NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY

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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 with the Mathematical Association of America.

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. Instructions for submission of abstracts can be found in the January 1993 issue of the *Notices* on page 46. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below.

Meetings

Meeting #		Date	Place	Abstract Deadline	Program Issue
895	†	October 28–29, 1994	Stillwater, Oklahoma	Expired	October
896	†	November 11–13, 1994	Richmond, Virginia	Expired	October
897	*	January 4–7, 1995 (101st Annual Meeting)	San Francisco, California	October 3	January
898	*	March 4–5, 1995	Hartford, Connecticut	December 1	March
899	*	March 17–18, 1995	Orlando, Florida	December 1	March
900	*	March 24–25, 1995	Chicago, Illinois	January 9	April
901		May 24–26, 1995	Jerusalem, Israel	February 9	May
902		August 6–8, 1995 (97th Summer Meeting)	Burlington, Vermont	May 18	August
903		October 7–8, 1995	Boston, Massachusetts	July 24	October
904		November 3–4, 1995	Kent, Ohio	August 15	November
905		November 17–18, 1995	Greensboro, North Carolina	August 15	November
		January 10–13, 1996 (102nd Annual Meeting)	Orlando, Florida		
		March 22–23, 1996	Iowa City, Iowa		
		April 13–14, 1996	New York, New York		
		April 19–21, 1996	Baton Rouge, Louisiana		
		November 1–3, 1996	Columbia, Missouri		
		January 8–11, 1997 (103rd Annual Meeting)	San Diego, California		
		January 7–10, 1998 (104th Annual Meeting)	Baltimore, Maryland		
		March 27–28, 1998	Manhattan, Kansas		

* Please refer to page 667 for listing of special sessions.
† Please refer to the Table of Contents for further information.

Conferences

January 2–3, 1995: Short Course on Coding Theory, and Short Course on Knots and Physics, San Francisco, California
June 25–July 27, 1995: Joint Summer Research Conferences in the Mathematical Sciences, University of Washington, Seattle, Washington
July 9–29, 1995: AMS Summer Institute on Algebraic Geometry, University of California, Santa Cruz, California
July 16–August 12, 1995: AMS-SIAM Summer Seminar in Applied Mathematics on the Mathematics of Numerical Analysis: Real Number Algorithms, Park City, Utah

Other Events Cosponsored by the Society

October 8–14, 1994: Symposium on the Legacy of Norbert Wiener: A Centennial Symposium, Massachusetts Institute of Technology, Cambridge, Massachusetts
October 16–18, 1994: Women in Probability Workshop, Cornell University, Ithaca, New York
November 27–December 3, 1994: Norbert Wiener Centenary Congress, Michigan State University, East Lansing, Michigan

Deadlines

	October Issue	November Issue	December Issue
Classified Ads*	August 29, 1994	October 3, 1994	November 7, 1994
News Items	August 24, 1994	September 21, 1994	October 25, 1994
Meeting Announcements**	August 24, 1994	September 21, 1994	October 25, 1994

* 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

FEATURE COLUMNS

DEPARTMENTS

NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY

SUBSCRIPTION INFORMATION
Subscription prices for Volume 41 (1994) are $146 list; $117 institutional member; $88 individual member. (The subscription price for members is included in the annual dues.) A late charge of 10% of the subscription price will be imposed upon orders received from nonmembers after January 1 of the subscription year. Add for postage: Surface delivery outside the United States and India—$15; to India—$28; expedited delivery to destinations in North America—$32; elsewhere—$67. Subscriptions and orders for AMS publications should be addressed to the American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904. All orders must be prepaid.

ADVERTISING
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∞ The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability.

♻ Printed on recycled paper.

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From the Executive Director . . .

PH.D. EMPLOYMENT: WHAT IS THE AMS DOING?

In the April 1994 issue of the *Notices* this column discussed employment of young mathematicians and progress toward the recommendations of the AMS Task Force on Employment. Considering the importance of this issue it seems appropriate to provide an update.

There are several conjectured causes of the current employment crisis, including a national economic retrenchment that has reached dramatically into academe, an influx of outstanding foreign mathematicians competing with new doctorates for a reduced number of academic positions, and a production rate of new doctorates in mathematics for the last several years that exceeds U.S. employment demand as estimated by as much as fifty percent.

Each of these conjectures is a variant of a supply and demand problem. The preparation and career path expectations for a mathematics doctorate are directed toward academic research. It is little wonder that an educational system predominately targeted toward one labor market encounters oversupply problems when that labor market is depressed. Students must be made aware of the variety of career path opportunities following study in mathematics, and we must broaden our system of preparation of mathematics doctorates to incorporate these opportunities. Providing broader preparation will require fundamental changes in thinking within our doctorate-granting departments and in our professional value system. The AMS will be joining with the Society for Industrial and Applied Mathematics in a project addressing nontraditional employment opportunities for the U.S. mathematics doctorate. The AMS is also undertaking a feasibility study for administration of a national internship program in mathematics. This program will allow upper-level undergraduates to learn of career opportunities available through the study of mathematics and have a work experience in business, industry, a government laboratory, or an academic setting. Such a program could also be available to departments that wish to have such an internship as a component of their graduate program in mathematics.

Given the economic crisis in most institutions of higher learning, mathematics departments cannot continue with business as usual. This is a defining time for most of these institutions, a time of reevaluation of their missions. Many mathematics departments have for decades handled steadily increasing student enrollments and service demands without making a cogent case for the necessary resources to meet these expanding needs. Departments are regularly faced with enlarging the numbers of part-time instructors and graduate teaching assistants when clearly what is needed is more faculty. We need to "make the case for mathematics" in our institutions of higher learning. The Society has appointed a task force to identify the critical issues for departments in meeting the expectations of their institutions. The task force will provide information and recommendations to assist departments in planning, allocating resources, and articulating their case to their administrations.

Even if these efforts are successful, it remains unclear that the demand for mathematics doctorates can be raised to meet the current supply. This concern has led to difficult questions concerning the size and structure of graduate programs. The AMS Committee on the Profession wants the Society to take a leading role in addressing these questions. However, it recognizes that there has been limited success in the past in predicting future trends in education and employment prospects for mathematicians. Therefore, the Committee has advised the Society that its role should not be to attempt to regulate the size and number of graduate programs in mathematics. However, it concluded that the Society is in a unique position to provide leadership on these issues and must make available to students and faculty the best possible and most complete information about career opportunities and the job market for mathematicians. The Society will be adding such information to its annual publication "Graduate Assistantships and Fellowships in the Mathematical Sciences" and will be adding an associate editor to e-MATH with the responsibility for collecting, organizing, and providing relevant employment information to the mathematics community.

Issues of graduate education and employment of mathematicians is a high priority for the AMS, and the Society will continue to commit resources to address these issues.

William Jaco

Letters to the Editor

Concerns about Obituaries Published in *JDMV*

We are worried by the editorial policy of the official organ of the German Mathematical Society (*Jahresbericht der Deutschen Mathematiker Vereinigung–JDMV*), as observed with respect to the articles on the Nazis Bieberbach (v. 88, 1986, pp. 190–205), Strubecker (v. 94, 1992, pp. 105–117), and Teichmüller (v. 94, pp. 1–39).

An historically accurate perspective on the past is withheld from young and future readers. This makes one wonder about current willingness to face the past.

1. Bieberbach. The obituary mentions without elaboration that he was a Nazi, but declares that he later recognized and deeply regretted these "errors" (Irrtümen), and asserts that "this is not the place" to go more deeply into the matter. No evidence is provided to suggest that he did in fact repudiate his past, nor are we aware of any. There is no hint as to how seriously any such alleged repudiation should be taken—not that this would matter much in the light of what he did, nor justify bypassing those events.

It mentions that he had been editor-in-chief and publisher of *JDMV*, 1920–1934. However, it does not report that he had abused this post for Nazi purposes so flagrantly that even in those perilous times the September 1934 DMV annual membership meeting adapted a formal motion which, although declaring loyalty to the new rulers of Germany, "regretted" his publication in the *JDMV* of his open letter attacking Harald Bohr and doing so against the wishes of both his coeditors and without the knowledge of the DMV executive (*JDMV*, v. 44, 1934, p. *86*). He soon resigned his *JDMV* posts and founded the notorious periodical *Deutsche Mathematik* for the designated purpose of promoting Nazism in the mathematical world.

None of this is mentioned in the obituary, nor his other behaviour, nor the sharp protests from G. H. Hardy (*Collected Works*, v. 7, p. 160) and others.

We believe that readers of the *JDMV* are entitled to a more accurate perspective on Bierbach's life and times.

2. Strubecker. This obituary casts a warm glow over his appointment and services as professor in the "newly-founded Reichsuniversität" in Strasbourg during the Nazi occupation of that city. It describes those years as the happiest and most productive of his life. (The eminent Alsatian mathematician Ch. Ehresmann had refused that post despite Nazi blandishments.) To top it off, the obituary characterizes the liberation of Strasbourg in 1944 by the French as an "occupation" (Besetzung) by Allied troops!

This evaluation of his life is completely silent on the content of his lengthy obituary on E. A. Weiss (*Deutsche Mathematik*, v. 7, 1943, pp. 254–298). In it, Strubecker glorifies the Hitler regime and praises Weiss fulsomely for his activism and leadership in the storm troops (S.A.) (p. 260).

3. Teichmüller. This is a memorial article, published nearly fifty years after his death, so that it is historical research rather than a traditional obituary. This imposes stringent obligations, particularly when discussing a man of extraordinary mathematical talent but who, already two years before the Nazi accession to power, became a militant activist and storm trooper for "a fanatical doctrine that was bent on stifling all feelings of decency and compassion", as J. Dieudonné observed in his review of the *JDMV* memorial article (*MR*, 93B, 01037).

One can expect much discussion to arise. There are those, for example, who fear that Teichmüller's predecessors are given far from sufficient credit, that the authors leaned over backwards in his direction and minimized the impact of the work of, say, H. Grötzsch (an anti-Nazi dismissed on that account, appointed to Halloe after the war), M. A. Lavrentyev (founder of the Novosibirsk Centre of the Soviet Academy), and M. M. Schiffer (forced to emigrate by the Nazis).

In words available long before this memorial article was composed, Lipman Bers, one of the foremost authorities on this specialty and highly appreciative of Teichmüller's contributions to it, had opened his Foreword to Krushkal's monograph on "Quasi-conformal mapping and Riemann surfaces" (Wiley, 1979, English translation) as follows: "The theory of quasi-conformal mappings is about half a century old. Its originators were Ahlfors, Grötzsch, and Lavrentyev . . . . The celebrated theorem by Teichmüller, obtained about ten years after Grötzsch's results, should be considered as a far-reaching deepening and extension of Grötzsch's beautiful but simple papers."

Grötzsch is barely mentioned in the memorial article.

And what of the human side?

We do not have the space to go into the shocking details of Teichmüller's actions; some are recorded in the memorial article. But there can be discussion as to how completely they—and the context in which they occurred—are analyzed, along with the nagging problem of personal responsibility for one's behaviour and of its consequences for other human beings.

So, all in all, there stretches a whole field for debate and eventual understanding, a field to which the publication in the *JDMV* has led us.

Yet we fear that the editor has closed the gate. A discussion article, detailing

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 e-mail to `notices@math.ams.org`, and will be acknowledged on receipt.

many reservations and offering other views on many points, was submitted by Dr. Bernhelm Booss-Bavnbek (Roskilde, Denmark). It was swiftly and unambiguously rejected by the editor of the *JDMV*. (Its text and related materials can be obtained from RUC/IMFUFA, P.O. Box 260, KD-4000 Roskilde, Denmark. The title is "B. Booss-Bavnbek, Perspectives on Teichmüller and the *Jahresbericht*", tekst 248/1993, ISSN 0106-6242.)

The letter of rejection accompanied the editor's summary of the referee's report. The full text of that report was not sent to the author. There was no invitation to the author to reply even to that brief summary, nor any suggestion that the article be rewritten in the light of that report, nor that a different article on that topic should be sent for consideration. There was a prompt, flat, and absolute rejection within a month.

We believe that the demands of history and the need for free discussion require a different response. We hope that the *JDMV* editor and the executive of the DMV will review thoughtfully the concerns which these three cases have aroused in us.

The poem read from the podium as part of the official inauguration of President Clinton makes the point clearly:

History, despite its wrenching pain,
Cannot be unlived, but if faced
With courage, need not be lived again. –*Maya Angelou.*

Jean-Pierre Kahane
Université de Paris-XI
Klaus Krickeberg
Université de Paris-V
Lee Lorch
York University

The three coauthors were joined by twelve cosigners, half present or former AMS Council members, including two specialists on Teichmuller's work, and covering a wide range of interests.

(Received November 16, 1993)

Response to Boris Kushner

In the December 1993 *Notices*, Boris Kushner complained that Russian mathematicians like Chebyshev, Markov, and Kolmogorov are often overlooked in standard histories of mathematics. He suggested that this was a result of "discrimination". David Burton responded by saying that his book was too short to be a comprehensive survey, like Morris Kline's *Mathematical Thought from Ancient to Modern Times*.

While I think that this is a reasonable response for Burton, whose book is a nice episodic text (I used it and liked it), there is still the ugly fact that Kolmogorov and Markov do not even appear in Kline's comprehensive 1972 book (Chebyshev gets very brief mention), although there is some devoted to Lobachevsky. This pattern recurs in many other books: if you browse through math history books, you usually find only brief mention of Eastern Europeans (except undeniably important people like Lobachevsky and maybe Bolyai). (As if Kolmogorov wasn't undeniably important, but you'll see what I mean.)

I do not think that there is anything sinister in this. In fact, by scanning the index of a typical math history book, even a book on recent math history (*especially* a book on recent math history), one gets a very human picture of what's going on. Very little probability appears in the typical index. Usually no combinatorics at all. Logic uncertain: sometimes lots, sometimes none. (Every mention of Frank Ramsey I've seen in these books has been on his work in logic and philosophy; nothing on combinatorics.) How much "deep" algebra and topology there is depends largely on how "advanced" the book is supposed to be; advanced books always have lots of this stuff. And the sections on computer science (if any) are often very respectably number theoretic, e.g., no juvenile stuff like cybernetics. In other words, many of those areas in which Eastern Europeans have really excelled during the last century or so are cursorily covered, if at all.

We all know that mathematics has its fads and fashions. For example, because of the incredible accomplishments of French mathematicians during the last four centuries, it is not surprising that France is a major force in mathematical fashion, and the mathematics that France produced is in all the books. And because the Eastern Europeans are relative latecomers, it is not surprising that the kind of mathematics they do is not regarded as being as "deep", especially since a lot of the mathematics they do is relatively new. Some mathematicians seem to feel that approximation theory is nothing more than some applied analysis, that combinatorics is just a bag of tricks, that probability is not real mathematics, and that logic is a debilitating disease from which one hopefully recovers. None of these fields are as respectable as, say, differential geometry.

So it is not surprising that mathematical historians would follow current fashion and write about the history of fashionable mathematics. That's only human. And as fashion changes (and with computers driving the almost revolutionary growth of mathematics that Russians have nurtured, fashions are changing), math history books with a different view of what's important will appear. That will take time: historians are slower than everyone else. And of course, by then, the historians will have found a new group to ignore.

Gregory McColm
University of South Florida

(Received December 21, 1993)

P.S. The sociologists have developed the irritating habit of investigating the influence of fashion on their fellow scientists. As if we didn't have enough problems. But they are right about one thing: even mathematicians are only human, after all.

Response to Gangolli and Mac Lane

In the issue of December 1993, the *Notices* has published an exchange between Professors R. Gangoli and S. Mac Lane concerning their ideas for the orientation of that part of the U.S. mathematical community centered around the AMS, particularly the relative weight to be assigned to education and research. While there is much that I agree with in both presentations, I feel compelled to point out (as I have done in many places for the past thirty years!) that neither piece seems to have adequately taken into account the renewed interaction between mathematics, science, and technology that has taken place in our professional lifetimes. Consider such terms of popular and scientific dis-

course as: artificial intelligence, black holes, cellular automata, chaos, computer languages, computer programs, control, filtering, fractals, gauge fields, modelling, neural nets, quarks, signal processing, supersymmetry, symmetry, wavelets, ... Each of the areas represented by these terms is based on a part of twentieth century science which was originated by professional mathematicians. With such a record of accomplishment, why are we in the position of begging Congress—and the NSF/DOD research bureaucracy!—for pennies while other areas of science and technology squabble over millions, if not billions? Congress quite rightly wants the National Science Foundation to emphasize work which will strengthen the national economy and educational structure: should not mathematics be at the head of the line? Why is not someone in the AMS pointing this out loud and clear to the media, the general public, and Congress?

Robert Hermann
Brookline, MA
(Received December 23, 1993)

Response to Horgan's "Death of Proof"

The October 1993 issue of the *Scientific American* carried a contentious article under the title "Death of Proof". There were wild claims for computers and no recognition of programming errors. There were a number of quotations, or perhaps misquotations, from William P. Thurston about set theory. Readers should be aware that they are in part tendentious and in part simply wrong.

Page 100 involves a discussion of the Gödel incompleteness theorem, under the misleading rubric, "It is impossible to codify mathematics." The theorem rather shows that no one formal system can contain all possible mathematical results. The discussion goes on to claim that this theorem applies to "any set of axioms". This is simply false. The Gödel theorem requires that the system have recursive rules of inference and be strong enough to contain arithmetic. This is essential to construct the famous Gödel numbers.

This page also asserts that Bertrand Russell "points out (that) . . . set theory is rife with logical contradictions related to the problem of self-reference"; the example cited is the statement "This sentence is false." Now this particular sentence—like other often-studied "semantical" paradoxes—just does not apply to standard set theory, which does not involve a predicate "false". (And, incidentally, Alfred Tarski long ago made a celebrated study of "truth" [in formalized languages], while the above statement is in informal language.)

Perhaps reference was intended to another famous (1901) Russell paradox about the "Set of all sets not members of themselves." But this paradox is not present in modern set theory. In 1908, Russell avoided it by his theory of ":Types". In the same year, Zermelo eliminated the paradox by his well-known axiomatics, involving his careful "comprehension": axiom. It is sad that this current comment does not recognize an achievement now eighty-five years old.

With this background it is hard to take credence in the subsequent statement that "Set theory is based on polite lies."

Other issues, much more substantial, could have been raised. It is often asserted that set theory is "the foundation of mathematics". One might have objected to this dogma by arguing that set theory does not illuminate important mathematical issues (geometry, applications, etc.) and is moreover much too formal, so should not be viewed as the "foundation".

This unfortunate article makes no such real point, though it is full of many other flamboyant or false claims.

Saunders Mac Lane
The University of Chicago
(Received December 29, 1993)

Response to Rade Zivaljevic

We read with interest the letter of Rade Zivaljevic in the November issue of *Notices*, regarding U.N. sanctions against the countries of the former Yugoslavia (Serbia and Montenegro) and the policy of Elsevier and Pergamon regarding these sanctions. This letter implies that our companies' policy discriminates against Yugoslav scientists. We assure your readers that this is not the case. Both Elsevier and Pergamon are committed to the principle of the universality of science, and authors who submit their papers to our journals will have their manuscripts processed in the normal way.

When U.N. sanctions were first imposed (based on U.N. Security Council Resolution 757) we, like other international businesses, had to formulate a policy which was consistent with observing the sanctions. Initially, we received different advice from a number of sources, and at the same time were having correspondence to Serbia and Montenegro returned as being undeliverable. In practical terms, therefore, it was difficult to serve our authors in those countries adequately.

Since then, the postal situation has improved; and following discussions with the ICSU Standing Committee on the Free Circulation of Scientists in early 1993, we were able to confirm that we can process papers from Serbian and Yugoslavian authors in the normal way.

Both Elsevier and Pergamon are committed to the principle of the free flow of scientific ideas and exchange of information among scientists. This includes Yugoslav scientists, who we can assure will have their papers handled in the same professional way as those of authors from other parts of the world.

Dr. Henk van der Rijst
Elsevier Science Publishers
Dr. Peter Shepherd
Pergamon Press
(Received December 29, 1993)

Request to Hear about Classroom Experiences

I am writing to make a suggestion in light of the article "Cultural Aspects of Mathematics Education Reform".

For the past several years I have been visiting mathematics classes in schools where the vast majority of students are African Americans.

I am always looking for suggestions of new things to try in the classes. It was great to read about some of the things the researchers tried in the classes they visited, only I was left wanting to know more. I would be delighted to hear about the experiences other mathematicians have had, especially suggestions

for new things to do with the students. Perhaps the *Notices* could run a regular feature where research mathematicians who visit schools can discuss their experiences and share ideas.

J. M. Landsberg
University of Pennsylvania
(Received February 10, 1994)

Gratitude for fSU Aid

During the last two years the American Mathematical Society and several other societies, foundations, and private citizens in the West established various stipends, grants, and other forms of financial support for mathematicians of Russia and other countries of the former Soviet Union. Let me use your journal to express our deep gratitude and appreciation of these efforts.

First of all, I should say that I do not know any other example in the history of sciences when such extensive financial and moral support to scientists of one country was given by their colleagues from other countries. Equally, there are very few examples of humanitarian action of such a mass scale that is undertaken now by the International Science Foundation, the AMS-fSU Fund, Promatematika Foundation, and others. We are witnesses of a very noble and rather unique phenomenon. I am convinced that my colleagues in Russia and other fSU countries join me in high esteem of generous help and unselfish efforts of the AMS-fSU Committee, and in the expression of appreciation and gratitude to similar initiatives of other societies and foundations.

A. M. Vershik
St. Petersburg Mathematical Society
(Received February 14, 1994)

Marilyn vos Savant's Book

Marilyn vos Savant has written a book entitled [*Is it solved?*] *The World's Most Famous Math Problem*, and in it she includes an acknowledgement to me. This acknowledgement has misled some people.

Before noticing Ms. vos Savant's book in a bookstore, I had never read a word of anything she had written. My only contact with her is that I answered a telephone request by sending her a reprint of one of my articles. On the basis of this level of familiarity, Ms. vos Savant writes:

"And a personal 'thank you' to Barry Mazur, Kenneth Ribet, and Karl Rubin for being such good sports . . ."

Ms. vos Savant goes on to recite my CV for the next eight lines of her text.

All this may give the impression that I had some prior knowledge of Ms. vos Savant's book (I didn't), or that I see some merit in it (I don't).

Barry Mazur
Harvard University
(Received February 18, 1994)

ADD THIS COVER SHEET TO ALL YOUR ACADEMIC JOB APPLICATIONS

The Joint Committee on Employment Opportunities has adopted the cover sheet on the facing page as an aid to job applicants and prospective employers. The AMS Committee on the Profession also endorses its use. The current imbalanced job market has left employers overwhelmed with large numbers of applications to be processed, and job candidates who are justifiably frustrated with the lack of timely responses to their applications. Both sides should benefit from the increased efficiency that a standardized cover sheet will bring to application processing in Mathematical Sciences departments.

How to use this form:

1. Using the facing page or a photocopy, (or a TEX version which can be downloaded from the e-MATH gopher on the "Professional Information for Mathematicians"/"Career Development Resources" menu), fill in the answers which apply to ALL of your academic applications. Make photocopies.
2. As you mail each application, fill in the remaining questions neatly on one cover sheet and include it ON TOP OF your application materials.

Mathematics Departments in Bachelor's, Master's and Doctorate granting institutions have been contacted and are expecting to receive the form from each applicant, along with any other application materials they require. Obviously, not all departments will utilize the cover form information in the same manner. It is hoped that this process will become a standard in the mathematical community and that in time further enhancements may lead to real improvement in the process of obtaining employment in the mathematical sciences. Please direct all general questions and comments about the form to dmm@math.ams.org or call the Professional Programs and Services Department, AMS, at 800-421-4267 extension 4105.

JCEO Recommendations for Professional Standards in Hiring Practices

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

(1) Acknowledge receipt of the application—immediately; and

(2) Provide information as to the current status of the application, as soon as possible.

The JCEO recommends a triage-based response, informing the applicant that he/she

(a) is not being considered further;

(b) is not among the top candidates; or

(c) is a strong match for the position.

Academic Employment in Mathematics

APPLICATION COVER SHEET

This cover sheet is provided as an aid to departments in processing job applications. It should be included with your other application material. Please print or type. Do not send this form to the AMS.

Last (Family) Name: _____ Social Security Number: ___-___-___ (Optional)

First Name or Initial: _____ Second Name or Initial: _____

Address through June 1995 _____ Work Phone: (_____) _____

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Current Institutional Affiliation: _____

Country of Citizenship: _____ If not U.S. Citizen, type of visa: ☐ Permanent Resident ☐ Temporary Resident

Ph.D. received/expected: _____ (Month) _____ (Year) Ph.D. Advisor: _____

Source of Ph.D.: _____ (Department) _____ (Insitiution)

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

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

_____

_____

Indicate the position for which you are applying: _____

If unsuccessful for this position, would you like to be considered for a temporary position? ☐ Yes ☐ No
If yes, please check the appropriate boxes. ☐ Postdoctoral Position ☐ 2+-Year Position ☐ 1-Year Position

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

☐ 1. _____

☐ 2. _____

☐ 3. _____

☐ 4. _____

This form is provided courtesy of the American Mathematical Society.

1991 Mathematics Subject Classification

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

Ivo Babuška and S. R. S. Varadhan Share 1994 Birkhoff Prize

The George David Birkhoff Prize is awarded every five years to a recipient selected by a joint committee of the AMS and the Society for Industrial and Applied Mathematics (SIAM). The prize recognizes outstanding contributions to "applied mathematics in the highest and broadest sense". Sharing the 1994 Birkhoff Prize are IVO BABUŠKA of the Institute for Physical Science and Technology at the University of Maryland and S. R. S. VARADHAN of the Courant Institute of Mathematical Sciences at New York University. The prizes will be presented on July 27, 1994, at the SIAM Annual Meeting in San Diego.

The Birkhoff Prize Fund was originally created in 1967 by the family of George David Birkhoff. The awards are currently augmented by monies from the AMS Leroy P. Steele Fund (presented to the AMS for prizes in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein). Professors Babuška and Varadhan will share the $4,000 award.

Previous recipients of the Birkhoff Prize are: Jürgen K. Moser (1968), Fritz John (1973), James B. Serrin (1973), Garrett Birkhoff (1978), Mark Kac (1978), Clifford A. Truesdell III (1978), Paul R. Garabedian (1983), and Elliott H. Lieb (1988).

The Birkhoff Prize is awarded by action of the Councils of the AMS and SIAM on the recommendation of the AMS-SIAM Committee to Select Winners of the Birkhoff Prize. On the committee for the 1994 prize were Michael Aizmenan, Princeton University; Thomas G. Kurtz, University of Wisconsin at Madison (chair); and Mary Fanett Wheeler, Rice University.

The following presents the citation for each recipient, his response upon receiving the award, and a brief biographical sketch.

Ivo Babuška

Ivo Babuška

Citation

Ivo Babuška is an internationally distinguished numerical analyst. For over forty years—first in Czechoslovakia and since 1968 in the U.S.—he has produced a steady stream of seminal work.

Babuška's most important contributions have been to the reliability of finite element methods, the development of a general framework for finite element error estimation, and p and h-p finite element methods. In the area of reliability, Babuška's papers initiated research into *a posteriori* error estimates and adaptivity. These papers have spawned a large effort. The importance of this work is that it validates finite element computations and ensures their reliability. The basic stability condition for finite element methods, now known as the Babuška-Brezzi condition, was obtained independently by Babuška and F. Brezzi. It is fundamental in the development and assessment of finite element methods. Babuška recognized the potential of the p method, first used by engineers (in particular by B. Szabo). He analyzed this method and greatly expanded its range of applicability and has gone on to develop and analyze the h-p method. These methods have great accuracy, and they have been effectively implemented in many industrial computer codes.

Babuška has trained over twenty-five students, many of whom have gone on to have successful scientific careers. In

addition, he has attracted and worked with many postdoctoral visitors and has collaborated widely with mathematicians and engineers. He is also the founder and leader of the "Finite Element Circus", a twice-yearly meeting of the finite element community that has continued for twenty years.

In summary, Babuška has had an enormous influence on numerical analysis and engineering computation.

Response from Ivo Babuška

I am very grateful and proud to be awarded the very prestigious Birkhoff Prize by the American Mathematical Society and the Society for Industrial and Applied Mathematics. I accept this award as a representative of those working in numerical mathematics, in general, and the finite element method, in particular—fields that have a direct relation to engineering computations. I appreciate very much the generous citation of my achievements. I have always believed that, on the one hand, the best mathematics takes its stimuli from applications, such as engineering, and, on the other hand, influences applications. On this occasion, I would also like to thank the large group of my scientific friends in mathematics and engineering whose discussions and collaborations have influenced significantly my work, its direction, and concrete results.

Biographical Sketch

Ivo Babuška was born March 22, 1926, in Prague, Czechoslovakia. After World War II he studied civil engineering at the Technical University in Prague and received the Ing. degree in 1949 and a Ph.D. degree in technical science in 1951. In the period 1949–1952 he studied mathematics as an "aspirant" (the analogue of a graduate fellowship in the U.S.) in the Mathematical Institute (later the Mathematical Institute of the Czechoslovak Academy of Sciences). In 1955 he received the C.Sc. degree in mathematical sciences. (The C.Sc. degree is equivalent to the Ph.D. degree in the U.S. and was introduced by a law passed in 1953, which accepted the USSR system.) In 1960 he received the D.Sc. degree of mathematical and physical sciences, awarded for highest scientific achievements. From 1952 until 1968 he was head of the section of constructive methods and differential equations in the Mathematical Institute of the Czechoslovak Academy of Sciences.

The main emphasis of Professor Babuška's group was on the theory of partial differential equations, with applications in mechanics and numerical mathematics. In the mid-1950s he was the leader of the computational analysis group for ORLIK, a gravitational dam about 120 meters high, which was built on the Moldau (Vltava) River. This collective work, which involved engineers and material scientists, concentrated on the technology of building a dam without artificial cooling. (The big dams in the U.S., such as Boulder Dam, were built with cooling, which removes the heat created during the hardening of the concrete.) The computations for ORLIK were performed on mechanical desk calculators.

Professor Babuška was the founder of the journal *Applications of Mathematics*. He organized a series of international conferences in differential equations, such as, for example, the conference EQUADIFF, which still takes place every four years, and a series of international workshops on numerical mathematics with emphasis on its optimality. In addition to publishing scientific articles, he has published books on elasticity and the numerical treatment of differential equations.

In 1968 Professor Babuška arrived in the U.S. and was a visiting professor at the Institute for Fluid Dynamics and Applied Mathematics at the University of Maryland at College Park. In 1969 he became a research professor at that institute (which is now called the Institute for Physical Science and Technology) and later in the Department of Mathematics at Maryland. The finite element method—its reliability, *a priori* and *a posteriori* error estimations, and adaptive approaches—became his main interest.

Professor Babuška's work is mathematically oriented and is heavily influenced by the needs of engineering computations. His results are now directly and indirectly used in engineering computational practice. He has published numerous articles on the finite element method in mathematical and engineering journals and has written two books on the subject. He has been involved with the education of numerous Ph.D. students, along with other scientific activities. With his colleagues, he is a founder and leader of the "Finite Element Circus", an informal meeting which, for more than twenty-three years, has taken place twice a year. He is also on the editorial board of many mathematical and engineering journals.

Professor Babuška has received recognition and various awards for his scientific work, including the Czechoslovak State Prize for Mathematics (1968), the Humboldt Senior U.S. Scientist Award of the Federal Republic of Germany (1976), and the Medal of Charles University in Prague (1992).

S. R. S. Varadhan

Citation

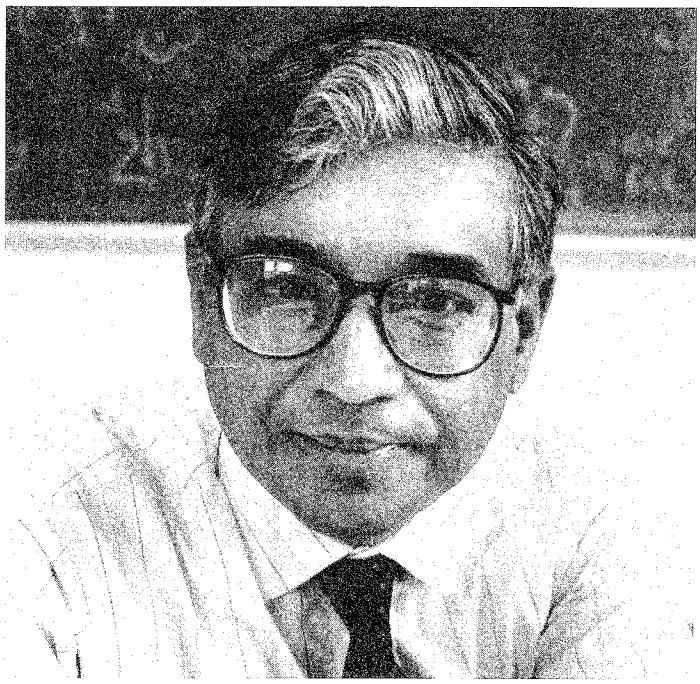
S. R. S. Varadhan is one of the leading probabilists of our time. Throughout his thirty-year career, he has contributed ideas and results that have had revolutionary impact on many fields.

Varadhan's work with Stroock on the martingale characterization of diffusion processes has changed the way Markov processes are studied, and their book on diffusion processes has become a classic.

The Donsker-Varadhan theory of large deviations for functionals of occupation times of Markov processes (with applications to spectral theory of second-order elliptic PDE) defined a new set of problems in the study of large deviations, and his formulation of the "large deviation principle" has served to define the field. This principle, presented in a series of basic works that are very original and full of technical innovations, has erected a recognized subject which is both of considerable interest on its own (as is evident from the significant number of international meetings devoted to it) and a powerful tool for theoretical problems based on applications (e.g., the polaron problem).

Varadhan's contributions with Papanicolaou to the study of random media and his introduction of large deviation and entropy methods into the study of hydrodynamic limits for the time evolution of interacting particle systems have also had major influence in these broad fields.

In summary, Varadhan has made highly visible and long-lasting contributions to probability theory and its applications, in a style which has been noted for its naturalness, effectiveness, and lucidity.



S.R.S. Varadhan

Response

I am indeed very happy that I am receiving the George David Birkhoff Prize from the American Mathematical Society and the Society for Industrial and Applied Mathematics. It is particularly gratifying to learn that my work is included in the broad category of applied mathematics. My mathematical interests and attitudes were influenced considerably by my colleagues at the Courant Institute, and over time I have learnt to view mathematics as a whole, rather than divided into pure and applied areas. I wish to thank my many collaborators over the years who have made my research experience all the more enjoyable.

Biographical Sketch

S. R. Srinivasa Varadhan was born in Madras, India, on January 2, 1940. He received his undergraduate education at the Presidency College of Madras University, where he earned a B.Sc. (Hons) degree in statistics in 1959. He then went to graduate school at the Indian Statistical Institute in Calcutta, receiving a Ph.D. in statistics in 1963. This was followed by three years of postdoctoral work at the Courant Institute of Mathematical Sciences at New York University.

He joined the faculty of Courant in 1966 as an assistant professor of mathematics, becoming an associate professor in 1968 and a professor in 1972. He was an Alfred P. Sloan Fellow (1969–1971) and a Guggenheim Fellow (1984–1985). Professor Varadhan was a visiting professor at the Mittag-Leffler Institute in Sweden (1972) and at Stanford University (1976–1977). He served as director of the Courant Institute during 1980–1984 and again during 1992–1994.

Professor Varadhan is a member of the AMS and the International Assocation of Mathematical Physics, as well as the Institute of Mathematical Statistics, of which he is an elected Fellow. He has also been elected to the Third World Academy of Sciences and the American Academy of Arts and Sciences.

Professor Varadhan serves on the editorial boards of several scholarly journals. His research interests include probability theory, partial differential equations, and statistical mechanics.

The Most Urgent Problem for the Mathematics Profession

William L. Duren, Jr.

The following article is based on a presentation made during the AMS Special Session "Meetings of Mathematicians", held at the Joint Mathematics Meetings in January 1994 in Cincinnati.

Crisis in Graduate Studies

In the years 1950–1971 this country initiated an enormous expansion of graduate studies in all fields of arts and sciences, not just mathematics, bringing in many regional universities that had never given the Ph.D. degree before and enlarging the older established ones. The quality of research and graduate studies in the expansion universities is remarkably good. But since 1971 America has been withdrawing, now stampeding, from this commitment. This is disastrous at a time when advanced mathematics has become more necessary than ever before in old and new fields of science, business, and technology that are vital to America's welfare. But the reduced public and private support does not provide enough jobs for new Ph.D.s and now threatens the research, and even the jobs, of established professors. Ironically, this is occurring when many more young Americans want to pursue graduate study, and would if the Ph.D. degree offered a satisfactory life. Is retrenchment the only solution, erasing our postwar gains?

Development of the Crisis

In the expansion, not much thought was given to the nature and purpose of these graduate studies. We simply copied the pattern of basic research and Ph.D. degree that Yale and Harvard had imported from Germany a century earlier. That pattern realized the European idea that the purpose of the university is to preserve, transmit, and advance the intellectual culture. Most American professors think in these terms, each interpreting the intellectual culture to be his or her special discipline. Although the propagation of that pattern has gotten us into economic trouble, we still believe that it is right and must be preserved.

But the American public and its elected legislators have always thought that the purpose of the university is to serve the students and, through them, the community and the nation. And the purpose of research is more like Francis Bacon's idea of harnessing science for the good of mankind. We call that mission-oriented research. So, after a few years of postwar idealism associated with the founding of the National Science Foundation (NSF) to support basic research, America has reverted to its natural pragmatism, and public support for basic research has been eroding ever since. I think this trend is intrinsically stable, not to be reversed by an upturn in the economy.

During the expansion, the availability of federal funds for graduate studies revealed a pent-up desire of regional colleges and universities, previously limited to undergraduate teaching, to enter the ranks of "the great research universities". It is impossible to overestimate their pride and idealism in taking this step, or their determination not to reverse it. Also, the rush of their students to respond uncovered a huge demand for graduate study. It is still there. But for both the regional universities and their students, the Ph.D. degree turned out to be a trap.

In mathematics our Ph.D.-producing capacity and the potential demand for a doctoral degree by qualified students now far exceed the visible supply of jobs appropriate to the abilities and training of our young Ph.D.s, either as research professor or college teacher. Although the AMS survey of our 1991 Ph.D.s showed only 12 percent unemployed, many more got unsuitable jobs, or jobs that were just rollovers from previous Ph.D.s bounced at the tenure threshhold. And, since our new graduate departments had only a fraction of the students they could accommodate, I would guess that our graduate studies capacity may be five to ten times the market demand for its potential Ph.D. graduates.

About 1971, with the onset of the first "Ph.D. glut", the NSF discontinued the support of faculty expansion. To maintain their research programs, the new "research universities" absorbed the cost internally, much of it added to undergraduate tuition. Now in a new round of budget slashing, parents, state, and municipal governments are rejecting the high cost of that college tuition. Neither alumni nor private foundations have been eager to pick up the tab for graduate studies. The result is huge deficits in university finances. No improvement of this outlook is in sight.

We know that if departments do not reduce these deficits, financial vice-presidents will do it for us by destructive, across-the-board budget cutting. That threatens not only many programs of graduate study and research, but also the

jobs of the professors in them, tenured or not. Within our departmental boundaries in all disciplines of arts and sciences, we feel betrayed and helpless to do anything about it. We have done what good departments are supposed to do, and we find that the public does not want to pay for our work.

Relief from Jobs in Industry?

In mathematics we turn to the concept of training our Ph.D.s for nonacademic employment as applied mathematicians. Success in that would both relieve our unemployment problem and provide proof of our worth to the tax-resisting public. Indeed, we have had some success in this direction. The AMS reported that in 1992 some 17 percent of our Ph.D.s found nonacademic employment. Mathematics departments are working to increase that figure, and we need all we can get from this sector.

The difficulty is that we would probably need to place 85 percent outside of academia to solve our problem of excessive Ph.D.-producing capacity. That educated guess is based on the sustainable ratio of practitioners to professors in the fields of law and medicine and on a figure from electrical engineering where the great majority of Ph.D.s do go into industry, and it is still not enough to avoid overproducing research professors. One must also take account of the huge, unused capacity that now exists in graduate studies. Back in the sixties, when jobs were in prospect, students rushed in to multiply our annual Ph.D. production sevenfold between 1963 and 1971. If good jobs are again visible, those students will return; but, since no academic expansion is in sight at this time, all of those jobs must come from outside. Otherwise, retrenchment! This applies even in the top graduate schools, whose own expansion was fed by the now-ended graduate expansion of the regional universities.

Moreover, mathematics departments are not equipped to train applied mathematics Ph.D.s, even if they want to. History says that most of those applied mathematicians will come from other departments: from engineering, physics, astronomy, economics, and business schools, even medicine. We should teach them their mathematics, but they will not be our Ph.D.s. The diversity of the applications makes it futile for most of our departments to attempt much more than teaching and research in applicable mathematics. So I think that the nonacademic employment of our Ph.D.s will level off nearer 17 than 85 percent and will not of itself resolve our troubles.

Vocational training in general has its own limitations too. While it provides better specific qualification for some jobs, it narrows the range of employment options. Such trainees are subject to technological obsolescence and have to go back from time to time for refreshers and updaters as new methods come in. Or graduates find that they do not follow the career of their training, which then may be wasted time and money. Besides, in America it lowers one's status to be a hired technical specialist. Not only does the Ph.D. in the various special forms of applied mathematics suffer this drawback, the academic Ph.D. itself does too, since it trains for the special jobs of professor or practitioner.

Search for a Solution

My message is that if we are willing to relax the constraints of departmental boundaries, we can resolve these difficulties in a far better way than mindless, across-the-board budget slashing. We can preserve our research tradition and its Ph.D. degree, but we must bring Ph.D. production into balance with supporting resources. To accomplish this we do not have to reinvent the university. We only have to find services we can offer, while remaining ourselves, that the public will buy.

They exist! They can be found in proven experience of the past and in successful educational operations around us right now. Consider some of these: (1) the solution of the analogous problem of the B.A. a century ago by Harvard's President C. W. Eliot, (2) the prewar college of arts and sciences in any university without a research degree that was service-oriented and stably financed on low tuition, (3) the J.D. degree of law, and M.D. degree of medicine, (4) the vocational master's degrees which have been the success story of higher education in the last thirty years. We must also consider what the NSF is saying now about government-industry-university teamwork in attacking urgent national problems.

To adapt to such supportable operations will require that the structure of the university faculty be modified to change the role of departments in it. Much of our inflexibility to adapt to the situation that faces us arises from the tradition of departmental independence and delegating every matter to some department. This is not a departmental problem. It is one for the whole arts and sciences faculty, since it affects all disciplines more or less equally. The revised structure must preserve the departments' basic research and Ph.D. degree, for this is also one of those historically successful functions of the university. And it must avoid demanding that departments render services that the public wants but that departments cannot provide.

A New University Structure

I believe the time has come to partition the faculty into a General College and a Graduate College and to introduce a new Doctor of Arts and Sciences degree given by the Graduate College. Let me explain.

The General College

The General College faculty is to be prohibited from having departments and is to be independent of faculty appointments, salaries, and the departments in its budget. Faculty research is to be voluntary, explicitly not required for tenure. This college will teach a substantial fraction of the courses, especially those practicing the basic quantitative and verbal skills. It is to control the B.A. degree and master's degrees that can draw on courses of various departments and schools of the university.

In return for release from "publish-or-perish" as requirement for tenure and from the direction of dissertations and national professional duties, the General College faculty will carry somewhat higher teaching loads, like those of a good prewar college of arts and sciences. This will tend to reduce and stabilize tuition, for those colleges were able to operate with tuition affordable in prewar dollars. The initial faculty

of the General College is to be made up of present members of the departments who choose to transfer under mutual agreement with the dean of the college, not the department chairman. So the new college will not require new financing.

There is no reason to think of the General College faculty as teaching drones who do no research. They can and should have moderate teaching loads which leave time for research for those who have something to say and want to say it. It has been proved in the past that one can be productive in such a free and unfrenzied environment. Actually this is the only form of support we have that leaves the researcher really free.

The Graduate College

The Graduate College is to contain the departments and administer the traditional Ph.D. degrees. It is also to have a new Doctor of Arts and Sciences (D.A.S.) degree administered by its whole faculty. This degree is a key element in my proposed solution. Besides conducting the traditional departmental teaching and research, the Graduate College faculty as a whole is also to have latitude to arrange cross-field research teams and associated Ph.D. degrees as the need or opportunity arises, without having to set up permanently organized "centers".

The rest of this paper will describe the historical basis of this proposal and explain how it can help us to move forward now when only retrenchment appears in prospect.

The B.A. a Hundred Years Ago

The B.A. degree about one hundred years ago reached a crisis strikingly similar to that of our Ph.D. today. There had been a huge expansion of colleges after the American Civil War in which the new colleges simply adopted the old general studies curriculum that had originally been designed to educate ministers of the gospel and school teachers. But by about 1885 it had become apparent that never again would there be jobs enough as minister of the gospel or teacher to employ the flood of new B.A.s being turned out. New sources of funds had to be found and new jobs for the graduates.

The first thought, of course, was vocational training. So new colleges of engineering, business, and agriculture were established as alternatives to the general studies curriculum. But the vocational alternative turned out to provide only limited relief for the same reasons just outlined for doctorates in applied mathematics.

The real solution for the B.A. was devised by mathematician-turned-chemist C. W. Eliot, president of Harvard. It was to convert the B.A. curriculum into a broad liberal arts education which gave no specific vocational qualification but offered evidence of superior attainment and gave the recipient the basic tools to undertake any task with informed intelligence. With later modifications this became the B.A. as we know it today. It solved the employment problem because of its adaptability to many more jobs and because it was perceived to confer a higher status than any trade school degree. It solved the financial problem, because students and their families were willing to pay tuition for these advantages.

A Doctor of Arts and Sciences in 1994

That has to be the solution for the problems of the Ph.D. in arts and sciences today: to extend broad liberal education three years to a D.A.S. degree in the Graduate College. We have the graduate universities to do it; we have the student demand; but the existing Ph.D. satisfies only a fraction of the demand of either the potential students or the supporting society.

The practical characteristics of the D.A.S. must match those of the J.D. and M.D. degrees, which are successful operations and are the main alternatives for a student who wishes to continue beyond the B.A. These attributes are: highly selective admission requirements, reasonably assured completion in three years, predictable total cost, and substantial tuition paid by the student. As currently operated, our Ph.D. programs violate all four of these conditions.

These constraints are far more important than the curriculum of the D.A.S., which will be developed by individual universities over time and adapted to many particular objectives. Let me just say that history says that each student should have a "major" and that the humanities requirements should continue. But, along with basic skill requirements, these humanities must be appropriate for older students being educated as potential leaders in public, professional, or business life, or just seeking self-fulfillment. And I think it would be a serious mistake not to include a research experience, but I am confident that this can be provided within the constraints of time and limited risk.

Do not confuse this Doctor of Arts and Sciences degree with the proposed "Doctor of Arts in Mathematics" that was rejected by the mathematics community back in 1962. That narrowly vocational, nonresearch D.A. was designed to qualify more college teachers in a time of acute shortage. If it had been implemented, it would have compounded our present glut of trainees for college teaching. The new D.A.S. goes in exactly the opposite direction. Like Eliot's B.A. a century ago, it seeks to open up and support the broadest possible spectrum of future careers and to avoid committing the graduate to an academic position in teaching and research, or any other specific employment.

