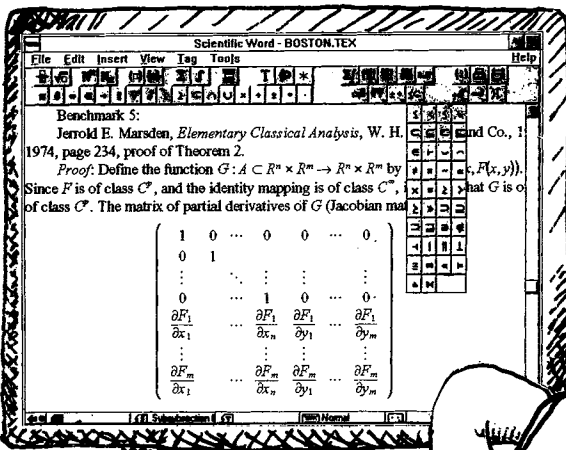
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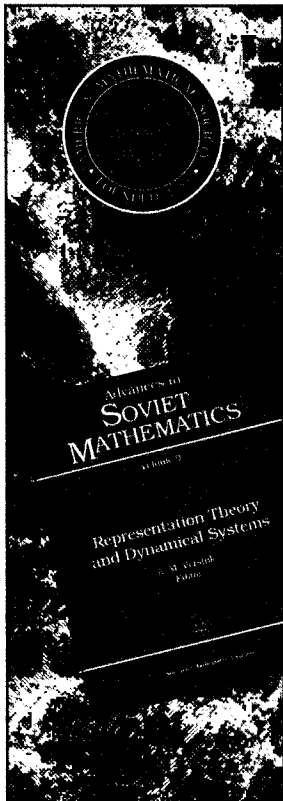
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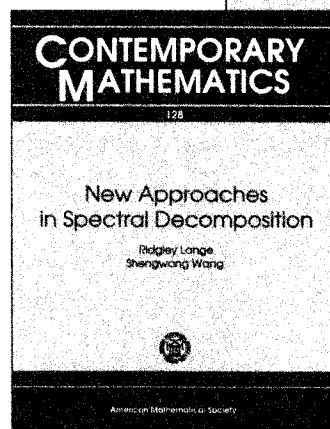
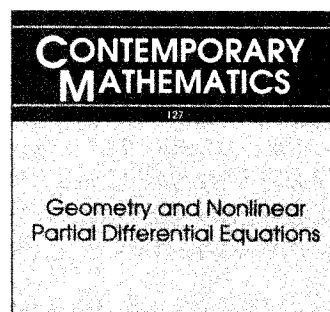
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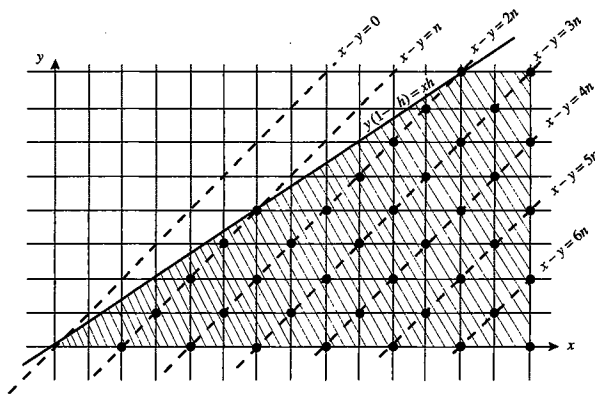
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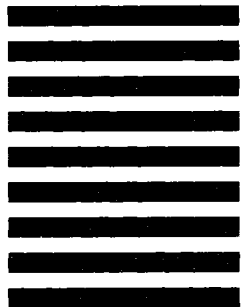
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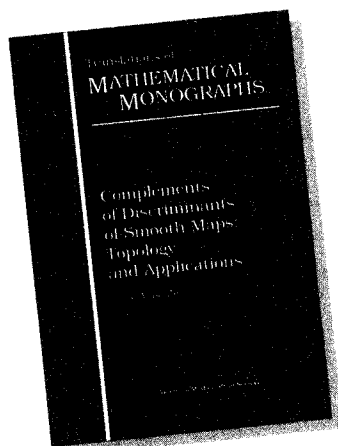


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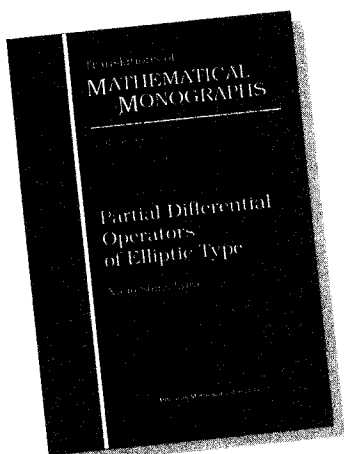
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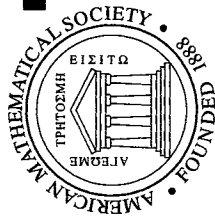
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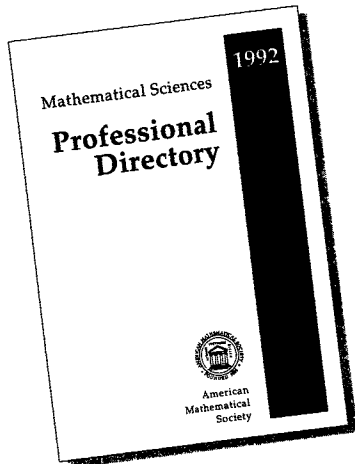
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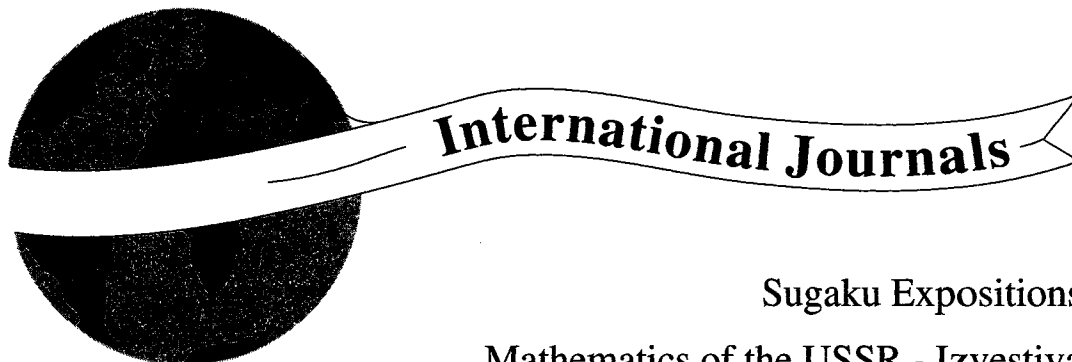
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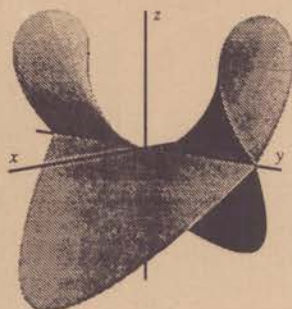
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