Don't dismiss such a D.A.S. degree out of hand as visionary, impractical, too remote to help in our real-world difficulties. It will probably take hold much more rapidly than you might think, if it is launched by a coalition of major learned societies, in which I hope that the AMS will take the lead. It is important that the subject of English be represented in that coalition.

Clearly among B.A. graduates a demand exists for a doctoral degree, and clearly the regional universities want to offer it. The Ph.D. satisfies this need for only a few. And the J.D., M.D., or M.B.A. is a viable alternative for only a fraction of them. Once launched, the three-year, low-risk, D.A.S. will grow very rapidly and bring in tuition income which will contribute to the financial support of graduate studies. Moreover, even before the D.A.S. gets into full operation, it will provide a framework to address some of our difficulties right now that are inaccessible by themselves.

Near-term Uses of the Graduate College

Consider first the new federal emphasis on government-industry-university team research to solve pressing problems of our society. Departments, particularly the new smaller regional ones, are at a disadvantage in qualifying for NSF grants to support this kind of cross-field, or team, research. The broader and more elastic framework of the Graduate College will at least offer a better chance to organize the needed research teams and take part in the national effort.

Doctors of Arts and Sciences with a major in mathematical sciences would contain a body of practitioners intermediate between the master's and the research doctorates. They will be useful in industry, especially in environmental or other multidisciplinary management. And, if we are going to expand the nonacademic employment of mathematicians, we must begin to build a much larger base of our pyramid of practitioners with B.A., M.A., D.A.S, or Ph.D. degrees. The pyramid cannot be built only at the top with Ph.D.s.

Think of yourself in the place of the president of a university which has recently, and with great pride, entered the ranks of "the great research universities", only to find now that neither the money nor the Ph.D.-candidate manpower is available to sustain your new graduate school. You face either humiliating withdrawal, with faculty firing, or bankruptcy. The new Doctor of Arts and Sciences program may allow you to remain as a graduate university to the doctoral level, since the general Graduate College faculty can be fewer in number than the combined departmental Ph.D. faculties, and therefore less costly. And the D.A.S. has potentially a much larger clientele of tuition-paying students than all the Ph.D.s combined.

If it is necessary to reduce your departmental faculties, this can be done rationally and considerately, partly by transfer to the General College faculties and partly by normal attrition, cutting graduate teaching assistants first. You may keep Ph.D. programs active, though reduced in size, by using the resources of related departments to fill out course plans. And you do not have to cancel any departmental Ph.D. programs. You can let them remain, still authorized in the Graduate College, until economic conditions permit their reactivation.

Or think of yourself as president of a leading, well-established, private university whose departments have national prestige but still generate deficits. A D.A.S. program has some of the same advantages for you too. We need some of them to lead in this reform, and I think it is to their advantage to do so.

Now consider the century-old problem that the Ph.D. is fine for research professors but unsatisfactory for the education of college teachers. The issue has often surfaced in the meetings of the AMS and MAA. Various doctoral degree programs have been advanced to correct the deficiencies of the Ph.D.: its narrow specialization and the handicap of its formidable research requirement. But none have had much success. Since college teaching jobs were needed to employ Ph.D.s, a separate graduate program for college teachers would cost too much, and it would divert resources from the more vital research activity. One byproduct of the D.A.S. degree in the Graduate College will be a broader, more appropriate, graduate education for college teachers, one that should satisfy the critics of the Ph.D. And this without a separate college teacher's degree!

New General Colleges in A&S

The departments of mathematics I know manage appointments, promotion, and tenure primarily in support of research ideals. I think that is the way it has to be. And that can continue in the Graduate College.

On the other hand, comparatively little of our income is designated for basic research, and that is shrinking. Most of the money we get is for teaching undergraduates, very few of whom will be mathematicians. It is our professional life blood, the only reliable financial support most of us have had over the long term. In the real world it is self-destructive folly to relegate such a prime business to people whose future hinges on other activities or to people who have no future and know it. Any executive who has a business that is his most important source of revenue knows that he has to assign some good people to it and reward them for performance in it.

This is my reason for calling for independent General College faculties to take charge of the essential business of undergraduate teaching. The model for this is the prewar college of arts and sciences in a university that had no doctoral graduate studies or formal research. It did better teaching than our fine research departments do today and at an affordable cost in prewar dollars. All over the country undergraduates are crying out for more time with their professors. And there are many fine professors who want to give them time, and would, if they were recognized and paid for it. Within graduate departments that is nearly impossible.

Although the General College will have no departments, it should be authorized to construct undergraduate major programs and master's degrees to meet students' needs for vocational qualification. These would be made up of its own and departmental course offerings, with great latitude to combine fields as needed. The model for this is the master's degree as it has emerged in recent years in community colleges, evening continuing education, schools of education, and such big conglomerate departments as electrical engineering. In these loose organizations with broad subject matter coverage and sensitivity to the needs of their students, the master's degree is the success story of higher education in the last thirty years. These modern master's students earn job-related degrees in such fields as medical technology, electronics, computer programming, career counseling, environmental management, and psychological support therapy. They frequently take multiple master's degrees, renewing, updating, or extending their employment qualifications. And they pay tuition.

Departments of arts and sciences, and particularly mathematics departments, have not caught on to this yet. Our master's degree is still confined primarily in the department. But giving this responsibility to the General Colleges would escape this limitation. It could compete in this flourishing business. And it would have a quality advantage over the community colleges, for it could draw on the advanced

courses of all the departments. It is also important to observe that the General College could do a better job than departments in training secondary school teachers.

Some years ago a CUPM committee headed by Alan Tucker studied the curriculum for an undergraduate major in mathematical sciences. The difficulty was that word *undergraduate*. Such a generalist's curriculum has never succeeded at the undergraduate level, but it is more feasible at the master's level. That CUPM report would be a good place to start in designing curricula for M.A. practitioners. I think that SIAM has also studied such curricula.

Finally, note that a university could have a number of such general colleges of arts and sciences to offer varied characteristics or just to hold them to a preset modular size. It would be good if they were resident colleges like those of Oxford and Cambridge, but that is not necessary. There is a better chance to attract large private donations to named colleges, or named college professorships, serving youth than for nebulous "arts and sciences" or "research". And it does not diminish the chances for endowed research professorships. Moreover, when word gets around about these new colleges, enrollment should increase, providing added tuition income.

Where Does This Leave the Departments?

Unlike Eliot's solution to the B.A. problem a century ago, we are leaving the old graduate study and Ph.D. program in place, only reducing its size. It still has prime importance to mathematics. Unquestionably some potentially excellent research prospects will be diverted to the D.A.S., but they need not be lost. Just as in law and medicine, the option remains open for some to continue for the research degree afterwards. Their broader education could well be an advantage in their research careers. The education of a researcher is never complete with the Ph.D. anyway. In fact, we can think of the AMS as our main postdoctoral research university.

More important are the many more prospects that the D.A.S. will save for the community of mathematicians, particularly American men, who have been leaving mathematics because the hazards of the Ph.D. outweigh its value for them. Also very important are the Doctors of Arts and Sciences who will find places in public life where the influence of scientists and mathematicians is much needed today.

But we have to get out of our departmental ruts to do this and out of our scientific ruts. I think the proper government interface for this kind of initiative may be the American Council on Education rather than the National Research Council (NRC), through which we are accustomed to working. It would help to have NRC and JSF join in though.

If I had a few more years of service to mathematics, this is the job I would like to undertake. But I don't! So I have told you, my younger colleagues, what I think the problem really is and what has to be done about it. With that I leave it to you. Good luck!

Testimony on the FY 1995 National Science Foundation Budget Request

The following is testimony presented in support of the budget request for fiscal year 1995 for the National Science Foundation. AMS President Ronald Graham of AT&T Bell Laboratories presented the testimony on May 5, 1994, before the Subcommittee on Veterans' Affairs, Housing and Urban Development, and Independent Agencies, which is a subcommittee of the Committee on Appropriations of the U.S. House of Representatives.

Good afternoon, Mr. Chairman and Members of the Subcommittee. I am Ronald Graham, the adjunct director of research at the Information Sciences Division of AT&T Bell Laboratories and the president of the American Mathematical Society. I thank you for this opportunity to comment on the FY 1995 budget request of the National Science Foundation. I speak on behalf of the Joint Policy Board for Mathematics, a joint effort of the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics, which have a combined membership of over 56,000 mathematical scientists and educators.

Mr. Chairman, as you might expect, the Joint Policy Board for Mathematics strongly supports the president's request for an overall NSF budget of $3.2 billion in FY 1995. We urge the subcommittee to approve the full requests for the Research and Related Activities and Education and Human Resources line items to ensure the continued success of NSF programs in the Division of Mathematical Sciences and the Division of Undergraduate Education.

I would like to make two points in support of this recommendation: First, I would like to demonstrate through examples the multifaceted impact that NSF support for the mathematical sciences has on national science and technology efforts. And then I would like to emphasize how with NSF support mathematical scientists are deeply involved in the cultivation of the nation's human resources, not only to produce future mathematicians, scientists, and engineers but to improve the mathematical knowledge and skills of all students in preparation for the jobs of tomorrow.

The Impact of NSF Support for Research in the Mathematical Sciences

The NSF budget request includes $88.7 million for the Division of Mathematical Sciences (DMS), an increase of $6.5 million over its FY 1994 budget. DMS support for the mathematical sciences as a discipline leads to new knowledge and powerful concepts and tools that enable progress throughout science and technology.

For example, DMS provides support for the study of nonlinear dynamics and chaos theory. It turns out chaos is so prevalent in nature, mathematical discoveries in this field are revolutionizing our view of the universe and prompting new methods for solving problems associated with a wide range of physical phenomena, biological functions, chemical reactions, and technological processes. I note that one of the DOE laboratories recently signed a CRADA to apply the principles of chaos to the operation of power plants to make them more efficient and environmentally friendly.

DMS also funds work in an area of mathematics called knot theory. While mathematicians have been systematically exploring knots for more than a century, this rather abstract body of knowledge is now being used to make surprising advances in the field of structural biology. For instance, DMS is sponsoring mathematical and biological scientists who study how knots and links in strands of DNA affect cellular processes.

In collaboration with the federal research initiatives and other divisions of NSF, DMS also supports the investigation of the mathematical foundations in areas of strategic national importance. This often involves the development of mathematical models to provide insight into complex phenomena and processes associated with critical areas of science and technology.

Mathematicians at the Courant Institute at New York University have developed a mathematical model and computer simulation of the complex fluid dynamics of the human heart. The model can be used for the investigation of cardiac function and reaction to disease and has become an effective tool in the design of better artificial heart valves, one of which was recently awarded a U.S. patent.

With funds from the High Performance Computing initiative, a mathematical scientist at the University of

Houston is leading an interdisciplinary research effort to write innovative software for use with high-performance computers in the development and analysis of new pharmaceuticals. The use of mathematics is central to the formulation of efficient programming strategies. This work is an excellent illustration of how sophisticated mathematical tools and computational "laboratories" are replacing expensive physical facilities and time-consuming processes. Just as the aircraft industry now uses mathematical models to simulate wind tunnels so that aircraft designs can be tested before prototypes are built, the pharmaceutical industry could soon be able to design and test potential drugs on a computer before committing them to costly experimental programs.

DMS programs are also a crucial mechanism for connecting mathematical ideas, tools, and human resources to the solution of specific problems, including those of industry.

The NSF Institute for Mathematics and Its Applications (IMA) at the University of Minnesota supports a number of postdoctoral fellows who work directly with industry. For example, an IMA fellow worked with Honeywell to model the behavior of light as it passes through very small optical devices. The models reduce costly trial-and-error efforts to build and test prototypes. Applications include lasers, displays, sensors, and other advanced technologies based on lightwaves. This year DMS will begin supporting industrial postdocs throughout the country to facilitate exchanges of people and knowledge between academia and industry.

Recent advances funded by DMS in the area of wavelet theory—a mathematical method to represent and identify signals with erratic patterns, such as speech, seismic tests, and radar echoes—have led to a host of applications in areas where large amounts of data have to be simplified for accurate interpretation. For instance, wavelet theory is the basis for an impressive new system for digitizing and compressing fingerprint data for the FBI.

Finally, I'd like to note that DMS provides virtually the only support for fundamental mathematical inquiries—the search for unifying structures and deep relationships among seemingly dissimilar things—that advance our understanding of the universe in unpredictable ways. This pursuit of discovery, insight, and creativity stretches back to antiquity and continues to yield a vast and versatile intellectual resource for humanity.

Last year the mathematical community was excited by the announcement of a possible proof of "Fermat's Last Theorem" by Andrew Wiles of Princeton. Wiles's inspiration and tenacity in tackling this intriguing problem were widely reported in newspaper accounts. Less well known, however, is that the continuous web of research on the theorem has led to significant advances in a wide range of mathematical fields and even the creation of entirely new fields. Wiles's work relied on recent results in the area of elliptic curves, mathematical structures that also happen to be increasingly important in the field of cryptography.

Mr. Chairman, it would be difficult to overstate how important the National Science Foundation is to sustaining a robust mathematical sciences enterprise in the U.S., one that can consistently turn out a wide range of results like the ones I've listed here. We urge the subcommittee to help us maintain the capacity of the discipline to serve the nation by supporting the DMS budget request.

The Importance of NSF Mathematical Programs to the Nation's Future Workforce

The combination of support from DMS and the Education and Human Resources (EHR) Directorate is an important force in mathematics education reform and human resource development. This integrated set of programs enables mathematical scientists to work toward improved teaching and learning of mathematics at all levels. With NSF support, academic mathematical scientists contribute extensively to precollege education reform through materials and curriculum development, teacher enhancement programs, and direct intervention programs designed to increase interest in mathematics and science among precollege students, especially girls and minorities.

With NSF support, mathematical scientists at the University of Georgia have been preparing K–12 mathematics teachers in two rural Georgia counties to integrate the most promising instructional tools and the latest computer technologies into their regular classes. The goal of the project is no less than the transformation of the mathematics classroom environment. State, local, and private funds bought calculators, computers, and other equipment for the schools. With the help of the university faculty, the teachers have been learning to use the new curricula and technologies with confidence and are enthusiastic about the improvement of student learning.

Today I would like to emphasize the importance of EHR's Division of Undergraduate Education (DUE). The quality of undergraduate education is of paramount concern because it is where future scientists, engineers, businesspersons, K–12 teachers, and many others learn the mathematics they will use in their careers. In fact, undergraduate education is the linchpin for systemic reform of K–12 education, because precollege mathematics teachers not only receive their mathematical education at this level but are also exposed to instructional techniques that will influence their own teaching. The competency of the future workforce clearly depends on the effectiveness of undergraduate mathematics education.

The mathematical community recognizes its profound responsibility for ensuring that future teachers are adequately prepared and that college students acquire the mathematical knowledge and versatile problem-solving skills they will need

for the jobs of the future. Undergraduate mathematics reform is a high priority for the mathematical community, which since 1988 has been working with NSF support to revitalize the entire undergraduate mathematics curriculum.

Preparing teachers, especially elementary school teachers, to teach according to national standards is an important concern for many college and university mathematics faculty. From New York to Florida to California, new courses have been developed for these future teachers. This summer, college and university faculty will attend DUE-supported workshops to adapt these courses for use in their own institutions.

Calculus courses have also been the focus of a major reform effort. In NSF-sponsored pilot projects at a variety of colleges and universities, mathematics faculties are developing new courses in which students, often working in teams, analyze realistic science and engineering problems and solve them with the help of computers and advanced calculators. Many of the projects are proving to be successful in terms of the numbers of students completing them and moving on to courses that require knowledge of calculus. While Oregon State University, the University of Michigan, a consortium of five colleges and universities in New England, a consortium of midwestern universities, Duke University, and a consortium led by Harvard University are among the originators of innovative courses, nearly every institution in the U.S.—whether it has NSF financial support or not—is considering how to approach calculus reform so that more of their undergraduates are prepared for continued study in technical fields.

The next step in calculus reform is adaptation of the best of the projects for widespread implementation, related enhancement for faculty teaching these courses, and careful assessment of the results. Also needed is revision of the courses that lead to and follow calculus. This year DUE has also launched an initiative that will link improved mathematics instruction more closely with courses in engineering and the sciences. DUE's support and leadership for this ambitious overhaul of undergraduate mathematics education are indispensable. We urge the subcommittee to enable continued progress in this effort by supporting the DUE budget request.

I should also note that DMS plays a complementary role in revitalizing undergraduate education by providing research experiences for undergraduates and other education activities that are integrated with research activities. While curriculum reform is imperative, we also need to convey to teachers and students the challenge and excitement of doing mathematics.

Since 1989 DMS has supported three Regional Geometry Institutes that bring together mathematical researchers, educators, including high school teachers, and students at all levels to explore recent advances in geometric research. This successful summer program is now being expanded to encompass timely topics in a wider variety of mathematical fields.

Collectively, the mathematical programs funded by NSF's research and education directorates represent a critical investment in the nation's human resources. This comprehensive support helps ensure that we remain poised to answer the mathematical questions that inevitably emerge during the pursuit of understanding, innovation, and quality of life.

In conclusion, Mr. Chairman, full funding of the proposed FY 1995 NSF budget requests for the Division of Mathematical Sciences and the Division of Undergraduate Education is crucial to maintain the effectiveness of the discipline as an educational and intellectual resource for the nation and to enable mathematical scientists to respond consistently to national needs as they arise. We urge your continued support for these important activities. Thank you for this opportunity to express our views for the record regarding appropriations for the National Science Foundation.

The National Science Foundation Budget Request for Fiscal Year 1995

Early this year, President Clinton submitted his request to Congress for the fiscal year 1995 budget for the National Science Foundation (NSF). The request contained a 6% increase for the NSF, a fairly ambitious figure in these times of budget constraint. At the time of this writing, the House and the Senate were negotiating the appropriations for the federal budget, and the final outcome for the NSF was not yet known. Congress is expected to pass the NSF budget in time for the start of the 1995 fiscal year on October 1, 1994.

One of the difficulties this year is that, for the first time in recent memory, discretionary funds are down from the preceding year, both in dollar amount and in the percentage of the overall budget. This means that any increases for the NSF will come at the expense of other discretionary federal programs. According to the electronic newsletter *Tidbits*, prepared by Lisa Thompson of the Joint Policy Board for Mathematics, the costly and controversial space station was a key sticking point. "Many budget observers agree," writes Thompson, "that the final NSF budget will depend largely on whether the space station is in or out."

Support for science has generally been strong in the administration and Congress. However, there have been persistent calls by the executive branch through the President's Office and by various key Congressional members and their staffs to insure that federally funded science serves national needs. Barbara Mikulski, a Maryland Democrat, chairs the Senate Appropriations Committee for Veterans' Affairs, Housing and Urban Development, and Independent Agencies, which has jurisdiction over the NSF. A strong supporter of science, Mikulski has nevertheless insisted that federal funding of science should target "strategic" areas that serve national needs. She clarified her position in a speech in January at the National Academy of Sciences. "Nor does it mean that every proposal must guarantee a private sector payoff in a number of years... I am saying that we should spend more than half of our basic research dollars in areas that we have identified as strategic." Which areas are considered strategic should be based upon national needs and goals.

Frederic Y. M. Wan, director of the Division of Mathematical Sciences (DMS) at NSF, notes that, in testimony about the foundation's budget, NSF director Neal Lane was "very well received" both by Mikulski's committee and by its counterpart in the House. "Mikulski was very effusive in her support not only of Lane's testimony, but of his plans as well," Wan states.

The DMS is slated for a 7.9% increase, which is the highest increase among the divisions housed in the NSF's Mathematical and Physical Sciences (MPS) directorate. "MPS feels we are doing things consistent with its goals and the goals of the foundation," Wan explains. For example, he says that the industrial postdoc program, launched as a pilot program last year by the DMS, was "so well received internally in the NSF and outside, in industry, academia, and Congress" that the program is being extended to the entire MPS directorate. In addition, it will be expanded to include a component by which academic researchers can take sabbaticals working at industrial research sites, and industry scientists can visit academic institutions. Also in the works is a graduate student internship program, through which mathematics graduate students can work as full-time interns or part-time research assistants in industry. Four million dollars from the MPS reserve is slated for these programs. The five MPS divisions will compete for a share, so it is not clear how much of that will go to the DMS. However, because of the experience DMS had with the pilot program, it has a good chance of getting its fair share (in addition to its scheduled increase) if it participates.

Another possible new direction for the DMS was set for discussion at the meeting of the DMS Subcommittee of the MPS Advisory Committee on June 7-8. The idea is to establish a program for "group grants". Groups of at least three mathematicians, not necessarily all at the same institution, could use these grants for things not usually supported on regular grants, such as computing facilities maintenance and support personnel, as well as as postdocs, graduate students, and travel. Salaries for senior principal investigators are specifically excluded from the group grants. The grants could be as large as $250,000, says Wan, but most will be less. MPS director William Harris has promised new funds from the fiscal 1995 DMS budget, should the DMS choose to launch the program.

With these new programs, and the generally good relationship between NSF director Lane and Congress, mathematics at the NSF might do fairly well despite the lean fiscal times.

Allyn Jackson

Note: The following tables, prepared by AMS staff, present different aspects of the NSF budget. Table I helps readers see the Division of Mathematical Sciences (DMS) budget in the context of the whole National Science Foundation budget. Table II shows the DMS budget in the context of the Mathematical and Physical Sciences Directorate. Table III presents information broken down in the same way as in Table I, showing constant-dollar changes in the budget figures.

Table I. National Science Foundation

(Millions of Dollars)

	1991 Actual	Change	1992 Actual	Change	1993 Actual	Change	1994 Plan	Change	1995 Request
(1) Mathematical Sciences Research Support	$ 72.0	6.3%	$ 76.5	1.4%	$ 77.6	5.9%	$ 82.2	7.9%	$ 88.7
(2) Other Research Support (Note A)	1872.6	0.2%	1868.3	7.1%	2001.0	9.3%	2186.6	6.3%	2325.2
(3) Education and Human Resources (Note B)	322.0	37.1%	441.4	14.4%	505.1	14.2%	576.7	1.6%	586.0
(4) Salaries and Expenses (Note C)	104.1	9.4%	113.9	0.5%	114.5	11.4%	127.5	10.0%	140.3
(5) Science and Technology Centers	42.4	11.1%	47.1	9.3%	51.5	12.8%	58.1	2.9%	59.8
(6) Totals	$2413.1	5.6%	$2547.1	8.0%	$2749.7	10.2%	$3031.0	5.6%	$3200.0
(7) (1) as % of (1) and (2)	3.70%		3.93%		3.73%		3.62%		3.67%
(8) (1) as % of (6)	2.98%		3.00%		2.82%		2.71%		2.77%

Note A. Support for research and related activities in areas other than the mathematical sciences. Includes scientific research facilities and instrumentation, Antarctic program, and certain research centers. Excludes Science and Technology Centers.
Note B. The programs in this category provide support in all fields, including the mathematical sciences.
Note C. Administrative expenses of operating the Foundation, including the Office of the Inspector General.

Table prepared by AMS staff.

Table II. Directorate for Mathematical and Physical Sciences

(Millions of Dollars)

Division	1991 Actual	% of Total	1992 Actual	% of Total	1993 Actual	% of Total	1994 Plan	% of Total	1995 Request	% of Total
Mathematical Sciences	$ 72.0	(12.8%)	$ 76.5	(12.3%)	$ 75.6	(12.9%)	$ 80.2	(12.9%)	$ 86.7	(13.2%)
Astronomical Sciences	97.5	(17.3%)	109.9	(17.7%)	100.8	(17.2%)	103.9	(16.8%)	109.3	(16.6%)
Physics	129.1	(22.9%)	136.6	(22.0%)	126.2	(21.5%)	131.2	(21.2%)	139.2	(21.2%)
Chemistry	101.9	(18.1%)	108.4	(17.4%)	108.3	(18.5%)	117.3	(18.9%)	125.6	(19.1%)
Materials Research	122.3	(21.7%)	131.3	(21.1%)	151.6	(25.9%)	162.9	(26.3%)	172.3	(26.2%)
Science and Technology Centers	18.8	(3.3%)	21.5	(3.5%)	23.5	(4.0%)	24.4	(3.9%)	24.7	(3.8%)
Major Research Equipment*	22.5	(4.0%)	38.0	(6.1%)	–	(–%)	–	(–%)	–	(–%)
Totals	$564.1		$622.3		$585.9		$619.9		$657.7	

*Starting with the 1994 Budget Request, the NSF listed "Major Research Equipment" as a separate line item and not as a part of the Mathematical and Physical Sciences budget.

Table prepared by AMS staff.

Table III. Compilation of the NSF Budget, 1990–1995

(Millions of Dollars)

	1990 Actual	1991 Actual	1992 Actual	1993 Actual	1994 Plan	1995 Request	Increase 1990–1993	Increase 1990–1995
(1) Mathematical Sciences Research Support	$ 69.3	$ 72.0	$ 76.5	$ 77.6	$ 82.2	$ 88.7	12.0%	28.0%
Constant dollars *	*53.0*	*52.9*	*54.5*	*53.7*			*1.3%*	
(2) Other Research Support	1610.4	1872.6	1868.3	2001.0	2186.6	2325.2	24.3%	44.0%
Constant dollars	*1232.1*	*1374.9*	*1331.7*	*1384.8*			*12.4%*	
(3) Education and Human Resources	220.6	322.0	441.4	505.1	576.7	586.0	129.0%	165.6%
Constant dollars	*168.8*	*236.4*	*314.6*	*349.6*			*107.0%*	
(4) Salaries and Expenses	98.7	104.1	113.9	114.5	127.5	140.3	16.0%	42.1%
Constant dollars	*75.5*	*76.4*	*81.2*	*79.2*			*4.9%*	
(5) Science and Technology Centers	27.1	42.4	47.1	51.5	58.1	59.8	90.0%	120.7%
Constant dollars	*20.7*	*31.1*	*33.6*	*35.6*			*72.0%*	
(6) Totals	2026.1	2413.1	2547.1	2749.7	3031.0	3200.0	35.7%	57.9%
Constant dollars	*1550.2*	*1771.7*	*1815.5*	*1902.9*			*22.8%*	

*Current dollars are converted to constant dollars using the Consumer Price Index (based on prices during 1982–1984).

Table prepared by AMS staff.

The following consists of excerpts of the text prepared by the staff of the Division of Mathematical Sciences of the NSF and submitted to Congress as part of the Administration's Budget Request for the Fiscal Year 1995.

Mathematical Sciences

The FY 1995 Budget Request for the Division of Mathematical Sciences contains an increase of 7.9% over the FY 1994 Current Plan.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Percent Change
Disciplinary Research	$45.13	$46.64	$49.00	5.1%
Cross-Disciplinary and Computational Research	15.77	17.37	20.01	15.2%
Special Projects	16.72	18.20	19.70	8.2%
Total, DMS	$77.62	$82.21	$88.71	7.9%

NSF plays a crucial role in the support of academic research in the mathematical sciences, providing approximately 50% of all federal support. In all areas of the mathematical sciences, Foundation-supported research involves a broader range of infrastructure, basic research, and cross-disciplinary research topics than those sponsored by the mission agencies.

Ongoing research activities within Disciplinary Research include areas such as classical analysis, modern analysis, geometric analysis, topology, foundations, algebra, and number theory. Activities within the Cross-Disciplinary and Computational Research program element include applied mathematics, statistics and probability, and computational mathematics. Awards through these program elements support basic and cross-disciplinary research in the mathematical sciences, with grants usually including funding for graduate and postdoctoral students as well as computing equipment and other research needs. The Science and Technology Center for Computation and Visualization of Geometric Structures at the University of Minnesota (the "Geometry Center") is supported within the Cross-Disciplinary and Computational Research program element.

The Special Projects program supports various efforts that cut across the mathematical sciences, including: research institutes; postdoctoral research fellowships; research conferences, workshops, and special years; shared scientific computing research equipment; and undergraduate programs managed in collaboration with the Education and Human Resources Activity.

The FY 1995 Budget Request includes increases that will continue to support the participation of the mathematical sciences in a variety of interagency, NSF, and MPS initiatives. They reflect both the importance of mathematical modeling, simulation, control, visualization, and algorithm development, and the readiness of the mathematical sciences to enhance research in these areas. The problems of science are framed in the language of the mathematical sciences; thus, the mathematical sciences as both the modeling tool and the language of science are continually challenged to develop new constructs that expand capabilities.

- Disciplinary Research increases by $2.36 million in FY 1995 to a total of $49 million. Enhancing capabilities in nonlinear science and participation in the **High Performance Computing and Communications** (HPCC) initiative are high priorities.
- Cross-Disciplinary and Computational Research increases by $2.64 million to a total of $20.01 million. Increases are for enhanced participation in **Global Change, High Performance Computing and Communications, Advanced Manufacturing Technology**, and **Civil Infrastructure Systems**.
- An increment of $1.50 million for Special Projects to a total of $19.70 million will enhance activities in education, with emphasis on Research Experiences for Undergraduates sites and postdoctoral fellowships.

Number of People Involved in DMS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,490	1,500	1,500
Other Professionals	50	50	50
Post-Doctorates	220	240	250
Graduate Students	880	940	950
Undergraduate Students	100	100	110
Total Number of People	2,740	2,830	2,860

The following consists of excerpts of the text prepared by the staff of the Division of Computer and Computation Research of the NSF and submitted to Congress as part of the Administration's Budget Request for the Fiscal Year 1995.

Computer and Computation Research

The FY 1995 Budget Request for the Computer and Computation Research (CCR) Subactivity contains an increase of 11.3% over the FY 1994 Current Plan.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Percent Change
Theory of Computing	$8.54	$9.09	$10.15	11.7%
Numeric, Symbolic and Geometric Computation	6.07	7.01	7.72	10.1%
Computer Systems	3.88	4.12	4.50	9.2%
System Software	11.96	12.68	14.00	10.4%
Software Engineering	4.33	4.76	5.54	16.4%
Total, CCR	$34.78	$37.66	$41.91	11.3%

The Computer and Computation Research Subactivity contributes to the fundamental understanding of the theory of computation, alternative architectures for computer systems, and the methodology of and tools for designing software. Ongoing programs support research in such areas as funda-

mental theory underlying the development of better algorithms for selected applications; numerical solutions of science and engineering applications; problems in creating, maintaining, and managing real time systems; programming languages for high-performance computing; computer security; and computational geometry. This Subactivity is a major source of funding for basic research in these fields. By focusing its basic research priorities, CCR plays an important role in several interagency programs, such as **High Performance Computing and Communications** (HPCC).

The FY 1995 Budget Request includes participation by all program elements.

- Ongoing research in CCR, totaling $37.66 million, includes $30.64 million for HPCC including **Information Infrastructure Technology and Applications** (IITA). Activities include basic research on heterogeneous parallel and distributed computation—architectures that are key technologies for future advances in high-performance computing.
- An increase of $4.25 million in FY 1995 will bring the total for HPCC (with IITA) to $34.89 million. Of this, $3 million will increase research in problem solving environments for high-performance computing and the application of the theory of algorithms to other science and engineering disciplines. Also included is research aimed at techniques for reducing the cost of software development, tools for grand challenge applications, and new technologies to make using computers less costly and less error prone.
- Within the $4.25 million, the IITA component of HPCC will increase $1.25 million for additional research on reliable computer-controlled systems, such as flight control systems and the application of computer science research to manufacturing, with special attention on the application of geometric modeling. Funding will be increased for the S&T centers by $350,000.

Number of People Involved in CCR Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	410	450	500
Other Professionals	0	0	0
Post-Doctorates	30	30	30
Graduate Students	410	450	500
Undergraduate Students	40	50	50
K–12 Teachers	0	0	0
K–12 Students	0	0	0
Total Number of People	890	980	1,080

The following consists of excerpts of the text prepared by the staff of the Division of Information, Robotics, and Intelligent Systems of the NSF and submitted to Congress as part of the Administration's Budget Request for the Fiscal Year 1995.

Information, Robotics and Intelligent Systems

The FY 1995 Budget Request for the Information, Robotics and Intelligent Systems (IRIS) Subactivity contains an increase of 16.4% over the FY 1994 Current Plan.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Percent Change
Knowledge and Database Systems	$11.89	$13.13	$14.78	12.6%
Robotics and Machine Intelligence	6.29	7.10	8.35	17.6%
Interactive Systems	4.67	4.80	5.90	22.9%
Information Technology and Organizations	4.13	4.80	5.70	18.8%
Total, IRIS	$26.98	$29.83	$34.73	16.4%

IRIS supports research to enable the rapidly emerging information society. The principal goals are to improve basic understanding and design of information and knowledge processing mechanisms, to facilitate information and knowledge exchange between humans and machines, and to understand better the impact of advanced information technologies in distributed work environments. This Subactivity is a major source for academic research in these fields. By focusing its basic research priorities, IRIS plays an important role in several interagency programs, especially in the new IITA component of the HPCC program.

Ongoing programs support research in such areas as the design of database and knowledge-based systems, information systems in distributed and networked environments, virtual reality and multimedia environments, human language technology, and sensor-based control in intelligent robots. One Science and Technology Center, co-funded with the Social, Behavioral and Economic Sciences Activity, deals specifically with interdisciplinary research involving information and cognitive science.

In the FY 1995 Budget Request:

- Ongoing research in support of the HPCC program, including IITAs, totals $16.47 million across the Subactivity.
- Ongoing research under the IITA component totals $1.98 million. It focuses on the underlying science and the development of technology and prototypes to speed the realization of distributed electronic knowledge networks and the national information infrastructure. In FY 1995, within the IITA increase of $3.85, $1 million will be added to significantly involve twenty to twenty-five smaller institutions in six planned core projects. The remainder will extend research on virtual prototyping for advanced manufacturing and will add support for national challenges in government information systems, civil infrastructure, and health care. This will require attention in areas such as heterogeneous databases, knowledge systems, intelligent automation, and interactive use of sensor, displays, and effectors.
- In FY 1995 an additional $1.05 million will be distributed across all program elements to increase intelligent systems research and Grand Challenge Applications. One goal is to encourage scale-up experiments and to connect research

more closely with real applications.

- Ongoing activities in Advanced Manufacturing Technology include research on information access, knowledge bases, intelligent automation, and human-computer interfaces in design and production.

Number of People Involved in IRIS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	440	480	560
Other Professionals	0	0	0
Post-Doctorates	40	40	50
Graduate Students	450	500	570
Undergraduate Students	40	40	50
K–12 Teachers	0	0	0
K–12 Students	0	0	0
Total Number of People	970	1060	1230

The following consists of excerpts of the text prepared by the staff of the Division of Advanced Scientific Computing of the NSF and submitted to Congress as part of the Administration's Budget Request for the Fiscal Year 1995.

Advanced Scientific Computing

The FY 1995 Budget Request for the Advanced Scientific Computing (ASC) Subactivity contains an increase of 13.8% over the FY 1994 Current Plan.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Percent Change
Supercomputer Centers	$65.91	$69.86	$78.47	12.3%
New Technologies	4.10	5.00	6.70	34.0%
Total, ASC	$70.01	$74.86	$85.17	13.8%

ASC supports advanced research on the development, use, and application of state-of-the-art high-performance computing hardware and software systems. It provides the U.S. academic research community with access to state-of-the-art supercomputers, both vector and parallel; provides training on systems at all levels of the educational range; works closely with industry on the development and use of these systems; and plays a key role in the HPCC program.

The four NSF Supercomputer Centers are:

- Cornell National Supercomputer Facility at Cornell University;
- National Center for Supercomputing Applications at the University of Illinois;
- Pittsburgh Supercomputing Center at Carnegie Mellon University, University of Pittsburgh, and Westinghouse; and
- San Diego Supercomputer Center at the University of California at San Diego.

These centers serve the computational needs of all NSF science and engineering disciplines. Additional activities at the centers include information on and access to emerging technologies; software tools for high-performance computing; core functions of the Metacenter; support for Grand Challenge Applications; and education, training, and outreach at all levels. The centers have pioneered partnerships with the private sector working to introduce high-performance computing technologies into national industries to solve design and manufacturing problems, and they are involved in testing the next generation of capabilities.

Laying the basis for future high-performance computation, the New Technologies Program supports research such as development of software to support new parallel systems and techniques for performance assessment. A Science and Technology Center, which has strong commitment from and involvement with industry, advances computer graphics and scientific visualization.

In the FY 1995 Budget Request:

An increase of $8.61 million in FY 1995 for a total of $78.17 million will continue enhancing the centers' computing technology, facilitate application of this technology, and broaden access to it by providing:

- $4.30 million for support of new systems/upgrades of current systems at the Supercomputer Centers;
- $2 million to enhance Metacenter activities, with emphasis on enabling a national file system and connection to the very high-speed Backbone Network Service;
- $2 million additional for regional affiliates to enhance local and regional scale computing and communications expertise of a wide variety of institutions and individuals in the university that are affiliated with the expanding Metacenter activities of the NSF Supercomputer Centers;
- $300,000 to augment Science and Technology Center activities.

A total increase of $1.70 million will increase cross-disciplinary research related to Grand Challenge Applications and National Challenges. In particular,

- $1 million will be added for National Challenges in the Information Infrastructure Technology and Applications Program, with emphasis on Health Care and Education.
- $700,000 will be added for additional computational science and engineering Grand Challenge Applications Groups.

Number of People Involved in ASC Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	80	90	100
Other Professionals	0	0	0
Post-Doctorates	100	110	130
Graduate Students	150	150	170
Undergraduate Students	170	200	200
K–12 Teachers	40	40	40
K–12 Students	60	60	60
Total Number of People	600	650	700

The following consists of excerpts of the text prepared by the staff of the Division of Networking and Communications Research and Infrastructure of the NSF and was submitted to Congress as part of the Administration's Budget Request for the Fiscal Year 1995.

Networking and Communications Research and Infrastructure

The FY 1995 Budget Request for the Networking and Communications Research and Infrastructure Subactivity contains an increase of 13.2% over the FY 1994 Current Plan.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Percent Change
NSFNET	$30.10	$41.16	$46.66	13.4%
Networking and Communications Reseach	9.80	10.30	11.60	12.6%
Total, NCRI	$39.90	$51.46	$58.26	13.2%

NCRI is responsible for development and operation of NSFNET, coordinating the National Research and Education Network (NREN(sm)) part of the HPCC program, and for fundamental research on communications theory and data networks. NCRI is involved in extensive collaborative development of national and international networks with other agencies. It leads the federal implementation of the NREN(sm) program, and it has managed the explosive and successful growth of the national infrastructure providing access to information and computing resources to academic and industrial organizations in all states. Fundamental research, both disciplinary and interdisciplinary, is supported in such areas as coding, network security and survivability, lightware network architectures, protocol theory, and dynamic network control to lay the groundwork for future developments. Facilities supported by the Networking and Communications Research and Infrastructure Subactivity include the NSFNET/Internet.

The FY 1995 Budget Request builds on activities in support of HPCC, including IITA, for a total $50.96 million in FY 1994.

- Ongoing activities enable NSFNET to provide for final transition activities to the new NSFNET architecture. It includes operation of Network Access Points; the Routing Arbiter; provision for interregional connectivity; the very high-speed Backbone Network Service; Internet Registration, Information, and Directory services, and continued interagency participation in shared Internet infrastructure. An increase of $5 million in FY 1995 will increase interregional connectivity and upgrade regional infrastructure to provide for bandwidth-intensive scientific/engineering applications.
- Smaller colleges and universities, as well as precollege institutions, will continue to be connected into the NSFNET. Collaboration with the National Library of Medicine to connect medical campuses and public health facilities will be maintained, along with other interagency partnerships. Basic research in networking and communications, including a collaborative effort with the Engineering Activity in all-optical networks, will increase $1.30 million in FY 1995 to further emphasize fundamental research on the basic theory of extremely high-speed networks.
- In FY 1995, $500,000 within the IITA component will provide additional support for network-intensive National Challenges Applications.

Number of People Involved in NCRI Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	160	210	240
Other Professionals	0	0	0
Post-Doctorates	< 10	< 10	< 10
Graduate Students	170	210	240
Undergraduate Students	50	50	60
K–12 Teachers	0	0	0
K–12 Students	0	0	0
Total Number of People	380	470	540

The following consists of excerpts of the text prepared by the staff of the Directorate of Education and Human Resources of the NSF and submitted to Congress as part of the Administration's Budget Request for the Fiscal Year 1995.

Education and Human Resources

The FY 1995 Budget Request for Education and Human Resources (EHR) contains an increase of 2.9% over the FY 1994 Current Plan.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Percent Change
Systemic Reform	$82.29	$109.98	$117.98	7.3%
Elementary, Secondary and Informal Education	184.68	198.28	199.28	0.5%
Undergraduate Education	61.91	81.01	83.01	2.5%
Graduate Education and Research Development	85.41	66.46	71.06	6.9%
Human Resource Development	49.61	66.39	66.39	0.0%
Research, Evaluation and Dissemination	41.16	47.48	48.28	1.7%
Total, EHR	$505.06	$569.60	$586.00	2.9%

EHR's responsibility is to define and fund programs and projects that support the educational aspects of the Foundation's mission. The programs supported by EHR represent a cohesive and comprehensive set of activities, augmented by informal science experiences, which encompass every level of education and every region of the country. Providing direct support to students and teachers, these programs offer a level of commitment, visibility, and continuity that is responsive to the national concern with science, mathematics, engineering,

and technical education. EHR also plays a major role in developing human resources of science and engineering.

In FY 1991, EHR initiated the only major federal agency program encompassing comprehensive, systemic approaches to improve science and mathematics education, particularly at the K–12 level. The Statewide Systemic Initiatives, followed by the Urban Systemic Initiatives in FY 1993 and the Rural Systemic Initiatives in FY 1994, illustrate this approach. The focus is on whole systems aimed at making improvements in science, mathematics, and technology education at the state level, in major urban centers, and in rural areas through the involvement of broad partnerships in the development of goals, solutions, and actions. The goal of total system reform is based on the underlying philosophy that all students can learn and achieve in science and mathematics at much higher levels than at present.

EHR participates in several interagency initiatives:

- Science, Mathematics, and Technology Education (SMETE) initiative will total $531.66 million in FY 1995. This initiative addresses many of the challenges posed by the National Education Goals established by the president and the nation's governors in 1990.

Advanced Technology Education, a new program, established in FY 1994 to meet the increasing demands of a highly skilled, competitive workforce, will continue to be a major focus in the SMETE initiative in FY 1995.

- HPCC initiative, including the IITA component, will total $17.87 million in FY 1995. In the Applications of Advanced Technology program, EHR supports the expansion of the networking Infrastructure for Education test beds, demonstration projects, and research and development related to interagency collaborations.
- Participation in the biotechnology initiative in FY 1995 will total $11.80 million, and in the Advanced Materials and Processing Program initiative the total will be $7.10 million.

Participation in these activities will help create a sustainable infrastructure for education reform and expand other NSF initiatives. The following table details the SMETE initiative support by level of education.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
K–12	$351.18	$360.05	2.5%
Undergraduate	99.81	102.25	2.4%
Graduate	58.79	63.39	7.8%
Public Understanding of Science	58.79	63.39	7.8%
SMETE Total	515.81	531.66	3.1%
Other*	53.79	54.34	1.0%
Total, EHR	$569.60	$586.00	2.9%

*Includes EPSCoR, Faculty Awards for Women, Visiting Professorship for Women, and Minority Research Centers for Excellence.

EHR plays a major role in science, mathematics engineering, and technology education, funding about thirty percent of the total federal effort in FY 1995. The FY 1995 Budget Request by level of education includes the following.

K–12 Support

Support at the K–12 level totals $360.05 million over the FY 1994 estimate. This support is focused primarily in the Systemic Reform and Elementary, Secondary and Informal Science Activities of EHR.

- Systemic Reform activities increases $8 million, or 10.2 percent to total $86.06 million. The Urban Systemic Initiatives will increase $6 million, enabling six to ten of the awardee cites to continue to the planned second year level. The Rural Systemic Initiatives will increase $2 million, providing one to two implementation awards. The Statewide Systemic Initiatives is sustained at the FY 1994 level, with twenty-six ongoing awards. The Improving America's Schools Act of 1993 will target school attendance in areas with a high percentage of low-income school children. Some of these areas are being addressed by NSF's rural and urban initiatives.
- Advanced Technological Education (ATE), a new program in FY 1994, will increase $1 million for a total of $5.83 million. ATE, jointly operated in the Elementary, Secondary and Informal Science and the Undergraduate Education Activities, promotes improvement in secondary curricula and instruction to help in the transition of students to the high-performance workforce. The FY 1995 increase provides support for instructional materials for improving course and curriculum.
- Presidential Awards for Excellence in Science and Mathematics Teaching totals $4.20 million. Awards go to two science and two mathematics teachers from each state and each of the four jurisdictions: the District of Columbia, Puerto Rico, the Department of Defense Dependent Schools, and the United States Territories (Guam, American Samoa, the Commonwealth of Northern Marianas, and the Virgin Islands) each year.
- Other K–12 activities will be sustained at the FY 1994 level. This substantial ongoing funding will permit continued support of the Teacher Enhancement program ($100.80 million), Instructional Materials Development ($42.45 million), Informal Science Education ($29.75 million), the K–12 programs for minorities ($14.83 million), the Young Scholars program ($11 million), and Teacher Preparation ($18 million). The Research, Evaluation and Dissemination Activity also has selected activities in research studies and evaluation supporting K–12 education in FY 1995 ($34.82 million).

Undergraduate Support

Support at the undergraduate level is $102.25 million, an increase of $2.44 million over the FY 1994 level. This support is focused primarily in the Undergraduate Education and Human Resource Development Activities. This funding also supports evaluation of undergraduate programs in the Research, Eval-

uation and Dissemination Activity. A description of some of the programs supported:

- Course and Curriculum ($22.24 million) supports the intellectual effort necessary to restructure courses and curricula in light of current needs, new technologies, improved teaching methods, and new knowledge within and across disciplines.
- Instrumention and Laboratory Improvement ($23 million) supports projects designed to generate new and improved approaches to laboratory and field-based instruction.
- Advanced Technology Education (ATE) ($11.77 million) supports improvements in advanced technological education at the national and regional level. The $22 million increase will go towards new centers and expansion of projects for ATE.
- Other undergraduate activities remain close to FY 1994 levels. This substantial ongoing funding will permit continued support for Faculty Enhancement ($8 million) and support for minority programs, such as the Alliances for Minority Participation ($27 million).

Graduate Support

Support at the graduate level is $63.39 million, an increase of $4.60 million over the FY 1994 level. This support is in the Graduate Education and Research Development Activity.

- Graduate Fellowships increases in FY 1995 to provide for modest increases in both the stipend and the cost of education allowance and at the same time to sustain the number of fellows at approximately 2,400. The Graduate Traineeship program will be sustained at the FY 1994 level.

Public Understanding of Science

Support for Public Understanding of Science projects remains close to the FY 1994 level of $6 million. This support comes from both the Elementary, Secondary and Informal Science (ESIE) and the Research, Evaluation and Dissemination (RED) Activities.

- Informal Science Education in ESIE supports projects designed to provide rich and stimulating environments outside of school where individuals of all ages, interests, and backgrounds can increase their appreciation and understanding of science, mathematics, and their applications.
- Research in Teaching and Learning in RED focuses on public literacy in science, encompassing all ages from kindergarten through adulthood.

Number of People Involved in EHR Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	4,540	5,330	5,420
Other Professionals	1,450	1,630	1,650
Post-Doctorates	280	340	350
Graduate Students	4,070	4,460	4,560
Undergraduate Students	4,900	6,810	6,840
K–12 Teachers	46,070	55,070	59,370
K–12 Students	11,010	12,770	12,770
Total Number of People	72,320	86,410	90,960

EHR Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	2,255	2,638	2,700
Statistics for Competitive Awards:			
Number	1,268	1,300	1,300
Funding Rate	25%	24%	23%
Median Annualized Award Size	$40,353	$41,000	$42,000
Average Annualized Award Size	$104,953	$108,000	$110,000
Average Duration (yrs.)\ 1	1.6	1.7	1.7

1\ Average Duration includes all awards.

1993 Annual AMS-IMS-MAA Survey

(Second Report)

Enrollments, Faculty Characteristics, and Update on New Doctorates, Fall 1993

John D. Fulton

This is the second report of the 1993 Survey. A first report appeared in the November 1993 *Notices*, pages 1164–1179. It included a report on the 1992–1993 new doctorates, starting salaries, faculty salaries, and a list of names and thesis titles of the 1992–1993 doctorates. A supplementary list of 1992–1993 doctorates appears in the April 1994 issue of the *Notices*.

The 1993 Annual AMS-IMS-MAA Survey represents the thirty-seventh in an annual series begun in 1957 by the Society. The 1993 Survey was under the direction of the AMS-IMS-MAA Data Committee whose members are Paul W. Davis, Lorraine Denby, John D. Fulton (chair), James F. Hurley, Don O. Loftsgaarden, James W. Maxwell (*ex officio*), Donald B. Rubin, Donald C. Rung, Ann K. Stehney, and Ann E. Watkins. Comments or suggestions regarding the Annual Survey may be directed to members of the AMS-IMS-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 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.

[1]These 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.

Highlights

- The final (spring) count of new doctorates shows a total of 1,214 doctorates in the mathematical sciences awarded by U.S. institutions in the period July 1, 1992, through June 30, 1993. This equals the 1970–1971 all-time high of 1,214 and is an increase of 14% over the 1991–1992 count.

- The final count shows 532 U.S. citizens among the 1,209 doctoral recipients whose citizenship status is known. This is the highest count of U.S. citizen new doctorates in the last twelve years and is 19% above last year's final count. The count of 679 non-U.S. citizens awarded doctorates in 1992–1993 exceeds the 1990–1991 record high by 11%.

- Recruitment of new faculty showed a decrease for the fourth year in a row. The decline of 4.5% in positions under recruitment by mathematics departments in 1992–1993 was half the decline recorded the previous year. The cumulative effect of the four-year decline translates into recruitment for 31% fewer positions in mathematics departments in 1992–1993 than in 1989–1990.

- Final counts indicate that the unemployment figure for 1992–1993 new doctorates represents a new record high rate of 8.9% at the time of the spring update of employment status. In addition, 5.5% of the new doctorates took part-time employment.

- While there were small increases in the total numbers of both full-time faculty and full-time doctoral faculty in mathematics departments from fall 1992 to fall 1993, there was a significant increase (8.3%) in the number of nontenure-track doctoral full-time faculty.

- After increasing for two years in a row, the number of junior/senior majors in mathematics departments decreased by 2%. Women junior/senior majors in mathematics departments decreased by 4%.

- The total number of full-time first-year graduate students in Ph.D.-granting mathematics departments declined 7.2% from fall 1992 to fall 1993.

I. Introduction

The Annual AMS-IMS-MAA Survey collects information each year about departments, faculties, and students in the mathematical sciences at four-year colleges and universities in the United States. This article reports results from two parts of the 1993 Annual AMS-IMS-MAA Survey. First, we update information about new doctorates reported earlier in the November 1993 issue of the *Notices* (see pages 1164–1179). Second, we present results about the 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. Details are presented concerning employment patterns for new doctorates, department faculty characteristics, and distribution of enrollments in different types of departments.

We follow the procedure started in the 1991 Second Report of reporting projections of survey responses to the entire population of mathematical sciences departments. The projections of survey responses to the entire population are done within strata defined by the survey Groups. For example, on the part of the Departmental Profile Survey concerned with faculty, there were 30 usable responses from the 39 departments in Group I (see Table 3A). The 30 responding departments reported 34 full-time faculty to have retired or died, and this tally was multiplied by 39/30 to obtain the projected value of 44 for the Group as a whole.

We caution the reader that survey responses and the proportional projections are potentially biased due to (i) selection bias of the responding departments and (ii) inhomogeneity of departments within the survey Groups. The responses and projections for total faculty size are slightly affected by this bias. Nonetheless, the problems of a possible selection bias are mitigated by the generally high response rates to the Annual Survey. In Groups with lower response rates (e.g., Groups M and B), there is greater risk of biased projections.

II. Update on the 1992–1993 New Doctorates

Information about new doctorates awarded between July 1, 1992, and June 30, 1993, was collected from doctorate-granting departments in late spring 1993 and from a follow-up census of individual degree recipients. The First Report of the 1993 Annual Survey (November 1993 issue of the *Notices*, pages 1164–1179) presents the survey results obtained about new doctorates up to late September 1993. Here we update the earlier figures on the basis of more complete returns.

The spring count of new doctorates (Table 1) shows a total of 1,214 doctorates in mathematical sciences awarded by U.S. institutions. This is the highest number awarded in the past 20 years, and is equal to the 1970–1971 count (the 1970–1971 count has been adjusted to show only the total for the Groups we currently survey. The reported count of 1,414 included both Computer Science and Canadian departments). The final count is 14% greater than that of the previous year and 47% greater than the count five years ago (828 in 1987–1988).

Table 1: New Doctorates, Fall and Spring Counts

	1988–89		1989–90		1990–91		1991–92		1992–93	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
U.S.	905	919	933	950	1074	1125	1050	1062	1202	1214

Citizenship status is known for most of the new doctorates (1,209 of 1,214). The spring count of new doctorates who are U.S. citizens is 532, the highest since 1980–1981. The proportion of 1992–1993 new doctorates who are U.S. citizens increased a percentage point over 1991–1992 to 44%, the first increase since 1988–1989. The spring count of new doctorates who are non-U.S. citizens increased by 14% to a record high of 679 from last year's spring count of 596. Page 1169 of the First Report displays further information on the geographic distribution of the citizenship of the 1992–1993 new doctorates.

Of the 532 U.S. citizen new doctorates, 146 are women and 386 are men. The 146 women new doctorates comprise 27% of the U.S. total for 1992–1993, an increase of 4 percentage points from the 1991–1992 figure and an all-time high both in number and in percent of the U.S. citizen total. The 386 U.S. citizen men who were awarded Ph.D. degrees in mathematical sciences during 1992–1993 represent both an 11% increase from the previous year and the most U.S. citizen male new doctorates since 1981–1982.

Tables 2A and 2B display updates of employment data for the fall count of 1992–1993 doctorates, broken down by field of thesis research and by the survey Group of their degree department. At the time of the spring report, the employment status of 1,076 of the 1,202 1992–1993 doctorates was known. Of the 1,076, 52% assumed academic employment in the U.S., and 68% took academic employment in the U.S. or other countries. Both of these percentages are down from 1991–1992 and 1990–1991.

Employment of 1992–1993 doctorates by U.S. Ph.D.-granting institutions increased 10% from the corresponding figure for 1991–1992. Other U.S. academic employment of the new doctorates remained constant. Foreign academic employment of new doctorates declined by 17%.

Among those 1992–1993 doctorates taking employment in the U.S., 23% took nonacademic employment (Government or Business and Industry). The fraction taking nonacademic employment varied significantly by field of thesis. Of those whose field of thesis was either Algebra/Number Theory, Real or Complex Analysis, Geometry/Topology, or Logic, 8% took nonacademic employment. For Probability or Statistics, the analogous figure is 38%, and for Applied Math, Discrete Math/Combinatorics, Numerical Analysis, or Linear/Nonlinear Optimization, the analogous figure is 27%.

Group I departments continued to award the most doctorates. Of the 1,214 1992–1993 mathematical sciences doctoral degrees awarded, 36% were awarded by Group I departments (439) more than double that of any other Group. Production of new doctorates increased significantly in all Groups except

Table 2A: Employment Status of 1992–1993 U.S. New Doctorates in the Mathematical Sciences, Updated March 1994

TYPE OF EMPLOYER	FIELD OF THESIS											
	Algebra/ Number Theory	Real or Complex Analysis	Geometry/ Topology	Logic	Probability	Statistics	Applied Math	Discr. Math/ Combina-torics	Numerical Analysis	Linear or Nonlinear Optim.	Other	TOTAL
Group I	20	25	31	2	6	2	15	4	2			107
Group II	4	8	12	1	3	3	15	1	2	2		51
Group III	4	11	4		3	10	16	4	3	2	1	58
Group IV						40						40
Group V					1	1	6			2		10
Masters	15	7	11	3	2	17	5	3	1	4	2	70
Bachelors	38	25	18	2	4	10	16	8	6	1	1	129
Two-year Colleges	6	5	3			3	2	4		1		24
Other Academic Departments	3	3	1	3	2	27	11	2	5	9	9	75
Research Institutes	3	4	5		1	4	8	2	2		1	30
Government	1	1	1		1	17	5	1	1	3	3	34
Business and Industry	7	4	6	3	7	60	19	8	11	14	8	147
Foreign, Academic	23	21	26	5	9	35	18	4	9	5	8	163
Foreign, Nonacademic		1	2		2	11	2	3			3	24
Not seeking employment	2	2	2			6	5	1				18
Still seeking employment	17	10	16	1	2	13	18	7	2	6	4	96
Unknown (U.S.)	8	7	4	3	2	13	17	3	4	3	5	69
Unknown (non-U.S.)*	7	6	3	2	2	15	10	4	1	2	5	57
Column Total	158	140	145	25	47	287	188	59	49	54	50	1202
Column Subtotals: Male	115	115	118	19	36	205	149	40	38	39	42	916
Column Subtotals: Female	43	25	27	6	11	82	39	19	11	15	8	286

*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 1992–1993 U.S. New Doctorates by Type of Granting Department, Updated March 1994

TYPE OF EMPLOYER	TYPE OF DOCTORATE-GRANTING DEPARTMENT					ROW TOTAL	ROW SUBTOTALS	
	Group I Math	Group II Math	Group III Math	Group IV Statistics	Group V Applied Math/OR		Male	Female
Group I	90	7	4	1	5	107	79	28
Group II	19	22	4	2	4	51	38	13
Group III	21	9	21	7		58	43	15
Group IV	1	2		37		40	25	15
Group V	2				8	10	4	6
Masters	30	11	16	13		70	53	17
Bachelors	43	40	38	6	2	129	97	32
Two-year Colleges	3	6	14	1		24	19	5
Other Academic Departments	16	4	5	24	26	75	56	19
Research Institutes	17	1		4	8	30	20	10
Government	6	3	6	14	5	34	25	9
Business and Industry	26	16	20	49	36	147	113	34
Foreign, Academic	74	19	17	33	20	163	128	35
Foreign, Nonacademic	3		4	11	6	24	22	2
Not seeking employment	4	5	4	2	3	18	12	6
Still seeking employment	33	22	18	10	13	96	80	16
Unknown (U.S.)	29	12	9	9	10	69	56	13
Unknown (non-U.S.)*	22	8	7	10	10	57	46	11
Column Total	439	187	187	233	156	1202	916	286
Column Subtotals: Male	344	145	143	168	116	916		
Column Subtotals: Female	95	42	44	65	40	286		

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

Group II, which remained approximately constant with last year's figure.

The fall unemployment rate for new doctorates, based on information gathered by the time of the spring report, increased significantly from 6.7% for 1991–1992 to 8.9% for 1992–1993. The counts on which these rates are determined do not include those new doctorates whose fall employment status was unknown at the time of the spring report. For the past three years the fall unemployment rates for new doctorates at the time of the spring report have risen steadily from 5% in 1990–1991, to 6.7% last year, and then to the present rate of 8.9%. This year's rate is the highest ever reported in the spring report of the Annual Survey and is triple the highest rate ever reported in the spring report prior to the 5% rate for 1991–1992.

The record high unemployment rate of 8.9% among the 1992–1993 mathematical sciences doctorates at the time of the spring report is not the only employment concern. An additional 5.5% of the new doctorates took part-time employment. The data presented in Tables 2A and 2B do not reflect the fact that 54% of 334 1992–1993 doctorates responded individually that they assumed academic positions that are not tenure-track, up three percentage points from last year. Fifty-four percent of those nontenure-track positions have contract durations of two years or less, down from 60% in 1991–1992. Of the 226 positions in U.S. Ph.D.-granting departments filled by 1992–1993 doctorates 83 (31%) were held by new doctorates who received their degree from the same institution. Fifty-nine (5.5%) of the positions reported as filled in Table 2A are part-time, and at least 21 of the 59 incumbents still are seeking full-time employment.

Individual respondents also provided information about applying for jobs. From 351 respondents who reported applying for academic positions, an average number of 62 applications for academic employment and an average number of 5.7 applications for nonacademic employment were reported. From 157 respondents who reported applying for nonacademic positions, an average number of 50 applications for academic employment and an average number of 13.6 applications for nonacademic employment were reported.

The names of the 1992–1993 new doctorates and their thesis titles were published in the November 1993 *Notices*, with a supplemental list published in the April 1994 *Notices*.

Table 3A. Faculty Attrition*

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	I+II+III+ M+B
Number of full-time faculty who retired or died (Group total)	44	33	64	141	26	8	171	150	463
% of full-time faculty in Group	2.2%	1.9%	2.4%	2.2%	2.1%	2.0%	3.1%	1.9%	2.3%
Number of usable responses**	30 (77%)	34 (79%)	55 (61%)	119 (69%)	41 (54%)	14 (45%)	93 (36%)	367 (37%)	579 (40%)

* Number and percentage of full-time faculty who were in the department in fall 1992 but were reported to have retired or died by fall 1993.

** 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. Recruitment of Doctoral Faculty

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	I+II+III+ M+B
Number of open doctoral positions (Group total)*	176	73	165	414	76	36	263	454	1131
Number that were tenured/tenure-track	48	51	133	231	44	32	213	304	748
Number that were open to new doctorates	150	62	144	355	44	30	240	391	987
Doctoral hires, male	140	43	119	303	43	23	180	254	737
Doctoral hires, female	23	22	33	78	19	7	53	77	207
Nondoctoral hires, male	0	0	0	0	0	3	0	44	44
Nondoctoral hires, female	0	0	0	0	0	0	6	25	30
Number of unfilled positions	12	9	13	34	15	4	25	55	113

* Number of full-time doctoral positions under recruitment in 1992–1993 to be filled for 1993–1994.
Subtotals of rounded table values may exhibit rounding errors.

Table 3C. Faculty Size, Fall 1993, and Percentage Change in Size, Fall 1992 to Fall 1993

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	I+II+III+ M+B
Total number of full-time faculty (Group total)	1998	1768	2690	6456	1242	406	5543	8100	20100
% change in full-time faculty	1.1%	1.5%	1.0%	1.2%	1.1%	–0.6%	0.0%	0.1%	0.5%
Number of doctoral full-time faculty	1957	1628	2463	6047	1196	406	4352	5677	16076
% change in doctoral full-time faculty	0.7%	0.6%	1.8%	1.1%	0.9%	–0.6%	1.7%	0.9%	1.2%
Number of tenured doctoral full-time faculty	1440	1308	1807	4555	758	319	3255	3846	11656
% change in tenured doctoral full-time faculty	–1.0%	1.7%	3.1%	1.4%	2.5%	2.4%	0.6%	3.1%	1.7%
Number of untenured, tenure-track doctoral full-time faculty	156	231	537	924	300	62	956	1516	3369
% change in untenured, tenure-track doctoral full-time faculty	–7.7%	–8.0%	0.3%	–3.3%	–3.6%	–16.8%	4.8%	–5.8%	–2.3%
Number of nontenure-track doctoral full-time faculty	360	89	119	568	137	26	141	315	1024
% change in nontenure-track doctoral full-time faculty	13.1%	11.1%	–9.9%	7.0%	2.8%	10.9%	8.5%	10.6%	8.3%
Number of part-time faculty	83	187	532	802	154	31	1818	3510	6130
% change in part-time faculty	–15.8%	–4.5%	–8.5%	–8.4%	23.9%	1.6%	4.4%	5.2%	3.0%

Table 3D. Women Faculty Size, Fall 1993, and Percentage Change in Size, Fall 1992 to Fall 1993

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	I+II+III+ M+B
Total number of full-time women faculty (Group total)	166	231	344	741	200	30	1163	1989	3894
% change in full-time women faculty	15.3%	12.3%	2.4%	8.1%	9.1%	7.3%	4.7%	1.0%	3.4%
Number of doctoral full-time women faculty	148	143	221	512	174	30	597	1037	2146
% change in doctoral full-time women faculty	15.2%	13.0%	5.5%	10.2%	8.0%	7.3%	10.2%	0.3%	5.2%
Number of tenured doctoral full-time women faculty	70	77	118	265	50	15	354	580	1199
% change in tenured doctoral full-time women faculty	5.9%	13.0%	18.0%	13.1%	28.6%	0.0%	5.8%	9.8%	9.3%
Number of untenured, tenure-track doctoral full-time women faculty	10	39	90	140	80	9	210	391	741
% change in untenured, tenure-track doctoral full-time women faculty	–11.1%	3.3%	–3.5%	–2.3%	–8.5%	30.8%	15.2%	–12.3%	–3.9%
Number of nontenure-track doctoral f-t women faculty	68	27	13	107	44	6	33	66	206
% change in nontenure-track doctoral f-t women faculty	33.3%	31.3%	–20.0%	22.9%	26.3%	0.0%	33.3%	9.1%	19.6%
Number of part-time women faculty	25	51	216	291	54	2	785	1403	2480
% change in part-time women faculty	–29.6%	–25.9%	–0.8%	–9.3%	70.6%	0.0%	6.8%	3.8%	3.0%

III. Faculty Characteristics

The Departmental Profile Survey, sent in fall 1993 to mathematical sciences departments at four-year colleges and universities as part of the Annual Survey, provided information about faculty and instructional programs. In order that more reliable year–to–year comparisons could be made, data for fall 1992 and fall 1993 was gathered, except for data on retirement, deaths, and faculty recruitment. The percent change figures reported in Tables 3C and 3D, Tables 4A and 4D, and Tables 5A, 5B, and 5C are based on these two years of data. On pages 1172–1179 of the November 1993 issue of the *Notices*, the First Report presented information collected earlier about faculty salaries.

Table 3A displays losses of full-time mathematical sciences faculty due to retirements or deaths. While there was little overall change between the reported attrition rate for fall 1992 of 2.4% and the fall 1993 reported rate of 2.3% for Groups I+II+III+M+B, both percentages are significantly ahead of the 1.8% faculty attrition rate reported for fall 1991. Likely, these increased attrition rates reported for fall 1992 and 1993 reflect the many early retirement programs which have been established in the past two years in academic institutions. Numbers of retirements tend to fluctuate substantially from year to year. For example, faculty attrition in Group M increased by 47% from the reported figure for fall 1991 to the reported figure for fall 1992, yet remained constant from the fall 1992 figure to the fall 1993 figure.

Table 3B displays Departmental Profile Survey information on the number of full-time faculty positions in mathematical sciences departments under recruitment in 1992–1993. The number of positions in mathematics departments under recruitment has decreased significantly for four straight years (by 31% since 1989–1990 and by 5.2% from last year). The number of positions under recruitment declined from 1990–1991 to 1991–1992 for every Group except Group II. A comparison of Table 3B in this spring's report with Table 3B of last spring's report indicates that every Group except Groups II and B had increases in the number of positions under recruitment, yet the declines in Groups II and B (29% and 15%, respectively) account for the overall decrease in number of positions under recruitment.

Table 3B indicates that 87% of the positions under recruitment in 1992–1993 by mathematics departments were available to new doctorates. However, only 66% of those available to new doctorates were tenured/tenure-track positions. The total number of tenured/tenure-track positions under recruitment by mathematics departments declined by 13% from last year's count.

Tables 3C and 3D describe the makeup of faculties by sex, tenure status, and doctoral/nondoctoral degree in the different Groups. Table 3C indicates that the total number of full-time faculty in mathematics departments increased slightly (by 0.5%) from fall 1992 to fall 1993. Among all Groups, except Group III, significant increases were recorded in the numbers of nontenure-track, doctoral, full-time faculty. In mathematics departments this number increased by 8.3% (I+II+III+M+B entry). Table 3D indicates that women accounted for major portions of the increases in nontenure-track, doctoral, full-time faculty, except in Groups III, V, and B.

IV. Enrollment Profile and Undergraduate Majors

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

For mathematics departments (Groups I+II+III+M+B), Table 4A indicates that undergraduate course enrollments declined by 2.5% from fall 1992 to fall 1993. The graduate course enrollments declined by 1.4% over the same period. A comparison of Table 4B, which displays fall 1993 undergraduate enrollments distribution, with Table 4B from last year's Second Report, p. 608 of the July/August 1993 *Notices*, shows a similar pattern of enrollment distribution. A comparison of Table 4C based on the fall 1993 report and Table 4C based on the fall 1992 report in the July/August 1993 *Notices* shows some considerable decline both in undergraduate and total course enrollments per full-time faculty member for all of the Groups except: Group IV for undergraduate course enrollments, and Group V for total course enrollments. Graduate course enrollments per full-time faculty member remained essentially constant except for Groups IV and Group V where the ratio decreased significantly.

Table 4D reports a decline in both total number of junior/senior majors in mathematics departments (Groups I+II+III+M+B), and in number of women junior/senior majors from fall 1992 to fall 1993. The decline in the number of women junior/senior majors was over double the decline of the total junior/senior major population. Only Groups I and III reported increases in women majors.

V. Graduate Student Profile

Tables 5A through 5C summarize population statistics for graduate students gathered by the 1993 Departmental Profile Survey. Table 5A indicates that the total number of full-time graduate students in mathematics departments (Groups I+II+III+M) declined by 1% from fall 1992 to fall 1993 and declined in every Group except Group M. Table 5B data shows that the total number of women full-time graduate students in mathematics departments also declined (but by 2.8%) during the same interval and declined in all Groups except Group V. Table 5C indicates an increase of 2% in the total number of U.S. citizen full-time mathematics graduate students from fall 1992 to fall 1993, but only in Groups M and III were increases reported. Groups IV and V reported small decreases.

These three tables also show significant declines in first-year graduate students from fall 1992 to fall 1993 for all doctorate-granting departments. Running counter to these declines is the significant increase in first-year graduate students reported in all three tables for Group M (the relatively small response rate from Group M departments in-

Table 4A. Undergraduate and Graduate Enrollments (thousands), Fall 1993, and Percentage Change in Enrollments, Fall 1992 to Fall 1993

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	total
Number of undergraduate course enrollments (thousands)	166	174	296	637	66	18	589	720	2029
% change in undergraduate course enrollments	−1.4%	−0.1%	−6.4%	−3.5%	2.0%	−0.2%	−4.0%	0.6%	2.5%
Number of graduate course enrollments (thousands)	10	8	12	30	19	9	16	2	76
% change in graduate course enrollments	0.3%	−3.2%	1.7%	−0.1%	2.1%	−1.2%	−3.3%	−4.4%	−0.5%
Number of usable responses*	30 (77%)	34 (79%)	54 (60%)	118 (69%)	38 (50%)	13 (42%)	91 (35%)	376 (38%)	636 (41%)

* 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 only. All counts are projected from the survey response to the respective Group as a whole.

Table 4B. Distribution of Undergraduate Enrollments (thousands), Fall 1993

COURSES	GROUP							
	I	II	III	I+II+III	IV	V	M	B
Remedial mathematics* (thousands, %**)	18 11%	13 8%	34 12%	66 12%			102 17%	126 18%
Precalculus	22 13%	36 21%	75 25%	133 25%	1 1%	1%	104 18%	103 14%
1st-year Calculus (mainstream)	53 32%	37 21%	57 19%	147 19%		2 12%	75 13%	95 13%
1st-year Calculus (non-mainstream)	18 11%	22 12%	24 8%	63 8%	1 1%	1 4%	39 7%	34 5%
Statistics	1 1%	8 4%	19 6%	28 6%	60 91%	4 21%	53 9%	70 10%
Computer Science	2 1%		5 2%	7 2%	2 4%	1%	27 5%	75 10%
Other department courses for majors	28 17%	30 17%	40 13%	97 13%	1%	7 39%	75 13%	79 11%
Other undergraduate courses	23 14%	29 17%	42 14%	95 14%	2 3%	4 21%	114 19%	138 19%

* Arithmetic, high school algebra, geometry.

** Percents are "column percents" describing relative enrollments within the respective Survey Groups of the different types of undergraduate courses.

Table 4C. Undergraduate and Graduate Enrollments per Full-time Faculty Member, Fall 1993

	GROUP						
	I	II	III	IV	V	M	B
Undergraduate course enrollments per full-time faculty member	83	99	110	53	44	106	89
Graduate course enrollments per full-time faculty member	5	5	5	15	22	3	0
Total course enrollments per full-time faculty member	88	103	115	68	66	109	89

Table 4D. Undergraduate Junior/Senior Majors (hundreds) and Undergraduate Women Junior/Senior Majors (hundreds), Fall 1993, and Percentage Change in Majors, Fall 1992 to Fall 1993

	GROUP							
	I	II	III	IV	V	M	B	I+II+III+ M+B
Number of junior/senior majors (hundreds)	59	36	78	13	16	236	281	689
% change in junior/senior majors	0.4%	−7.6%	2.7%	−5.8%	−6.1%	−3.7%	−1.1%	−1.8%
Number of women junior/senior majors (hundreds)	22	14	36	4	5	105	122	299
% change in women junior/senior majors	1.2%	−10.0%	4.5%	−13.6%	−7.8%	−7.9%	−2.6%	−3.9%
Number of usable responses*	29 (74%)	34 (79%)	53 (59%)	37 (49%)	14 (45%)	84 (33%)	331 (33%)	531 (38%)

* 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.

creases the risk of bias in the projections for these three tables). The declines for the doctorate-granting departments are large enough to suggest a decline in the number of new doctorates three to five years hence. The extent of the decline will depend on next year's figure for first-year graduate students as well as possible changes in the next three to five years in the rate of attrition from doctoral programs.

Acknowledgment

The Annual AMS-IMS-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 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-IMS-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. Elizabeth 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.

Table 5A. Full-time Graduate Students, Fall 1993, and Percentage Change in Graduate Students, Fall 1992 to Fall 1993

	GROUP							
	I	II	III	I+II+III	IV	V	M	I+II+III+M
Total number of full-time graduate students	3615	2499	3749	9863	3278	1742	3917	13780
% change in full-time graduate students	–3.1%	–6.1%	–0.7%	–3.0%	–0.3%	–1.2%	4.5%	–1.0%
Number of first-year graduate students	800	667	1136	2602	887	330	1737	4339
% change in first-year graduate students	–10.3%	–3.7%	–7.0%	–7.2%	–19.8%	–15.2%	14.7%	0.5%
Number of usable responses*	30 (77%)	34 (79%)	55 (61%)	119 (69%)	39 (51%)	16 (52%)	83 (32%)	202 (47%)

* 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 1993, and Percentage Change in Women Graduate Students, Fall 1992 to Fall 1993

	GROUP							
	I	II	III	I+II+III	IV	V	M	I+II+III+M
Total number of full-time women graduate students	839	715	1263	2816	1271	417	1514	4330
% change in full-time women graduate students	–3.6%	–8.0%	–0.4%	–3.4%	–0.6%	0.3%	–1.8%	–2.8%
Number of first-year women graduate students	243	225	419	887	331	107	669	1556
% change in first-year women graduate students	–2.6%	1.1%	–3.0%	–1.9%	–28.6%	–1.8%	9.6%	2.8%

Table 5C. U.S. Citizen Full-time Graduate Students, Fall 1993, and Percentage Change in U.S. Citizen Graduate Students, Fall 1992 to Fall 1993

	GROUP							
	I	II	III	I+II+III	IV	V	M	I+II+III+M
Total number of full-time U.S. citizen graduate students	1777	1414	2306	5497	1682	868	2681	8178
% change in full-time U.S. citizen graduate students	–3.2%	–5.7%	0.6%	–2.3%	–0.9%	–1.4%	12.3%	2.0%
Number of first-year U.S. citizen graduate students	400	436	761	1598	485	187	1192	2790
% change in first-year U.S. citizen graduate students	–14.7%	0.3%	–5.3%	–6.5%	–26.8%	–17.5%	21.5%	3.7%

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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 1,000 and 2,500 words long. Readers are invited to submit articles for possible inclusion in Forum to:

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

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Fighting for Tenure: Another View

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In the March 1994 issue of the *Notices*, Allyn Jackson wrote an article, "Fighting for Tenure" [J], on Jenny Harrison's discrimination suit against the University of California at Berkeley. Jackson outlines the history of the case, drawing from earlier discussions, including Kirby's "A History and Critique of Virginia Harrison 'vs' UC Berkeley Math Department" [K], Selvin's *Science* magazine articles [S], and Blum's "Breaking the Silence" [B]. Jackson did an admirable job given the information she had. Here we provide relevant additional facts which did not appear in her report.

Some Facts

Prior to Jackson's article, most of the public information about the case had come from Harrison and her supporters. Jackson brings to light elements absent from their story. For example, she gives a detailed description of Harrison's "tenured" Oxford position [J], illuminating incomparabilities between the tenure systems at Somerville College and Berkeley. Here we cite another central example.

A major point of contention has been Harrison's work on the Seifert conjecture. The conjecture asserts that any continuous flow on the 3-sphere must have a periodic orbit or a fixed point. In 1970 Paul Schweitzer gave a counterexample [Sch, 1974]. Since his flow was C^1, attention focused on the possibility that the conjecture might be true for sufficiently smooth flows. Early in 1978 Harrison and Rourke informally announced a C^∞ counterexample. Shortly thereafter, Mike Handel showed that their construction could not possibly be better than C^2, although there was no philosophical reason why their construction could not yield a C^2 counterexample. Difficulties with the construction persisted. Only much later (1985) was Harrison's manuscript describing a C^2 countererexample accepted for publication [H, 1988, 1989]. In 1993 Krystyna Kuperberg gave a simple C^∞ (even analytic) counterexample, completing the story [Ku].

Despite the unsettled state of Harrison's work on the Seifert conjecture, her claims played an important role in her appointment to the tenure track at Berkeley in 1978 [K1, G, Sm]. In Chairman Kelley's letter to the dean recommending her appointment that spring, Harrison's work on the Seifert conjecture was explicitly mentioned.

Five years later, her work on the Seifert conjecture was still in a state of flux. According to David Gale, who was chairman of Harrison's midcareer review committee, her midcareer review (1983) stipulated that in order to get tenure, she would have to complete her C^2 counterexample work as well as produce a piece of research of roughly equal caliber. However, the combination of her C^2 Seifert counterexample along with her thesis was the cornerstone of her 1986 case for tenure.

There are murky references to the Seifert conjecture in the publicity surrounding the Harrison case that were never clarified by Harrison or her supporters. As an example, Brady Kahn in the *East Bay Express*, March 8, 1991, writes, "[Harrison] returned to Berkeley [in 1982], having achieved an 'important result' in her research, the proof of something called the 'Seifert Conjecture'." While the Seifert conjecture is mentioned many times in that long article, Schweitzer's name is never cited. The same remark applies to Morris Hirsch's letter to Provost Kuhi on June 16, 1986, presenting "new information" on the promotion case.

Threats and Intimidation

In the spring of 1986 the Berkeley Mathematics Department tenure committee, consisting of six faculty members including Morris Hirsch, voted 4 to 1, with 1 abstention, against tenure for Harrison. Subsequently, the department voted against tenure, 19 to 12. The only time the department has overturned its committee's recommendation for a tenured position has been in the opposite direction: it has denied an appointment even when the committee's recommendation was favorable. Usually votes that result in tenure are overwhelmingly positive.

On March 10, 1988, Harrison filed a complaint with the Academic Senate Committee on Privilege and Tenure (P&T) alleging improprieties in her tenure denial. The P&T Committee, composed of five faculty members including two women, investigated Harrison's allegations. Harrison was represented by counsel during the entire proceedings. After eighty hours of testimony from over twenty-five witnesses, it unanimously concluded that discrimination on the basis of sex did not play a role in the tenure denial. Within one day [of receiving the committee's report] Harrison filed suit against the university in the Alameda County Superior Court, charging sex discrimination.

The seventeen-page P&T report was not released by Harrison when it was issued (September 5, 1989) but has since become part of the public record. It is well worth reading [PT]. The report stated:

> We find it unfortunate that Dr. Harrison has concluded that anyone who does not believe that she warrants tenure is biased, and that he or she could not have a legitimate reason for a negative view and position.*

It is noteworthy that in its report, the P&T Committee felt compelled to comment specifically on "serious charges" made against seven faculty members at Berkeley. In all cases the committee found that Harrison's charges were not substantiated. Some seemed even frivolous. For example:

> Prof. Kobayashi is accused of bias for using the Citation Index when reviewing the record of Dr. Harrison, and for a comment about his daughter to the effect that "Oh, she should go get a job." The committee finds that it is Prof. Kobayashi's right to use the Citation Index; this information can be presented to others to interpret in any fashion desired—to support or to argue against a case. With regard to the statement about his daughter, we find nothing in it either by itself or within the context in which it was made that suggests bias against females.

In these times, accusations of sexual discrimination, intimation of sexual harassment, even casual charges of sexism are loaded and deadly serious. As the trial date approached, such tactics intensified. A letter from Harrison's attorney to the University Counsel (February 19, 1992) set the tone. It outlined Harrison's demand for settlement:

(1) Appointment to a tenured position as a full professor of mathematics...

(2) Payment of damages...in the amount of 1.5 million dollars....

It warned:

> Should this case go to trial, Professor Harrison will be able to demonstrate that certain members of the Mathematics Department refused to support granting her tenure for personal reasons having nothing to do with her qualifications.... In this regard this case demonstrates pure quid pro quo sex discrimination.

On March 16, 1992, Harrison's attorneys served notice on the Regents of the University of California of their intention to take deposition of twenty-two persons associated with UC Berkeley. A deposition is a pretrial procedure in which the attorneys are entitled to question potential witnesses under oath. It is sometimes used as a fishing expedition. Those called to deposition included administrators ranging from the dean up to the former chancellor of the Berkeley campus, and mathematicians such as John Neu, Shoshichi Kobayashi, Arthur Ogus, Ole Hald, Marc Rieffel, Michael Klass, Hung-Hsi Wu, Marina Ratner, Leon Henkin, Robion Kirby, Calvin Moore, John Addison, Steve Smale, and Lenore Blum. Several others, including Alexandre Chorin and Paul Chernoff, had been deposed earlier.

Steve Smale was one of the mathematicians served notice. Harrison had made an issue that Smale, one of the strongest proponents of her initial appointment, abstained in the department vote (e.g., see *The Los Angeles Times Magazine*, May 2, 1993). In response to a query about his abstention, Smale wrote (August 5, 1993):

> First, far more than most people, I tend to abstain if I don't have a very strong position on one side or the other. For example, I don't usually vote in elections.
>
> In the Harrison case I felt that there was not a strong case for promotion, based on what I knew of Harrison's work, what the letters of reference said, and what the department committee asserted. This decision to abstain took into account the fact that I had wanted the department to have more women professors.

And Smale was threatened in strongest terms. As he relayed (by e-mail, September 2, 1993):

> I spoke with Judy Keyes, the University lawyer, many hours about my scheduled deposition. At one point I recall her quoting Dan Siegel, Harrison's lawyer, that there would be "blood on the wall" at my deposition (if it were to take place).

After a series of postponements, Smale's deposition never took place.

The Settlement

During the latter part of 1992 Harrison and the university reached an out-of-court agreement. The centerpiece of the settlement was a new review for tenure.

The university's decision to settle was discussed by Blum in "Breaking the Silence". There she proposed that "the University could have won a court case on the specific issue as to whether or not there was discrimination in the Harrison case. What it probably could not have won, and of which the University administration was ultimately aware, would be the larger case in the public's mind: why are there so few women and minorities in the Math Department at Berkeley? The University just didn't want its track record in terms of women and minorities examined under a public microscope, which of course is what would have inevitably happened [B]."

However, on January 6, 1994, Provost Christ told Blum that her speculation on the reason to settle was mistaken. The provost identified "the precipitating factor" as fear of damages resulting from a personal allegation made by Harrison. This comment is consistent with remarks made during a meeting

*In Jackson's article, there was an omission from this quotation. The words "Dr. Harrison has concluded that" were left out, thus reversing the meaning of the sentence. *Editor's Note: this omission was noted in an erratum in the April Notices, page 312.*

held in August 1993 between the vice-chancellor and provost and a group of mathematics faculty including Gale, Rieffel, Ratner, and Kirby.

If Provost Christ is correct about the university's reason to settle, then the university seized on a convenient excuse both to divert attention from fundamental issues and to avoid defending its own tenure review process. Its eagerness to settle calls into question the legitimacy of the special review agreed upon in the settlement.

The structure and rules of Harrison's new review were to be kept secret as part of the agreement. However, some information about the review procedure was leaked to *Science*, and it appears in the various accounts of the case. In response to a request for verification from Kirby, Provost Christ (in e-mail, September 3, 1993) corrected one item, saying, "the committee was asked to judge Harrison's qualifications for tenure in '93, without regard to the number of years that it took her to complete her research and without reference to the '86 decision."

The "glowing" conclusion of the secret review committee report was provided to *Science* (15 October 1993, p. 325) by Harrison's lawyers [S]. We note that Hirsch, in a letter to the *Notices*, March 1994 [Hi], cited the *Science* article to substantiate his claims that the report of the 1993 review committee strongly suggested that tenure was justified in 1986, but he neglected to mention where *Science* got its information.

Harrison was appointed Full Professor Step I with tenure effective July 1, 1993.

We note the following:

1. The university upheld its earlier decision, asserting that Harrison's 1986 denial of tenure was not based on gender bias. Rather, she was denied tenure since her credentials at that time did not merit a tenure appointment.

2. However, the university asserted that in 1993 Harrison did merit a tenure appointment. In an article in *Science* (16 July 1993) Provost Christ remarked, "It's a win-win resolution . . . . We're all very happy [Harrison] was qualified in 1993."

At least one person asked to write a recommendation for the review process has taken issue with this statement. On September 2, 1993, this person wrote to the provost: "I have recently seen an article in the July 8 *San Francisco Chronicle* attributing to you the statement that Harrison did not meet the rigorous standard for tenure in 1986 but that she is qualified now. There is no basis for your statement in *my* letter; it certainly cannot be read to give her more recent work that much importance. I would be surprised if I were so far off the mark . . . . I am at a loss to understand what Berkeley standards are, and am under the impression that my opinions may have been solicited frivolously."

While we do not necessarily infer that this letter represents the conclusions of the secret committee, we do feel that it highlights the need for the university administration to account for their actions.

3. Attempts by members of the department to obtain documents and information supporting the review committee conclusion have been fruitless.

More Threats and Intimidation Follow the Settlement

Harrison now claims that she wants to end the fuss and get down to her new job. While this sentiment is laudable, Harrison's sincerity is brought into question by events subsequent to the tenure decision.

Harrison's supporters continued to make vague and unsupported allegations about members of the Math Department. For example, Hirsch wrote in a letter to the *San Francisco Examiner* on July 25, 1993:

> University administrators refused to even consider an out-of-court settlement until faced with the certainty that a trial would reveal some unpleasant facts about how the old-boy network functions. . . many of these facts came out anyway, embarrassing and upsetting members of the Math Department.

The result of the abrupt and secretly determined appointment, together with the public statements made by the Harrison camp, was an irate eruption in the Math Department. A barrage of angry e-mail "to all faculty" appeared from various writers. Perhaps the best-known example is an e-mail by Marina Ratner, an expanded version of which was sent to the editor of the *San Francisco Examiner*, July 25, 1993, and was subsequently republished in the March *Notices* [R]. Follow-ups to Ratner's letter by Alexandre Chorin, David Gale, Murray Protter, Robion Kirby, Marc Rieffel, and Andrew Casson appeared swiftly.

Last fall Harrison's lawyers asked the university to put an end to these exchanges or risk a lawsuit; the exchanges were referred to as "classical retaliation" by Harrison (*San Francisco Chronicle*, November 22, 1993). This touched off a new flurry, this time by faculty not involved in the earlier fray.

On November 23, Bill Arveson e-mailed his colleagues:

> Dear Colleagues:
>
> Yesterday's *Chronicle* ran yet another article on the Harrison case on page one of the Bay Area section. It's clear that, despite protestations to the contrary, there is a war in progress.
>
> Among other things, the article refers to an exchange of electronic mail messages relating to this appointment, and I quote: "Recently, Harrison's lawyer asked the university to put a stop to the campaign or risk a lawsuit."
>
> I want to put myself on record as opposing any attempt by the university or Harrison's lawyer to control the content of email messages that we send or receive. I will continue to exercise my own judgement in such matters. If the university or Harrison's lawyer attempts to restrict the content of our email exchanges, then I will publicly defy that order.
>
> Bill Arveson

Subsequently, Harrison wrote a letter to the department denying any intent to sue. However, a few weeks before the *San Francisco Chronicle* article appeared in November, Blum received a phone call from the university's lawyer. The latter conveyed (ultimately, to Blum's lawyer) the concerns of Harrison's lawyers that Blum was about to distribute

information about the deposition as well as the settlement review procedure.

Then on January 25 Marina Ratner received a call from the provost expressing concern, again in response to calls from Harrison's lawyers, about a brief postscript Ratner had submitted to the *Notices* of the AMS. The postscript, intended to accompany Ratner's letter about the Harrison case [R], referred to substantiating material such as the P&T report and stated that the interested reader could contact Ratner. The provost was concerned about the distribution of the P&T report (which by now has had worldwide circulation) [PT]. Ratner asked, "Why does the university continue to surrender to Harrison's threats?" to which the provost replied, "You do not realize what danger you are in." [R1] (Ratner's letter appears in the March 1994 *Notices* sans postscript.)

The conflict continues on the Berkeley campus. Recently, Harrison spoke at a conference organized by a women's group called the "Boundaries in Question Collective". A front-page article in the student paper, *The Daily Californian* (March 8, 1994), attributed to Harrison pejorative comments about Math Department faculty members. The article provoked a new round of e-mail protest. In a letter to the department and the paper, Harrison denied the quotations, saying she had just been describing "the standard profile of the typical academic harasser of students . . ." The organizers of the conference also wrote a letter to corroborate Harrison's story. However, the reporter, an eighteen-year-old woman who is an aspiring journalist, stands by her article. Moreover, her handwritten notes from the conference, which were presented to Harrison for review after the presentation, agree with the original article.

Conclusions

Although Harrison won her tenure case, the mathematical jury is still out. Ultimately her position in the mathematical community will be determined by her contributions, not by her Support Committee or by a review committee which cannot be held accountable for its conclusions.

However, the Harrison case touches on subjects which go well beyond the question of mathematical merit and which may not so easily come to light. We object to the suppression of information that has surrounded the Harrison case, settlement, review process, and tenure award.

1. Will the University of California at Berkeley, or more generally, the scientific community, accept that a university administration hire, tenure, and promote in secret? We do not.

2. The legacy of this secrecy is an angry, divided mathematical community. Negative repercussions have been felt throughout the university. Deeply affected is the group of female math graduate students at Berkeley for whom this case is a divisive issue. The murky circumstances surrounding Harrison's appointment may cast suspicion on the credentials of all women mathematicians. We know of at least one junior woman mathematician who applied for a tenure-track position in a prominent mathematics department and was told that the department would only hire a woman with tenure, since they feared a "Jenny Harrison" type lawsuit.

3. Some who have been touched by this case are afraid or unwilling to speak out. We know several of these first hand, and we know of no way to determine how many there are. It has been asserted by Hirsch and Jackson that the opposition to Harrison derives from a "vocal minority . . ." [Hi,J]. However, as time passes, increasing numbers of her colleagues have joined the vocal minority; examples have been given in this article. According to Marina Ratner, more than thirty members of the department have expressed their opposition in various ways. [R1]

4. Silence conspires to sanction unacceptable behavior. It would be tragic if young women today see the Harrison model as an acceptable, even praiseworthy, one to be cheered on and emulated. We sincerely hope not.

There Are Other Ways

The Association for Women in Mathematics has been promoting women mathematicians and their work for many years. A large cadre of women now have successful careers in mathematics. They serve as positive role models and mentors for younger women. This progress has been accomplished through the tremendous energy, enthusiasm, and hard work of many women in mathematics. We hope that this constructive approach will prevail.

References

[B] Lenore Blum, *Breaking the Silence*. Preprints of this article have been circulating in the mathematical community since September 1993, somewhat like a samizdat publication. Responses came from a broad spectrum of the community, often providing new corroborating information. Some of this information has been incorporated into a revised version, which may be obtained directly from Blum.

[G] David Gale, personal communication.

[H] Jenny Harrison, *C^2 counterexamples of the Seifert conjecture*, Topology **27** (1988), and *Denjoy fractals*, Topology **28** (1989).

[Hi] Morris Hirsch, response to Ratner's letter to the Notices Amer. Math. Soc., March 1994.

[HSC] In this article, when we speak of Harrison supporters, we refer to an activist subgroup around Charity Hirsch, the Harrison Support Committee chair.

[J] Allyn Jackson, *Fighting for Tenure*, Notices Amer. Math. Soc., March 1994.

[K] Robion Kirby, *A history and critique of Virginia Harrison 'vs' UC Berkeley Math Department*, September 1993, available from `math.berkeley.edu` by anonymous ftp or by gopher.

[K1] Robion Kirby, personal communication.

[Ku] Krystyna Kuperberg, *A C^∞ counterexample to the Seifert conjecture in dimension three*, preprint, 1993.

[PT] Report of the Committee on Promotion and Tenure, September, 1989, see Appendices in [K].

[R] Marina Ratner, letter to the Notices Amer. Math. Soc., March 1994.

[R1] Marina Ratner, personal communication.

[Sch] Paul Schweitzer, *Counter-examples to the Seifert conjecture and opening closed leaves of foliations*, Ann. of Math. **100** (1974).

[S] Paul Selvin, Science, July 16, 1993, and October 15, 1993.

[Sm] Steve Smale, personal communication.

The opinions, findings, conclusions or recommendations expressed in this article are those of the authors and do not necessarily reflect those of MSRI, ICSI, or BARRA.

April 1, 1994

Computers and Mathematics

Edited by Keith Devlin

This month's column

In the third of a series of articles on recent advances in TEX implementations, George Grätzer describes a new version of LATEX. Following that are two software reviews: Marvin Margolis looks at *Scientific Programmer's Toolkit* and Gustaf Gripenberg reports on *Converge*.

Susan Fishel then describes her experiences teaching with *Computational Laboratories in Number Theory*, a series of twelve labs designed to supplement the fifth edition of Ivan Niven's book *An Introduction to the Theory of Numbers*.

Finally, two of the developers of *Maple* correct some assertions made in the review of *Maple V* that appeared in this column in March of this year.

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Advances in TEX Implementations. III. A New Version of LATEX, Finally

George Grätzer*

Introduction

When I submitted my first article [2] to the Computers and Mathematics Column, Keith Devlin, the editor, asked for a hard copy. "I have $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX and LATEX, but I do not have $\mathcal{A}\mathcal{M}\mathcal{S}$-LATEX on my computer", he wrote. The mathematical community was split.

LATEX 2_ε has set out to unify it.

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Acknowledgments

As usual, I wrote a pretty crude first draft of this article, and I have gratefully received many useful suggestions to improve it. I would like to thank especially Barbara Beeton, Michael Doob, Frank Mittelbach, Craig Platt, Sebastian Rahtz, and Chris Rowley for their patience and advice.

The LATEX3 project

Leslie Lamport's LATEX documentation preparation system for mathematicians has been with us for about a decade [6]. Unfortunately, Version 2.09 has never progressed to Version 2.1. I guess Lamport decided that enough is enough.

It is well known in the mathematical community that a talented group of scientists/programmers (Frank Mittelbach, Chris Rowley, and Rainer Schöpf)—with Lamport's encouragement—formed the "LATEX3 team" with the aim of updating LATEX.

The goals of LATEX3 are very ambitious:

- The LATEX3 system will provide high quality typesetting for a wide variety of document types and typographic requirements.
- For editors and designers, it will support the direct formatting commands which are essential to the fine-tuning of document layout.
- It will process complex structured documents and support a document syntax that allows automatic translation of documents conforming to commonly used SGML document type definitions into LATEX documents—this syntax will therefore, for example, support the SGML concepts of "attribute" (or "named argument") and "short reference", in such a way that these can be easily linked to the corresponding SGML features.

See [7]—from which the above goals are quoted—for a complete statement of goals (and 34 references) and [8] for a progress report (and 24 references). See also the directory `ltx3pub` at the `ftp` site `niord.shsu.edu` for articles and reports describing the work on LATEX3.

A number of projects have already been completed that will be (in functionality, if not in code) part of LATEX3, including the following:

The New Font Selection Scheme. LATEX uses the Computer Modern fonts of Donald Knuth. In LATEX, the "size-changing declarations specify roman style, regardless of the

style currently in effect. For large bold letters, you must type `\large \bf` *not* `\bf \large`." (Quoted from [6].) In 1989 Frank Mittelbach and Rainer Schöpf coded the New Font Selection Scheme (NFSS) which allowed the *independent changing* of font attributes. NFSS also makes it easy to integrate new font families into LaTeX. With the spread of PostScript fonts and PostScript printers (see [4]), more and more users would wish to do just that.

$\mathcal{A}\mathcal{M}\mathcal{S}$-TEX as a LaTeX option. For the AMS, Michael Spivak has developed a large set of macros, $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX, for typesetting complicated multiline mathematical formulas. Romesh Kumar, Frank Mittelbach, and Rainer Schöpf (with the assistance of Michael Downes) recoded $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX so that it will work as a LaTeX option.

Theorems with style. Theorem-like structures in LaTeX all appear in the same style, whether it is the Main Theorem or a lowly Comment. Frank Mittelbach and Rainer Schöpf coded a sophisticated scheme that allows theorem styles to be specified (the meaning of the theorem styles is to be defined in the document stylesheet).

New and improved environments. Improved `verbatim` and `comment` environments by Rainer Schöpf, and a new multicolumn environment by Frank Mittelbach.

The first interim solution: $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX

In 1990 the AMS released $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX. This release contains $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX recoded as a LaTeX option, the NFSS, the styles for theorem-like structures, and the new `verbatim` environment.

While the LaTeX3 team wants to unify the mathematical community, this first attempt has further split it. Many $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX users have stayed with $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX. And now even the LaTeX community is split into the users of the old LaTeX and those whose LaTeX includes the NFSS (the latter group includes the $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX users).

The second interim solution: LaTeX 2_ε

When it became obvious that the many goals of LaTeX3 could not be fulfilled soon, the LaTeX3 team decided to issue a new standard version of LaTeX, named LaTeX 2_ε, to replace LaTeX Version 2.09 until the release of LaTeX3 (see [10] and [11]). LaTeX 2_ε was released in the spring of 1994, with periodic updates twice a year to fix bugs. LaTeX Version 2.09 will not be supported after the release of LaTeX 2_ε.

LaTeX 2_ε will reunify the LaTeX community.

A test version of LaTeX 2_ε was released in December of 1993. In this article we briefly review how to get it, install it, and use it. (This article was tested with the release of February 14.)

Where to get it?

You find the files of LaTeX 2_ε at the Comprehensive TEX Archive Network (CTAN) sites: `ftp.shsu.edu` (U.S.), `ftp.tex.ac.uk` (U.K.), and `ftp.dante.de` (Germany). Here is how you get them with "anonymous ftp":

```
ccu\% ftp ftp.shsu.edu
Connected to PIP.SHSU.EDU.
220 pip.shsu.edu FTP server
   (Version 2.1aWU(1))
Fri Aug 20 14:31:05 CDT 1993) ready.
Name (ftp.shsu.edu:gratzer): anonymous
331 Guest login ok, send your complete
e-mail address as password.
Password:
230 Guest login ok, access restrictions apply.
ftp> cd /tex-archive/macros/latex2e/core
ftp> prompt
ftp> mget*
```

(Of course, you should type your e-mail address as password—this will not be visible on your screen.) This will transfer a large number of files (currently 65), which you can then download to your personal computer.

The CTAN sites support subdirectory compression on-the-fly; if you are in the directory `latex2e`, the commands

```
ftp> binary
ftp> get core.tar.Z
```

transfer the LaTeX 2_ε files as a compressed packed directory. Read about this feature with the command

```
ftp> get README.archive-features -
```

The CTAN sites are undergoing some reorganization. If you cannot find a file, say, `unpack2e.ins`, issue the command

```
ftp> quote site index unpack2e.ins
```

and you will be given a list of directories where the file is available.

Setting up LaTeX 2_ε

It is easiest to place all these files into the TEX input folder/directory. Make sure that `hyphen.tex` is there also, and run `Initex` on the file `unpack2e.ins` (`ins` stands for "install")—on a Mac running *Textures*, typeset `unpack2e.ins` with *Virtex*. Be patient; lots of new files are being created (currently 77). One of the new files is `latex2e.ltx`; running `Initex` on it (on a *Mac* running *Textures*, typeset `latex2e.ltx` with *Virtex*) creates the LaTeX 2_ε format file. Place the format file in the appropriate directory/folder, and you are ready to use LaTeX 2_ε. (If in the meanwhile the name of the `unpack2e.ins` file has been changed, read the `readme` file for the new name.)

Using LaTeX 2_ε

It could not be simpler: take any LaTeX document, and LaTeX 2_ε will typeset it. This was one of the design criteria for the LaTeX3 team: complete backwards compatibility of LaTeX 2_ε.

How does LaTeX 2_ε achieve this? A LaTeX Version 2.09 document is recognized as one that starts with the line

```
\documentstyle{article}
```

(or another stylesheet name, with or without options). When LaTeX 2_ε reads this line, it goes into "compatibility mode" and acts as if it were LaTeX Version 2.09.

I tested this with a number of documents—some large, some small—and the compatibility mode worked flawlessly. Of course, LaTeX 2_ε was not designed to be used in this mode, which is slower than LaTeX Version 2.09. But it is reassuring to know that we do not need to modify the thousands of old LaTeX documents, or keep LaTeX Version 2.09 around just so we can still typeset them.

Change

```
\documentstyle{article}
```

to

```
\documentclass{article}
```

and you now have a real LaTeX 2_ε document. In

```
\documentclass{article}
```

`article` refers to the file `article.cls` (before, it was LaTeX Version 2.09's `article.sty`). Carry out this change in a LaTeX document, typeset, and see what happens.

In the very first article I tried, I ran into a problem: the article used the box (2) symbol, and it caused the error message

```
LaTeX error.  See LaTeX manual for
explanation.
 Type  H <return>  for immediate help. !
Command \Box not provided in base NFSS.
\@latexerr ...e \errmessage {#1}
            \endgroup   l.219 ...ly from
Lemma 3.  $\Box
                                  $  ?
```

The error message indicates that the math symbol `\Box` (which is part of LaTeX) is not in standard LaTeX 2_ε. I would suggest that you always include

```
\usepackage{latexsym}
```

(right after the `\documentclass` line) to avoid this problem. With this minor change, all the test articles have been typeset perfectly as LaTeX 2_ε documents.

New features

The file `features.tex` in the LaTeX 2_ε distribution describes briefly the major new features of this release. It states that "The introduction of a new release also made it possible to add a small number of often-requested features."

First we notice, of course, the change from

```
\documentstyle{article}
```

to

```
\documentclass{article}
```

In addition, both of these commands now allow an optional parameter, release date. Additional macro packages (formerly called "style options") can be included with `\usepackage`. `\newcommand`, `\renewcommand`, `\newenvironment`, and `\renewenvironment` now allow the user to define a command/environment with an optional argument. There are also a number of new and enhanced commands for boxes, floats, measurements, and pagebreaks.

A cute new command is `\ensuremath`. Suppose you want to define a shorthand for $\alpha^2 + \beta$. If you define it as

```
\newcommand{\ab}{\alpha^2 + \beta}
```

then this works in math mode, but not in text. If you define this as

```
\newcommand{\ab}{$\alpha^2 + \beta$}
```

then this works in text, but not in math mode. The usual trick is to define it as

```
\newcommand {\ab}{\mbox{$\alpha^2 + \beta$}}
```

and then it works both in text mode and math mode. The problem is that `\mbox` will not properly change size in subscripts, fractions, etc.

In LaTeX 2_ε you can define this macro as follows:

```
\newcommand{\ab}{\ensuremath{\alpha^2 +
\beta}}
```

Now `\ab` will work correctly in all contexts. ($\mathcal{AMS}$-LaTeX users are familiar with this feature; instead of `\mbox`, $\mathcal{AMS}$-LaTeX provides `\text` which changes size properly. The command `\text` is available also in LaTeX 2_ε with the macro packages `amstex` and `amstext`.)

`features.tex` lists eight more pages of commands for programmers and writers of LaTeX packages. Of greater importance to the average user is the NFSS.

Font changing commands

The NFSS has gone through three stages. NFSS (now called NFSS1) was the first version; this was a part of $\mathcal{AMS}$-LaTeX. The next version, NFSS2, was released for testing with LaTeX Version 2.09. The final version is the one in LaTeX 2_ε.

Although the three versions differ in some detail, they agree on the basic principle: a *font* is defined in terms of four basic attributes, *shape* (normal, italic, etc.), *series* (weight and width, as in Bold Extended), *size* (say, 14 pt with an 18 pt baseline), and *family* (such as Computer Modern or Times); and these four basic attributes can be *independently* changed.

In LaTeX 2_ε, all the two-letter LaTeX font-changing commands have been replaced by longer, more descriptive, commands. `\rm` is now `\rmfamily`, `\bf` is `\bfseries`, and so on. All are now also available as commands with arguments: `\textrm{ }`, `\textbf{ }`, `\emph{ }`, which also automatically insert italic corrections when required. The font-changing commands for math follow the same pattern: `\mathrm{ }`, `\mathcal{ }`, and so on.

The most significant change from NFSS1 to NFSS2 was to require font encoding schemes for font definitions. NFSS2 supports a number of encoding schemes, including the (256-letter) Cork encoding.

Using PostScript fonts

We illustrate with two examples the ease with which PostScript fonts can now be used.

The Times font and *MathTime*

As our first example, we step through the process of incorporating the Times font into a LaTeX 2_ε document to replace the Computer Modern text font, and, optionally, of using the *MathTime* math symbol fonts to replace the Computer Modern math italic, math symbol, and math extension fonts.

Step 1. Install the Times PostScript font and the TeX font metric file for the Times font. (*Textures* has the Times TeX font metric file built into the application.)

Step 2. Get the files `psfonts.ins` and `psfonts.dtx` (written by Sebastian Rahtz) from one of the LaTeX 2_ε distribution sites (see Section 5). Use the `quote site index` command to find them. At present, they are in the subdirectory

`/tex-archive/macros/latex2e/contrib/supported/psnfss`

Copy them into your TeX input directory/folder. Typeset `psfonts.ins` with the LaTeX 2_ε format file. This will produce the `sty` (style) and `fd` (font definition) files for the standard PostScript fonts—the `fd` files are utilized by the style files. The Times files are called `times.sty` and `OT1ptm.fd` (`OT1` is the old TeX font encoding scheme, `p` is PostScript, `tm` is Karl Berry's name for the Times font).

Step 3. If you use a Mac with *Textures*, there are two more files by Sebastian Rahtz you have to get: `macnames.ins` and `macnames.dtx`. Typeset `macnames.ins` with the LaTeX 2_ε format file. (Step 2 *has to follow* Step 1.)

Now if you want to use the Times font as the default text font, specify

```
\usepackage{times}
```

after the `\documentclass` line. This is all.

Alternatively, you may not wish to change the default text font, but you want occasionally to use the Times font, then

```
{\fontfamily{ptm}\selectfont
 This is typeset in the Times font.
 }
```

will typeset "This is typeset in the Times font." in the Times font. The text preceding and following will not be affected. The same is achieved by

```
\fontfamily{ptm}\selectfont
 This is typeset in the Times font.
\normalfont
```

The command `\normalfont` restores the default text font.

Take a look at a mathematical article with the Times text font. The Computer Modern math symbols look too thin. Michael Spivak modified the CM math symbols to work well with the Times font (and other PostScript fonts); he named these modified fonts *MathTime*. (You can purchase the *MathTime* fonts from Y&Y, 508-371-3286.)

Step 4. Install the *MathTime* PostScript font and the TeX font metric file for the *MathTime* fonts.

Step 5. Get the files `mathtime.ins` and `mathtime.dtx` (written by Aloysius G. Helminck) from the same distribution site and subdirectory as in Step 2. Copy them into your TeX input directory/folder. Typeset `mathtime.ins` with the LaTeX 2_ε format file. This will produce the file `mathtime.sty` and some `fd` files.

Now if you want to use the Times font as the default text font and the *MathTime* as the default math symbol fonts, specify

```
\usepackage{times,mathtime}
```

after the `\documentclass` line.

LucidaBright fonts

In our second example, we step through the process of replacing the Computer Modern fonts with *LucidaBright* fonts (both text and math fonts) in a LaTeX 2_ε document. (You can buy the *LucidaBright* fonts from Y&Y, 508-371-3286.)

Get the files `lucida.ins` and `lucida.dtx` (by Sebastian Rahtz) from the `psnfss` subdirectory. Copy them into your TeX input directory/folder. Typeset `lucida.ins` with the LaTeX 2_ε format file. This will produce the `lucbr.sty` file (and some others).

Now after the `\documentclass` line, add

```
\usepackage[yy]{lucbr}
```

It is that simple.

The `yy` option is necessary for the *LucidaBright* package from Y&Y.

$\mathcal{A}\mathcal{M}\mathcal{S}$-TeX and $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX with LaTeX 2_ε

So does LaTeX 2_ε unify $\mathcal{A}\mathcal{M}\mathcal{S}$-TeX, $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX, and LaTeX? Yes, it does . . . or it will pretty soon. Under LaTeX 2_ε, $\mathcal{A}\mathcal{M}\mathcal{S}$-TeX is a macro package invoked by the command:

```
\usepackage{amstex}
```

$\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX is invoked by the stylesheet `amsart.cls` (which automatically loads `amstex`). Of course, `amsart` and `amstex` were written for NFSS1, so they needed a rewrite. This was done by Frank Mittelbach for NFSS2; the modified files are available in the directory

`/tex-archive/macros/latex/distribs/nfss2`

in the archives listed in Section 5. There is only one problem: there were some small internal changes from NFSS2 to

LaTeX 2_ε. So either wait for an update in these archives, or wait until the AMS comes out with $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX Version 1.2 (which may be available by the time you read this article).

New books

LaTeX 2_ε is within ε of LaTeX Version 2.09 from a user's point of view. So to use LaTeX 2_ε, you need a working knowledge of LaTeX Version 2.09 and nothing more.

The most popular introductory book to LaTeX is Leslie Lamport's [6]. A new edition of this book is planned for the first half of 1994.

To complement the introductory LaTeX books, Michel Goossens, Frank Mittelbach, and Alexander Samarin's brand new *The LaTeX Companion* [1] was published to coincide with the test release of LaTeX 2_ε. "This companion is a detailed guide through the visible and not-so-visible beauties of LaTeX. As such, it is a comprehensive treatise of those points not fully discussed in Leslie Lamport's LaTeX: *A Document Preparation System*. Extensions to basic LaTeX, as described in that book, are discussed, so that the LaTeX book, together with this companion, provide a ready reference to the full functionality of the LaTeX system." (Quoted from the preface of [1].)

Who should buy this book and why? There may be many reasons for buying this book (including that 50% of the royalty helps fund the LaTeX3 project), but the following stand out for me:

- Any user who wants to use NFSS and PostScript fonts (Chapters 7 and 11).
- Users interested in the two best-known programs to complement LaTeX, namely, *MakeIndex* (Chapter 12) and BibTeX (Chapter 13).
- Multilingual and non-English language users (Chapter 9).
- Users who want to learn the details of tabular material (Chapter 5), floats (Chapter 6), and portable graphics (Chapter 10).
- Experts who want to change the shape and structure of sectioning commands and the table of contents (Chapter 2), and the layout of the page (Chapter 4).
- Experts who want to write macro packages (the whole book, but especially Chapter 14 and Appendix A).
- Finally, this book is our only source for the documentation of a large number of macro packages. Since these packages already existed for LaTeX Version 2.09, this book is useful also for LaTeX Version 2.09 users.

Who should not buy this book? Any beginner wanting to learn LaTeX 2_ε. This book is definitely not meant for beginners, although even beginners may enjoy reading some sections, for example, the excellent introduction to fonts (Section 7.2). As a rule, however, a beginner should pick up an introductory LaTeX book and venture into [1] only when quite at home in LaTeX.

To switch or not to switch

The most important question for the working mathematician is whether (and when) to switch from LaTeX Version 2.09 to LaTeX 2_ε. The "whether" is easy to respond to: of course, everybody should switch. But when? If you use LaTeX Version 2.09 for your everyday work, switch

- when you need a new package (e.g., `amstex`) or stylesheet (e.g., `amsart`) provided only in the new format;
- if you need to use PostScript fonts;
- if you have to design a complex document format (say, a book) and need the assistance of [1] to accomplish it;
- when the AMS releases Version 1.2, if you are an $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX user;
- when LaTeX 2_ε is really stable (when you would switch for the unity of LaTeX users).

References

[1] Michel Goossens, Frank Mittelbach, Alexander Samarin, *The LaTeX Companion*, Addison-Wesley, Reading, MA, 1994.

[2] George Grätzer, $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX, Notices Amer. Math. Soc. **40** (1993), 148–150.

[3] _____, *Advances in TeX implementations*. I. *PostScript fonts*, Notices Amer. Math. Soc. **40** (1993), 834–838.

[4] _____, *Advances in TeX implementations*. II. *Integrated environments*, Notices Amer. Math. Soc. **41** (1994), 106–111.

[5] _____, *Math into TeX. A simplified introduction using* $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX. Birkhäuser, Boston, 1993.

[6] Leslie Lamport, LaTeX: *A document preparation system*, Addison-Wesley, Reading, MA, 1985.

[7] Frank Mittelbach and Chris Rowley, LaTeX 2.09 → LaTeX3, *TUGboat* **13** (1992), 96–101.

[8] _____, *The LaTeX3 project*, submitted to the Euromath bulletin, April 1993.

[9] _____, *The LaTeX3 project; Report* 1991–1992.

[10] _____, LaTeX 2_ε—*A new version of* LaTeX, TeX and TUG NEWS, **2** (1993), 10–11.

[11] _____, LaTeX3 *in* '93, TeX and TUG NEWS, **3** (1994), 7–11.

Reviews of Mathematical Software

Scientific Programmer's Toolkit

Reviewed by Marvin S. Margolis*

A short description

The *Scientific Programmer's Toolkit*, Turbo Pascal Edition, comes in a box containing software on floppy disks and a ring-bound manual. The collection of mathematical, graphical, and utility and user-interface routines combines to make an integrated software library of programming tools. The authors copyrighted the *Toolkit* (software and manual) in 1991 to provide a framework for writing Turbo Pascal language programs in the mathematics area.

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What kind of program is it and who might use it?

The *Toolkit* includes the following mathematical routines: solution of equations, maxima and minima, fitting curves to data, integration, ordinary differential equations, and Fourier transforms. A second set of mathematical routines for linear algebra covers: solution of linear equations, matrix eigenvalues, matrix decomposition, and least squares data fitting. The *Toolkit* includes graphic routines at two different levels to draw curves, surfaces, and other graphic demonstrations.

The authors adapted many of the mathematical routines from *Computer Methods for Mathematical Computations*, by Forsythe, Malcolm, and Moler (Prentice-Hall, 1977). The *Toolkit* includes the standard numerical analysis routines authors often present in a numerical analysis text: the bisection method for finding roots of algebraic equations, the Newton-Raphson Method, Gaussian elimination, the method of least squares, Romberg integration, the fourth-order Runge-Kutta method for solving ordinary differential equations, and many other mathematical routines.

Designed for use with Turbo Pascal, the *Toolkit* disks contain two types of programs: those executable at once (present as `.EXE` files and ready for execution), and those one must compile before running (present as `.PAS` files and containing Pascal source code). To save space, the authors store the larger Pascal files in a compilable but unreadable form and provide a program that formats them into standard readable form.

Consultants, researchers, and students in any quantitative science, profession, or technology can potentially learn from the *Toolkit*. It provides a Pascal software environment for anyone writing programs in mathematical, engineering, or science areas.

Who developed the *Toolkit*?

The *Toolkit*'s three authors helped found the CIText Group: Dr. M. H. Beilby, a lecturer and director of the Centre for Computer-based Learning at the University of Birmingham; Dr. R. D. Harding, the assistant director of research in the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge; and Dr. M. R. Manning, a computer officer at the Department of Applied Mathematics and Theoretical Physics, University of Cambridge.

What does one need to run the *Toolkit*?

The software needs DOS-based IBM and compatible personal computer hardware. The hardware and software requirements resemble those Turbo Pascal for DOS needs. The *Toolkit* manual states the software will run on single- and double-drive floppy disk systems, although I did not test that claim. I only tested the program on a hard disk system.

The authors recommend that *Toolkit* users have Turbo Pascal version 4.0 or later. Since Turbo differs from ISO Pascal, if a programmer uses a Pascal compiler other than Turbo for DOS, he or she will probably have to adapt the *Toolkit*'s Level 0 routines. Like Turbo Pascal, the *Toolkit* extensively uses units, that is, libraries of precompiled Pascal routines. For example, I had no problems with the *Toolkit*'s units in DOS-based Turbo Pascal, but I did when I tried to run them in *Turbo Pascal for Windows*. The *Toolkit* authors assume users already know Turbo Pascal basics, and they do not attempt to teach Pascal from the beginning.

Acquiring the *Toolkit*

You may order 5.25- or 3.5-inch disks and, for an additional price, all the *Toolkit*'s source code. Multiple purchasers earn a discount. In the U.K. and rest of the world, buyers can order the *Toolkit* from:

IOP Publishing (Institute of Physics)
Customer Services Department
Techno House
Radcliffe Way
Bristol BS1 6NX
UK

IOP publishes the manual under the Adam Hilger imprint. In the U.S.A. and Canada, the publisher charges $180.00 for the package. North American buyers can order from:

IOP Publishing
c/o AIDC
64 Depot Rd.
Colchester, VT 05446
USA

Phone 800-488-2664 in the U.S.A. and Canada.

My experience

Before receiving the *Toolkit* for review, I had never used nor seen it. I also had never used a mathematical package designed for use only with a specific programming language. The IMSL FORTRAN routines are more extensive and expensive. I have used symbolic manipulation mathematical packages, such as *Derive*, *Maple*, and *Mathematica*, and other mathematical packages such as *Mathcad*. According to the catalogue included with the *Toolkit* package, the company does not make *Toolkit*s available in other computer languages.

Main features

The programs and routines fall into three categories: screen text and graphic, mathematical, and utilities and user-interface. Cutting across the categories, the authors further subdivide the routines into three levels, Levels 1 through 3. Level 3 requires the least user experience with the Turbo Pascal language, while Level 1 requires the most.

Level 3 consists of complete, ready-to-run, stand-alone programs. Already compiled, they require no user programming effort and run without any compiler. Users can incorporate Level 2 "off-the-peg" routines in their own programs with a minimum of fuss. Level 1 gives the programmer more control over his or her program by decomposing a task such as function plotting into many component tasks.

Level 0 routines ("primitives") are the underpinnings of the higher levels. They interface to the machine operating

system and graphics drivers. If the programmer were to implement his or her code on another computer or Pascal system, the programmer only needs to change parts of the Level 0 routines.

The *Toolkit* includes example Pascal programs, and many manual sections refer to relevant example programs. The authors sometimes illustrate several *Toolkit* features in one example. They designed the *Toolkit* so that a user stores the examples in an `Examples` directory with subdirectories that accord with the manual chapters.

How does it compare?

As far as I know, the *Toolkit* is unique because users can buy the complete source code for the program. Of the competing commercial software of which I am aware, none makes their source codes available even for a price. I judge from past software reviews in this column that many mathematicians place a high value on the ability to alter a program's source code. The *Toolkit*'s mathematical capabilities clearly do not compare with those of higher-priced competing programs; however, the *Toolkit* provides more than a set of mathematical routines; it also helps the user learn how to program in depth in a specific programming language.

Interaction

Level 3 use: Suppose I want to plot a single-valued function with no programming involved. I switch to the **tk** directly and run the **tk** object program. From the opening menu bar, I select the Tools pull-down menu. In that menu, I select the command `plot curve`. From a second pull-down menu, I select `y=f(x)` from among many choices. The program opens one window to graph the function and a second window for the user to specify the function and its parameters. After I finish specifying the function and selecting the parameters, the parameter window disappears. Then the program draws the graph in color and a third window opens, giving me many choices as to what to do next (print, save, repeat, go to main menu, etc.).

Level 2 use: I must write a Turbo Pascal program, compile, and run it. I can easily write the program, since I will probably base it on an already-provided example program. The *Toolkit* also provides me with units containing variable types, procedures, functions, and practically anything else I need to do a mathematical operation. If, for example, I want to graph a function, then I use the *Toolkit*'s Cit_draw unit in my program. My plotting program will need no more new information than the nature of the specific function and its parameters that I want to graph.

Good and bad

By using the *Toolkit*, I learned many Pascal features that I previously did not know. At my university, freshmen computer science students learn Pascal in their first programming course. They can take advantage of the *Toolkit* in sophomore or later quantitative courses. Using it, professors of mathematics, the sciences, and other quantitative fields can show students that the programming language the students learned as freshmen has direct use in several quantitative fields.

The increasing pace of change in commercial software continues to amaze me. In the *Toolkit* manual, the authors say nothing about Borland International's newest Pascal version, *Turbo Pascal for Windows*. Possibly *Turbo Pascal for Windows* became available in the United States before the *Toolkit* did, even though the *Toolkit* has the earlier copyright date. Since the authors designed the *Toolkit* for DOS-based versions of Turbo Pascal, they devote considerable effort to creating innovative "windows". Borland-based *Turbo Pascal for Windows* is based on the Microsoft *Windows* idea of a "window". Since I am neither a professional Pascal nor Microsoft *Windows* programmer, I can only guess at the differences in the two window designs. I could not decipher how to convert the *Toolkit* window routines so that they would run in *Turbo Pascal for Windows*. The transition may require exactly the kind of windows programming in *Turbo Pascal for Windows* that the authors were trying to save the user from in the first place. In any case, the *Toolkit*'s authors could improve *Toolkit* routines to make them compatible with *Turbo Pascal for Windows* and object-oriented programming.

Serious bugs?

In my rush to load the program, I got the floppy disks out of their correct order. As a result the installation program put the *Toolkit* files in my main directory instead of creating and installing them in a *Toolkit* directory. The programs worked anyway, and I consider this annoying but not a serious bug. I did not encounter serious bugs.

The documentation

Chapter 1 of the manual helps the user to discover "what to use to do what". It explains the Pascal concept of units, how to use them, and what units are provided in the *Toolkit*. In Chapter 3 onwards, the authors describe the units, each chapter dealing with one or more. Chapter sections deal with groups of related routines. The sections contain specifications of how to call each routine and a listing of examples of programs using the routines.

I found the 438-page manual easy to read, informative, and always helpful. The *Toolkit* also includes on-line documentation files and the ring-bound manual, which lays flat on a table.

Will I continue using the *Toolkit*?

No. In my work, I do symbolic manipulation mathematics more than anything else; however, if I wanted to learn Turbo Pascal in depth, I would continue to use the *Toolkit*. I highly recommend it to anyone simultaneously learning applied mathematics and the Pascal language for the first time.

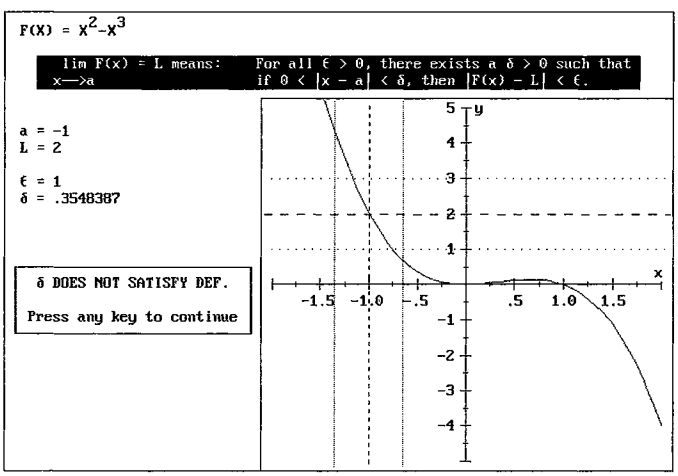
Converge

Reviewed by Gustaf Gripenberg*

Converge is a program to be used as an aid in teaching and learning calculus. It requires nothing more than a standard PC computer (no coprocessor or 386 needed) and works well with most types of displays, but requires almost 4M bytes of hard disk space.

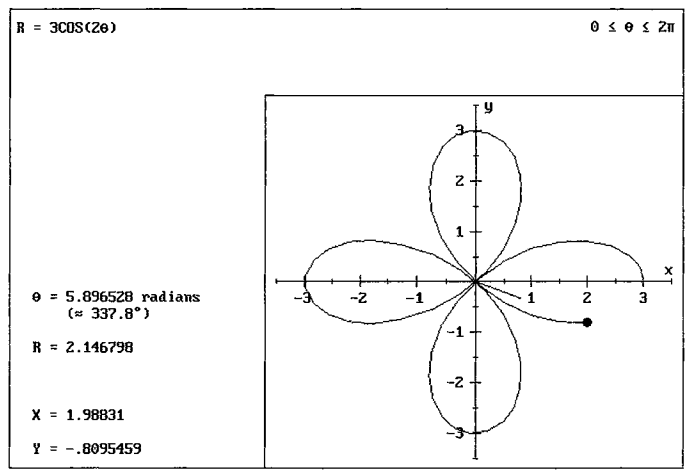
It is a menu-based program. In the usual configuration, the screen is divided into a graphics window and a text part. To some extent, the user can modify this setup, but the default is, on the whole, quite satisfactory. There is an accompanying 164-page manual in addition to the on-line help function. Some parts of the program can be used without looking at the manual; but to get other things to work in an optimal fashion, a close study of the manual may be in order. The main menu includes Graphing, Calculus, and Algebra/Trigonometry, with submenus that contain most subjects included in a standard calculus course. There is, though, a certain rigidity in the program so that, for example, the variables used in polar coordinates must be R and θ (written ALT-T) and not something else one may have become used to.

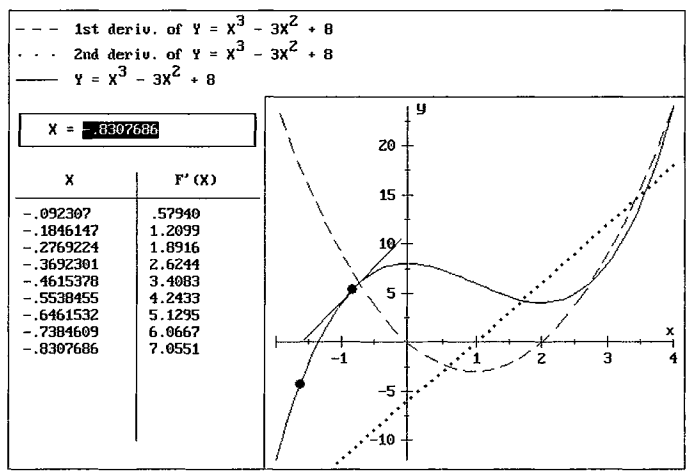
I have not had the opportunity to use *Converge* as a teaching aid, but it seems to be quite an attractive tool. Students may gain a lot of insight into key concepts by using *Converge* and going through all the steps in the process of arriving at a result. On the other hand, it is not a program to be used for "serious" computations, and therefore I don't think students will in the long run gain much from mastering the program itself. For example, if one is going to use other systems as well, there is not much point in getting used to writing AB instead of $A * B$. But if you want to illustrate almost any basic concept in calculus, you can find convenient tools in *Converge* that would be often difficult, although not impossible, to program in some other system.



An example of one very nice feature is a graphical application of the $\epsilon - \delta$ definition of continuity in which one can choose different values for ϵ and δ and see in the graphics window if δ is sufficiently small. In addition, the program can say if it believes this to be the case or not. The necessary zooming must be done by hand, however, but the method is very convenient.

The graphing speed can be slowed down so that one can better follow what is happening, and there is also a possibility to freeze the graphing and proceed with one point at a time. This can be a particularly attractive feature when looking at a function and its derivative or plotting a function given in polar coordinates.





Three-dimensional graphs may be a little tricky, but *Converge* works quite well for them too.

The program includes a matrix calculator, which is quite appropriate for an elementary introduction to linear algebra; and although (for example) the procedure for doing Gaussian elimination in a matrix is very nice, the limitations of *Converge* become very obvious at this point.

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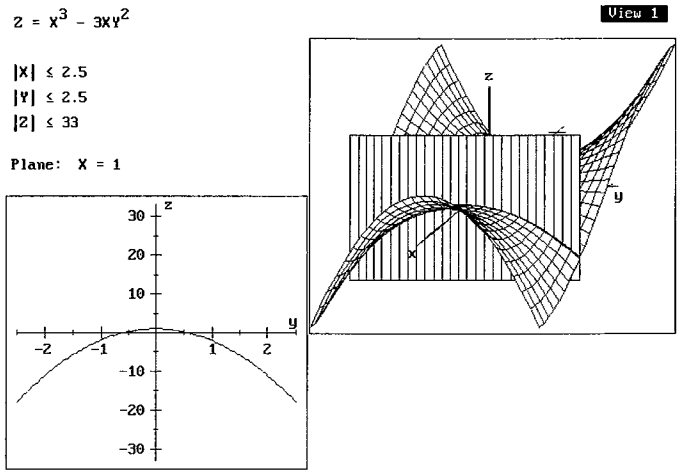

Macros can be recorded, function files used when drawing graphs and the screen saved, and graphics exported into PCX files for further processing or inclusion in documents. In addition there are a great number of other options and possibilities that make the use of *Converge* more convenient and effective.

There are five different types of licenses for *Converge*, and the software is available from JEMware, The Kawaiahao Plaza Executive Center, 567 South King Street, Suite 178, Honolulu, Hawaii 96813-3076.

Computational Laboratories in Number Theory

Susanna Fishel*

Computational Laboratories in Number Theory, by Hugh L. Montgomery, is twelve labs designed to supplement the fifth edition of *An Introduction to the Theory of Numbers*, by Ivan Niven, Herbert S. Zuckerman, and Hugh Montgomery. The twelve labs use 58 programs, all but two of which use algorithms discussed in the text. The text is intended for a first course in number theory, for upper-level undergraduates or beginning grad students, although a course which uses the book could be constructed for freshman.

Several of the labs develop material which is new to this edition. For example, the sections on public key cryptography, pseudoprime tests, and Pollard rho factorizations are new, and there are labs on these topics.

The programs are written in Borland's Turbo Pascal Version 5.5, running under DOS on IBM PC-compatible machines. I ran the programs on a 386 PC. I needed a math coprocessor to do a few of the labs, but completed most of them without one. There are three types of programs in the supplement. The "Tab" programs, which present tables of data; the "Dem" programs, which demonstrate calculations; and what I think of as the quickie programs, which perform specific calculations without showing their work. Lab 3, "Powers and Factorials (mod m)" requires students to use programs of all three types and is fairly representative of the whole group of twelve labs.

The first program introduced in Lab 3, *PowerTab*, lists all the powers of a (mod m). In the first five (out of thirteen) problems the user is asked to make conjectures, based on data from this program. There are questions about the order of a (mod m), the order of $p-1$ (mod p), and the order of ab, given the order of a and the order of b, among others. This works quite well here. There is enough guidance in the manual, and it is reasonable to believe the user will discover theorems. For example, the second question is:

> The least positive integer h such that $a^h \equiv 1 \pmod{m}$ is called the *order of a modulo m*. Use PowerTab to determine the order of a for each residue class a (mod 11). What orders occur? How many times do they occur? What is the least common multiple of these orders? Repeat this with 11 replaced by some other prime number. Formulate conjectures regarding the situation for a general prime modulus.

PowerTab is easy to use—there is a menu at the bottom of the screen so that the base and the modulus can be quickly changed. There are several other "Tab" programs used in the labs. *FacTab* lists smallest prime factors, *FctrlTab* lists factorials (mod m), *IndTab* lists the indices of the reduced residue classes (mod p), *JacobTab* lists the values of the Jacobi symbol, *QFormTab* lists values of quadratic forms, and *ArFcnTab* lists the values of six arithmetic functions. Throughout the twelve labs, students are asked to make conjectures using the "Tab" programs.

Lab 3 next discusses algorithms for calculating a^k (mod m). *PwrDem1a*, *PwrDem1b*, and *PwrDem2* demonstrate a faster method than the obvious $k-1$ multiplications of residue classes. The faster method, using the binary expansion of k, is discussed in the text. What follows are the calculations from *PwrDem1b*, given $a = 2$, $k = 33$, and $m = 7$.

For clarity, as the calculation is performed, all exponents are displayed in binary. The desired exponent is

$$\begin{aligned} k &= 33 \text{ (decimal)} \\ &= 100001 \text{ (binary)} \end{aligned}$$

$$\begin{aligned} 2^1 &= 2^1 \\ &\equiv 1 \bullet 2 \\ &\equiv 2 \pmod{7} \end{aligned}$$

$$\begin{aligned} 2^{10} &= 2^1 \bullet 2^1 \\ &\equiv 2 \bullet 2 \\ &\equiv 4 \pmod{7} \end{aligned}$$

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$$\begin{aligned} 2^{100} &= 2^{10} \bullet 2^{10} \\ &\equiv 4 \bullet 4 \\ &\equiv 2 \pmod 7 \end{aligned}$$

$$\begin{aligned} 2^{1000} &= 2^{100} \bullet 2^{100} \\ &\equiv 2 \bullet 2 \\ &\equiv 4 \pmod 7 \end{aligned}$$

$$\begin{aligned} 2^{10000} &= 2^{1000} \bullet 2^{1000} \\ &\equiv 4 \bullet 4 \\ &\equiv 2 \pmod 7 \end{aligned}$$

$$\begin{aligned} 2^{100000} &= 2^{10000} \bullet 2^{10000} \\ &\equiv 2 \bullet 2 \\ &\equiv 4 \pmod 7 \end{aligned}$$

$$\begin{aligned} 2^{100001} &= 2^{00001} \bullet 2^{100000} \\ &\equiv 2 \bullet 4 \\ &\equiv 1 \pmod 7 \end{aligned}$$

$2^{33} \equiv 1 \pmod 7$

The "Dem" programs appear throughout the twelve labs, performing the calculations step by step. Other examples are *CRTDem*, for the Chinese Remainder Theorem, and *SPSPDem*, for strong probable pseudo prime testing. There are many more. *Power*, which computes $a^k \pmod m$, is an example of the quickie type of program.

Question 7, Lab 3 introduces using Fermat's congruence as a method for proving a number is composite without actually factoring it. Next, Lab 3 discusses factorials. In question 10, the user is led to conjecture Wilson's Theorem and its corollaries by eyeballing the tables in *FctrlTab*. Question 11, about $k(m)$, the least positive integer k such that $k! \equiv 0 \pmod m$, is sort of vague. We are asked to determine $k(m)$ for several m and interpret our findings, but I found no obvious patter.

Later labs develop ideas introduced earlier. For example, Lab 5 follows up on the idea that Fermat's congruence can be used as a method for proving a number is composite; however, it is not necessary to do Lab 3 before Lab 5, as long as the prerequisite material in the text has been covered.

I think these labs and programs are well executed and a good idea. Reading about public key cryptography in Section 2.5 of the book and then decoding messages in Lab 6 was a delight. If the labs are assigned just before the corresponding material in the text, students discover theorems on their own. Usually, the manual gently points out patterns in the "Tab" programs, and the student has to figure out the pattern, write down the conjecture, and then prove it. Sometimes counting numbers with a certain property by pointing a pen at the computer screen got irritating; but if I had had a printer, this could have been avoided.

The demonstration programs clearly explain algorithms and calculations. The first few labs and parts of the later ones could be done by most math majors with little guidance. The rest of the labs are pretty challenging. The conjectures are trickier to prove, but always fun, and they should be manageable for grad students or sharp undergraduates.

Some labs have problems that begin "For the programmer". Since the Pascal code comes with the supplement, it is possible to modify the programs; and there are questions which ask the user to do this.

If you are using *An Introduction to the Theory of Numbers*, the manual and the program may be obtained by anonymous ftp from `ftp.math.lsa.umich` in the subdirectory `/pub/clint`. The command `type binary` must be given before getting the file `tpprgms.exe`. The other files in the directory should be transferred as ASCII files. If you are unable to obtain the files this way, write to Mathematics Editor, John Wiley & Sons, 605 Third Avenue, New York, NY. Once the programs are on the hard drive, type `tpprgms`. A directory called "run" will be created. You must be in this directory to run the programs. The manual is made up of four TEX files and will run on any system equipped with TEX software.

Reference

[1] Ivan Niven, Herbert S. Zuckerman, and Hugh L. Montgomery, *An introduction to the theory of numbers*, Fifth Edition, Wiley & Sons, New York, 1991.

Commentary on *Maple V* Review

Chris Howlett and Michael Monagan*

We at Waterloo Maple Software read with interest the review of our *Maple V* product, published in your March 1994 *Notices*. We appreciate the positive comments by the reviewer, John A. Crow.

However, the reviewer appears to have been under a misconception regarding extremely important features of *Maple V* Release 2. Specifically, he complained that for monitor displays, "symbols needed are constructed from standard keyboard characters," and suggests that "it would be a nice touch . . . to . . . display its typeset version." Indeed, it would be nice. But *Maple V* Release 2 introduced this facility, for graphical display devices. The reviewer was reviewing

*Chris Howlett is director, Research and Development, and Michael Monagan is *Maple* research associate at Waterloo Maple Software.

"maple" rather than "xmaple" on a Unix workstation. The difference is that "maple" is designed for text-only display devices, i.e., for users who do not have access to a graphical user interface. The "xmaple" interface of *Maple* is designed for Unix users with access to a workstation running the X Windowing system. In the reviewer's evaluation environment, he would have enjoyed "typeset" symbols for integration, sums, products, limits, Greek characters, and so on had he used "xmaple".

Here is the difference. In "maple" the output of the integral on page 199 looks like

```
Pi / ||f(x) cos(m x) dx |/ 0
```

In "xmaple" it looks like

$$\int_0^{\pi} \mathrm{f}(x)\cos(m\,x)\,dx$$

Here is how the differential equation example in the review would have looked in the "xmaple" user interface.

```
eqns := diff(x(t),t) + x(t) =
a*y(t), diff(y(t),t) = b*x(t)-y(t);
```

$$eqns := \left(\frac{\partial}{\partial t}\mathrm{x}(t)\right) + \mathrm{x}(t) = a\,\mathrm{y}(t), \frac{\partial}{\partial t}\mathrm{y}(t) = b\,\mathrm{x}(t) - \mathrm{y}(t)$$

```
fncs := {x(t),y(t)}:
```

```
Sol := dsolve( {eqns, x(0)=1, y(0)=0},
fncs );
```

$$Sol := \left\{\mathrm{x}(t) = \frac{1}{2}\mathrm{e}^{((-1+\sqrt{ab})t)} + \frac{1}{2}\mathrm{e}^{(-(1+\sqrt{ab})t)},\ \mathrm{y}(t) = \frac{1}{2}\frac{b\,\mathrm{e}^{((-1+\sqrt{ab})t)}}{\sqrt{ab}} - \frac{1}{2}\frac{b\,\mathrm{e}^{(-(1+\sqrt{ab})t)}}{\sqrt{ab}}\right\}$$

Note, these new "typesetting" facilities were also available on the Macintosh and the PC (under Windows), and now, at the time of this writing, the NeXT.

The reviewer decided not to review *Maple*'s graphical user interface. We believe that the user interface is important for anyone who is going to actually use the system. One important feature of the *Maple* graphical user interfaces that was not mentioned in the review is *Maple*'s worksheet facility (in *Mathematica*, worksheets are called notebooks). This is extremely important in a teaching environment. You need some medium for submitting the work done by a student for an assignment to an instructor for grading. You also need some medium for presenting your work done to other people. This is what worksheets are for. Worksheets can be printed or saved in a file and sent by electronic mail to your colleagues or your students—an assignment perhaps. What you are reading was written as a *Maple* worksheet.

Please be aware that since the time the review was written, we have begun shipping a new major release of *Maple*, *Maple V* Release 3. Among the many enhancements in Release 3 is a new facility in the area of typesetting mathematics with *Maple*—the ability to export entire *Maple* worksheets to LaTeX. This document is a *Maple* worksheet that has been converted to LaTeX and sent to the editor in this format.

There are many new mathematical enhancements as well. We would like to show one example from the many improvements to ODE's that would be of interest to your readers. In the last few years, there has been considerable progress towards finding effective algorithms for solving analytically ODE's of arbitrary order. Here solving means finding a Liouvillian solution if one exists. A Liouvillian function is an elementary function or an integral of a Liouvillian function. For example, the exponential integral, Ei(n,x), is a Liouvillian function, but the Bessel functions are not. Implemented in *Maple V* Release 3 is an algorithm of Manuel Bronstein that finds rational and exponential solutions of an ODE. Here is a nice example

```
ode := (20*x^2-40*x^3+6*x+16*x^4-32*x^5+3)*
  y(x)+(44*x^3-15*x+48*x^5-3)*
  diff(y(x),x)+(-16*x^5-26*x^2-24*x^4+9*x)*
  diff(y(x),x$2)+(-4*x^3+6*x^2+8*x^4)*
  diff(y(x),x$3);
```

$$\begin{aligned} ode :=\ & (20x^2 - 40x^3 + 6x + 16x^4 - 32x^5 + 3)\mathrm{y}(x) \\ & + (44x^3 - 15x + 48x^5 - 3)\left(\frac{\partial}{\partial x}\mathrm{y}(x)\right) \\ & + (-16x^5 - 26x^2 - 24x^4 + 9x)\left(\frac{\partial^2}{\partial x^2}\mathrm{y}(x)\right) \\ & + (-4x^3 + 6x^2 + 8x^4)\left(\frac{\partial^3}{\partial x^3}\mathrm{y}(x)\right) \end{aligned}$$

```
dsolve( ode, y(x) );
```

$$\mathrm{y}(x) = \_C1\,\mathrm{e}^{x} + \_C2\,\mathrm{e}^{x}\mathrm{Ei}(1,-x) + \_C3\,\mathrm{e}^{x}\int e^{(x^2)}\sqrt{x}\,dx$$

Inside the AMS

Magid and Small Announce Retirement as Associate Secretaries

Robert M. Fossum,
AMS Secretary

Andy Magid, associate secretary for the Central Section, and Lance Small, associate secretary for the Western Section, have announced that they will retire from their positions as associate secretary at the conclusion of their terms, which in both cases is January 31, 1996. Magid and Small have each served as associate secretary for their respective sections since January 1, 1988.

Magid, from the University of Oklahoma in Norman, will have organized his last annual meeting with the San Francisco meeting in January 1995. In addition, he will have been in charge of sixteen sectional meetings, several summer Mathfests, and several annual meetings. During his term as associate secretary, he has also served as chair of his department. He has been instrumental in seeing that innovative elements of the scientific program have been introduced into sectional meetings. His influence in the Central Section will extend well beyond his term of office, as he has scheduled meetings into 1997. Magid will continue to serve the Society as an associate editor on the *Notices* Editorial Committee.

Andy Magid and Lance Small in Jerusalem. (Photo by Lynne Small.)

Small, from the University of California, San Diego, has also served the Society with distinction during his term as associate secretary. He too will have organized sixteen sectional meetings, several summer meetings, including the Joint AMS-CMS-MAA Meeting in Vancouver, British Columbia, in August 1993, and several annual meetings. Small has been influential in arranging the joint meeting planned with the Israel Mathematical Union in May 1995. Small will continue to serve the Society in many ways. Currently, in addition to his duties as associate secretary, Small is serving as chair of the Graduate Studies in Mathematics Editorial Committee.

The Society is beginning a search for replacements for Magid and Small. A search committee, chaired by John Polking, Rice University, has been appointed by the Executive Committee and Board of Trustees (ECBT). Its recommendations will go to the ECBT, which will then forward the recommendations to the Council for final appointment for a two-year term beginning on February 1, 1996. The Society wishes to have replacements appointed by the Council that meets in January 1995 so that the individuals who will be serving as associate secretaries in these sections will have at least a year to familiarize themselves with the duties involved.

Applications and nominations for the positions as associate secretary in the Central and Western Sections of the Society are encouraged and welcomed. They can be sent to: John Polking, Department of Mathematics, Box 1892, Rice University, Houston, TX 77251-1892, e-mail `polking@rice.edu`; or to AMS Secretary, Robert M. Fossum, Department of Mathematics, 1409 West Green Street, University of Illinois, Urbana, IL 61801, e-mail `rmf@math.ams.org`. It is expected that the final appointments will be made by the January 1995 Council. Applications and nominations should be submitted by October 1, 1994.

Committee on Education

Ronald G. Douglas, chair
SUNY at Stony Brook

At its April 1994 meeting, the Committee on Education looked at a range of issues pertaining to the Society's involvement in education, including some new ideas for undergraduate activities, the status of educational activities at the National Research Council (NRC), getting representation of research

mathematicians in educational reform groups, and plans for a study on evaluating teaching.

Undergraduates at the Summer Institutes

The Committee on Education discussed having an undergraduate component to the AMS Summer Research Institute. David Cox of Amherst College, a member of the subcommittee on undergraduate education, has prepared a draft proposal describing such an activity at the Summer Institute on Algebraic Geometry, to be held in 1995 in Santa Cruz. The plan is to submit a proposal to the National Science Foundation (NSF) for an REU (Research Experiences for Undergraduates program) situated at Santa Cruz, where the REU would overlap with the Summer Institute. After trying it in this particular case, the AMS could then proceed in the future based on the experience. It would be similar in some ways to the NSF's Regional Geometry Institutes, but in this case the location would change.

The Status of MSEB

The Committee had a rather lengthy discussion about the Mathematical Sciences Education Board (MSEB) of the NRC. Lynn Steen, executive director of MSEB, brought the Committee up to date on what has happened with the NSF funding for education at the NRC and on the restructuring of the educational mission of the NRC. There are some uncertainties as to exactly how MSEB fits into that restructuring and what MSEB will look like in the future.

The NRC educational activities started with MSEB, which has been in existence almost a decade. The NRC's Coordinating Council on Education (CCE) came into existence four years ago. Bruce Alberts, the new head of the NRC, has been reassessing and reorienting NRC activities. As a result, there is now the question of whether all NRC educational activities will take place under the CCE and what identity or role MSEB will have. In addition, the NSF, a key player in financing educational activities at the NRC, has also been reconsidering how it wants to fund education there. These reconsiderations have led to a lot of uncertainty about the future of MSEB. To provide more time for these deliberations, the Committee on Education endorsed a plan whereby the three societies (AMS, MAA, and SIAM) would contribute limited funds to MSEB to help keep it operational until the summer.

In addition, the Committee on Education has written a letter to Bruce Alberts, President of the National Academy of Sciences expressing strong support for MSEB and pointing out its many accomplishments. The letter urges that, in its restructuring, the NRC maintain some means of carrying out the kinds of activities MSEB does. The letter does not try to tell the NRC what to do, but it tries to make clear the positive benefits of MSEB and what is needed to continue them.

Researchers in the Education Arena

The Committee discussed the new Assessment Standards of the National Council of Teachers of Mathematics (NCTM) now being prepared. AMS President Ronald Graham had contacted Mary Linquist, president of NCTM, to discuss how to get appropriate research mathematicians involved with the committee developing the new NCTM assessment standards. Lindquist was receptive to the idea, so the Committee on Education discussed who might play that role. More generally, it was decided that the Committee should assume responsibility for identifying research mathematicians who can interact effectively in the education arena. Often national groups would like representation from the research community, but they do not know to whom to turn. The Committee on Education plans to act as a "broker" in this way. It will seek representatives from the community who hold a broad spectrum of opinions while also identifying people able to work constructively with educational groups.

Evaluating Teaching

Following up on a key issue in the recent study on professional recognition and rewards conducted by the Joint Policy Board for Mathematics, the Committee on Education endorsed the idea that the four societies sponsor a study of evaluation methods. The main question the new study would look at is, How do you evaluate teaching? Here teaching includes not just what happens in the classroom, but also student advisement, curriculum development, work with students on individual projects, etc. Many groups are calling upon universities and colleges to make teaching more important, but there is little consensus on how to evaluate teaching. If decisions about tenure and salary are to rest on such evaluations, then there must be confidence, particularly on the part of the faculty, that the evaluation methods work. The study should take into account what is being done in other disciplines and other studies. However, what is appropriate in mathematics might be a little different, and I doubt that what is currently being done will suffice. That may be a place to start, but more has to be done.

At this point, the Committee on Education recommended to the ECBT and other groups within the AMS that the Society should participate with MAA, SIAM, and AMATYC in such a study. However, it is possible that the Committee will have a bigger role in the study, through a subcommittee or through overlapping membership with the study committee.

Education as Part of the AMS

My goal for the current meeting of the Committee was to "clear the decks"—to pick up the topics that the Committee has considered for a while and to either decide on some action and get it moving or to set them aside and perhaps consider them later. If we could not agree on some sort of action on a particular item, then it was assigned to a group to work on between now and the next meeting in September.

A substantial part of the AMS community remains skeptical of educational initiatives. However, that group now comprises a much smaller percentage than it has in the past. As proof, one need only look at the discussions during the AMS Council meeting in Cincinnati in connection with the National Policy Statement. The part of the statement that was the most controversial was the part dealing with educational issues. There was a lot of debate; many raised objections;

many said that the AMS shouldn't be worrying about education. But when all was said and done, the majority of the Council voted to approve it.

The AMS is primarily a research organization. But there is a big difference between being "primarily" and being "exclusively" a research organization. Education is an important component of Society activities. First, there is the domain of graduate education and postdoctoral programs, where the AMS clearly has a role to play. Second, there is a great deal happening in education reform, and, to be effective, it requires the involvement of those people who comprise the community best represented by the AMS. A large amount of mathematics education occurs at the universities, which is where most of these people teach. These people also train most of the future mathematics faculty who will end up teaching at colleges and universities. And they prepare large numbers of high school and junior high school teachers. In addition, society sees mathematics education as being of critical importance. For all these reasons, it would be very unwise for a large part of the community to cut itself off from these important endeavors. The Committee on Education is attempting to bring into focus the appropriate role for the AMS in education.

The Committee on Education welcomes input and suggestions from the community. Comments may be sent to: Ronald G. Douglas, E3350 Main Library, SUNY at Stony Brook, Stony Brook, NY 11794-3391; e-mail `rdouglas@sunysb.edu`.

Annual Report of the Secretary

Robert M. Fossum, Secretary

Introduction

Calendar Year 1993 found the Society engaged in many international activities, considering new paradigms of funding, facing serious employment problems in the profession, and continuing its efforts to affect an efficient and responsive governance. This report is meant to highlight some of these activities during 1993. The Society attempts to keep its members well informed of its activities through the *Notices*, and most of what is reviewed below has appeared throughout 1993.

The Council

The Council of the Society met three times during 1993: once at the Annual Meeting in January in San Antonio, once in April at an Eastern Sectional Meeting in Washington, DC, and once during the Joint International Meeting in August in Vancouver, BC.

Reports of these Council meetings have appeared in these *Notices*. A review of the minutes reveals a broad spectrum of actions taken on topics that represent many areas of concern to the mathematical community.

The Council continued its efforts to strengthen the governing structure of the Society by addressing the committee structure, the nominating and election process, and the duties of the Society's officers and staff.

The Council established a Committee on Science Policy in 1974. This remained the only committee that was devoted to the study and recommendation of policy until the Council established the Committee on Education in 1990. In 1993 the Council created three more policy committees: the Committee on Meetings and Conferences, the Committee on the Profession, and the Committee on Publications. These five committees are charged to provide major direction to the Society in these five areas that have been identified as the major thrusts of the mission of the Society.

In particular, these committees are to provide advice to the leadership and make recommendations on Society policy, to provide long range views in their areas, to conduct reviews of Society activities in their areas, to report regularly to the membership, and to coordinate with other professional organizations.

The Council determined the membership of these committees so as to represent the leadership, the Board of Trustees, the Council, and the members-at-large of the Society. All new committees were appointed and were in full operation by the end of the calendar year.

The Council discussed the procedures for the Nominating Committee. It modified them only slightly in order to guarantee efficient and essential communication between the Council and the committee. The Council did resolve that residency in North America was not a prerequisite for candidacy for election to positions in the Society or membership on committees of the Society. It also adopted approval voting for election to the Nominating Committee and the Editorial Boards Committee (in place of the single transferable ballot used previously).

The Council addressed the duties of the officers of the Society, codifying those of the president, vice-presidents, secretary, treasurer, and the executive director. Some of these actions require amendments to the bylaws, which will be put to the members in the pending election.

[It can be noted here and will be mentioned elsewhere that in this 1994 election ballots and envelopes for domestic members will appear in the September issue of the *Notices*, while foreign members will receive their voting material by regular mail.]

At the January 1993 meeting in San Antonio, the Council joined with the Board of Governors of the Mathematical Association of America in recommending that the Annual Meeting scheduled to be held in Denver, Colorado, in January 1995 be moved to another state because of actions taken by the electorate in Colorado in the November 1992 election. The Colorado voters adopted an amendment to the Colorado constitution that prohibits the inclusion of sexual orientation in state and municipal antidiscrimination clauses. The reasons for this Council action have been discussed in past issues of the *Notices*. Interested readers are welcome to peruse these articles and letters. [This amendment has been temporarily suspended by court action.] The January 1995 Annual Meeting has been rescheduled to be held in San Francisco in early January 1995.

The Council considered ethical guidelines and procedures

for its Committee on Professional Ethics. One question concerning procedures for this committee was whether the Council wished to adopt rather strict operational procedures or wished to stay with an informal "ombudsman" form of consideration of cases which are referred to the committee. Also the Council grappled with the question of whether it wished to adopt guidelines for ethical conduct as policy of the Society. Proposed guidelines have been published in recent issues of the *Notices*, and members are asked to send comments to the leadership.

In May 1993 the National Research Council's Board on Mathematical Sciences dissolved the United States National Committee for Mathematics (USNCM) and established itself as the USNCM while it considered the role the USNCM should play and how it should be constituted and appointed. The Council reacted quite strongly to this action by requesting that the USNCM be reinstated. The role of the USNCM within the U.S. mathematical community is being considered by several organizations. The USNCM is the principal U.S. liaison with the International Mathematical Union, that international body that organizes the International Mathematical Congresses. Because the Society is becoming increasingly involved with mathematical policy throughout the world, the means by which international mathematical relations are conducted is quite important to the Society and its members. International activities are mentioned later in this report.

Meetings and Conferences

The meetings and conferences organized and sponsored by the Society represent a principal benefit to the members and a huge effort on the part of the staff and leadership. For this reason, the Council established the Committee on Meetings and Conferences (COMC) as one of the five policy committees. One of the principal activities of the Committee on Meetings and Conferences will be to monitor the current offerings of meetings, conferences, and institutes, and to recommend enhancement when necessary.

There are many components of the meetings and conferences offerings. The Society is continuing to become involved with international meetings. Its smørgåsbord of conferences and institutes has always been recognized as a very important aspect of the research life of mathematicians. The sectional meetings provide the venue for members to meet with colleagues and friends in a congenial atmosphere conducive to informal conversations and collaboration. The Annual Meeting and MathFest provide a national platform for the dissemination of mathematics, and they give members the opportunity to see current developments in all aspects of their mathematical life.

The Committee on Meetings and Conferences established a task force to study the Society's menu of conferences and institutes. This task force will report sometime this year. COMC is also working closely with the associate secretaries and secretary (the Secretariat) to enhance the annual and sectional meetings of the Society.

International Meetings

The Society joined in cosponsorship of three international meetings during 1993.

The Summer Meeting of the Society was held during the period 15–19 August in Vancouver, BC, together with the Canadian Mathematical Society and the Mathematical Association of America. The five-day International Joint Mathematics Meetings in Vancouver attracted over 1,200 registrants. It was held on the beautiful University of British Columbia campus. The meeting was highlighted by many joint activities. There was one joint AMS-CMS-MAA Invited Address by Barry Mazur, who spoke on *Fermat's Last Theorem*. There were five Joint AMS-CMS Invited Addresses and six Joint AMS-CMS Special Sessions. The AMS sponsored a Colloquium Lecture Series delivered by Sergiu Klainerman, who spoke on *On the regularity properties of gauge fields in Minkowski space-time*; two Progress in Mathematics Lectures, one each by Armand Borel and Avner Friedman; and eight Special Sessions.

The first Joint International Meeting sponsored by the Deutsche Mathematiker-Vereinigung e.V. (DMV) and the AMS was held in Heidelberg, Germany, in the period 01–03 October. There were six Invited Addresses, eleven Special Sessions, and sessions for contributed papers. Over 400 registrations were recorded for this meeting. The Society and its members owe many thanks to the officers, members, and staff of the DMV and the University of Heidelberg for the efforts expended in order to insure the success of this meeting.

The AMS and the Sociedad Mathemática Mexicana (SMM) sponsored a joint International Meeting in Merida, Mexico, in the period 01–04 December 1993. There were six Invited Addresses, nine Special Sessions, and several workshops. Over 300 mathematicians attended the meeting. The officers, staff, and members of the SMM and the faculty and staff of the University of the Yucatan were excellent hosts, insuring an impressive mathematical program and a wonderful meeting.

The SMM also invited the AMS to send two distinguished members to give Invited Addresses at their Congress in October 1993. Richard Tapia and Jean Taylor attended the Congress as guests of SMM and representatives of the AMS.

Sectional Meetings

During 1993 there were seven sectional meetings of the Society, at which twenty-eight Invited Addresses and numerous Special Sessions and sessions for contributed papers were held. Three of these meetings were held in conjunction with the MAA. The total deficit for these sectional meetings was over $20,000, about $3,000 for each meeting. These deficits are covered by the general funds of the Society. This is mentioned here in order to show the members that registration fees do not cover the expenses of these sectional meetings.

Abstracts

Abstracts appear to be an important component of meetings. During 1993 the Meetings Department of the AMS handled

3,275 abstracts for eleven meetings and by title. Of this total, 47 percent were submitted electronically.

Annual Meeting

The Annual Meeting of the Society was held jointly with MAA in the period 13–16 January in San Antonio, Texas. A total of 3,545 mathematicians registered for the meeting. There were 1,204 abstracts for papers to be presented at the meeting.

There were four Joint AMS-MAA Invited Addresses, three Joint AMS-MAA Special Sessions, and a joint AMS-MAA Prize Session, at which the AMS and the MAA awarded their prizes.

The Sixty-sixth Josiah William Gibbs Lecture, entitled *Fluid dynamics and fiber architecture of the heart and its valves*, was presented by Charles S. Peskin. Luis A. Caffarelli presented the series of three Colloquium Lectures on the subject *Nonlinear differential equations and Lagrangian coordinates*. There were six Invited Addresses and twenty-three Special Sessions.

Other Meetings and Conferences

The Society sponsored its annual AMS Summer Research Institute. In 1993 the topic was *Stochastic Analysis*, organized by Michael Cranston, Richard Durett, and Mark Pinsky. The Institute was held at Cornell University, Ithaca, NY.

The Arnold Ross Lecture Series was held on April 30, in conjunction with Math Awareness Week, at the Ohio State University. The lectures were given by Ronald L. Graham and Karl Rubin.

The Society cosponsored, with the Society for Industrial and Applied Mathematics (SIAM), the twenty-third Summer Seminar in Applied Mathematics at Mount Holyoke College, South Hadley, MA, during the period 7–18 June. The topic was *The mathematics of tomography, impedance imaging, and integral geometry.*

The Society, together with SIAM and the Institute for Mathematical Statistics, sponsored the twelfth series of Joint Summer Research Conferences in the Mathematical Sciences. These were held on the campus of the University of Washington, Seattle, WA, during the period 11 July to 6 August.

The Society sponsored a symposium on *Mathematics of Computation* 1943–1993; *A half century of computational mathematics* at the University of British Columbia, Vancouver, BC, during the period 9–13 August.

Together with SIAM and the Society for Mathematical Biology (SMB), the Society cosponsored the twenty-seventh annual Symposium on Some Mathematical Questions in Biology. The symposium entitled *Theories for the evolution of haploid–diploid life cycles* was held on June 23 in Snowbird, Utah, in conjunction with the annual meeting of the Society for the Study of Evolution.

The AMS helped to support mathematical sciences activities at the American Association for the Advancement of Science (AAAS) by contributing to the sponsorship of speakers in mathematical symposia it cosponsors with AAAS.

The AMS also joined with the Mathematicians Education Reform network (MER) to sponsor three workshops during the year: one in March in Berkeley, one in July in Ann Arbor, and one in November in Troy, NY.

The Profession

The Society continues to study the employment situation, which is one of the most serious problems facing the profession at this time. The Committee on the Profession, which was appointed late in 1993, has considered many proposals that attempt to deal with the situation. Since it had met only once before the end of 1993, it had not had time to address this problem directly.

The Society jointly sponsors the Joint Committee on Employment Opportunities. This committee has a data subcommittee that has collected data on the profession for many years. The reports of the Data Committee appear frequently in the *Notices* and will not be reviewed here.

Society efforts in this area will be more evident as the Committee on the Profession becomes an active committee.

Publications

It is well known that publications comprise a substantial part of the Society's activities. The portion of revenues and expenses allocated to publications is nearly 75 percent. The fiscal well being of the Society depends upon a successful publication program. The Society is fortunate and proud to be the publisher of several of the finest primary research mathematics journals. Certainly *Mathematical Reviews* is considered the first among secondary journals. The Society is also proud of its series and individual monographs. During 1993 the publication program continued to thrive.

In addition to the usual offerings of research journals, review journals, and monographs, the Society published in 1993 the first annual *What's Happening in the Mathematical Sciences*. This journal, in its inaugural year distributed for the most part freely throughout the world, describes the newest results in the mathematical sciences. It is written in a style that is more journalistic than technical. The second issue is in preparation as this is being written.

The Society has two regular journals that are received by all members (privilege of membership), the *Notices of the American Mathematical Society* and the *Bulletin of the American Mathematical Society*. In 1992 the Society convened a special Committee to Review Member Publications to study the nature and content of these two journals, among others. The August 1993 Council approved the report of this committee. A complete description of the report, written by the chair of the review committee, Hugo Rossi, can be found in the *Notices* of September 1993 (page 843).

There are two main recommendations that will be adopted.

The first concerns the *Notices*. In January 1995 members will begin receiving an "enhanced" *Notices*. As stated in the Rossi article, the *Notices* will "communicate information and commentary on the discipline, the profession, and the Society and its activities; be a privilege of membership in the AMS; and serve as the journal of record of the Society." In a major

departure from the current editorial practice, the *Notices* will be edited by an editor-in-chief, who will be assisted by a panel of associate editors. A major feature of the *Notices* will be expository articles on mathematics written by experts. You experts are encouraged to take pen to paper (or fingers to keyboard) to write about the latest results in your field. Hugo Rossi is serving as interim editor while a search is continuing for a permanent editor.

The second recommendation concerns the *Bulletin*. The *Bulletin* will continue to provide good expository writing and book reviews. It will continue to be divided into three sections: Research Reports, Research/Expository Surveys, and Book Reviews, each section having its own board of associate editors.

Look for these changes in format in 1995.

Science Policy

The formulation and promulgation of mathematical science policy continues to be a major task within the Society. Members are continually updated on science policy matters by the *Notices*. The Committee on Science Policy considered two major items during 1993. It appointed a subcommittee that was charged to bring forth a "National Policy Agenda" for the Society. [This National Policy Agenda was adopted by the Council in April 1994 and has been mailed to each member of the Society.] It was charged by the Council to consider funding by the National Science Foundation. The Committee continues to monitor the shifting policies of the federal Government with regard to funding of mathematical research. Both these reports were to be filed early in 1994.

Prizes and Awards

The Society awards several prizes each year, usually at the Annual or Summer Meeting. At the Annual Meeting in San Antonio in January 1993 the Society awarded Steele Prizes to Jacques Dixmier, James Glimm, and Peter Lax; the Award for Distinguished Public Service to I. M. Singer; and the Ruth Lyttle Satter Prize to Lai-Sang Young. At the Joint International Meeting in Vancouver the AMS awarded Steele Prizes to Walter Rudin, George Daniel Mostow, and Eugene B. Dynkin.

Centennial Fellowships were awarded to Jacques Hertubise, Andre Scedrov, and David Webb. 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. They are awarded to individuals who received a Ph.D. from seven to twelve years prior to winning the award. Funds for these awards are supported by contributions from members of the Society. The Society contributes to the program from its general fund. The number of awards in each year depends on the amount of contributions received from the members in the previous year.

Elections and Officers

The Society elected Cathleen Morawetz as president-elect in the 1993 elections. It also approved revisions to the bylaws that eliminated the Committee to Monitor Problems in Communications. The results of the 1993 election have been reported elsewhere in these *Notices* and will not be repeated here.

International Activities

The AMS is engaged in international activities on several fronts. Two of the basic areas of Society activities are meetings and publications. Recently the Society has also become involved with supporting mathematicians and institutions financially or in kind, depending upon resources that become available. What follows is a summary of the role the Society is playing on the international mathematical front, with emphasis on activities that have taken place in 1993. (Since the international meetings were discussed above, these are not mentioned in this section.)

Approximately a quarter of the 29,000 AMS members reside outside North America (when considering dues paying members, the percentage becomes 36 percent). In order to serve all our members, the Society is most interested in international mathematical affairs. Currently the Society has reciprocity agreements with over fifty-five mathematical organizations throughout the world. These agreements allow members of those organizations to become full members of the AMS at half the dues rate. (And conversely, AMS members can become members of those organizations at half their dues rates.)

The AMS does provide subsidized memberships for members from currency-weak countries. And it has in place a sponsored membership program which permits members to sponsor another member at a considerable reduction in the dues. The number of reviewers for *Mathematical Reviews* who reside outside North America is considerable (perhaps even a majority of the reviewers). These reviewers receive an $8 credit for each review, which can be used to offset dues or any other purchase from the AMS.

In addition to the large number of foreign sales of AMS journals, in particular *Mathematical Reviews*, the Society participates in many book and journal donation efforts.

The AMS is a member of the Consortium of Affiliates for International Programs of the American Association for the Advancement of Science (AAAS). Through this consortium, the Society contributes books and journals to many underdeveloped countries and is now participating in the AAAS former Soviet Union journal donation program in addition to our own effort.

The AMS is donating its journals and books to twenty-three mathematical libraries throughout the former Soviet Union (fSU). The Society is also establishing five mathematical information centers in key concentrated areas of mathematics (Moscow, St. Petersburg, Novosibirsk, and Kharkov, Ukraine). These centers will contain AMS-donated computers, modems, fax, and copying machines to allow better international communication.

Furthermore, the Society is studying the extension of the book and journal donation effort beyond the fSU to all third world countries. The Society has established contacts in international funding at the highest levels of the NAS, NSF, ISF, and other foundations, including the Alfred P. Sloan Foundation. It has established working relationships with the international efforts of the AAAS, APS, AAS, ACS, and others for the purposes of assisting book and journal donation programs and other forms of support of mathematicians.

The Society has had an automatic checkoff on its dues form to support the International Mathematical Union travel program. Over the past five years members of the Society have contributed over $110,000 directly to the IMU via contributions through dues forms. These funds are collected by the AMS and sent directly to the IMU. The amounts for the last five years are:

1989	$16,191
1990	$14,773
1991	$27,787
1992	$32,500
1993	$30,550

The Society administered a program sponsored by NSF for travel grants to the International Mathematical Congress to be held in Zurich, Switzerland, in August. The fully allocated cost to the Society for administering this program is certainly not completely recovered from the grant.

American Mathematical Society Former Soviet Union Aid Fund

The political and economic problems resulting from the breakup of the former Soviet Union caused immediate and severe problems for mathematicians in the former Soviet Union (fSU). Recognizing the many important contributions to the mathematical sciences that have come from these mathematicians, the United States mathematical community, led by officers and staff from the American Mathematical Society, established an AMS fSU Aid Fund.

The Society has raised more than $700,000 for this fund, over $100,000 of which resulted from private contributions. These monies have been targeted to individual stipends, support of new and promising institutions, and other support.

The fund is supporting 367 mathematicians (Ph.Ds and graduate students with monthly stipends of $25 for students and $50 for Ph.Ds.) These monthly amounts are soon to be increased to cover inflation. While the majority of recipients are in Moscow, St. Petersburg, Kiev, Kharkov, and Novosibirsk, other Russian areas are represented as well as most of the new independent states of the fSU.

Funds have been expended to provide administrative support for the Independent University of Moscow and for some select mathematics high schools. The Society has provided legal advice for the U.S. tax exemption for the Moscow Mathematics Institute.

The Society has worked in partnership with the International Science Foundation to help it direct its aid to the best mathematicians in the fSU. With an AMS database of over 5,000 fSU mathematicians and experience in the first-ever peer review of fSU mathematicians, the ISF felt the Society had the expertise to assist in organizing its peer review panel for grants to fSU mathematicians. Society advocacy of fSU mathematicians resulted in the ISF increasing its commitment to support mathematicians from $1.1 to $2.2 million.

The Society has underwritten all administrative costs of this effort so that all funds donated to the AMS fSU Aid Fund have been directly applied to the need in the fSU.

It is expected that the Society will continue to be active in aiding mathematicians from the former Soviet Union either with direct financial assistance or with support for institutes and other activities.

Executive Director Resigns

William H. Jaco, the executive director of the Society, announced that he would be resigning from the position as of mid-1995 in order to return to Oklahoma State University as Kerr Professor of Mathematics. The Society has seen enormous growth during Jaco's term as executive director. He has been influential in refocusing the mission of the Society.

A committee chaired by Ramesh Gangolli is searching for a replacement. Nominations are welcome. A display announcement has appeared in several issues of these *Notices*.

Conclusion

The officers, members of the Council, trustees, committee members, staff, and others have contributed much time and effort in these activities of the Society. The Society and its members appreciate very much the work that its members contribute to the profession and to the Society.

The financial report by the treasurer can be found in this same issue of the *Notices*.

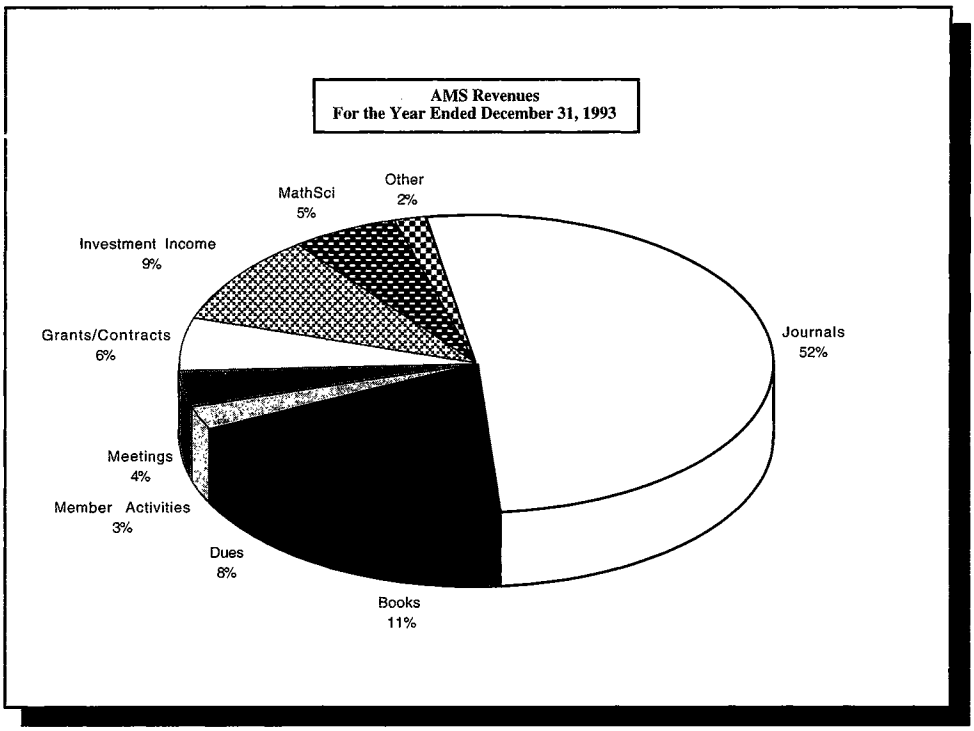
The Nominating Committee, the Editorial Boards Committee, prize selection committees, and other search committees are always seeking input from the membership. Display announcements frequently appear in the *Notices* requesting nominations and suggestions and informing the membership of points of contact within the organization where these nominations can be sent. Responses to these calls have been minimal. The secretary reminds members that these suggestions and nominations are always taken seriously. A lack of input into these matters is taken by these committees as a lack of interest in the process of governing the Society. As always, members are invited to contact officers and members of the Council directly with questions and suggestions.

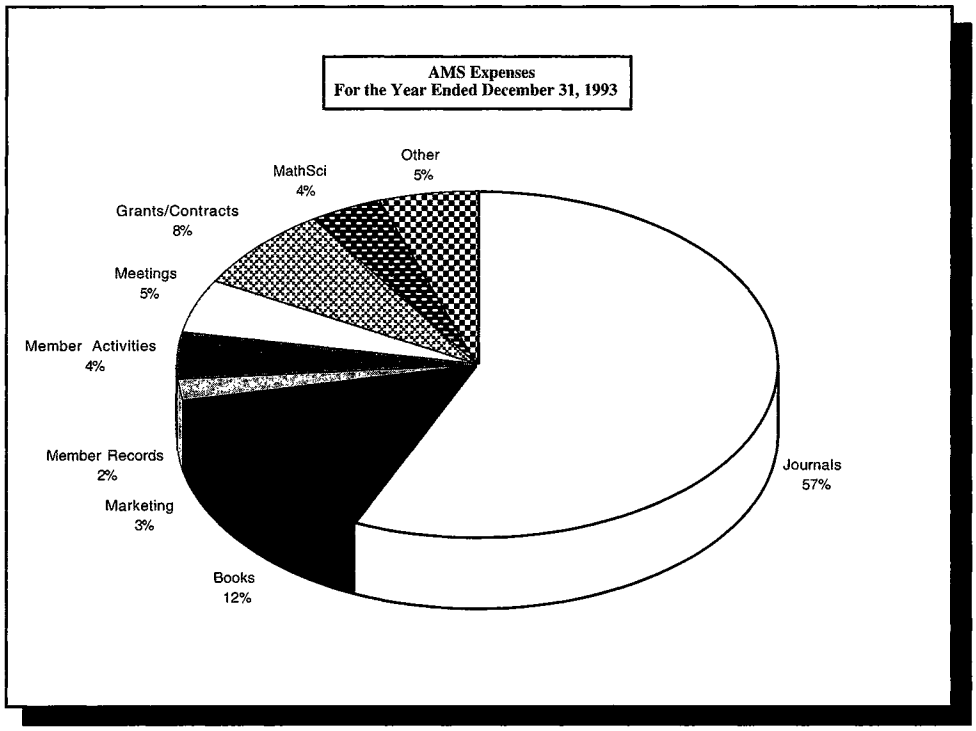
Report of the Treasurer (1993)

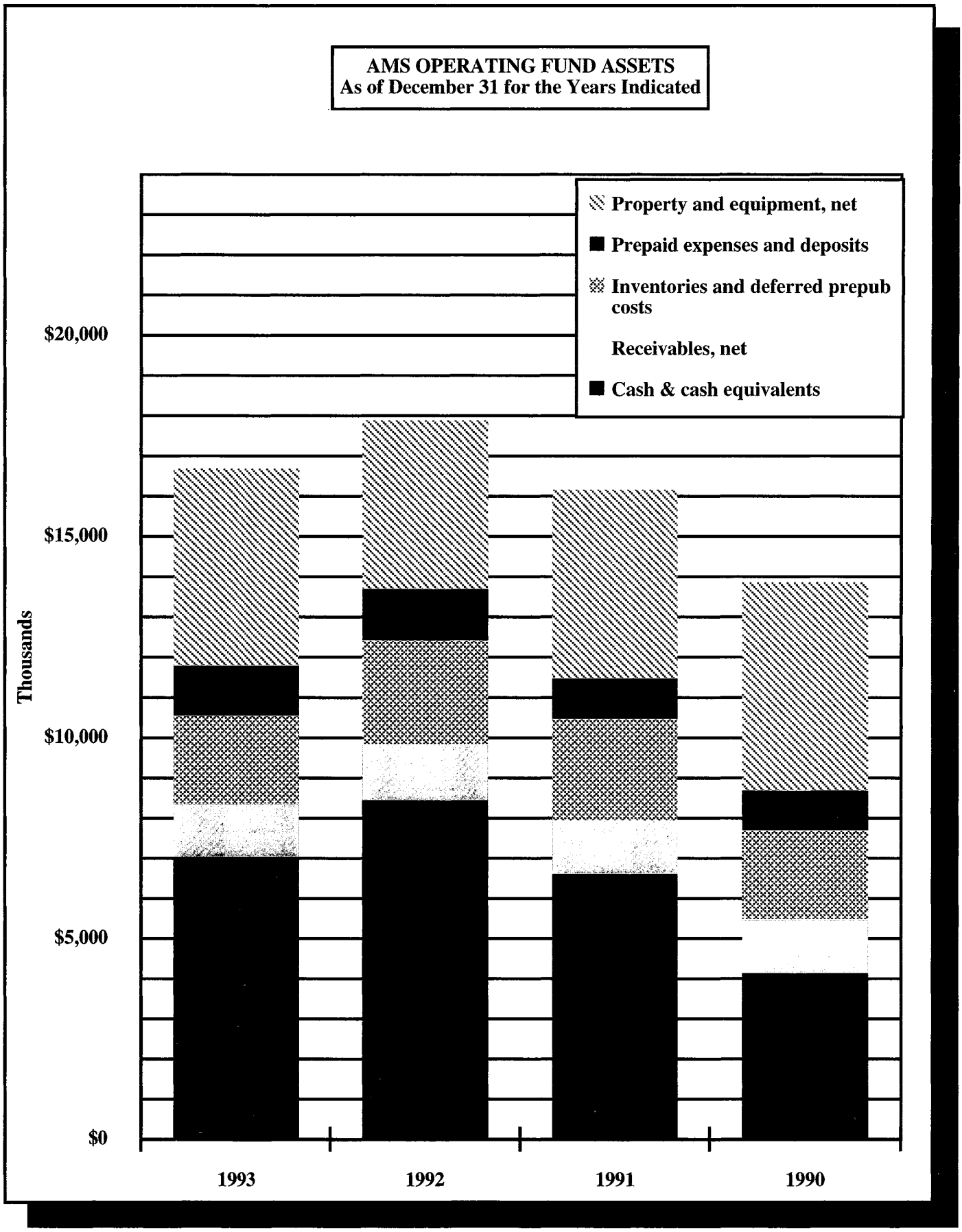
Franklin P. Peterson

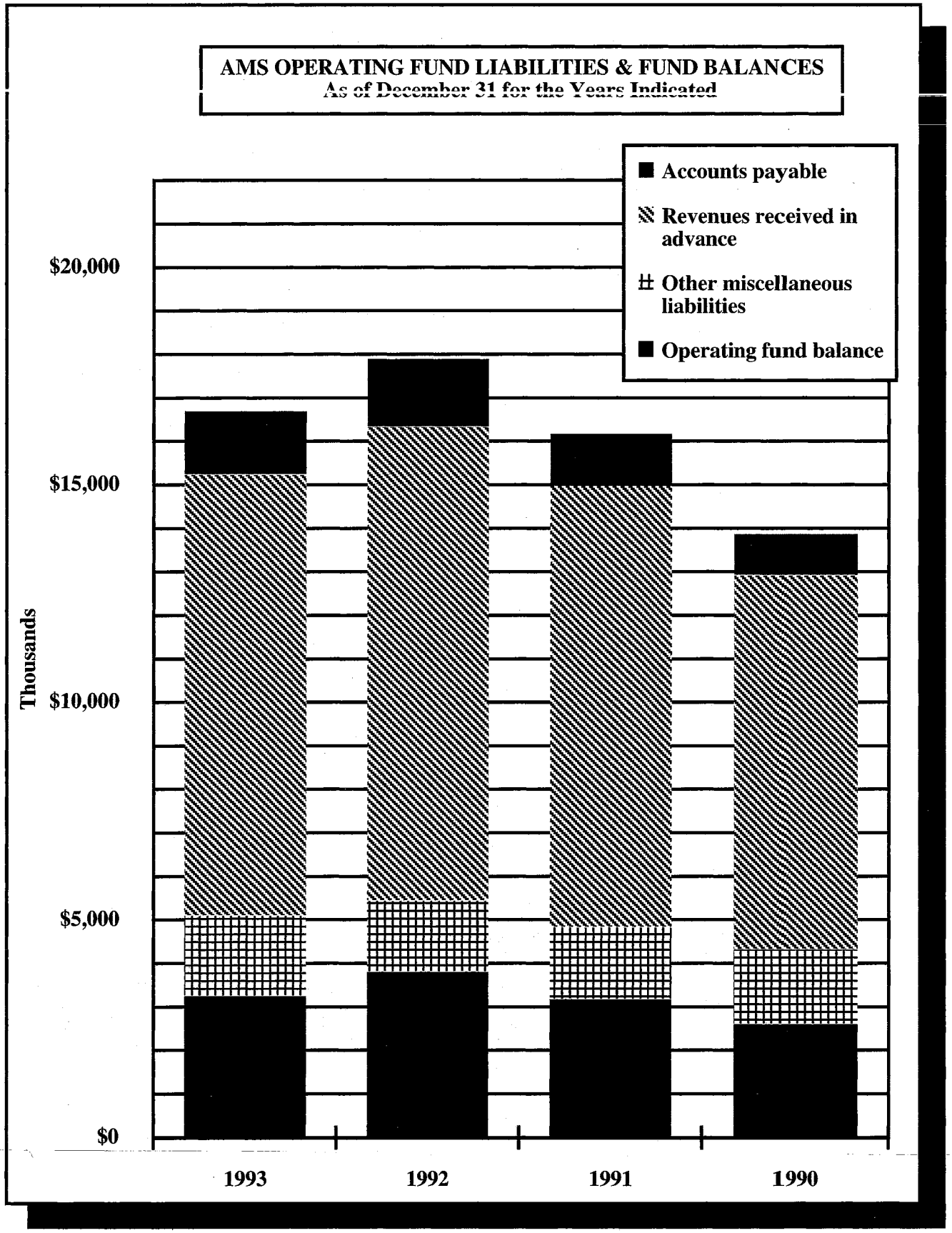
I. Introduction

The Society ended 1993 with an excess of revenues over expenses of approximately $2,594,000, an increase of $42,000 over 1992. A more detailed explanation by revenue and expenditure type follows the summary financial statements.


AMS Revenues
For the Year Ended December 31, 1993
Other
2%
MathSci
5%
Investment Income
9%
Grants/Contracts
6%
Journals
52%
Meetings
4%
Member Activities
3%
Dues
8%
Books
11%


AMS Expenses
For the Year Ended December 31, 1993
Other
5%
MathSci
4%
Grants/Contracts
8%
Meetings
5%
Member Activities
4%
Member Records
2%
Marketing
3%
Journals
57%
Books
12%


AMS OPERATING FUND ASSETS
As of December 31 for the Years Indicated
Property and equipment, net
Prepaid expenses and deposits
Inventories and deferred prepub costs
Receivables, net
Cash & cash equivalents
Thousands
$20,000
$15,000
$10,000
$5,000
$0
1993
1992
1991
1990


AMS OPERATING FUND LIABILITIES & FUND BALANCES
As of December 31 for the Years Indicated
Accounts payable
Revenues received in advance
Other miscellaneous liabilities
Operating fund balance
Thousands
$20,000
$15,000
$10,000
$5,000
$0
1993
1992
1991
1990

The Society's combined fund balances total over $18,991,000 at December 31, 1993. $3,454,000 is restricted, consisting principally of gifts and bequests received by the Society and related realized investment gains earned on those funds. $15,537,000 is unrestricted, and of that amount, $11,093,000 has been designated by the Board of Trustees as an Economic Stabilization Fund. This fund's purpose is to provide a source of cash in the event of a financial crisis and is being funded by the Society until it eventually approximates 75% of our budgeted annual expenditures. The Operating Fund Balance totals $3,262,000 at December 31, 1993. Ordinarily, operating fund surpluses in excess of immediate needs are transferred into the Society's long-term investments. However, recent operating surpluses have been retained in order to provide for the renovation and expansion of the Society's Providence, Rhode Island, facility.

The Society's balance sheet remains healthy. As in recent years, there was no long-term or short-term bank debt, and at the end of the fiscal year, cash and cash equivalents totaled almost $7,022,000. Unrestricted fund balances at December 31, 1993, amounted to $15,537,000, 48% of total assets, which reflects an increase of 9% as compared to 1992.

II. Summary Financial Statements and Graphs

The treasurer this year again presents to the membership summary financial statements of the Society. Graphs of the Society's 1993 Revenues & Expenses are also presented, as well as a comparison of Assets, Liabilities, and Fund Balance from 1990 through 1993. A copy of the Society's audited financial statements, as submitted to the Trustees and the Council, will be sent from the Providence office to any member who requests it from the treasurer. The treasurer will be happy to answer any questions members may have regarding the financial affairs of the Society.

SUMMARY STATEMENT OF ACTIVITY

For the Years Ended December 31, 1993 and 1992
(Thousands of Dollars)

Revenue	**1993**		**1992**	
Journals	$11,038	52%	$10,807	54%
Books	2,280	11%	2,294	11%
Dues	1,794	8%	1,715	9%
Membership Activities	543	3%	343	2%
Meetings	832	4%	502	3%
Grants and Contracts	1,234	6%	1,263	6%
Investment Income	2,060	9%	1,556	8%
MathSci Online/Tapes and Disk	1,244	5%	1,117	6%
Other	343	2%	441	2%
Total revenue	**$21,368**	**100%**	**$20,038**	**100%**
Expenses:				
Journals	$10,648	57%	$10,048	57%
Books	2,177	12%	2,097	12%
Marketing	632	3%	609	3%
Membership Records	400	2%	334	2%
Membership Activities	810	4%	789	5%
Meetings	928	5%	587	3%
Grants and Contracts	1,488	8%	1,478	8%
MathSci Online/Tape and Disk	714	4%	721	4%
Other	977	5%	823	5%
Total expenses	**$18,774**	**100%**	**$17,486**	**100%**

SUMMARY BALANCE SHEET

For the Years Ended December 31, 1993 and 1992
(Thousands of Dollars)

Assets	**1993**		**1992**	
Cash & temporary investments	$4,787	29%	$5,323	30%
Other short-term investments	742	4%	940	5%
Investments in Treasury Notes & Bills	1,493	9%	2,191	12%
Receivables—members & others (less allowance for doubtful accounts)	1,308	8%	1,375	8%
Due from invested funds	24	0%	1	0%
Deferred prepublication costs	894	5%	849	5%
Inventory of completed books & back volumes of journals	1,296	8%	1,734	10%
Prepaid expenses and deposits	1,259	8%	1,287	7%
Property and equipment (less accumulated depreciation)	4,899	29%	4,201	23%
Total operating assets	**$16,702**	**100%**	**$17,901**	**100%**
Long-term investments	15,753		11,950	
Total assets	**$32,455**		**$29,851**	
Liabilities and fund balances				
Accounts payable	$1,461	11%	$1,566	11%
Subscriptions, dues, and other revenues received in advance	10,138	75%	10,892	77%
Other miscellaneous liabilities	1,841	14%	1,628	12%
Total liabilities	**$13,440**	**100%**	**$14,086**	**100%**

	1993	**1992**
Unrestricted fund balances:		
Operating fund balance	3,262	3,815
Unrestricted invested fund balances:		
Economic stabilization	11,093	8,965
Friends of Mathematics	124	124
Other	18	23
Undistributed net unrealized gains on investment transactions	1,040	
Total unrestricted invested funds	12,275	9,112
Total unrestricted fund balances	**15,537**	**12,927**

Restricted fund balances:		
Endowment funds:		
The Endowment Fund	100	100
Robert Henderson	548	548
Joseph Fels Ritt	23	23
Prize funds	188	188
Waldemar J. Trjitzinsky	196	196
C. V. Newsom Fund	100	100
Centennial Research Fellowship	51	41
Pooled Income Fund	5	5
Eliakim Hastings	3	3
Undistributed net realized gains on investment transactions	1,749	1,633
Undistributed net unrealized gains on investment transactions	491	
Total restricted funds	**3,454**	**2,837**
Due to operating funds	24	1
Total liabilities and fund balances	**32,455**	**29,851**

The following is a more detailed discussion of the Society's 1993 operations:

Journals. Journals continue to provide the largest percentage of the Society's revenues and expenses, 52% and 54% in 1993 and 1992, respectively. Primarily due to sales price increases, which are set to approximate CPI indexes; increases in pages published; and loss of subscribers, these revenues increased approximately $231,000 or 2.1% from 1992 to 1993. Since 1985, journals (in the aggregate) have provided a very significant portion of the Society's surplus (the excess of revenues over expenses in the summary financial statements above). We expect that the amount of surplus generated by journals will decrease over the next few years. This is a result of pressure from libraries to keep prices low, increases in costs which are largely outside of the control of the Society, attrition in subscribers, and the move to nontraditional forms of publishing. Alternative cost-saving opportunities and alternative sources of support are being sought to compensate for the higher expenses.

Books. In 1993 book sales decreased slightly from 1992 levels. The Society has reorganized its publishing units to devote more resources to the acquisition and sale of high-quality books. This should provide for future growth in the book program and allow for less reliance on the revenues generated by the journal program.

Dues, Membership Activities, and Membership Records. The Society had 491 institutional members and 29,351 individual members at December 31, 1993, compared to 488 and 28,038, respectively, at the end of 1992. Of the latter, about 12,000 pay no dues because they are student nominees, emeritus members, or foreign reviewers without convertible currency. Increases in dues for individual members are set annually by a cost-of-living index.

Costs which can be considered to be partially covered by dues include the cost of maintaining membership records; the deficits of *Abstracts*, *Bulletin*, *EIMS*, *Notices* and the *Professional Directory*; deficits from meetings, including the Employment Register; and the AMS support of the Joint Policy Board on Mathematics.

Meetings. Meetings has operated at an overall deficit as a service to the mathematics community. The 1993 deficit equaled approximately $96,000. Revenues for 1993 were approximately $330,000 higher than in 1992, primarily due to there being a summer meeting in 1993 with no such meeting held in 1992.

Grants and Contracts. Grants and contracts continue to be a significant part of the Society's activities. This category includes not only traditional grants (from agencies such as the National Science Foundation) but also "sale of service". The Society markets publications and other services to other organizations for the purpose of recovering fixed costs outside of its traditional customer base (libraries and members). During 1994 the Society will investigate expanding this activity.

Investment Income. Income in this category includes earnings from both short-term and long-term investments. In 1993 approximately $245,000 was earned on the cash and cash equivalents which comprise the Society's short-term portfolio, an overall rate of return of about 4%, and approximately $1,135,000 was recognized in connection with the long-term portfolios. In addition, $550,000 of income was recognized in connection with a change in accounting principles to a method under which the accounting valuations match the actual market values of the investments. During 1993 the overall return of the Society's long-term investments was 12.4%.

Other Revenues and Expenses. The principal components of other revenue and expenses are e-MATH, videotapes, Electronic Journal Platform, and AMS support of the Joint Policy Board on Mathematics.

IV. Assets and Liabilities

So far this report has dealt with sources of revenue and expenditures. Another aspect of the Society's finances is what it owns and owes, or its assets and liabilities, which are reported above in the Summary Balance Sheet. The Society maintains its accounts in fund groups. The operating funds include membership and publications activities; the invested funds include both endowment funds (gifts and bequests whose principal is required to be invested in perpetuity and whose income must be used for the purpose stated by the donor) and quasiendowment funds (those funds set aside by the Board of Trustees for designated purposes). Most of the quasiendowment investments have been reserved as an economic stabilization fund as a hedge against future economic difficulties.

The Society's fiscal year coincides with the period covered by subscriptions and dues. Since dues and subscriptions are generally received in advance, the Society reports a large balance of cash and temporary investments on its financial statements at December 31, its fiscal year-end. This amounted to about $7,022,000 in 1993 and $8,454,000 in 1992. The recorded liability for the revenues received in advance was about $10,138,000 and $10,892,000 on the same dates. The difference can be thought of as having been invested in the Society's other assets. Effectively, the Society borrows from

its subscribers to finance current operations and long-term investments. This is a common practice in the publishing industry and allows the Society to operate free of short- or long-term bank debt.

The Society's property and equipment include land, buildings and improvements, office furniture, and equipment as well as software. The Society also owns a small amount of transportation equipment. The land, buildings, and improvements include the Society's Rhode Island headquarters, with buildings in Providence and Pawtucket, and the *Mathematical Reviews* offices in Ann Arbor. The largest part of the Society's office equipment is its investment in computer facilities.

News and Announcements

Tian Receives NSF Waterman Award

GANG TIAN of the Courant Institute of Mathematical Sciences at New York University has been selected to receive the 1994 Alan T. Waterman Award of the National Science Foundation (NSF). The Waterman Award is the NSF's most prestigious honor for young researchers.

Tian received the award for his work in complex differential geometry. His work is of great interest to string theory physicists, especially in connection with the new field of "mirror symmetry", in which startling algebraic geometry formulas are derived by quantum field theory methods.

Named in honor of NSF's first director, the Waterman Award has been given annually since 1976 to an outstanding young researcher in any field of science, mathematics, or engineering. Recipients must be U.S. citizens or permanent residents no more than thirty-five years old and must have received their Ph.D. within the past five years.

Tian is the nineteenth winner of the Waterman Award and the fifth mathematician to be so honored. The award was presented at a formal dinner ceremony on May 4 at the Department of State attended by leading scientists, engineers, educators, members of Congress, and others concerned with national science and technology policy. Tian will also receive $500,000 in research support over three years.

A list of Tian's major research accomplishments includes his solution of the problem of existence of Kähler-Einstein metrics on complex surfaces; his proof that the moduli space for Kähler-Einstein metrics with zero first Chern class is nonsingular; and his proof of the stability of algebraic manifolds by using Kähler-Einstein metrics. Other achievements include his systematic construction, with S.T. Yau, of Kähler-Einstein metrics on the complements of divisors satisfying certain positivity conditions and his compactification, with Jeff Cheeger, of complete Ricci-flat Kähler manifolds with certain asymptotic conditions.

Tian was born in the People's Republic of China in 1958 and became a permanent U.S. resident in 1991. He received a B.S. from Nanking University, an M.S. from Peking University, and a Ph.D. from Harvard University (1988), all in mathematics. He was an assistant professor at Pinceton University, and an associate professor at the State University of New York at Stony Brook and the Courant Institute of Mathematical Sciences at New York University. He has been professor of mathematics at Courant since 1992. He has also served on the faculty of the Mathematics Institute at Academia Sinica in China since 1988 and in the Department of Mathematics at Beijing University since 1991.

On the Alan T. Waterman Award Committee for 1994 were Rita R. Colwell (chair), director of the Maryland Biotechnology Institute, University of Maryland; David H. Auston, dean of the School of Engineering and Applied Sciences, Columbia University; George Castro, manager of X-ray analysis, IBM Almaden Research; Sylvia T. Ceyer, Department of Chemistry, Massachusetts Institute of Technology; Vicki L. Chandler, Institute of Molecular Biology, University of Oregon; Gordon P. Eaton, director of U.S. Geological Survey; John Ferejohn, senior fellow, Hoover Institution; Ronald.L. Graham, adjunct director of Research and Information Science, AT&T Bell Laboratories; Anita K. Jones, director of Defense for Research and Engineering, Department of Defense; Norman Scott, vice-president for Research and Advanced Studies, Cornell University; and Ewart A. C. Thomas, Department of Psychology, Stanford University.

– Prepared from NSF News Release

Laczkovich and Ratner Receive Ostrowski Prize

On July 8, 1994, in Basel, Switzerland, the 1993 Ostrowski Prizes were awarded to MIKLÓS LACZKOVICH of Loránd Eötvös University, Budapest, and to MARINA RATNER of the University of California, Berkeley. The prizes of 50,000 Swiss francs each recognize outstanding mathematical achievements in the previous five years. Presenting the prizes were Marianne Ludin, president of the Ostrowski Foundation, and János Aczél of the University of Waterloo, president of the Ostrowski Prize jury for 1992–1994. The prize citations were read by Catherine Bandle of the University of Basel and Marc Burger of the University of Lausanne.

Miklós Laczkovich

One characteristic of mathematical work of Miklós Laczkovich is that he attacks well-known problems which for a long time resisted efforts at solution. In doing so he has discovered unexpected connections of the problems to other, apparently quite distant fields of mathematics and then solved both the translated and the original problem by unrelenting work

and further ingenious insights. For instance, he solved a problem of Kemperman on functional inequalities for real functions, open for more than ten years, by reducing it to a problem on diophantine approximations. Another example: he solved a problem of Daróczy and Redheffer on the order at infinity of solutions of certain recursions by finding oscillating solutions of an "averaging type" integral equation. His best known achievement is, of course, the solution of Tarski's 1925 "circle squaring" problem. Again Laczkovich applied deep ideas from graph theory and on uniform distribution of sequences in number theory to prove that the circle and the square are equidecomposable and moreover that this can be established by translations only. This most surprising result goes even beyond Tarski's conjecture. (For a short description and appreciation of the proof, see the paper by Richard J. Gardner and Stan Wagon in the December 1989 issue of the *Notices*, pages 1338–1343.)

Miklós Laczkovich received his M.Sc. in 1971 and his Ph.D. in 1974 from Loránd Eötvös University. He also received a candidate's degree (1980) and a D.Sc. (1992) from the Hungarian Academy of Sciences, to which he was elected as a corresponding member in 1993. A professor of mathematics at Loránd Eötvös University, Laczkovich has held visiting positions at the University of Naples (1978), University of Waterloo (1983), Michigan State University (1983), University of California at Santa Barbara (1984), St. Olaf College (1986), Mathematical Institute of the Hungarian Academy of Sciences (1988–1989), and University College London (1992). He has presented lectures at various conferences around the world. He was an invited speaker at the first European Congress of Mathematics, held in Paris in 1992.

Marina Ratner

Marina Ratner created a deep and rather complete theory concerning the dynamics of actions of subgroups of Lie groups on homogeneous spaces of these groups and also discovered connections to ergodic theory. Based upon her previous work on horocycle flows, she completely proved the "topological Raghunathan conjecture" through the "measure theoretic Raghunathan conjecture". It was she who recognized the importance of the latter, which says roughly the following. Let Γ be a discrete subgroup of a Lie group G, and let H be the subgroup generated by G's unipotent elements. Further, let μ be a finite measure on G/D, invariant and ergodic under the left action of H onto G/D. Then m is the Haar measure on some homogeneous space embedded in G/D. The main tool in her ingenious and technically difficult proof is Birkhoff's ergodic theorem. She also proved an S-arithmetic version of the topological Raghunathan conjecture, which eventually helped A. Borel and G. Prasad prove the S-arithmetic version of the Oppenheim conjecture (the original conjecture was proved by Margulis), using p-adic techniques.

Marina Ratner received her M.A. in 1961 from Moscow State University and for several years worked in Kolmogorov's applied statistics group, as well as in his special school for gifted high school students. Her main mathematical influences at that time were A. N. Kolmogorov and Ya. G. Sinai. In 1965 she returned to Moscow State University, finishing her doctorate in 1969 under the supervision of Sinai. She was an assistant at the High Technical Engineering School in Moscow (1969–1970), a lecturer at the Hebrew University of Jerusalem (1971–1974), and a senior teacher at the Pre-academic School of the Hebrew University of Jerusalem (1974–1975). She came to the University of California at Berkeley in 1975 as an acting assistant professor and rose to her present rank of professor in 1982. Ratner was an Alfred P. Sloan Research Fellow (1977–1979), a Miller Research Professor at the University of California at Berkeley (1985–1986), and a John Simon Guggenheim Fellow (1987–1988). In 1992 she was elected to the American Academy of Arts and Sciences and the following year to the National Academy of Sciences (NAS). In 1994 the NAS awarded her the John J. Carty Award for the Advancement of Science. Ratner will present a plenary lecture at the International Congress of Mathematicians in Zurich in August 1994.

About the Ostrowski Prize

Alexander M. Ostrowski (1893–1986) was one of the greatest mathematicians of the twentieth century. He did foundational work on the theory of valuations, Hermitian matrices, zeta functions (where he solved one of Hilbert's famous problems), quasi-analytic functions, and functional equations and inequalities. As an example, one of his results from 1929, which has not been substantially improved since then, says that every additive real function, bounded from one side on a set of positive measure, is linear. He also did fundamental work on iterative processes, stability, and "numerical" solution of equations in Banach spaces, to name just a few of his accomplishments.

Ostrowski left his estate in trust to the Ostrowski Foundation for the purpose of awarding prizes biennially to one or more mathematicians who during the preceding five years have accomplished the highest scientific achievement in pure mathematics or in the theoretical foundations of numerical analysis. Previous prizes went to Louis de Branges of Purdue University (1989) and to Jean Bourgain of Institut des Hautes Études Scientifiques (1991). While the amount of the prizes depends on the current assets of the Foundation, each prize given to date has been worth 50,000 Swiss francs. The five-member jury which selects the recipient(s) consists of mathematicians from the Universities of Basel, Jerusalem, and Waterloo, and from the Academies of Sciences of Denmark and of the Netherlands. The members assume the presidency of the jury in rotation. For 1992–1994, the members of the jury were: Catherine Bandle (Basel), Joram Lindenstrauss (Jerusalem), János Aczél (Waterloo), Gert Pedersen (Denmark), and Jacob Korevaar (Netherlands).

– From Announcement of Ostrowski Prize Jury

Sullivan Wins Faisal Prize

DENNIS P. SULLIVAN of the City University of New York and of Institut des Hautes Études Scientifiques has received the 1994 King Faisal International Prize in Science (Mathematics). The Faisal Prizes are awarded each year in the areas

of science, medicine, Arabic literature, Islamic studies, and service to Islam. Each prize consists of a certificate, a gold medal, and SR 350,000 ($93,333).

Dennis P. Sullivan

Dennis Parnell Sullivan was born in Port Huron, Michigan, in 1941. He received his Ph.D. from Princeton University in 1965. Sullivan's early work was in homotopy theory and surgery, to which he brought a new, geometric point of view. His geometric insights led to many important results on the topology of manifolds. His theory of real or rational homotopy types, based on differential forms, has had profound applications, for example, to the topology of complex algebraic varieties.

Sullivan has made important contributions to the study of foliations and dynamical systems. He has also proved foundational results on quasiconformal and Lipschitz manifolds, categories which are intermediate between the topological and smooth ones. Over the last fifteen years he has been responsible for the emergence of the field of conformal dynamics as a lively and important branch of mathematics that straddles the traditional borders between pure and applied fields.

Sullivan is a member of the National Academy of Sciences, a fellow of the American Academy of Arts and Sciences, and a former vice-president of the AMS. He is the Albert Einstein Professor of Mathematics at CUNY and a professor at IHES.

HM King Faisal ibn Abdul Aziz, son of Saudi Arabia's founder and the kingdom's third monarch, ruled from 1964 until his death in 1975. In 1976, the eight sons of King Faisal honored their father's memory by establishing the King Faisal Foundation. Through its diverse philanthropic activities, the Foundation seeks to preserve religious values, advance education and health, promote cultural programs, and raise the standard of living for less fortunate peoples, especially those in developing countries. The Foundation offers scholarships to graduate students, contributes to scientific research projects, and provides grants to various causes. Established in 1979, the King Faisal International Prize is awarded based on nominations received from institutions and organizations throughout the world.

In 1987 Sir Michael Atiyah, PRS, of Cambridge University received the first Faisal Prize for mathematics. The Faisal Prize in Science rotates among the areas of mathematics, chemistry, biology, and physics. A mathematics prize was not awarded in 1991; the next mathematics prize will be awarded in 1998. Nominations are due by September 1, 1997. For further information, write to: Secretary General, King Faisal Foundation, P. O. Box 352, Riyadh 11411, Saudia Arabia.

– Prepared from the King Faisal Foundation Brochure

Humboldt Foundation Awards

The Alexander von Humboldt Foundation in Bonn, Germany, recently presented the Humboldt Award for Senior American Scientists to ERIC FRIEDLANDER of Northwestern University. Presented to some seventy-five Americans each year, this award honors internationally recognized scientific achievements.

The Humboldt Foundation has an extensive program of awards to promote international scholarly cooperation, through research and supporting activities. Since 1953, the Foundation has enabled more than 3,000 highly-qualified individuals to participate in collaborative research projects conducted in Germany.

See the "Funding News" section of the January 1994 issue of the *Notices* (page 35) for information on Humboldt Foundation programs. Or contact: Dr. Jan Keppler, Alexander von Humboldt Foundation, North American Office, 1350 Connecticut Avenue, NW, Suite 390, Washington, DC 20036; telephone: 202-296-2990; fax: 202-833-8514; electronic mail: `humboldt@umail.umd.edu`.

– Humboldt Foundation News Release

Guggenheim Fellowships Awarded

The John Simon Guggenheim Memorial Foundation has announced the selection of 147 artists, scholars, and scientists from among 3,157 applicants for Guggenheim Fellowships. Guggenheim Fellows are appointed on the basis of unusually distinguished achievement in the past and exceptional promise for future accomplishments. This year's fellowship awards total $4,070,000.

Among this year's fellows are six who work in the mathematical sciences. Their names, affiliations, and areas of research follow. JOAN S. BIRMAN, Barnard College, Columbia University, an algorithmic solution to the knot problem; BERNARD CHAZELLE, Princeton University, sampling and randomness in computational geometry; MICHAEL H. FREEDMAN, University of California at San Diego, the topology and geometry of three-dimensional manifolds; KARL RUBIN, The Ohio State University, applications of Euler systems in number theory; BLAKE TEMPLE, University of California at Davis, multi-dimensional shock waves and gravitational collapse in general relativity; and ROBERT TIBSHIRANI, University of Toronto, studies in computer-intensive statistical methods.

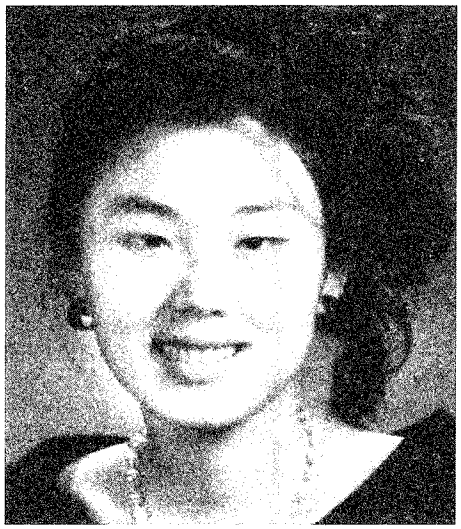
– Prepared from Guggenheim Foundation News Release

AWM Alice Schafer Prizes Awarded

JING REBECCA LI, a junior at the University of Michigan, is the winner of the fifth Alice T. Schafer Mathematics Prize, awarded annually by the Association for Women in Mathematics (AWM). The $1,000 prize recognizes an undergraduate woman for excellence in mathematics.

Three runners-up, each of whom receive $150, were also named: PATRICIA

HERSH, a junior at Harvard University, JULIA J. REHMEYER, a senior at Wellesley College, and NINA ZIPSER, a senior at Columbia University. The prizes will be presented on July 24, 1994, at the conclusion of the AWM workshop held in San Diego in conjunction with the annual meeting of the Society for Industrial and Applied Mathematics.



Jing Rebecca Li

Jing Rebecca Li is a relative newcomer to mathematics. An outstanding mechanical engineering student with a published paper on the deformation of bicrystals, she changed to the honors program in mathematics only last fall. Since then, she has excelled in demanding undergraduate and graduate courses, performing at the level of the best graduate students. During the preceding summer she participated in a National Science Foundation (NSF) Research Experiences for Undergraduates (REU) program at the Geometry Center at the University of Minnesota, where she studied computer music. In nominating Li for the Schafer Prize, one of her professors writes, "I have taught some very bright undergraduates, but I would rank her in the upper one-half percent of the undergraduates (male and female) I have known." In addition to praising Li for her remarkable achievements in mathematics in so short a time, Li's nominators comment on her impressive record in such diverse disciplines as physics, computer science, philosophy, Russian literature, and Asian history. Her letters of recommendation for the prize stress her determination, her "burning desire to learn", her love of mathematics, and her energy.

Patricia Hersh has already written two papers on graph theory, which have been submitted for publication. Last summer she participated in an REU program at the University of Minnesota, Duluth. The director of the program writes, "In my seventeen years running summer research programs, it has been my experience that each year only one or two of the participants seem to have the ideal blend of talent, work ethic, and personality. Patricia Hersh is one of these people." In previous summers she served as a counselor at an NSF mathematics program at Boston University for talented high school students, a program she participated in while in high school.

Julia J. Rehmeyer's work in undergraduate courses at Wellesley and in graduate courses at the Massachusetts Institute of Technology has been outstanding. One of her professors writes, "Ms. Rehmeyer is certainly the strongest student I have known in my fourteen years at Wellesley, but that doesn't describe how different she is from any other student I have known here. She is extraordinarily bright, self-motivated, and thorough, with an intellectual maturity that would suit a mature mathematician." She has been awarded an NSF Graduate Fellowship.

Nina Zipser has been awarded Columbia University's prestigious Kellet Fellowship for study at Cambridge University. She also won the competition for the mathematics department's Van Buren Prize. One of her nominators called her "the overall best student I have taught." Having earned top grades in graduate mathematics courses, she is now working on two research projects, one on the universality of lengths of closed geodesics in hyperbolic manifolds and another on degenerate groups.

There were also two Honorable Mentions. JENNIFER M. SWITKES, a senior at Harvey Mudd College, is working on a double major in mathematics and physics. She was commended by nominators for her outstanding coursework and her "original and ambitious research". She has won numerous awards and scholarships for her work in both mathematics and physics. YI WANG, a senior at Bryn Mawr College, is completing a double major in mathematics and economics. Described as a "truly extraordinary student", she has participated in several research programs, such as the Bryn Mawr-Spelman Summer Programs, an REU program at Mount Holyoke College, and a senior research program on wavelets.

The Alice T. Schafer Prize was established in 1990 and is named for former AWM president and founding member Alice T. Schafer of Marymount University, who has contributed a great deal to increasing the participation of women in mathematics. The criteria for selection for the prize include, but are not limited to, the quality of the nominee's performance in mathematics courses and special programs, an exhibition of real interest in mathematics, the ability to do independent work, and, if applicable, performance in mathematical competitions.

The Schafer Prize is funded by an endowment with continuing contributions. For more information about the prize, contact: Association for Women in Mathematics, 4114 Computer and Space Sciences Building, University of Maryland, College Park, MD 20742-2461; e-mail `awm@math.umd.edu`.

– Prepared from AWM News Release

Martin Gardner Wins Communications Award

MARTIN GARDNER has received the Joint Policy Board for Mathematics Communications Award. The award was presented during the 1994 Annual Meeting of the Society for Industrial and Applied Mathematics, held in San Diego in July.

The author of numerous books and articles about mathematics, Gardner is perhaps best known for his long-running *Scientific American* column, "Mathematical Games". His books include *Fads and Fallacies in the Name of Science* and *Mathematical Carnival*.

Gardner received his bachelor's degree in philosophy from the University of Chicago in 1936 and pursued graduate work in the philosophy of science. In 1941 he enlisted in the U.S. Navy and served until the end of World War II.

Previous JPBM Communications Awards have gone to James Gleick (1988), author of *Chaos: Making a New Science*; the playwright Hugh Whitemore (1990), for his play about Alan Turing, *Breaking the Code*, Ivars Peterson (1991), author of several books and an editor for *Science News*; and Joel Schneider (1993), content director for "Square One TV" of the Children's Television Workshop.

–JPBM News Release

AMS Karl Menger Awards at the 45th International Science and Engineering Fair

For the seventh time the American Mathematical Society has presented Karl Menger Memorial Awards at the International Science and Engineering Fair (ISEF).

This year's ISEF was held May 8–14, 1994, in Birmingham, AL, with a field of 900 students in many areas of science, each of whom had already won regional prizes at science fairs in the states, territories, and other countries. The AMS judging panel considered forty-eight projects carefully, forty-six that were entered in the mathematics category and two of the many in other categories that had significant mathematical content. Of the forty-eight students, eleven had entered projects in previous years. The panel was impressed by the uniformly high quality of the projects and the students' enthusiasm.

The Karl Menger Awards were First Place: $1,000; Second Place: $500 each; Third Place: $250 each; Honorable Mention: Certificate. In addition, each winner received a personalized certificate plus a copy of "What's Happening in the Mathematical Sciences" (Volume 1) and a booklet about Karl Menger.

This year for the first time the AMS panel decided to award up to five Honorable Mentions. The Honorable Mention awards significantly increase the panel's ability to honor excellent projects.

The winners (listed alphabetically within each category) were:

First Place: Davesh Maulik (Roslyn High School, Roslyn Heights, New York), "Rational Right Triangles".

Second Place: Eric Matthew Dennis (Torrey Pines High School, San Diego, California), "Space-time Structure for Geometric and Topological Fluctuation"; Sarah Ann Lord (Big Sky High School, Missoula, Montana), "Investigation of a MacDonald Identity".

Third Place: Timothy Stephen Eller (George C. Marshall High School, Falls Church, Virginia), "Upper Boundary and Average Order of the Sigma Function"; Rahul Manu Kohli (Detroit Country Day School, Beverly Hills, Michigan), "Applications of Chebyshev Trigonometric Polynomials to Pell's Equation"; Fam-ye Lin (Taiwan Provincial Taichung Girl's Senior High School, Taichung, Taiwan), "Count of Solution Partitions Corresponding to Balance Weights"; Benedek Valko (A&M Consolidated High School, College Station, Texas), "Guessing at Guessing".

Honorable Mention: Mary Kathleen Clavenna (Home School, St. Louis, Missouri), "Factoring Prime Number Cryptographic Codes"; Vinay Kumar Goyal-Singhal (Eugenio Maria De Hostos, Mayaguez, Puerto Rico), "Zeros of Special Polynomials of nth Degree"; Jan Kristian Haugland (Oslo, Norway), "New Ideas and Methods in Minimum Overlap Problem"; Wes Andres Watters (South Eugene High School, Eugene, Oregon), "W-Systems Curves: New Fractal Geometry"; Ian George Zacharia (Thomas Jefferson High School for Science & Technology, Alexandria, Virginia), "Theoretical Model of Pendant Drop with Computational Analysis".

Especially noteworthy is the fact that Ms. Lord was a third place winner last year.

Nine mathematicians were selected to serve as the AMS panel. They were Gisele Ruiz Goldstein (Louisiana State University); Jerome A. Goldstein (Louisiana State University); Reiner Hempel (University of Alabama, Birmingham); Roger Lewis (University of Alabama, Birmingham); Peter Massopust (Sam Houston State University); Marius Nkashama (University of Alabama, Birmingham); Peter O'Neil (University of Alabama, Birmingham); Julian Palmore, chair (University of Illinois); Li Shen (University of Florida). At the last minute Professor Lewis was unable to attend.

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 5904, Boston, MA 02206-5904.

Julian Palmore
University of Illinois

ISEF Award winners: Back row: Jan K. Haugland, Wes A. Watters, Ian G. Zacharia, Mary K. Clavenna, Vinay K. Goyal-Singhal. Middle row: Benedek Valko, Rahul M. Kohli, Fam-ye Lin, Timothy S. Eller. Front row: Julian Palmore (AMS panel), Davesh Maulik, Eric M. Dennis, Sarah A. Lord.

Famous Number Factored

This spring a group of Internet volunteers factored a 129-digit number that had eluded factorization since it was first published seventeen years ago. The

achievement made headlines in the *New York Times* and was reported in several scientific magazines.

The number, known as RSA129, is named after three researchers who dreamed it up: Ronald Rivest of the Massachusetts Institute of Technology, Adi Shamir of the Weizmann Institute in Israel, and Leonard Adleman of the University of Southern California. The number first appeared in 1977 in Martin Gardner's *Scientific American* column, with an offer of $100 to anyone who could factor it and thereby decode the encrypted message. About 600 Internet volunteers participated in the RSA129 project, running the code (or a variation of it) on a total of about 1,600 computers over a period of eight months. The encoded message says, "The magic words are squeamish ossifrage."

The organization of the RSA129 project was carried out by Derek Atkins of MIT, Michael Graf of Iowa State University, and Paul Leyland of the Oxford Computing Center in Oxford, England. The code used to factor the number was developed in 1988 and 1989 by Arjen Lenstra of Bell Communications Research and Mark Manasse of Digital Equipment Corporation. Lenstra helped out by doing the final computation, which took two days on a Bellcore MasPar MP-1, which is "by now fairly old", says Lenstra; it would have taken a day or so on the new model.

The factorization was mainly a matter of putting enough computing power to work on the job rather than developing new mathematics for the task. "It was clear by the early 1980s already that cracking the challenge would be much easier than predicted in *Scientific American* in 1977, though no one really knew how to do it, or if it would be doable," says Lenstra. "By the late 1980s, it became clear that it would indeed be doable, but an awful lot of work. By the early 1990s, it was more or less irritating that it was still not done, because it was clearly feasible; it was simply the problem of finding someone who was willing to do it."

The algorithm used to factor RSA 129 is based on the "quadratic sieve", invented in the early 1980s by Carl Pomerance of the University of Georgia. The quadratic sieve is so named because it uses the values of a quadratic polynomial at consecutive integers. Peter Montgomery of the Center for Mathematics and Computing in Amsterdam developed a variation of the quadratic sieve that uses many different quadratic polynomials, instead of just one. This was the approach used with RSA129. One of the advantages of the multiple polynomial version is that "it makes distributing the problem to many computers somewhat easier, since different computers can be working with different polynomials," says Pomerance.

Codes that use large prime factors are nowadays used routinely in banking, communications, and other areas. What significance does the factorization of RSA129 hold for such applications? "It is very easy for cryptographers to switch to bigger numbers," Pomerance observes. "Right now 200 digits seems very safe. But it is hard to predict the future." Lenstra notes that the same program and the same approach could in principle be used to break even larger codes; it would simply be a question of getting enough volunteers to spend enough time on it. "A malicious approach would be to spread a virus or worm" that looks for the bits of data necessary for the factorization and then sends them to a central location, says Lenstra. "It is not inconceivable that such a program could run for a long time before it is detected." A three-day weekend might be enough to collect what is needed, he says, if the virus could get access to enough fast machines.

"A bigger threat, however, is posed by a new factoring method, the number field sieve," Lenstra notes. Pomerance says that the number field sieve is faster for "very large" numbers, but the quadratic sieve is faster for smaller numbers. The number field sieve was not used on RSA129 because RSA129 appeared to be near the crossover between "very large" and smaller numbers, says Pomerance, and also because it was simpler to use the "well-worn" computer code that utilizes the quadratic sieve.

Right now it is too early to say how hard it would be to use the number field sieve to crack the larger codes now in use. "So for the moment bigger numbers will still give safe codes," says Lenstra. "How big is unclear. So far our predictions about the difficulty of factoring have been quite bad [as with RSA129], so why would our current predictions be better?"

—Allyn Jackson

Sunley to Serve in NSF Director's Office

Neal Lane, director of the National Science Foundation (NSF), has appointed Judith S. Sunley as the NSF's assistant to the director for Science Policy and Planning. Her principal responsibilities will be to assist in the coordination of programmatic and budget planning, with particular emphasis on developing an NSF-wide strategy for working with the National Science and Technology Council and incorporating the Council's guidance into NSF budgeting, planning, and program implementation. For the past two years she has been the executive officer of the Directorate for Mathematical and Physical Sciences. Sunley began at the NSF as a program director in mathematics in 1980 and served as director of the Division of Mathematical Sciences from 1987 until 1992. *—Prepared from JPBM Tidbits*

Grants to fSU Mathematicians

The International Science Foundation (ISF) has awarded grants to 125 proposals in mathematics for the support of mathematics in Russia and other parts of the former Soviet Union (fSU). These grants were chosen in the first round of awards. The decisions for awards were made by the ISF with the advice of a panel of mathematicians from the United States and the fSU.

A typical proposal involves a principal investigator, several associate investigators, and possibly "students". At the recommendation of the panel, the level of the awards was calculated on the following basis: For the top group of proposals all investigators with a Ph.D. (*candidat* or *doctor*) receive a minimum of $130 per month; for the second group, such investigators receive a minimum of $90 per month; in both groups investigators without a Ph.D. (*candidat* or *doctor*) receive $50 per month. There was also a small third group of "emeritus"

professors, where only the principal investigator is funded at a rate of $130 per month. In all cases the level of awards was calculated under the assumption that the duration of the grant is two years. In fact, however, the payments will be accelerated, so that the investigators will receive their grants over a period of twelve to eighteen months, with additional support for the second year made possible through additional matching grants from the Russian and other fSU governments. For each grant, the recommended budget also included an allocation for the cost of a personal computer. Modest institutional overhead is included in the grant awards.

A second (and final) round of grants will be determined this summer.

–ISF

Struik Celebrates Centenary

On September 30, 1994, Professor Dirk J. Struik will deliver his centenary lecture "Mathematicians I Have Known" at 3:30 p.m. in List Auditorium, Brown University. The event is cosponsored by Brown University, Providence College, and the American Mathematical Society. For information please call 401-863-2708. For dinner reservations send $25 by September 15 to Brown University–Struik Dinner, Box 1917, Brown University, Providence RI 02912.

–Brown University

Project MATHEMATICS! Wins Film Festival Awards

Project MATHEMATICS!, a series of animated mathematics videotapes, this year won two major awards in film festivals for its recent production, *Sines and Cosines, Part II*.

In January 1994 the film won a gold medal at the 36th Annual New York Festivals, held in New York City. The festivals annually draw about 7,000 entries from more than fifty nations. The awards presented at the festivals recognize outstanding achievements in nonbroadcast media.

In May 1994, *Sines and Cosines, Part II* received a Gold Apple in the National Educational Film & Video Festival in Oakland, California. This year the festival drew nearly 1,500 entries from the U.S. and abroad. Project MATHEMATICS! also received Gold Apples in the 1991 and 1992 festivals. This award brings to eleven the number of gold or silver medals captured by Project MATHEMATICS! during its first five years of existence.

Project MATHEMATICS! is the brainchild of Tom Apostol, a mathematician at the California Institute of Technology, and James Blinn, the renowned computer animator. The two designed Project MATHEMATICS! to bring mathematics to life with colorful moving pictures and graphs, music, and a sense of humor. Their videotapes are used by tens of thousands of educators around the world.

–Prepared from Caltech News Release

Call for Nominations for AWM Hay Award

The Louise Hay Award for Contributions to Mathematics Education is presented annually by the Association for Women in Mathematics (AWM) at the AWM Business Meeting during the Joint Mathematics Meetings each January. The award recognizes outstanding achievements in any area of mathematics education, to be interpreted in the broadest sense.

Louise Hay was widely recognized for her contributions to mathematical logic and for her strong leadership as head of the Department of Mathematics, Statistics, and Computer Science at the University of Illinois at Chicago. Her devotion to students and her lifelong commitment to nurturing the talent of young women and men secure her reputation as a consummate educator. The annual presentation of this award is intended to highlight the importance of mathematics education and to evoke the memory of all that Hay exemplified as a teacher, scholar, administrator, and human being.

Nominations for the award should be received by **October 15, 1994**. One original and four copies of the nomination should be sent to: The Hay Award Selection Committee, Association for Women in Mathematics, 4114 Computer & Space Sciences Building, University of Maryland, College Park, MD 20742-2461. The AWM office may be contacted by telephone 301-405-7892 or electronic mail `awm@math.umd.edu`. *–AWM*

Visiting Professorships for Women Awardees

The National Science Foundation (NSF) has a program through which women scientists and engineers can hold visiting professorships in educational institutions and conduct research and mentorship activities. The program, Visiting Professorships for Women (VPW), is designed to enhance the visibility of women scientists and engineers in academia.

For fiscal year 1993 three VPW awards were made in mathematics. SUSAN FRIEDLANDER of the University of Illinois at Chicago is visiting at Brown University and Northwestern University; her research topic is hydrodynamics. BARBARA MACCLUER of the University of Richmond is visiting Purdue University; her research topic is composition operators. DUSA MCDUFF of the State University of New York at Stony Brook is visiting the University of California, Berkeley; her research topic is symplectic topology.

–National Science Foundation

AMS Moves to Recycled, Acid-free Paper

All of the publications of the AMS (with an occasional exception because of special requirements) are produced on recycled paper which is also acid-free. This has been true of AMS books for quite some time now, but only recently did recycled paper of the right weight and opacity become available for the Society's journals. Readers will notice that on the copyright page of all AMS books and journals there are now both the logo for acid-free paper (∞) and the logo for recycled paper (♻). Readers may recall that acid-free paper is necessary to avoid the kind of rapid deterioration of books or journals which has been forcing libraries to undertake major efforts to protect or duplicate items produced in the late nineteenth and early twentieth centuries. The use of recycled paper is, of course, an attempt to reduce the unnecessary cutting of trees, as well as a contribution to the slowing of the growth of waste landfills. The Society also man-

ages an active recycling program in its offices; it is estimated that 75% to 80% of the office waste paper is recycled.
–AMS

News from DIMACS

DIMACS, the Center for Discrete Mathematics and Theoretical Computer Science, a consortium of Rutgers and Princeton Universities and AT&T Bell Laboratories and Bellcore, is planning a 1994–1995 "special year" on "Mathematical Support for Molecular Biology". The program will start in August 1994 and run through August 1995, with some supplementary activities scheduled for the 1995–1996 year.

The special year will focus on those topics in molecular biology that seem especially amenable to treatment using the methods of discrete mathematics and the related algorithmic approaches of theoretical computer science. It is intended to expose a large number of discrete mathematicians and theoretical computer scientists to the problems of molecular biology that seem to be fundamentally problems of their field and to forge lasting partnerships between mathematical scientists and biological scientists.

The special year will be chaired by Joachim Messing and Fred Roberts of Rutgers University, co-chaired by Lawrence Shepp of AT&T Bell Laboratories and Michael Waterman of the University of Southern California.

The program will include extensive collaboration with biologists through the participation of the Wakeman Institute for Molecular Genetics at Rutgers, the Center for Molecular Biotechnology at the University of Washington, the Genome Center at the University of Pennsylvania, the Center for Theoretical and Applied Genetics at Rutgers, and the Departments of Molecular Biology and of Ecology and Evolutionary Biology at Princeton, as well as the involvement of prominent biologists in the planning and organization of all major activities. Industrial participation in the special year is also expected.

Among the prominent visitors expected for periods of as much as a year are Charles Cantor, Michael Gribskov, Dan Gusfield, Timothy Havel, Herbert Hauptman, Leroy Hood, Samuel Karlin, Richard Karp, Eric Lander, Gene Lawler, Gene Myers, Maynard Olson, Pavel Pevsner, Steve Skiena, Temple Smith, Gary Stormo, and Michael Waterman.

The special year program will be centered around a series of workshops, open to the entire community. The scheduled workshops are: Combinatorial Methods for Mapping and Sequencing DNA (Oct. 6–9), Sequence Alignment (Nov. 10–12), Phylogeny (Feb. 6–8), and HIV Sequence Analysis (last week in April or first week in May). Also running will be the fourth in a series of "DIMACS Algorithm Implementation Challenges", to culminate in a workshop in September 1995. Researchers will be challenged to develop algorithmic methods for a series of benchmark problems dealing with DNA sequence determination from shotgun sequence data.

There will be a series of one-day mini-workshops, organized around a topic of current interest. Already scheduled are Combinatorial Structures in Molecular Biology (Nov. 4), DNA Topology and Regulation (Dec. 9), and Gross and Fine Structure of DNA (Mar. 6 at the Genome Center at Penn). There will be a series of four mini-workshops on protein structure in the period March 20–27. These will deal with Global Minimalization of Nonconvex Energy Functions, Computational Geometry and Protein Structure, Sequence-based Methods for Protein Folding, and Antibody Sequence and Structure.

Further information can be obtained at `special@dimacs.rutgers.edu`.
–DIMACS

News from the Institute for Mathematics and its Applications

University of Minnesota

The Institute for Mathematics and its Applications (IMA) is now accepting proposals from the mathematical sciences community for future programs. **Academic-year programs** typically involve a number of long-term visitors, plus six- to eight-week-long workshops focusing on a specific mathematical topic and appropriate applications in the sciences. Special emphasis is placed on interaction between mathematicians and other scientists from specialties who have not had sufficient opportunity in the past to learn of one another's work. The program now ending is "Emerging Applications of Probability"; the 1994–1995 program is, "Waves and Scattering" (see the announcement in the May/June 1994 issue of the *Notices*). Future programs will be "Mathematical Methods in Materials Science" in 1995–1996 and "Mathematics in High-Performance Computing" in 1996–1997. Proposals are requested for future years. **Summer programs** are typically one month long, with a strong educational aspect as well as research interaction. "Molecular Biology" will take place in July 1994 and "Large-Scale Optimization" in July 1995. Proposals are needed for summer 1996 and thereafter. Proposals may be submitted by e-mail to `friedman@ima.umn.edu`, with copies to `ima-staff@ima.umn.edu`.

IMA Director Avner Friedman has announced the appointment of a new associate director, **Robert Gulliver** of the University of Minnesota. Thanks are in order to Willard Miller, Jr., who has served admirably as associate director since 1987.

For for more information about IMA activities, see the "Meetings and Conferences" section of the *Notices* or contact the IMA (`ima-staff@ima.umn.edu`). Weekly IMA seminar schedules with titles and abstracts are available on Usenet (`umn.math.dept`) or by fingering `seminar@ima.umn.edu`. TEX files for the *Newsletter* and the *Update*, as well as IMA Preprints, are available via anonymous ftp at `ima.umn.edu`.
–IMA Announcement

News from the Mathematical Sciences Institute

Cornell University, University of Puerto Rico, and SUNY Stony Brook

The Algorithmic Number Theory Symposium (ANTS) was held in Ithaca, New York, May 6–9, 1994. ANTS, coorganized by L. Adleman and M. Sweedler, was sponsored by the U.S. Army Research Office through the ACSyAM branch of MSI. Over

one hundred scientists came from Australia, Canada, France, Germany, Italy, Russia, Sweden, USA, and the United Kingdom. They included L. Adleman, N. Elkies, A. Lenstra, H. Lenstra, A. Odlyzko, and C. Pomerance. Scientists from China were not able to attend but submitted to the proceedings. Most of the attendees were from academia, but over 10% came from U.S. industrial and governmental laboratories. These included AT&T Bell Laboratories, Bellcore, IBM-Watson Research Center, Intel Corporation, Mitre Corporation, the National Security Agency, and Sandia National Laboratory. Springer-Verlag will publish the proceedings, and ANTS-II will take place in Bordeaux, France, in 1996.

On October 28–30, 1994, MSI at Cornell University will sponsor a workshop on "Hybrid Systems and Autonomous Control". The field is rapidly advancing in theory and applications and is at the interface of computer science, control engineering, and mixed dynamical systems. The program committee, all of whom have contributed strongly to this area, will form a core of lectures for the workshop. The final results of the workshop will be a sequel to "Hybrid Systems" (R. Grossman, A. Nerode, H. Rischel, A. Ravn, eds.), LNCS 736, 1993, consisting of a cross-section of invited research papers. The registration fee will be $95 for nonstudents and $40 for students. Registration packets may be obtained from: Valerie Kaine, Mathematical Sciences Institute, 409 College Avenue, Ithaca, NY 14850; telephone 607-255-8005; e-mail `vdk1@cornell.edu`.

Initial planning is underway for a two-and-a-half-day workshop on "Logic and Optimization" to be held at MSI at Cornell University, August 1–3, 1995. Suggested topics should be sent to Anil Nerode by e-mail at `anil@msiadmin.cit.cornell.edu`.

—From MSI Announcement

Erratum

The May/June 1994 issue of the *Notices* carried an obituary of Herbert Busemann on page 472. The date given for Busemann's death was incorrect; Busemann died on February 3, 1994. In addition, the name of the author of the obituary, Shiing S. Chern of the University of California, Berkeley, was inadvertently omitted. The *Notices* regrets these errors.

Funding Information for the Mathematical Sciences

AMS Centennial Fellowships Invitation for Applications, 1995–1996 Deadline: December 1, 1994

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, 1983, and December 31, 1988, and should not have had the equivalent of more than two years of full-time postdoctoral support.

The stipend for fellowships awarded for 1995–1996 has been set by the Trustees of the Society at $43,900 for nine months. In addition there will be an expense allowance of $1,435. 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 individuals should 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 seven years.

The deadline for receipt of applications is **December 1, 1994**. Awards will be announced in February 1995, or earlier if possible.

For application forms, write to the Executive Director, American Mathematical Society, P.O. Box 6248, Providence, RI 02940 or electronic mail `ams@math.ams.org`. (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.)

–AMS

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, 1995; (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, 1995; and (4) will not previously have held any other NSF postdoctoral fellowship. Subject to the availability of funds, it is expected that in FY 1995 thirty to forty awards will be made. The evaluation of applicants will be based in part on ability as evidenced by past research work and letters of recommendation, likely impact on the future scientific development of the applicant, and scientific quality of the research likely to emerge. Applicants' qualifications will be evaluated by a panel of mathematical scientists. Women, underrepresented minorities, and persons with disabilities are strongly encouraged to submit applications.

For copies of the application brochure or further information, contact the Office of Special Projects, Room 1025, Division of Mathematical Sciences, National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230, 703-306-1870, e-mail `msprf@nsf.gov` (Internet) or `msprf@nsf` (Bitnet); or the American Mathematical Society, 401-455-4105, e-mail `nsfpostdocs@math.ams.org`.

The deadline for applications is Saturday, **October 15, 1994**.

–NSF

NSF-AWM Travel Grants for Women

Through a grant from the National Science Foundation (NSF), the Association for Women in Mathematics (AWM) has a program of travel grants for women mathematicians to attend mathematical conferences. The purpose of the NSF-AWM travel grants is to provide an opportunity for women mathematicians to advance their research activities and their visibility in the research community.

The grants provide full or partial support for travel and subsistence for a meeting or conference in the applicant's field of specialization. A maximum of

$1,000 for domestic and $2,000 for foreign travel will be applied. The research conference must be in an area supported by the NSF's Division of Mathematical Sciences; so, for example, certain areas of statistics are included, but many areas of mathematics education and history of mathematics are excluded. Applicants must be women holding doctorates (or possessing equivalent experience) and having a work address in the U.S. (or a home address, in the case of unemployed mathematicians). Anyone who has been awarded an AWM-NSF travel grant in the past two years or who has other sources of external funding, such as a regular NSF grant, is ineligible. Partial institutional support does not make an applicant ineligible.

There are three award periods per year, with applications due **February 1**, **May 1**, and **October 1**. An applicant should submit *five* copies of the following: (1) a description of her current research and how the proposed travel would benefit her research program, (2) her curriculum vitae, (3) a budget for the proposed travel, and (4) information about all other sources of travel funding available to the applicant. These materials should be sent to: Travel Grant Selection Committee, Association for Women in Mathematics, 4114 Computer & Space Sciences Building, University of Maryland, College Park, MD 20742-2461; telephone 301-405-7892; e-mail `awm@math.umd.edu`.

–AWM

Workshop for Women Graduate Students and Postdocs

Over the past five years the Association for Women in Mathematics, with funding from the National Science Foundation and the Office of Naval Research, has held a series of workshops for women graduate students and postdocs in conjunction with major mathematics meetings. The next workshop in the series is scheduled to be held in conjunction with the annual AMS-MAA Joint Mathematics Meetings in San Francisco in January 1995. The actual date for the workshop will be announced later, but it will be held during the week of the meetings, January 3–8, 1995.

AWM will offer funding for travel and subsistence for up to ten women graduate students and ten women postdocs to participate in the workshop. Participants will have the opportunity to present and discuss their research and to meet with other women mathematicians at all stages of their careers. The workshop will also include a panel discussion, a luncheon, and a dinner banquet.

All mathematicians (female and male) are invited to attend the entire program even though only twenty women will be funded. Departments are urged to help graduate students and postdocs obtain some institutional support to attend the workshop and the meetings.

To be eligible for funding, graduate students must have begun work on a thesis problem; postdocs must have received their Ph.D.s within approximately the last five years. Each application should include a curriculum vitae and a concise description of research; a graduate student applicant should include a letter of recommendation from her thesis advisor. Nominations by other mathematicians (accompanied by the information described above) are also welcome.

Applications must be received by **October 15, 1994**. Please send *five* copies of the application materials to: Workshop Selection Committee, Association for Women in Mathematics, 4114 Computer & Space Sciences Building, University of Maryland, College Park, MD 20742-2461; telephone 301-405-7892; e-mail `awm@math.umd.edu`.

–AWM

Peace Corps Offers Opportunities

Over the past thirty years, more than 130,000 Americans have been Peace Corps volunteers. Today about 6,000 volunteers serve in over ninety countries in Africa, Asia, the Pacific, South and Central America, the Caribbean, and now also in Cental Europe. The Peace Corps offers the chance to gain credentials for professional careers in many fields while helping to solve pressing problems in the developing world. National and international employers in government and private enterprise recognize the work and experience of Peace Corps volunteers.

Serving for a period of two years or longer, volunteers work in a variety of areas such as agriculture, forestry, fish culture, health and nutrition, education, engineering, skilled trades, small business and cooperative development, and community development. Before going overseas, volunteers attend orientation workshops and receive further appropriate training upon arrival in their assigned countries. During their service, Peace Corps volunteers receive a monthly allowance for housing, food, clothing, and incidentals. They also receive free medical and dental care, transportation to and from their overseas sites, and twenty-four vacation days a year. Following Peace Corps service, volunteers receive a readjustment allowance of $200 for each month of training and service, approximately $5,400 after a two-year assignment. They are also eligible for certain kinds of employment and educational assistance.

For more information contact: Peace Corps Recruitment Office, 90 Church Street, Room 1317, New York, NY 10007; telephone 212-264-6981; in Connecticut, New Jersey, and New York dial toll-free, 800-972-0970.

–Peace Corps Announcement

For Your Information

The 1994 Arnold Ross Lecture Series

Tracy A. Bibelnieks,
Harvey B. Keynes,
University of Minnesota, Minneapolis

On April 26, 200 talented high school students and their teachers from around the state of Minnesota came to the University of Minnesota in Minneapolis to take part in the 1994 AMS Arnold Ross Lectures. The lectures were hosted by the university's School of Mathematics through its Office of Special Projects. Many of the students are enrolled in the University of Minnesota Talented Youth Mathematics Program or are active in Minnesota Math League.

The AMS committee of Paul Sally (University of Chicago), Harvey Keynes (University of Minnesota), and Jean Taylor (Rutgers University) invited two extremely distinguished speakers, Charles Fefferman, and Ingrid Daubechies. Fefferman who received the Fields Medal in 1978, who is currently professor of mathematics at Princeton University. His research in Fourier analysis, partial differential equations, and several complex variables has brought fresh insight to classical areas of mathematics while also contributing to modern analysis. Daubechies, trained as a theoretical physicist, became interested in applied mathematics through signal analysis. Today she is one of the leading world experts in wavelet theory and its uses. On leave from Rutgers University, Daubechies is a member of the technical staff at AT&T Bell Labs. In January 1995, she will join Fefferman as a professor of mathematics at Princeton.

As the first lecturer, Fefferman shared with the audience how, as a child, he studied mathematics to understand his love and fascination—science. He related how he was easily hooked on the beauty of mathematics. In line with his love for science, Fefferman's lecture focused on unsolvable mathematical questions related to the universe and the theory of relativity. The students were intrigued by his discussion of the question: Is the geometry of the universe hyperbolic or Euclidean? He touched on mathematically mature ideas of the Poincaré half plane, the projective plane, Riemannian geometry, and manifolds in a way that was accessible and meaningful to the students. Here are some quotes from students on Fefferman's talk: "very captivating—it pulled the foundations out from underneath geometric thinking"; "the topic made you stretch your mind and think"; "this talk excited me about pursuing two careers combining mathematics like this with theories of the universe in astrophysics and particle physics"; "I was truly motivated"; "the talk made me more interested in the 'cooler' aspects of math." One teacher commented: "Their mouths were dropped! I heard a lot of discussion about things that Charles was talking about. You could sense how their enthusiasm was amplified when he was talking about new explanations of things they had heard about."

Charles Fefferman and Ingrid Daubechies speaking with students.

Equally acclaimed was Daubechies's lecture on wavelets and their applications to the work of engineers, mathematicians, and physicists. She gave an overview of how wavelets are used to analyze a signal or image and to decompose it into layers of information. She then discussed how wavelets are used by the FBI to compress fingerprint records. Excellent slides illustrating the data compression of the fingerprints

enhanced the understanding of her talk. Some student quotes about her talk: "very interesting to see how math and imaging time-frequencies can be applied to practical real-world applications"; "the applications [of wavelets] was amazing"; "[Daubechies] showed that mathematics is not just the language of science but of music, literature, and art"; "these kinds of super applications [of mathematics] yield high motivation to learn more"; "I would love to take a class on this topic."

An informal afternoon discussion between the audience and the invited lecturers gave a large group of students the opportunity to ask questions about the lectures, about mathematics, and about careers in mathematics. Some of the questions to Fefferman were: Would you care to comment on the Axiom of Choice? and Does hyperbolic space affect the concept of the speed of light? Daubechies fielded the questions: What is speech analysis and how are wavelets used in this area? and Where can we learn more about wavelets? Both speakers responded to the questions: What are you working on now? How did your math experience and background influence your career? Are there fields and careers that are growing in mathematics? What do you do when you have no idea how to solve a problem? and Why should one study the beauty of mathematics?

The purpose of the Arnold Ross series of lectures is to stimulate the interest of talented high school students in mathematics beyond the traditional classroom. It is also intended to show young people the tremendous opportunities for them to pursue careers in mathematics. The students' enthusiasm for the 1994 Arnold Ross lectures leaves no doubt that the lectures were an overwhelming success.

NRC Report on Renewing the "Contract" Between Science and Society

A new report by the National Research Council (NRC) puts a finger on a very sore spot in the scientific community today: the deteriorating relations between science and public policy. The report, which is based on an NRC conference held in Chantilly, Virginia, in August 1993, takes an unflinching but ultimately hopeful look at how science can renew its "contract" with society so that science continues to thrive while also responding to societal needs.

The report begins with a preface by the cochairs of the conference, Richard N. Zare, a chemistry professor at Stanford University, and Radford Byerly, Jr., vice-president of the University Corporation for Atmospheric Research. Zare is also chair of the NRC's Commission on Physical Sciences, Mathematics, and Applications. Following the preface are a summary of the conference by Princeton University President Harold T. Shapiro and five commissioned papers by participants in the conference.

The gathering was deliberately kept small, with only about forty people attending the two-day meeting. Among them were three mathematicians: Ronald G. Douglas, vice-provost of the State University of New York at Stony Brook; Phillip A. Griffiths, director of the Institute for Advanced Study; and Ettore Infante, senior vice-president of the University of Michigan. Mathematics is not discussed explicitly in the report itself, and many of the specific examples provided are drawn from the physical sciences. Nevertheless, many of the arguments and ideas apply to all areas of science. Much of the document examines why public confidence in and support for science has eroded and attempts to frame a new dialogue to help both sides to see how their interests mesh and how each can support the other.

"The impetus for organizing the 'dialogue' was a growing recognition among senior researchers, administrators, and science policy analysts that science—especially the physical and mathematical sciences—is being affected by major changes in its external environment, nationally and internationally," the report's preface states. The end of the cold war, changing patterns of federal support, new roles for national laboratories, and industry's reexamination of its research needs are some of the changes cited as influencing support for science. In addition, the pressures of competing in a global economy come into play. Albert Narath of Sandia Corporation and P. A. Fleury and R. J. Eagan of Sandia National Laboratories put it this way: "[T]he realization that the real threat to national security is an economic struggle in which many foreign nations have achieved startling successes without sizable investments in basic science is causing a critical reassessment of national research priorities."

In this climate, science is being asked to justify in new ways what it does. For example, the preface cites as a central question being asked today, "How can we reconcile the apparent conflict between scientists following their own best judgments as to where the best opportunities for scientific breakthroughs are to be found and the need for funders of the scientific enterprise to demonstrate accountability and to direct the work of scientists to those areas most likely to yield benefits to society?" These pressures appear to affect the mathematical and physical sciences more than other areas. As the preface puts it, "the rationale for public support of [the mathematical and physical] sciences is no longer as clear as the argument for publicly funding the biomedical or the engineering sciences."

Shapiro's synthesis of the conference lays out some of the central issues. The conference participants agreed that science is "an enormous source of ideas through which society can achieve many important goals," but that science alone cannot solve all problems and, in particular, there are many important problems that science cannot solve. They also agreed that "science requires public support, and publicly supported science is therefore a civic activity. . .a sense of public responsibility should pervade the [research] enterprise." Among the main problems emerging in discussions were how to decide the appropriate level and allocation of federal investment in research, who should control the scientific agenda in order to best serve the nation's interests, the tendency to view all branches of science as having the same or roughly similar problems, and what the appropriate goals are for U.S. science policy.

The report provides bracing glimpses at how some sectors

perceive the nation's investment in science. One of the commissioned papers, by William Ascher of the Sanford Institute of Public Policy at Duke University, writes, "Federal funding for basic and applied research, excluding development, increased from $8 billion in 1960 to $21 billion in 1990 (in constant 1990 dollars)—an increase of more than 160% during a period in which per capita incomes increased by 80%. And yet, since 'putting a man on the moon', there have been no successful charismatic developments in science that have captured the public's awe. Conceivably this could change with the discovery of a cure for AIDS or the peaceful harnessing of fusion power, but thirty years has been a very long time to wait for inspiring breakthroughs."

"The breakdown of the justifying myth of science appears to be a very strong possibility," Ascher writes in his conclusion. "The argument for science for its own sake seems unnecessary (why would science that can be justified for its short- or long-term potential for serving societal needs be any less promising a priori than science undertaken out of curiosity or as a result of the momentum of Ph.D. mills and peer-review cliques?), and the Bush economic argument for basic science is increasingly problematic. In short, scientists will be held accountable."

In his paper "In Defense of Basic Research", Daniel Kleppner, a physicist at the Massachusetts Institute of Technology, discusses how the "serendipity argument" for supporting basic research has met with skepticism in recent years. In support of this argument, he describes current-day benefits of his work in the 1950s on the development of the atomic clock. "The atomic clock research took years to start paying off: more than two decades for military use, more than three decades for a consumer industry," he notes. "However, the financial return from this single project is likely to considerably exceed the cost of all the basic research in atomic physics ever done in the United States."

"Science critics will argue that the serendipity argument is unconvincing because it is anecdotal and anecdotal arguments are suspect," he goes on. "Furthermore, serendipity can happen anywhere: science has no monopoly on good luck. In practice, however, it is difficult to think of any institution in which serendipity pays off so relentlessly and so bountifully as it does in basic research. Technology-driven programs, for example, are not particularly good bets for serendipity. To cite one example, the spin-offs from NASA's manned space program have been paltry." By comparison, the discovery of the buckyball and C_{60} compounds, he says, has far greater potential for applications. This discovery grew out of an area of basic research that, Kleppner drily notes, "would not rank high on most lists of potentially useful projects and whose cost, one might add, would be in the noise of a NASA budget."

Hampering communication between the scientific community and policymakers are a lack of realistic understanding of and overblown confidence in what science can deliver. "Too often policymakers turn to science in the search for political cover," writes Dale Jamieson of the Center for Values and Social Policy at the University of Colorado at Boulder. "If science will decide an issue, the policymaker won't have to make a decision. . . . In their search for funding, the research community encourages this attitude. Indeed, over the last several decades leading scientists have sometimes made predictions about what they could accomplish with large sums of money that would have embarassed P.T. Barnum (and in some cases their predictions have been just about as credible)." On the other hand, he notes, "Too often science has been promoted for instrumental reasons as providing solutions to problems it cannot really solve. Instead it should be celebrated for its connections with some of our most fundamental human needs and desires."

A number of writers touch on the fact that, in the United States, much of scientific research is centered in educational institutions, which have become the focus of a great deal of mistrust on the part of the public. Shapiro calls this the "university problem": "Many (not all) [conference] participants expressed the concern that the nation's research universities are not being adequately responsive to the nation's contemporary challenges. . . . Some of the concerns focused on inefficiency, some on the claimed distortions of the tenure system, and some on the question of whether or not the social outputs of the university are well balanced (e.g., teaching versus research)."

"The best researchers are not always the best teachers, and the best teachers are not always the best researchers," Jamieson flatly states. "The plain truth is that, on the whole the scientific community values research more than education, and universities are structured in a way that expresses this priority. . . . Without a better-developed link to education, some areas of research could find themselves in much the same position as symphony orchestras—imperiled because they are expensive and elitist and have done little to develop their audiences."

The aim of the conference was not to provide easy answers (there don't seem to be any), but rather to start a dialogue. Therefore the report provides little in the way of concrete recommendations toward solving these confounding problems. But some first steps are suggested. "A good place to start is for the science community to strongly and unequivocally oppose earmarked or pork barrel projects in the federal research funding portfolio," write Narath, Fleury, and Eagan. "A second need is for priority setting among different fields of science, a challenge that remains unmet today. Finally, every effort must be made to remove barriers that impede constructive interactions between discovery and utility phases."

They go on to say that, without a science base that encourages curiosity-driven research, demands excellence, and achieves balance among different areas of science, "there will eventually be *no* discoveries to transform into utility. Yet without improved efficiency and accountability in transforming discoveries into utility, the tangible societal benefits will be insufficient to argue convincingly for sustained support of science at levels much higher than our society has traditionally deemed appropriate for purely intellectual endeavors like poetry or music. The simple, inescapable truth is that science needs society in order to thrive, and society needs science if its dreams of a better world for future

generations are to be realized."

The NRC intends the report as a first step toward discussion of these issues. Bruce Alberts, president of the National Academy of Sciences, sent a copy of the report to the AMS to ask for input and for ideas about how to stimulate discussion. The AMS Committee on Science Policy (CSP) has undertaken the task of formulating a response to the report, in order to contribute to the discussion and to insure that the point of view of mathematics is represented. By the time this issue of the *Notices* reaches its readers, two more meetings organized by the NRC will have taken place, one in San Francisco and one in Denver, Colorado. Ronald Douglas will attend the Denver meeting, as a representative of the CSP.

The CSP urges the mathematical sciences community to contribute thoughts and ideas that could be used in formulating the AMS response to the report. To obtain a copy of the report, send an e-mail message requesting the "Chantilly Report" to the NRC's Board on Mathematical Sciences, `bms@nas.edu`. Or contact Ruth O'Brien, Board on Mathematical Sciences, National Research Council, 2101 Constitution Avenue NW, Washington, DC 20418; telephone 202-334-2421. Comments on the report may be directed to the CSP by sending e-mail to `comsp@math.ams.org` or by writing to: Committee on Science Policy, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248.

Allyn Jackson

1994 AMS Elections

(Memorandum)

To: All AMS Members

From: Robert Fossum, Secretary

Subject: Important Election Information for 1994

Date: June 6, 1994

The *Notices* of the American Mathematical Society has traditionally been used as a vehicle to convey election information to all members. Since 1991, all pertinent election material (except for the actual ballot) has been included in the September *Notices*. In addition, the election materials (with the ballot included) have always been sent in a separate mailing in September to all members.

At the request of the Secretary, the method for distributing and collecting ballots has been reviewed by the AMS staff. Several proposals were considered by the Committee on the Profession (CPROF) at its meeting in May of this year. The proposals were also considered by the Executive Committee and Board of Trustees later that month. Based on recommendations from these committees, the Secretary has approved the process under which, beginning with the 1994 election, all election materials will be printed in the September *Notices*. In those *Notices* mailed to individual domestic members, a colored ballot sheet and return envelope will be included. For individual foreign members only, the ballot materials will be extracted from the September *Notices* and formatted as an 8 1/2 × 11 booklet. The booklet, along with a ballot sheet and return envelope, will be mailed ISAL to individual foreign members. Under the new procedures, the Society will eliminate the separate September mailing.

The ballots should be returned in the envelope provided, addressed to the Society's ballot processing service. This service is instructed to count only those ballots returned in envelopes with signatures. So please sign the outside of the envelope when returning your marked ballots.

When you receive your September issue of the *Notices*, I urge you to study the ballot materials enclosed and, more importantly, to return a completed ballot. I hope that the percentage of members who participate in the election continues to increase.

If you have comments about this procedure they should be directed to the Secretary. Comments included in the ballot envelope will NOT be read. Comments and suggestions as to how to improve the election process are always welcome.

1994 AMS Elections

Biographical information on candidates in the 1994 AMS Election and full text of proposed Amendments to the Bylaws will appear in the **September 1994** issue of the *Notices*.

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 1994.

The vice-president will serve for a term of three years effective February 1, 1995. The Council has nominated three candidates for the position, namely:

C. Herbert Clemens
Joseph B. Keller
Gian-Carlo Rota (by petition)

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

Georgia M. Benkart
Carlos Castillo-Chavez
David B. A. Epstein
Cameron M. Gordon
James M. Hyman
Jerrold E. Marsden
Cora Sadosky
Alice Silverberg
Mark W. Winstead
Benjamin A. Lotto (by petition)

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

Donald E. McClure
Frank C. Hoppensteadt

President's Candidates

Nominating Committee for 1994 and 1995

Three members of the Nominating Committee are to be elected in the fall of 1994. Continuing members are Jerome A. Goldstein, Morris W. Hirsch, Vaughan F. R. Jones, Hugh L. Montgomery, Linda Preiss Rothschild, and Nancy K. Stanton.

President Ronald Graham has named six candidates for the other three places:

Jerry L. Bona
Ingrid Daubechies
William James Lewis
Rogers J. Newman
Stephen D. Smith
Susan Gayle Williams

Editorial Boards Committee

Two members of the Editorial Boards Committee are to be elected in the fall of 1994. Continuing members are Bryan J. Birch, Fan R. K. Chung, Martin Golubitsky, and Carolyn S. Gordon.

President Ronald Graham has named four candidates for the other two places:

Robert J. Blattner
Rhonda J. Hughes
Harold M. Stark
Herbert S. Wilf

Robert M. Fossum
Secretary
Urbana, Illinois

Minneapolis Mathfest
Minneapolis, Minnesota, August 15–17, 1994

Preliminary Program

The preliminary program for the Minneapolis Mathfest follows. Individuals who registered by June 11 and who so elected will have their badge and the final program mailed to them before the Mathfest. All other registrants must pick up the final program at the Registration Desk in the Terrace Room in Middlebrook Hall on the West Bank Campus of the University of Minnesota, Minneapolis. Participants who have not yet registered should read the information in the April and May/June issues of the *Notices* for further details. The additional information below is to assist those who will register at the meetings and those registered in advance who elected not to receive their badges and final programs by mail.

Program Updates

AMS Sessions

The Committee on Science Policy panel discussion will not be held.

MAA Sessions

Presenters in the *SUMMA Workshop* include **Lily E. Christ**, John Jay College, CUNY; **Nadina M. Duran**, Texas A&M University, Corpus Christi; and **Lyle Anderson**, Montana State University.

Social Events

Constance Reid will be the featured speaker at the MAA 25-year Member Banquet on Wednesday night.

Registration at the Meetings

Mathfest registration fees only partially cover expenses of holding meetings. All mathematicians and students who wish to attend sessions are expected to register and should be prepared to show the meetings badge, if so requested. Badges are required to obtain discounts at the AMS and MAA Book Sales and to cash a check with the meetings cashier. If advance registrants should arrive too late in the day to pick up their badges, they may show the acknowledgment received from the Mathematics Meetings Service Bureau (MMSB) as proof of registration.

Registration fees: Registration fees may be paid at the meetings by cash, traveler's checks, or by VISA or MasterCard. Although other credit cards are being accepted by hotels for housing payments, only VISA or MasterCard can be accepted for registration. Checks drawn on Canadian banks must be marked "in U.S. funds."

Letters verifying attendance at the meetings can be obtained from the cashier or at the Registration Assistance Section of the Registration Desk.

Participants wishing to attend sessions for one day only may take advantage of a one-day fee. These special fees are effective daily, August 15 through 17. These one-day fees are not applicable to librarians, high school teachers, unemployed or emeritus participants, or high school, undergraduate, or graduate students.

Minneapolis Mathfest	
Member of AMS, Canadian Mathematical Society, MAA, ΠME	$163
Nonmember	252
Emeritus Member of AMS, MAA, Graduate Student, Unemployed, Librarian, High School Teacher, Third-World Country Participant	45
Undergraduate Student	26
High School Student	5
Minneapolis Mathfest One Day	
Member of AMS, CMS, MAA	$ 98
Nonmember	135
MAA Minicourses (if openings available)	
Minicourse #1	$ 65
Minicourses # 2–8	45

All **full-time students** currently working toward a degree or diploma qualify for the student registration fees, regardless of income.

The **unemployed** status refers to any person currently unemployed, actively seeking employment, and not a student. It is not intended to include any person who has voluntarily resigned or retired from his or her latest position.

Persons who qualify for **emeritus** membership in either the Society or the Association may register at the emeritus member rate. The emeritus status refers to any person who has been a member of the AMS or MAA for twenty years or more and who is retired on account of age or on account of long-term disability from his or her latest position.

The **high school teacher** status refers to any person whose primary employment is teaching in any high school or secondary school.

The **librarian** status refers to any person who has a degree in library science and whose primary employment is working in a library.

Third-world country status refers to those participants from the third world where salary levels are radically non-commensurate with those in the U.S.

Nonmembers who register at the nonmember fee will receive mailings containing information about a special membership offer from AMS and MAA after the meeting is over.

There is no extra charge for members of the families of registered participants, except that all professional mathematicians who wish to attend sessions must register independently.

Participants should check with their tax preparers for applicable deductions for education expenses as they pertain to this meeting.

Accommodations

Participants who did not reserve a room during advance registration but who would like to obtain a dormitory room should go to the front desk of Middlebrook Hall on the West Bank Campus. **The number of rooms available is very limited and participants may not be accommodated.** Participants who are assigned a room should then go to the registration assistance section of the Mathfest Registration Desk in the Terrace Room to make payment. All room payments must be made before the end of the meeting to avoid invoice charges after the meeting. **University staff cannot accept any room payments.**

Those who would like hotel accommodations should refer to the list of hotels on page 340 in the April issue of the *Notices* and call directly for reservations. Because the deadline for reservations has passed, we regret that the MMSB can no longer guarantee availability of rooms.

Registration Dates, Times, and Locations

Minneapolis Mathfest
and MAA Minicourses (until filled)
Terrace Room, Middlebrook Hall

Sunday, August 14	noon to 5:00 p.m.
Monday and Tuesday August 15 – 16	8:00 a.m. to 4:00 p.m.
Wednesday, August 17	8:00 a.m. to 2:00 p.m.

Travel

The campus is located along the Mississippi River, which divides the East Bank Campus from the West. These are connected by a covered bridge on Washington Avenue. Bus #16 runs along this major avenue. Another main artery, University Avenue, is along the north border of the West Campus; Washington Avenue intersects it slightly east of the campus.

Air Travel: Call **Continental** at 800-468-7022 (refer to Easy Access Number ZM34) or **Northwest** Airlines at 800-328-1111 (refer to Worldfile Number NC79U) for specially negotiated rates. We strongly urge participants to make use of these special deals if at all possible, since the AMS and MAA can earn complimentary tickets on these carriers. These tickets are used to send meetings' staff (not officers or other staff) to the Mathfest, thereby keeping the costs of the meeting (and registration fees) down.

AMTRAK: The nearest AMTRAK station is located about three blocks north of University Avenue, a few miles east of the campus. Taxis are available to take you to your hotel. If you wish to take a public bus, walk south down Transfer Road to University Avenue. At the northeast corner of the intersection, take the #16 bus going west to the campus. Call 800-872-7245 for AMTRAK reservations.

Travel from the airport: A taxi from the Minneapolis/St. Paul International Airport to the campus costs approximately $20–25 for the 10 mile ride. The Airport Express shuttle will take you to some of the major hotels near the campus for $10 one way, or $15 round trip. (Comstock and Middlebrook Residence Halls are a five- to ten-minute walk from the Holiday Inn Metrodome.) Their office is located near baggage carousel #9.

Bus #7 runs from the airport to downtown every 20 to 30 minutes. You must transfer to the #16 bus to the campus area. Fare is $1.25, exact change required.

Automobile approaches to the East Bank campus: From the south, go north on Interstate 35W to University Avenue. Exit east and go about five blocks. The university is on your right.

From the north, go south on 35W and take the Washington Avenue exit. Go east on Washington through the covered bridge over the Mississippi to campus.

From the west, go east on Interstate 394 to Route 94 to 35W (going north). Follow directions as if coming from the south.

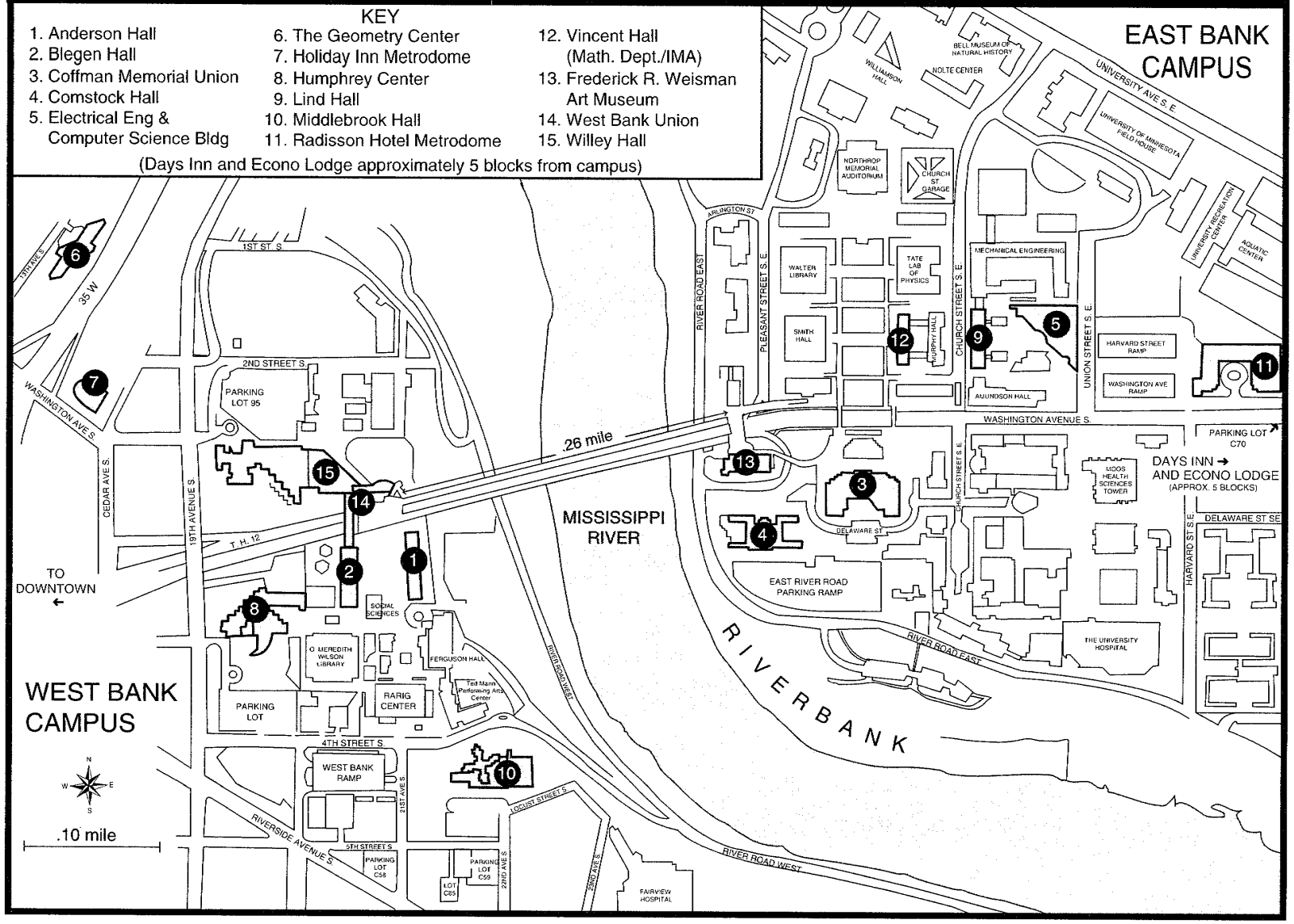
From the east, go west on Route 94 and take the University exit to 4th St., SE. At the intersection with 15th Avenue, go south one block until you see the main entrance to the campus ahead of you.

To drive to Middlebrook Hall: Take the Riverside Avenue exit from I-94 on the west side of the Mississippi. Turn north and follow Riverside Avenue for approximately 1/2 mile. Turn right onto 22nd Avenue (at Smiley's Point Clinic) and go down the hill to Middlebrook.

To drive to Comstock Hall: Take the University exit from I-94 and follow to Oak Street. Turn left onto Washington Avenue, the second stoplight. Turn left again onto Church Street and right at the stop sign on Delaware Street. Go behind Coffman Union to Comstock Hall.

On campus: Complimentary shuttle service is provided on the campus Monday through Friday. Service begins at 7:10 a.m. from Blegen Hall and runs every half hour until 5:30 p.m. Route details will be available at the meeting.

UNIVERSITY OF MINNESOTA, MINNEAPOLIS



Program of the Sessions

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

Abstracts of papers presented in the sessions at this meeting will be found in the August 1994 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

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

Papers flagged with a solid triangle (▸) may be of interest to undergraduate students.

Sunday, August 14

MAA Board of Governors

8:30 a.m.–4:00 p.m.

AMS Council

9:00 a.m.–6:30 p.m.

Monday, August 15

AMS-MAA Invited Address

8:30 a.m.–9:20 a.m.

(1) *Reform in mathematics education: New or simply a variation on an old theme?*
Carole B. Lacampagne, U. S. Department of Education, Washington, DC (894-00-102)

MAA Earle Raymond Hedrick Lectures: Lecture I

9:35 a.m.–10:25 a.m.

▸ (2) *Searching for the shortest network.*
Ronald L. Graham, AT&T Bell Laboratories, Murray Hill, New Jersey (894-00-106)

AMS Progress in Mathematics Lecture

10:40 a.m.–12:10 p.m.

(3) *On Boltzmann's equation and its applications.* Part I.
Pierre Louis Lions, Université de Paris IX, France (894-00-104)

11:30 a.m. Part II

Pi Mu Epsilon Council

noon–2:30 p.m.

MAA Minicourse #1: Part A

1:00 p.m.–3:00 p.m.

Building discrete and continuous ecological models using the SLAM simulation language.
James V. Caristi, Valparaiso University

MAA Minicourse #2: Part A

1:00 p.m.–3:00 p.m.

Calculus from graphical, numerical, and symbolic points of view.
Arnold M. Ostebee and **Paul Zorn**, Saint Olaf College

MAA Minicourse #3: Part A

1:00 p.m.–3:00 p.m.

Combinatorics via functional equations.
Donald R. Snow, Brigham Young University

AMS Special Session on q-Series, I

1:30 p.m.–4:40 p.m.

1:30 p.m. (4) *Some values for the Rogers-Ramanujan continued fraction.*
Bruce C. Berndt* and **Heng Huat Chan**, University of Illinois, Urbana-Champaign (894-33-25)

2:10 p.m. (5) *On Ramanujan's cubic continued fraction.*
Heng Huat Chan, University of Illinois, Urbana-Champaign (894-11-19)

2:50 p.m. (6) *Transformations between products and continued fractions.*
Douglas Bowman, University of Illinois, Urbana-Champaign (894-33-72)

3:30 p.m. (7) *Some new observations on the Göllnitz-Gordon and Rogers-Ramanujan identities.*
Krishnaswami Alladi, University of Florida (894-11-20)

4:10 p.m. (8) *Irrationality and orthogonality.*
Peter Borwein, Simon Fraser University (894-33-37)

AMS Special Session on History of Mathematical Logic and Theoretical Computer Science, I

1:30 p.m.–3:20 p.m.

1:30 p.m. ▸ (9) *Forty years of automated theorem proving.*
Ronald W. Fechter and **Ronald Sklar***, Saint John's University (894-01-58)

2:10 p.m. ▸ (10) *The axiomatic method and Ernst Schröder's algebraic approach to logic.*
Volker Peckhaus, University of Erlangen-Nurnberg, Germany (894-01-61)

2:50 p.m. (11) *Computing collective rational decisions.*
Francine F. Abeles, Kean College of New Jersey (894-01-59)

AMS Special Session on Computer Graphics as a Research Tool in Geometry and Topology, I

1:30 p.m.–5:30 p.m.

1:30 p.m. (12) *Crystalline surface diffusion.*
Jean E. Taylor, Rutgers University, New Brunswick (894-49-13)

2:10 p.m. (13) *The surface evolver.*
Kenneth Brakke, Susquehanna University (894-49-34)

2:50 p.m. (14) *Approaches to simulating 4D worlds.*
Andrew Hanson, Indiana University, Bloomington (894-57-65)

3:30 p.m. (15) *Using the evolver for geometric optimization problems.* Preliminary report.
John M. Sullivan, University of Minnesota, Minneapolis (894-53-64)

4:10 p.m. (16) *Untangling unknots, unlinks and untangles with the Möbius energy.*
Robert Barnard Kusner, University of Massachusetts, Amherst (894-57-69)

5:00 p.m. (17) *Surfaces embeddable in R^3 with ergodic geodesic flow.*
Victor J. Donnay*, Bryn Mawr College, and **Keith H. Burns**, Northwestern University (894-58-23)

AMS Session of Contributed Papers, I

1:30 p.m.–4:25 p.m.

1:30 p.m. (18) *Pseudo-uniform convergence and its nonstandard formulation.*
Nader Vakil, Western Illinois University (894-03-30)

1:45 p.m. (19) *Counting arrangements of 1's and -1's.*
Donald F. Bailey, Trinity University (894-05-24)

2:00 p.m. (20) *Tree singularity.*
Brigitte Servatius*, Worcester Polytechnic Institute, **John W. Kennedy**, Pace University, and **Ivan Gutman**, University of Kragujevac, Yugoslavia (894-05-76)

2:15 p.m. (21) *Recurrences for 2-colored and 3-colored F-partitions.*
James A. Sellers, Cedarville College (894-11-08)

2:30 p.m. (22) *A note on polynomials of the form $x^{ll} + a_k x^k + \ldots + a_1 x + a_0$ over finite fields.* Preliminary report.
Javier Gomez-Calderon, Pennsylvania State University, New Kensington Campus (894-11-22)

2:45 p.m. (23) *ACF algorithm and infinite series.* Preliminary report.
Malvina Baica, University of Wisconsin, Whitewater (894-12-18)

3:00 p.m. (24) *Efficient generation of the ring of invariants.*
Shou-Jen Hu, Tamkang University, Taiwan, Republic of China (894-13-27)

3:15 p.m. (25) *Spectra of modules.*
Sylvia C. Lu, University of Colorado, Denver (894-13-52)

3:30 p.m. (26) *The Jacobian problem from the viewpoint of ind-affine varieties.* Preliminary report.
T. Kambayashi, Tokyo Denki University, Japan (894-14-33)

3:45 p.m. (27) *Minimum permanents of doubly stochastic matrices with zero main diagonal.* Preliminary report.
John Brian Burghduff, Kingwood College (894-15-45)

4:00 p.m. (28) *Nilpotency of derivations in prime rings.*
David W. Jensen, United States Military Academy (894-16-32)

4:15 p.m. (29) *Characterization of spherical transform of functions and Schwartz multipliers on the Heisenberg Group.* Preliminary report.
Tefera Worku, State University of New York, Albany (894-22-53)

MAA-Mu Alpha Theta Lecture

1:40 p.m.–2:30 p.m.

(30) *Generating enthusiasm while pursuing equity in mathematics.*
Pamela J. Drummond, Kennesaw State College (894-00-112)

SUMMA Workshop

2:00 p.m.–3:50 p.m.

Intervention projects for minority precollege students.

Organizer: **William A. Hawkins**, Director of SUMMA

Monday, August 15 (cont'd)

The Geometry Center Poster and Video Session

2:00 p.m.–4:00 p.m.

MAA Session on Recreational Mathematics and Computing, I

2:20 p.m.–5:35 p.m.

2:20 p.m. ▸ (31) *Using graph theory to solve an instant insanity puzzle.* **Helen Christensen**, Loyola College (894-00-221)

2:40 p.m. ▸ (32) *Applied probability on the "The Price is Right".* **William Butterworth***, Barat College, and **Paul R. Coe**, Rosary College (894-00-220)

3:00 p.m. ▸ (33) *Optimal stopping in "The Showcase Showdown". II: The spin-off.* **Paul R. Coe***, Rosary College, and **William Butterworth**, Barat College (894-00-222)

3:20 p.m. ▸ (34) *The return time for a random walk on a regular figure equals the number of vertices in the figure.* **Thomas J. O'Reilly**, Saint Joseph's University (894-00-226)

3:40 p.m. ▸ (35) *How to lose at Tetris.* **Heidi Burgiel**, University of Washington (894-00-219)

4:00 p.m. ▸ (36) *Juggling matrices.* **Michael Keith**, Beaverton, Oregon (894-00-223)

4:20 p.m. ▸ (37) *Computational approaches to the Josephus problem.* **Bill Marion, Jr.**, Valparaiso University (894-00-225)

4:40 p.m. ▸ (38) *Mastermind revisited.* **Leonard Smiley**, University of Alaska (894-00-227)

5:00 p.m. (39) *Combinatorial properties of Mancala.* **Daniel E. Loeb**, Université de Bordeaux I, France (894-00-224)

5:20 p.m. ▸ (40) *The computer solution of two unsolved Pentomino problems.* **Charles D. Ashbacher**, DecisionMark Corporation (894-00-218)

MAA Student Paper Sessions

2:45 p.m.–5:00 p.m.

PME Contributed Paper Sessions

2:45 p.m.–5:00 p.m.

AWM Panel Discussion

3:00 p.m.–4:30 p.m.

Celebrating women's achievements in algebra, analysis, combinatorics, and geometry: past, present, and future.

Organizer: **Joan Hutchinson**, Macalester College

Panelists: **Jane P. Gilman**, Rutgers University
Karen Saxe, Macalester College
Doris J. Schattschneider, Moravian College
Marie A. Vitulli, University of Oregon

MAA Minicourse #4: Part A

3:30 p.m.–5:30 p.m.

Multivariable calculus using the Harvard Calculus Consortium materials. **Thomas W. Tucker**, Colgate University

MAA Minicourse #5: Part A

3:30 p.m.–5:30 p.m.

Mathematical models of epidemics. **Sonja Sandberg**, Framingham State College

MAA Minicourse #6: Part A

3:30 p.m.–5:30 p.m.

Unifying themes for discrete mathematics. **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology

MAA Section Officers' Meeting

3:45 p.m.–5:45 p.m.

Institute for Mathematics and its Applications Presentation

4:30 p.m.–5:30 p.m.

Mathematical modeling for instructors.

Tuesday, August 16

AMS-MAA Invited Address

8:30 a.m.–9:20 a.m.

(41) *Knots.*
Cameron McA. Gordon, University of Texas, Austin (894-00-101)

MAA Earle Raymond Hedrick Lectures: Lecture II

9:35 a.m.–10:25 a.m.

▶ (42) *Some generalizations of* $1 + 1 = 2$.
Ronald L. Graham, AT&T Bell Laboratories, Murray Hill, New Jersey (894-00-107)

AMS History of Mathematics Lecture

10:40 a.m.–11:30 a.m.

(43) *The well-poised thread: Some amazing sums of Gauss, Kummer, Ramanujan and others.*
George E. Andrews, Pennsylvania State University, University Park (894-00-103)

AMS Business Meeting

11:45 a.m.–12:15 p.m.

NAM Special Invited Lecture

1:00 p.m.–1:50 p.m.

(44) *Large deviations for martingales.*
David Blackwell, University of California, Berkeley (894-00-111)

AMS Special Session on q-Series, II

1:00 p.m.–4:10 p.m.

1:00 p.m. (45) *Nonnegativity results for generalized q-binomial coefficients.*
Susanna D. Fishel, Southern Connecticut State University (894-05-48)

1:40 p.m. (46) *A nonnegative expansion for Hall polynomials* Preliminary report.
Lynne M. Butler*, Haverford College, and **F. Miller Maley**, Princeton University (894-05-73)

2:20 p.m. (47) *Applications of* q*-differential calculus to combinatorics.*
Warren P. Johnson, Pennsylvania State University, University Park (894-05-43)

3:00 p.m. (48) *More cranks and t-cores.* Preliminary report.
Frank Garvan, University of Florida (894-11-71)

3:40 p.m. (49) *Parity of the partition function in arithmetic progressions.*
Ken Ono, University of Georgia (894-05-14)

AMS Special Session on History of Mathematical Logic and Theoretical Computer Science, II

1:00 p.m.–2:55 p.m.

1:00 p.m. (50) *A new conceptual framework for large cardinals based on an old concept of infinity.* Preliminary report.
Paul Corazza, Maharishi International University (894-03-57)

1:45 p.m. (51) *Nonstandard analysis as a historiographic tool.*
Mark B. McKinzie, University of Wisconsin, Madison (894-01-75)

2:25 p.m. (52) *Applied logic in digital design.*
Curtis D. Tuckey, AT&T Bell Laboratories, Naperville, Illinois (894-01-79)

MAA Minicourse #7: Part A

1:00 p.m.–3:00 p.m.

Open problems in plane geometry. **William O. J. Moser**, McGill University, and **Janos Pach**, CCNY and Mathematical Institute of the Hungarian Academy of Sciences

MAA Minicourse #8: Part A

1:00 p.m.–3:00 p.m.

The Math Modeling/Precalculus Reform Project: Using discrete mathematical models to motivate mathematics.
Sheldon P. Gordon, Suffolk Community College, and **B. A. Fusaro**, Salisbury State University

AMS Session of Contributed Papers, II

1:00 p.m.–4:25 p.m.

1:00 p.m. (53) *Using orientation and fixed points to classify isometries.*
James M. Parks, State University of New York, College at Potsdam (894-51-47)

1:15 p.m. (54) *The generalized apollonius contact problem.* Preliminary report.
Jay P. Fillmore*, University of California at San Diego, La Jolla, and **Arthur Springer**, San Diego State University (894-51-26)

1:30 p.m. (55) *Isohedral triangular tilings in the hyperbolic plane and other 2-manifolds.*
Grattan P. Murphy, University of Maine, Orono (894-51-44)

1:45 p.m. (56) *The maximal number of* 3*-*D *spheres that can fit around a like sphere.*
C. Musès, Mathematics & Morphology Ed & Research Center, Canada (894-52-28)

Tuesday, August 16 (cont'd)

2:00 p.m. (57) *Wild arcs related to differential topology.*
Margaret M. LaSalle, University of Southwestern Louisiana (894-53-17)

2:15 p.m. (58) *Geodesics in Lorentzian Clairaut submersions.* Preliminary report.
Dean Allison, University of Northern Colorado (894-53-41)

2:30 p.m. (59) *Space curves with singularities.*
Paul D. Scofield, Washington & Lee University (894-53-77)

2:45 p.m. (60) *Simple arcs of positive measure.*
Shiojenn Tseng* and **Jyh-Ching Liang**, Tamkang University, People's Republic of China (894-54-31)

3:00 p.m. (61) *Random walks on finite groups supported on related subsets.*
Martin V. Hildebrand, University of Minnesota, Minneapolis (894-60-40)

3:15 p.m. (62) *Noncommutative harmonic analysis for image representation.*
Jacek Turski, University of Houston, Downtown (894-68-21)

3:30 p.m. (63) *Using writing assignments to motivate mathematics.*
Timothy R. Ray, Southeast Missouri State University (894-98-74)

3:45 p.m. (64) *Stable winning coalitions.*
Daniel E. Loeb, University of Bordeaux I, France (894-90-15)

4:00 p.m. (65) *Minimal shape preserving projections onto Π_n.*
Michael Prophet, Idaho State University (894-55-80)

4:15 p.m. (66) *Singularity index theorem and its applications.*
Jinghuang Tian, Institute of Mathematical Sciences, People's Republic of China (894-34-81)

MAA Session on Innovative Projects in First-year Courses, I

1:00 p.m.–4:35 p.m.

1:00 p.m. ▸ (67) *Fun with parametric equations.*
Howard Lewis Penn, United States Naval Academy (894-00-212)

1:20 p.m. ▸ (68) *A menu of computer-based projects.*
Emelie A. Kenney*, **Leonard J. Putnick**, **Steven Bloom**, **Thomas H. Rousseau** and **Susan Hurley**, Siena College (894-00-208)

1:40 p.m. ▸ (69) *Using spreadsheets to solve social choice problems.*
Lucy L. Deephouse* and **Margaret C. Cibes**, Trinity College (894-00-203)

2:00 p.m. ▸ (70) *Using biography and history to encourage students in beginning algebra.*
Paul E. Becker, Saginaw Valley State University (894-00-200)

2:20 p.m. ▸ (71) *Oxygen consumption, fatigue and athletic performance.*
Walter Barge, **Todd Crowder** and **David W. Jensen***, United States Military Academy (894-00-207)

2:40 p.m. ▸ (72) *A precalculus project on (exponential) population growth and (linear) food production.*
Michael A. McDonald*, Occidental College, **Emily E. Puckette**, Duke University, and **Charles M. Vuono**, Nagoya University, Japan (894-00-209)

3:00 p.m. ▸ (73) *Linguistics, culture and mathematics.*
Martin M. Sternstein, Ithaca College (894-00-215)

3:20 p.m. ▸ (74) *Modeling and calculators in first year mathematics courses.*
Dan A. Novak* and **Martin M. Sternstein**, Ithaca College (894-00-211)

3:40 p.m. ▸ (75) *Teaching trigonometric identities.*
Wilton E. L. Clarke, La Sierra University (894-00-201)

4:00 p.m. ▸ (76) *Modular arithmetic as a microcosm of mathematics.*
Catherine A. Gorini, Maharishi International University (894-00-206)

4:20 p.m. ▸ (77) *Optics workshop.*
Marc J. Dancer, Deerfield Academy, Massachusetts (894-00-202)

MAA Student Paper Sessions

1:00 p.m.–5:00 p.m.

MAA Ad Hoc Committee on Advising Panel Discussion

1:00 p.m.–2:30 p.m.

Advising undergraduate mathematics majors.

Moderator: **David J. Lutzer**, College of William and Mary

Panelists: **Judith Cederberg**, St. Olaf College
Stephen A. Doblin, University of Southern Mississippi
Diane L. Herrmann, University of Chicago
Andrew Sterrett, Jr., MAA

MAA Electronic Poster Session

1:00 p.m.–6:00 p.m.

Exploring mathematics on the Internet.

Organizer: **Eugene A. Herman**, University of Tennessee, Knoxville

Organizer: **Lawrence S. Husch**, University of Tennessee, Knoxville

PME Contributed Paper Sessions

1:00 p.m.–5:00 p.m.

MAA Panel Discussion

2:45 p.m.–4:30 p.m.

Calculus reform in different settings.
Organizer: **A. Wayne Roberts**, Macalester College
Organizer: **Sharon C. Ross**, DeKalb College

AMS Special Session on Computer Graphics as a Research Tool in Geometry and Topology, II

3:00 p.m.–5:30 p.m.

3:00 p.m. (78) *Visualization software development at the Geometry Center.* **Mark B. Phillips**, Geometry Center, Minneapolis, Minnesota (894-53-63)

3:40 p.m. (79) *Examples of energy flows for knotted surfaces in four-dimensions.* **Dennis Roseman**, University of Iowa (894-57-55)

4:20 p.m. (80) *Fourphront: A four-dimensional laboratory for examining surfaces.* **David C. Banks**, National Aeronautics & Space Administration, Hampton, Virginia (894-57-66)

5:00 p.m. (81) *A hierarchical classification of topological methods in pattern recognition.* **Monique L. Pavel**, University of Paris, France (894-68-01)

MAA Minicourse #1: Part B

3:30 p.m.–5:30 p.m.

Building discrete and continuous ecological models using the SLAM simulation language. **James V. Caristi**, Valparaiso University

MAA Minicourse #2: Part B

3:30 p.m.–5:30 p.m.

Calculus from graphical, numerical, and symbolic points of view. **Arnold M. Ostebee** and **Paul Zorn**, Saint Olaf College

MAA Minicourse #3: Part B

3:30 p.m.–5:30 p.m.

Combinatorics via functional equations. **Donald R. Snow**, Brigham Young University

MAA Panel Discussion

4:45 p.m.–6:00 p.m.

1994 International Olympiad winners' stories.
Organizer: **Walter Mientka**, University of Nebraska, Lincoln

PME J. Sutherland Frame Lecture

8:30 p.m.–9:30 p.m.

(82) *Cheating your way to the knot merit badge, by Scoutmaster Mel Slugbate.* **Colin C. Adams**, Williams College (894-00-109)

MAA Committee on the Participation of Women Presentation

8:30 p.m.–10:00 p.m.

Micro-inequities skits.

Wednesday, August 17

AMS-MAA Invited Address

8:30 a.m.–9:20 a.m.

(83) *Mathematical simulation of flow in porous media.* **Todd James Arbogast**, Rice University (894-00-100)

MAA Earle Raymond Hedrick Lectures: Lecture III

9:35 a.m.–10:25 a.m.

▸ (84) *Juggling drops and descents.* **Ronald L. Graham**, AT&T Bell Laboratories, Murray Hill, New Jersey (894-00-108)

AMS Progress in Mathematics Lecture

10:40 a.m.–12:10 p.m.

(85) *Galois representations and modular forms.* **Kenneth A. Ribet**, University of California, Berkeley (894-00-110)

Wednesday, August 17 (cont'd)

MAA Business Meeting

12:25 p.m.–12:55 p.m.

MAA Minicourse #4: Part B

1:00 p.m.–3:00 p.m.

Multivariable calculus using the Harvard Calculus Consortium materials. **Thomas W. Tucker**, Colgate University

MAA Minicourse #5: Part B

1:00 p.m.–3:00 p.m.

Mathematical models of epidemics. **Sonja Sandberg**, Framingham State College

MAA Minicourse #6: Part B

1:00 p.m.–3:00 p.m.

Unifying themes for discrete mathematics. **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology

MAA Student Lecture

1:40 p.m.–2:30 p.m.

(86) *What's really in the Cantor set?*
Gail S. Nelson, Carleton College (894-00-105)

AMS Special Session on q-Series, III

1:40 p.m.–4:50 p.m.

1:40 p.m. (87) *A constant term identity and a conjecture of Peter Forrester.*
Shaun Cooper, University of Wisconsin, Madison (894-05-35)

2:20 p.m. (88) *The Askey-Wilson polynomials and q-Sturm-Liouville problems.*
B. Malcolm Brown, W. Desmond Evans, University of Wales at Cardiff, Wales, and **Mourad E. H. Ismail***, University of South Florida (894-33-07)

3:00 p.m. (89) *Pearson equation and the q-beta integrals on the q-quadratic lattice.*
Mizanur Rahman*, Carleton University, and **Sergei K. Suslov**, Russian Research Centre, Russia (894-33-06)

3:40 p.m. (90) *$U(n+1)$ extensions of Rogers' form of the Bailey transform.*
Stephen C. Milne, Ohio State University, Columbus (894-33-46)

4:20 p.m. (91) *q-algebra representations of the euclidean, pseudo-euclidean and oscillator algebras, and their tensor products.* Preliminary report.
Willard Miller, Jr.*, University of Minnesota, Minneapolis, and **E. G. Kalnins**, University of Waikato, New Zealand (894-33-49)

AMS Special Session on History of Mathematical Logic and Theoretical Computer Science, III

1:40 p.m.–3:35 p.m.

1:40 p.m. ▸ (92) *Van Heijenoort in the logic classroom.*
Irving H. Anellis, Modern Logic Publishing, Ames, Iowa (894-01-62)

2:20 p.m. (93) *Propositional logic chez Boole, MacColl, Frege and Peirce.* Preliminary report.
Theodore Hailperin, Lehigh University (894-01-56)

3:00 p.m. (94) *The peripeties of intuitionistic logic.*
Colin McLarty, Case Western Reserve University (894-01-60)

AMS Special Session on Computer Graphics as a Research Tool in Geometry and Topology, III

1:40 p.m.–3:30 p.m.

1:40 p.m. (95) *Numerical geometry problems in the design of RTICA.*
George Francis, University of Illinois, Urbana-Champaign (894-53-67)

2:20 p.m. (96) *Optical models for volume rendering.*
Nelson Max, Lawrence Livermore National Laboratory, Livermore, California (894-78-29)

3:00 p.m. (97) *A system for computer-aided differential geometry.*
Paul Burchard, University of Minnesota, Minneapolis (894-57-68)

AMS Session of Contributed Papers, III

1:40 p.m.–4:50 p.m.

1:40 p.m. (98) *Univalent functions maximizing $Re[f(\zeta 1)+f(\zeta_2)]$.*
Intisar Qumsiyeh Hibschweiler, Daemen College (894-30-12)

1:55 p.m. (99) *New trigonometric expansions of Jacobian elliptic functions snu, cnu, dnu.*
David S. Tselnik, Fargo, North Dakota (894-33-02)

2:10 p.m. (100) *Multiple solutions of semilinear elliptic problems at resonance.*
E. Landesman, University of California, Santa Cruz, **S. Robinson**, Wake Forest University, and **Adolfo Rumbos***, Pomona College (894-35-16)

2:25 p.m. (101) *Second differences and the heat equation.* **Victor L. Shapiro**, University of California, Riverside (894-35-38)

2:40 p.m. (102) *Multipliers of sequence spaces.* II. Preliminary report. **George U. Brauer**, University of Minnesota, Minneapolis (894-40-11)

2:55 p.m. (103) *Simultaneous monotone approximation on the unit cube.* **Salem A. Sahab**, King Abdulaziz University, Saudia Arabia (894-41-03)

3:10 p.m. (104) *Strong proximinality in Banach spaces.* **D. Hussein**, **Roshdi Khalil*** and **F. Saidi**, Bahrain University, Bahrain (894-41-04)

3:25 p.m. (105) *A characterization of analytic functions in terms of their wavelet coefficients.* **Ahmed I. Zayed***, University of Central Florida, and **Gilbert G. Walter**, University of Wisconsin, Milwaukee (894-43-78)

3:40 p.m. (106) *New identities on Erdelyi-Kober fractional integrals.* Preliminary report. **Osman Yürekli**, Ithaca College (894-44-36)

3:55 p.m. (107) *PBVP for second order impulsive integro-differential systems of Volterra type.* Preliminary report. **M. V. Moorthy**, Ohio Dominican College (894-45-51)

4:10 p.m. (108) *Universal Pettis integrability property.* **Gunnar Stefansson**, Pennsylvania State University, Altoona (894-46-54)

4:25 p.m. (109) *Elementary upper and lower nests and matrix symbols.* **Jon M. Clauss**, Augustana College (894-47-42)

4:40 p.m. (110) *Uniqueness of induced operators.* **Robert E. Bradley**, Adelphi University (894-47-70)

MAA Session on Winning Women Into Mathematics, I

1:40 p.m.–3:15 p.m.

1:40 p.m. ▸ (111) *Using real mathematics to pave the path to girls' success in math.* **Edith M. Kort**, University of Rochester (894-00-229)

2:00 p.m. ▸ (112) *Hypatia Day: A program for girls, parents and undergraduate women.* **Miriam P. Cooney**, Saint Mary's College (894-00-228)

2:20 p.m. ▸ (113) *SummerMath: Connecting women and mathematics.* **Charlene Morrow*** and **James Morrow**, Mount Holyoke College (894-00-231)

2:40 p.m. ▸ (114) *Encouraging women by example.* **Sister M. Stephanie Sloyan**, Georgian Court College (894-00-232)

3:00 p.m. ▸ (115) *Results of an external evaluation of workshop-based calculus at UW-Madison.* **Heather A. Lewis***, University of Wisconsin, Madison, **Susan B. Millar**, Pennsylvania State University, University Park, and **Baine Alexander**, University of Wisconsin, Madison (894-00-230)

MAA Session on Innovative Projects in First-year Courses, II

1:40 p.m.–4:15 p.m.

1:40 p.m. ▸ (116) *Applications of spreadsheets in precalculus.* **Robert S. Smith**, Miami University (894-00-214)

2:00 p.m. ▸ (117) *Group problem solving.* **Aaron I. Stucker**, Washburn University of Topeka (894-00-216)

2:20 p.m. ▸ (118) *An experimental course in a Japanese faculty of management.* **Ronald D. Notestine**, Chukyo University, Japan (894-00-210)

2:40 p.m. ▸ (119) *Geometry and the visual world.* **Maria Terrell**, Cornell University, Ithaca (894-00-217)

3:00 p.m. ▸ (120) *On the fundamental theorem of algebra, a 3-dimensional approach.* **Javier Gomez-Calderon*** and **David M. Wells**, Pennsylvania State University, New Kensington Campus (894-00-205)

3:20 p.m. ▸ (121) *Using spreadsheets to develop concepts in college algebra.* **Alex Smith**, University of Wisconsin, Eau Claire (894-00-213)

3:40 p.m. ▸ (122) *The effect of integration of writing into college algebra.* **Aparna B. Ganguli**, University of Minnesota, Minneapolis (894-00-204)

4:00 p.m. ▸ (123) *Implementing changes in the mathematics developmental curriculum.* **Maria E. Calzada**, Loyola University (894-00-233)

MAA Student Workshop

2:45 p.m.–4:45 p.m.

The theory and practice of juggling.

Organizer: **Ronald L. Graham**, AT&T Bell Laboratories, Murray Hill, New Jersey

MAA Minicourse #7: Part B

4:00 p.m.–6:00 p.m.

Open problems in plane geometry. **William O. J. Moser**, McGill University, and **Janos Pach**, CCNY and Mathematical Institute of the Hungarian Academy of Sciences

MAA Minicourse #8: Part B

4:00 p.m.–6:00 p.m.

The Math Modeling/Precalculus Reform Project: Using discrete mathematical models to motivate mathematics.
Sheldon P. Gordon, Suffolk Community College, and **B. A. Fusaro**, Salisbury State University

Lesley M. Sibner
AMS Associate Secretary
Brooklyn, New York

Kenneth A. Ross
MAA Associate Secretary
Eugene, Oregon

Presenters of Papers

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

◇ AMS-MAA Invited Lecturer
◁ MAA-Mu Alpha Theta Invited Lecturer
π PME J. Sutherland Frame Lecturer
Ω AMS History of Mathematics Lecturer
∗ AMS Special Session Speaker
• AMS Invited Lecturer
○ MAA Invited Lecturer
▾ NAM Invited Lecturer
Φ MAA Student Lecturer
▶ Graduate Student

Oklahoma State University, Stillwater, Oklahoma
October 28–29, 1994

First Announcement

The eight hundred and ninety-fifth meeting of the American Mathematical Society will be held at Oklahoma State University in Stillwater, Oklahoma, on Friday, October 28, and Saturday, October 29, 1994. All sessions will be held in the OSU Student Union.

Invited Addresses

V. Lakshmibai, Northeastern University, *title to be announced.*

David E. Marker, University of Illinois at Chicago, *title to be announced.*

David J. Wright, Oklahoma State University, *title to be announced.*

Joel Zinn, Texas A&M University, *title to be announced.*

Special Sessions

New doctoral work in mathematics, **Efraim Armendariz**, University of Texas at Austin; **D. J. Lewis**, University of Michigan; **Andy R. Magid**, University of Oklahoma; and **Robert J. Zimmer**, University of Chicago.

Complex hyperbolic geometry and discrete groups, **Ara S. Basmajian** and **Robert R. Miner**, University of Oklahoma.

Representations of algebraic groups, **Edward T. Cline**, University of Oklahoma.

Number theory, **Brian Conrey**, Oklahoma State University, Stillwater, and **William D. Duke**, Rutgers University.

Algebraic geometry, **Bruce C. Crauder** and **Zhenbo Qin**, Oklahoma State University, Stillwater.

Geometry and representations of Lie groups, **Edward G. Dunne** and **Roger C. Zierau**, Oklahoma State University, Stillwater.

Fluid dynamics, **Alan R. Elcrat**, Wichita State University.

The evolving undergraduate mathematics curriculum, **Benny D. Evans**, Oklahoma State University, Stillwater.

Several complex variables, **Vladimir Ezhov** and **Alan V. Noell**, Oklahoma State University, Stillwater.

Technology in the classroom, **Jerry A. Johnson**, University of Nevada.

Arithmetic groups and topology, **Mark W. McConnell**, Oklahoma State University, Stillwater.

Geometry and geodesics, **Phillip E. Parker**, Wichita State University.

There also will be sessions of contributed ten-minute papers.

The deadline for submission of abstracts for all sessions has expired. Unfortunately, late papers cannot be accommodated.

Accommodations

Rooms have been blocked for participants at the Best Western, Holiday Inn, and Student Union hotels. Participants should make their own arrangements directly with the hotel of their choice and state that they will be attending the AMS conference. **All rooms will be on a space-available basis after October 1, 1994**.

Holiday Inn (2 miles to OSU Student Union): West 6th Avenue, Stillwater, OK 74074. Telephone: 405-372-0800. Single, double, and triple rooms are $45.00 (plus tax).

Best Western (0.5 miles to OSU Student Union): 600 East McElroy, Stillwater, OK 74074. Telephone: 405-377-7010. Single $41.00 (plus tax); double, triple, and quads are $46.00 (plus tax).

Transportation between these hotels and the OSU campus will be available.

Student Union Hotel (located on campus): Student Union Building, Stillwater, OK. Telephone: 405-744-6835. Single, double, and triple rooms are $42.00 (plus tax).

Registration

The registration desk will be located inside the Student Union in the east wing. The registration desk will be open from 7:00 a.m. to 7:00 p.m. on Friday, October 28, and Saturday, October 29. The registration fees are $30 for members of the AMS; $45 for nonmembers; and $10 for emeritus members, students, or unemployed mathematicians.

Social Events

There will be a Cowboy Barbecue Dinner on Friday evening, October 8, 1994. The price will be $15 per person. This is a ticketed event. Those interested in participating should contact Caroline Morris at 405-744-5688 or e-mail `morricm@math.okstate.edu` by **October 1**.

Travel

Delta has been selected as the official airline for this meeting. The following benefits are available exclusively to mathematicians and their families attending the meeting: a savings of up to 10% off any published domestic fare (includes U.S., Canada, Bermuda, the Bahamas, Puerto Rico, and the U.S. Virgin Islands), subject to applicable fare restrictions. Call 800-241-6760 between 8:00 a.m. and 11:00 p.m. EST to contact Delta directly or call any licensed travel agent. Instruct the ticket agent to refer to file **MO456** in order to qualify for the applicable discount.

University of Richmond, Richmond, Virginia
November 11–13, 1994

First Announcement

The eight hundred and ninety-sixth meeting of the American Mathematical Society will be held at the University of Richmond, in Richmond, Virginia, on Friday, November 11; Saturday, November 12; and Sunday, November 13, 1994.

Invited Addresses

Loren D. Pitt, University of Virginia, *Probabilistic studies of non-differential functions.*

Cora S. Sadosky, Howard University, *Lifting weights for fund and profit.*

Doron Zeilberger, Temple University, '='.

Special Sessions

Interpolation and dilation theory, **Joseph A. Ball**, Virginia Polytechnic University, and Cora S. Sadosky.

Set theoretic topology and set theory, **Amer Beslagic**, George Mason University.

Operators on Banach spaces of analytic functions, **Paul S. Bourdon**, Washington and Lee University, and **William T. Ross**, University of Richmond.

Groups, rings, and forms, **Douglas L. Costa** and **Gordon E. Keller**, University of Virginia.

Codes and designs, **James A. Davis**, University of Richmond, and **Harold N. Ward**, University of Virginia.

Quantum mechanics, **Ira W. Herbst**, University of Virginia.

Nonassociative algebras, **Teresa Magnus**, St. Mary's College.

Stochastic processes, **John P. Nolan**, American University.

Identities and enumeration, **Rodica E. Simion**, George Washington University, and **Doron Zeilberger**.

The deadline for submission of abstracts for consideration in any of these sessions has expired.

There will also be sessions for contributed ten-minute papers. This deadline has also expired.

Accommodations

Rooms have been blocked for participants at the following hotels. Participants should make their own arrangements directly with the hotel of their choice and request the AMS conference rate to obtain the rate listed. **All rooms will be on a space-available basis. The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.**

Comfort Inn: 7201 West Broad Street, Richmond, VA 23294. Telephone: 804-672-1108. Single or double is $45. **Deadline for reservations is October 27, 1994.**

Comfort Inn West: Parham and Quioccasin Roads, Richmond, VA 23229. Telephone: 804-285-9061. Rooms are $44 for single and $48 for double. **Deadline for reservations is September 10, 1994.**

Registration

The registration fees are $30 for members of the AMS; $45 for nonmembers; and $10 for emeritus members, students, or unemployed mathematicians.

Travel

USAir is the official airline for this meeting. The following benefits are available exclusively to mathematicians and their families attending the meeting: 10% discount off any published domestic fare with a seven-day advance purchase. Call USAir's Meetings and Convention Reservation Office at 800-334-8644 between 8:00 a.m. and 9:00 p.m. EST or call any licensed travel agent. Instruct the agent to refer to gold file **#16950015** in order to qualify for the applicable discount.

Invited Addresses, Special Sessions, and Contributed Papers

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. For full announcements or programs of meetings occurring prior to the first meeting listed below, see the table of contents in this issue. Members wishing to nominate candidates for invited addresses should send relevant information to the associate secretary for the section, who will forward it to the Section Program Committee.

San Francisco, CA, January 1995

Jerry L. Bona
Jeff Kahn
John William Lott
Andrew J. Majda (Gibbs Lecture)
Leila Schneps
Doris J. Schattschneider (AMS-MAA)
John Smillie

Hartford, CT, March 1995

Ben F. Logan
Nina N. Uraltseva
Kari Vilonen
Shouwu Zhang

Orlando, FL, March 1995

Dave Benson
Bjorn Jawerth
Krystyna M. Kuperberg
De Witt L. Sumners

Chicago, IL, March 1995

Rodrigo Banuelos
Berit Stensones
Jeremy T. Teitelbaum
Efim Zelmanov

Kent, OH, November 1995

Luchezar L. Avramov
Alice Silverberg
Peter J. Sternberg
Rodolfo H. Torres

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.

January 1995 Meeting in San Francisco, California

Associate Secretary: Andy R. Magid

Deadline for organizers: Expired

Deadline for consideration: September 9, 1994

Alex Adem and Jon F. Carlson, *Cohomology and representations of finite groups*

Walter Allegretto, Alfonso Castro, and Ratnasingham Shivaji, *Nonlinear elliptic boundary value problems and applications*

Thomas Archibald and Victor J. Katz, *History of mathematics*

Michael Aschbacher and Stephen D. Smith, *The simple group classification: Second generation proof and applications*

Eric D. Bedford and John Smillie, *Complex dynamics*

David C. Carothers, *Undergraduate research*

Gary Chartrand and Michael S. Jacobson, *Graph theory*

Saber N. Elaydi and John R. Graef, *Difference equations: Theory and applications*

Naomi Fisher, Harvey B. Keynes, Kenneth C. Millett, Hugo Rossi, and Christine Stevens, *Mathematics and education reform*

Ben A. Fusaro and Suzanne M. Lenhart, *Environmental modeling*

Jacob E. Goodman and Janos Pach, *Discrete geometry*

Daniel L. Goroff, *Research on undergraduate mathematics education*

Ian Graham and David Minda, *Geometric function theory in one and several complex variables*

Shouchuan Hu and Nikolaos S. Papageorgiuo, *Multivalued dynamical systems and applications*

A. G. Karstatos, *Theory and applications of nonlinear operators of accretive and monotone type*

Ellen E. Kirkman and James J. Kuzmanovich, *Noncommutative algebra*

Yanping Lin, *Numerical solution for integro-differential equations*

Terry A. Loring, *Almost multiplicative maps, C^*-algebras, and deformations*

John William Lott and Rafe R. Mazzeo, *Index theory and elliptic operators on manifolds*

Benjamin A. Lotto, *Holomorphic spaces*

Daniel Madden, *Effective approaches to the training of teaching assistants*

David E. Marker and Charles I. Steinhorn, *Model theory*

John L. Orr and David R. Pitts, *Non-self-adjoint operator algebras*

Jack R. Quine and Peter Sarnak, *Extremal Riemann surfaces*

Douglas C. Ravenel, *Homotopy theory*

Sivapragasam Sathananthan, *Stochastic systems and applications*

Seenith Sivasundaram, *Nonlinear dynamics*

Curtis D. Tuckey, *Applied logic*

Bernd Ulrich and Wolmer V. Vasconcelos, *Commutative algebra: Rees algebras and related topics*

Roger A. Wiegand and Sylvia M. Wiegand, *Commutative Noetherian rings and modules*

March 1995 Meeting in Hartford, Connecticut
Eastern Section
Associate Secretary: Lesley M. Sibner
Deadline for organizers: Expired
Deadline for consideration: November 9, 1994

William Abikoff, Aras S. Basmajian, and Andrew H. Haas, *Geometric function theory*
David A. Cox, *Enumerative geometry, toric varieties, and mirror symmetry*
Sarah Glaz and Evan G. Houston, *Commutative algebra*
Joe McKenna and Alan C. Lazer, *Nonlinear boundary value problems*
Michael D. Rice, *Cayley graphs and computation*
Steven Rosenberg, *Geometric methods in mathematical physics*
Alexander A. Voronov, *Moduli spaces, operads, and representation theory*

March 1995 Meeting in Orlando, Florida
Southeastern Section
Associate Secretary: Robert J. Daverman
Deadline for organizers: Expired
Deadline for consideration: November 9, 1994

Marcy Barge, *The geometry of dynamical systems*
Dave Benson and Clarence W. Wilkerson, *Classifying spaces and cohomology of groups*
Philip L. Bowers, *Discrete conformal geometry*
Robert C. Brigham and Richard P. Vitray, *Combinatorics and graph theory*
John R. Cannon, *Inverse and ill-posed problems*
Bettye Anne Case, Jean Larson, and Joe L. Mott, *Future directions for the mathematics doctorate*
S. Roy Choudhury, *Nonlinear dynamical systems, chaos, and turbulence*
S. Roy Choudhury and Lokenath Debnath, *Solitons and nonlinear waves*
Chat Yin Ho, Alexandre Turull, and Helmut Voelkein, *Finite groups and related topics*
Sam Huckaba and Bernard L. Johnston, *Commutative algebra*
Xin Li and Ram N. Mohapatra, *Approximation theory and special functions*
Piotr Mikusinski, *New trends in generalized functions*
De Witt L. Sumners, *Scientific applications of geometry and topology*
Wim F. Sweldens, *Wavelets for PDEs and integral equations*
Ahmed I. Zayed, *Sampling theory, wavelets, and signal processing*

March 1995 Meeting in Chicago, Illinois
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: Expired
Deadline for consideration: December 19, 1994

William Chin and Ian M. Musson, *Hopf algebras and quantum groups*
Stephen R. Doty, Daniel K. Nakano, and Karl M. Peters, *Lie theory*
Richard J. Maher, *Mathematics education reform*
Eric F. Rieders and Gang Wang, *Probability and harmonic analysis*
Jacob Towber, *Three manifolds, six j symbols, and coherent tensor operators*
Mary H. Wright, *Rings and modules*

May 1995 Meeting in Givat Ram, Jerusalem, Israel
(Joint Meeting with the
Israel Mathematical Union)
Associate Secretary: Lance W. Small
Deadline for organizers: August 24, 1994
Deadline for consideration: January 19, 1995

August 1995 Mathfest in Burlington, Vermont
Associate Secretary: Robert J. Daverman
Deadline for organizers: November 4, 1994
Deadline for consideration: April 27, 1995

October 1995 Meeting in Boston, Massachusetts
Eastern Section
Associate Secretary: Lesley M. Sibner
Deadline for organizers: January 6, 1995
Deadline for consideration: July 3, 1995

November 1995 Meeting in Kent, Ohio
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: February 4, 1995
Deadline for consideration: July 25, 1995

November 1995 Meeting in Greensboro, North Carolina
Southeastern Section
Associate Secretary: Robert J. Daverman
Deadline for organizers: February 17, 1995
Deadline for consideration: July 25, 1995

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

Daniel D. Anderson, *Commutative ring theory*
Tuong Ton-That, *Group representations and mathematical physics*

April 1996 Meeting in New York, New York
Eastern Section
Associate Secretary: Lesley M. Sibner
Deadline for organizers: July 13, 1995
Deadline for consideration: To be announced

April 1996 Meeting in Baton Rouge, Louisiana
Southeastern Section
Associate Secretary: Robert J. Daverman
Deadline for organizers: July 19, 1995
Deadline for consideration: To be announced

November 1996 Meeting in Columbia, Missouri
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: February 1, 1996
Deadline for consideration: To be announced

Mark S. Ashbaugh, *Partial differential equations and mathematical physics*
Nakhle Habib Asmar and Stephen J. Montgomery-Smith, *Harmonic analysis and probability*
John K. Beem and Adam D. Helfer, *Differential geometry*
Z. Q. Chen and Zhongxin Zhao, *Stochastic analysis*
Carmen C. Chicone and Yuri Latushkin, *Differential equations and dynamical systems*
Steven Dale Cutkosky and Hema Srinivasan, *Commutative algebra*
Fritz Gesztesy, *Spectral theory and completely integrable systems*
Jan Segert and Shuguang Wang, *Gauge theory and its interaction with holomorphic and symplectic geometry*

January 1997 Meeting in San Diego, California
Associate Secretary: Lesley M. Sibner
Deadline for organizers: April 8, 1996
Deadline for consideration: To be announced

January 1998 Meeting in Baltimore, Maryland
Associate Secretary: Robert J. Daverman
Deadline for organizers: April 10, 1997
Deadline for consideration: To be announced

March 1998 Meeting in Manhattan, Kansas
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 26, 1997
Deadline for consideration: To be announced

Information for Organizers

Potential organizers should refer to the January issue of the *Notices* for guidelines on organizing a session. Proposals for any of the meetings mentioned in the preceding section should be sent to the cognizant associate secretary by the deadline indicated. No Special Sessions can be approved too late to provide adequate advance notice to members who wish to participate.

Western Section
Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
E-mail: `g_small@math.ams.org`
Telephone: 619-534-3590

Central Section
Andy R. Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
601 Elm PHSC 423
Norman, OK 73019
E-mail: `g_magid@math.ams.org`
Telephone: 405-325-6711

Eastern Section
Lesley M. Sibner, Associate Secretary
Department of Mathematics
Polytechnic University
Brooklyn, NY 11201-2990
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Telephone: 718-260-3505

Southeastern Section
Robert J. Daverman, Associate Secretary
Department of Mathematics
University of Tennessee
Knoxville, TN 37996-1300
E-mail: `g_daverman@math.ams.org`
Telephone: 615-974-6577

Other Information

General information for speakers and full instructions for submitting abstracts, as well as information on site selection for Sectional Meetings, can be found in the January issue of the *Notices*. Electronic submission of abstracts is available to those who use the TEX typesetting system. The instructions for obtaining the envelopes for electronic abstacts from e-MATH via e-mail have changed slightly from those published in the January issue. Here are the updated instructions:

1. Type `telnet e-math.ams.org`.
2. Login and password are both `e-math`.
3. Type Q to bypass welcome information and go directly to the Main Menu.
4. In the Main Menu, select #10 for Gopher.
5. In Gopher, select #11 for Meetings and Conferences.
6. In Meetings and Conferences, select #2 for Abstract and registration forms and then #1 for Abstracts, and select the type of TEX macro package needed.

Users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to Electronic Abstracts, AMS Meetings Department, P.O. Box 6887, Providence, RI 02940. When requesting the abstracts package, be sure to specify either the plain TEX, $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX, or the LATEX package. Requests for general information concerning abstracts may be sent to `abs-misc@math.ams.org`. Completed electronic abstracts should be submitted to `abs-submit@math.ams.org`.

The Norbert Wiener Centenary Congress
November 27–December 3, 1994

Michigan State University, East Lansing, Michigan

A Congress sponsored by the Department of Statistics & Probability of Michigan State University (MSU), and cosponsored by the American Mathematical Society (AMS) and the World Organisation of Systems and Cybernetics (WOSC), will be held at Michigan State University, East Lansing, Michigan.

A mathematician on par with the greatest in the century, Norbert Wiener was a universal thinker of colossal proportions. His early training in mathematical logic and fascination for electricity were soon intertwined and led to his conception of the subject of cybernetics, and to a penetrating insight into our age of automation and into automatization in all its ramifications.

The aim of this Congress, to mark the 100th anniversary of Wiener's birth on November 26, 1894, is to reveal the depth and strong coherence of thought that runs through Wiener's entire legacy, and to exhibit its continuation in ongoing research. The following preliminary program with eight clusters is designed to accomplish this goal as best as a one-week period will allow.

Program

I. Wiener's concept of the stochastic universe.

The Wiener-Kolmogorov conception of the stochastic organization of nature, S. A. Molchanov, University of North Carolina, Charlotte.

Shannon-Wiener information and the analysis of complexity, J. Rissanen, IBM Research Division, San Jose, CA.

The mathematical ramifications of Wiener's program in statistical physics, L. Gross, Cornell University.

II. Potential and capacity before and after Wiener. D. Adams, University of Kentucky.

III. Generalized harmonic analysis and its ramifications.

Wiener and the uncertainty principle in harmonic analysis, D. H. Phong, Columbia University.

Generalized harmonic analysis and Gabor and wavelet systems, J. Benedetto, University of Maryland, College Park.

The Wiener-Hopf integral equation and linear systems, I. C. Gohberg, Tel Aviv University.

IV. Quantum mechanical ramifications of Wiener's ideas.

Quantum field theory and functional integration, I. E. Segal, M.I.T.

Optical coherence before and after Wiener, J. R. Klauder, University of Florida.

Wiener and Feynman: the role of path integration in science, S. Albeverio, Ruhr-Univ. Bochum.

Wiener and the hidden parameter problem, E. Carlen, Georgia Institute of Technology.

V. Leibniz, Haldane, and Wiener on mind.

The role of Leibniz in Wiener's cybernetics, E. Vailati, Southern Illinois University, Edwardsville.

Quantum mechanical coherence, resonance, and mind, H. P. Stapp, Lawrence Laboratory, Berkeley.

Evidence from brain research regarding conscious processes, K. H. Pribram, Radford University.

VI. Nonlinear stochastic analysis.

Some nonlinear problems in analysis on Wiener space, D. L. Burkholder, University of Illinois.

Nonlinear prediction and filtering, G. Kallianpur, University of North Carolina, Chapel Hill.

Stochastic analysis on Wiener space, S. Watanabe, Kyoto University.

Uncertainty, feedback, and Wiener's vision of cybernetics, S. K. Mitter, M.I.T.

VII. Prosthesis, ontogenetic, and phylogenetic.

Muscular and sensory prosthesis in the aftermath of Wiener, R. W. Mann, M.I.T.

Wiener's thought on the computer as an aid in visualizing higher-dimensional forms, and the problems of its implementation in the design of the robot arm, F. Potra, University of Iowa.

VIII. Wiener and the political economy: automatization, educational decline, and unemployment.

The relationship of cybernetics and automation to the economy, L. Klein, University of Pennsylvania.

The role of information in economic processes, L. Hurwicz, University of Minnesota.

The program will also include sessions devoted to 20-minute papers.

The organizing committee consists of J. Benedetto; D. L. Burkholder (AMS representative); T. Kailath, Stanford University; G. Kallianpur; V. Mandrekar, Michigan State University (MSU representative); P. R. Masani, University of Pittsburgh (WOSC representative); S. K. Mitter; and I. E. Segal.

Funding for the Congress has been requested from the NSF, ONR, AFOSR, ARO, and IMA.

Persons interested in submitting 20-minute papers or attending the Congress should write to V. Mandrekar, Department of Statistics and Probability, Michigan State University, East Lansing, MI 48824; telephone: 517-353-7172; fax: 517-336-1405; e-mail: `atmah@mandrekar.stt.msu.edu`. Further information regarding housing and other matters will be sent to all who apply. Women and minorities are encouraged to apply.

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. A complete listing of meetings of the Society, and of 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, or electronically to `notices@math.ams.org`.

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.

1994

1994–1995. **Mittag-Leffler Institute's Academic Program for 1994–1995: Statistical Mechanics and Stochastic Analysis**, Mittag-Leffler Institute, Djursholm, Sweden. (Dec. 1993, p. 1444)

July 1994

25–29. **Représentation des Groupes Reductifs *p*-adiques**, CIRM, Marseille, France. (Nov. 1992, p. 1122)

25–29. **1994 SIAM Annual Meeting**, San Diego, CA. (Sep. 1993, p. 927)

25–29. **Conference on Evolution Equations**, University of Strathclyde, Glasgow, Scotland. (Dec. 1993, p. 1451)

25–29. **European Colloquium of Category Theory (ECCT)**, Tours, France. (Jan. 1994, p. 56)

25–30. **Colloquium on Differential Geometry**, Mathematical Institute of the University of Debrecen, Hungary. (Mar. 1994, p. 248)

26–29. **Algebraic Combinatorics Conference in Honor of Adriano M. Garsia**, Taormina, Sicily, Italy. (Apr. 1994, p. 380)

26–30. **Seventh International Colloquium on Differential Geometry**, Universidade de Santiago de Compostela, Santiago de Compostela, Spain. (Dec. 1993, p. 1451)

26–30. **Algebraic K-Theory**, Université Paris VII, Paris, France. (Jan. 1994, p. 56)

27–30. **Inverse Problems in Engineering Sciences (IPES-94)**, Osaka Institute of Technology, Osaka, Japan. (Apr. 1994, p. 380)

27–August 1. **International Conference on Commutative Algebra (A Satellite Conference of ICM 94, Zürich)**, Universität Osnabrück, Standort Vechta, Germany. (Dec. 1993, p. 1451)

28–August 1. **Workshop on Harmonic Maps and Curvature Properties of Submanifolds**, University of Leeds, England. (Dec. 1993, p. 1451)

31–August 3. **Fourteenth International Conference on Critical Thinking and Educational Reform**, Sonoma State University, Rohnert Park, CA. (May/June 1994, p. 508)

31–August 4. **TEX Users Group Annual Meeting**, University of California, Santa Barbara, CA. (Feb. 1994, p. 143)

31–August 6. **Mechanics of Materials**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 415)

August 1994

1–5. **Third World Congress on Computational Mechanics (WCCM III)**, Chiba, Japan. (May/Jun. 1992, p. 497)

1–19. **IMA Course on Mathematical Modeling for Teachers**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Dec. 1993, p. 145)

3–11. **The International Congress of Mathematicans 1994**, Zürich, Switzerland. (Mar. 1994, p. 249, May/June 1994, p. 508)

7–13. **Effiziente Algorithmen**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

12–20. **1994 Summer Workshop-Conference on Classical and Quantum Geometry of Homogeneous Spaces**, International Sophus Lie Centre, Moscow. (Oct. 1993, p. 1087)

13–17. **Third Colloquium on Numerical Analysis**, Plovdiv, Bulgaria. (Apr. 1993, p. 416)

13–19. **International Conference on Potential Theory (ICPT '94)**, Kouty, Czech Republic. (Dec. 1993, p. 1452)

14–17. **1994 International Workshop on Complex Structures and Vector Fields**, Bulgaria. (Mar. 1994, p. 249)

14–20. **Nonlinear Evolution Equations**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

14–21. **International Conference on Functional Differential Equations and Applications**, Moscow, Russia. (Nov. 1993, p. 1257)

14–27. **NATO Advanced Study Institute on "Finite and Locally Finite Groups"**, Bosphorous University, Istanbul, Turkey. (Nov. 1993, p. 1257)

15–17. **Mathfest**, University of Minnesota, Minneapolis, MN (including the summer meetings of the AMS, AWM, MAA, and PME).

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

15–18. **Tenth Summer Conference on General Topology and Applications**, Free University, Amsterdam, The Netherlands. (Nov. 1993, p. 1258)

15–19. **Fifteenth International Symposium on Mathematical Programming**, University

of Michigan, Ann Arbor, MI. (May/Jun. 1993, p. 515)

15–19. **Fourth Conference of the International Linear Algebra Society (ILAS)**, Erasmus University, Rotterdam, The Netherlands. (Dec. 1993, p. 1452)

15–19. **1994 International Conference on Parallel Processing**, The Pennsylvania State University, University Park, PA. (Jan. 1994, p. 57)

15–26. **Advanced Workshop on Algebraic Geometry**, International Centre for Theoretical Physics, Trieste, Italy. (Jul./Aug. 1993, p. 714)

16–20. **ICMI-China Regional Conference on Mathematics Education**, Shanghai, China. (Jul./Aug. 1993, p. 714)

16–26. **Workshop on Representations of Algebras and Related Topics (to coordinate with 7th International Conference on Representations of Algebras (see August 22-26)**, Instituto de Matemáticas UNAM, Mexico. (Apr. 1994, p. 381)

17–20. **Second Upper Michigan Combinatorics Workshop on Codes, Designs, and Geometries**, Michigan Technological University, Houghton, MI. (May/June 1994, p. 508)

18–23. **Fifth Colloquium on Differential Equations**, Plovdiv, Bulgaria. (Apr. 1993, p. 416)

18–25. **Third International Conference on Group Theory**, Pusan, Republic of Korea. (Nov. 1993, p. 1258)

20–26. **International Conference on Rings and Radicals**, Shijiazhuang, China. (Mar. 1993, p. 287)

20–28. **International Conference on Algorithms in Algebra, Geometry, and Combinatorics**, near Nizhny Novgorod, Russia. (Feb. 1994, p. 143)

*21–25. **Crypto '94**, University of California, Santa Barbara, CA.

SPONSORS: International Assoc. for Cryptologic Research, in cooperation with the IEEE Computer Society Technical Committee on Security and Privacy and the Univ. of CA, Santa Barbara.

INFORMATION: J. Upton, Crypto '94, 1590 Oakland Rd., Suite B203, San Jose, CA 95131; tel: 408-451-8900; fax: 408-451-8900; e-mail: crypto94@uptronics.com.

21–26. **3rd International Conference on Numerical Methods and Applications**, Sofia, Bulgaria. (Apr. 1994, p. 381)

21–27. **Gruppen und Geometrien**, Oberwolfach, Federal Republic of Germany.

21–September 3. **Formation and Interactions of Topological Defects**, Newton Institute, Cambridge, UK. (May/June 1994, p. 508)

22–25. **Second Summer Conference, Numerical Modelling in Continuum Mechanics (Theory, Algorithms, Applications)**, Charles University Prague, Czech Republic. (Feb. 1994, p. 143)

22–26. **7th International Conference on Representations of Algebras (ICRA VII)**, Cocoyoc, Mexico. (Apr. 1994, p. 381)

22–26. **2nd International Congress on Mathematica as an Educational and Research Tool**, Universidad Autonoma de San Luis Potosi, San Luis Potosi, Mexico. (Apr. 1994, p. 381)

22–26. **Sixth Conference on Numerical Methods in Hungary**, Miskolc University, Miskolc, Hungary. (Sep. 1993, p. 928)

23–26. **HCI '94: People and Computers**, University of Glasgow, Glasgow, UK. (May/June 1994, p. 509)

26–28. **1994 Annual Meeting of the Australasian Association for Logic**, U. of Otago, Dunedin, New Zealand. (Feb. 1994, p. 144)

27–28. **Conference on the History of Mathematics in Honor of Boris Rosenfeld**, Pennsylvania State University, University Park, PA. (Dec. 1993, p. 1452)

27–September 3. **8th Banff Higher Order Workshop (Logics for Concurrency: Structure vs. Automata)**, The Banff Centre, Banff, Alberta, Canada. (May/June 1994, p. 509)

28–September 3. **Komplexe Analysis**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

28–September 3. **Second Order Logic**, Poland. (May/June 1994, p. 509)

29–September 2. **L'arithmetique des Courbes de Genre Deux.**, CIRM, Marseille, France. (Feb. 1994, p. 144)

29–September 2. **Mathematical Modelling and Computational Methods "Modelling 94"**, Prague, Czech Republic. (Mar. 1994, p. 250)

September 1994

Suslin Jubilee International Conferences, Suslin Foundation, Russia. (Oct. 1993, p. 1088)

Fall 1994. **Workshop on Exterior Differential Systems and Applications**, Centre de Recherches Mathématiques, Université de Montréal. (Jan. 1994, p. 57)

Fall 1994. **Workshop on Geometry of Noncompact Manifolds**, Centre de Recherches Mathématiques, Université de Montréal. (Jan. 1994, p. 57)

4–10. **Topologie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

5–7. **6th IMA Conference on the Mathematics of Surfaces**, Brunel University, London, UK. (May/June 1994, p. 509)

5–8. **4th European Workshop on Logics in AI (JELIA '94)**, York, UK. (Apr. 1994, p. 382)

5–8. **ECCOMAS-Second European Computational Fluid Dynamics Conference**, Stuttgart, Germany. (Dec. 1993, p. 1452)

5–9. **Meeting on Quaternionic Structures in Mathematics and Physics**, Trieste, Italy. (May/June 1994, p. 509)

5–9. **IX Brazilian Meeting of Topology**, Universidade Federal Fluminense, Instituto de Matematica, Niteroi, Rio de Janeiro, Brazil. (Jan. 1994, p. 57)

5–10. **Analyse Numérique des Polynômes Orthogonaux**, CIRM, Marseille, France. (Feb. 1994, p. 144)

6–8. **International Conference on Parallel Processing: CONPAR 94-VAPP VI**, Linz, Austria. (Oct. 1993, p.1088)

6–10. **8th International Conference of the European Consortium for Mathematics in Industry**, University of Kaiserslautern, Germany. (Apr. 1994, p. 382)

7–9. **1st International Conference on Constraints in Computational Logics (CCL)**, Munich, Germany. (May/June 1994, p. 509)

7–9. **IEEE European Workshop on Computer-Intensive Methods in Control and Signal Processing: Can We Beat the Curse of Dimensionality?**, Prague, Czech Republic. (Jan. 1994, p. 57)

7–9. **IMA Tutorial on Computational Wave Propagation**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 144)

11–17. **Homotopietheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

12–16. **Geometrie Algebrique et Analyse Reelle**, CIRM, Marseille, France. (Feb. 1994, p. 144)

13–17. **II International Symposium on Hamiltonian Systems and Celestial Mechanics**, Cocoyoc, Mexico. (May/June 1994, p. 509)

14–16. **Fourth International Conference on Algebraic and Logic Programming, Sixth International Symposium on Programming Language Implementation and Logic Programming (ALP '94, PLILP '94)**, Madrid, Spain. (Feb. 1994, p. 144)

14–18. **Sixteenth Linz Seminar on Fuzzy Set Theory, Topology, and Related Topics**, Linz, Austria. (May/June 1994, p. 510)

15–19. **Fifteenth International Symposium on Mathematical Programming**, University of Michigan, Ann Arbor, MI. (Apr. 1993, p. 416)

18–20. **Teaching of Mathematics for Industry**, Prague. (Jul./Aug. 1993, p. 715)

18–24. **Risk Theory**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

18–24. **DMV-Jahrestagung 1994 (Annual Meeting of the German Mathematical Society)**, Duisburg, Federal Republic of Germany. (Nov. 1993, p. 1258)

19–23. **IMA Workshop on Computational Wave Propagation**, Institute for Mathematics and its Applications, University of Minnesota,

Minneapolis, MN. (Feb. 1994, p. 144)

19–23. **3ème Atelier International de Théorie des Ensembles**, CIRM, Marseille, France. (Apr. 1993, p. 416)

21–22. **International Symposium on Object-Oriented Methodologies and Systems**, Palermo, Italy. (Nov. 1993, p. 1258)

21–23. **Meeting on Matrix Analysis and Its Applications**, Vitoria-Gasteiz, Spain. (Oct. 1993, p. 1088)

23–26. **EUROPROJ 94, Barcelona Annual Meeting**, Sant Feliu de Guixols, Spain. (Apr. 1994, p. 382)

25–October 1. **Mathematical Methods in Tomography**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

*26. **The Mathematics of Impact: The dynamics of discontinuous systems**, University of Bristol, U.K.

SPONSORS: Depts. of Mathematics and Engineering Mathematics.
PROGRAM: This meeting will focus on recent mathematical developments in the dynamics of systems with discontinuities. A panel discussion will examine the relationship between impact dynamics and wear. There will also be time for informal interactions. A small registration fee will be charged to cover catering costs.
INFORMATION: S.J. Hogan, tel: (UK) (0272) 303246, e-mail: `s.j. hogan@bristol.ac.uk`; C.J. Budd, tel: (UK) (0272) 303317, e-mail: `chris.budd@bristol.ac.uk`.

*26–27. **National Research Council Symposium on Large-Scale Structures in Acoustics and Electromagnetics**, National Academy of Sciences, Washington, D.C.

PROGRAM: Sponsored by the Office of Naval Research, this symposium will examine the dynamics of large-scale structures: structures that are large relative to their operating wavelengths. Large-scale structures typically involve many substructures and are characterized by an extended range of scales. The dynamics of the substructures and their interfaces include time-variant, dispersive, and dissipative aspects. Symposium focus will be on computational methods required to determine the dynamics of large-scale electromagnetic, acoustic, and mechanical systems. Frequency-domain methods, long dominant, have been complemented and occasionally supplanted over the past two decades by a growing collection of time-domain techniques. The main goals of the symposium are to clarify the current relationship between time-domain and frequency-domain methods, to point out opportunities for future development of these methods, and to foster progress in understanding the behavior of large-scale structures.
SPEAKERS: J.T. Oden (Texas Inst. for Computational and Applied Mathematics), H.A. Haus (MIT), A.T. de Hoop (Delft Univ. of Technology), R. Ziolkowski (Univ. of Arizona), I. Dyer (MIT), V.V. Shankar (Rockwell International Science Center), T.J.R. Hughes (Stanford Univ.), A.R. Mickelson (Univ. of Colorado at Boulder), T.B. Belytschko (Northwestern Univ.), L. Tamil (Univ. of Texas at Dallas), P. M. Pinsky (Stanford Univ.), and E.H. Newman (Ohio State Univ.).
INFORMATION: B. Wright, Board on Mathematical Sciences, National Research Council, NAS 315, 2101 Constitution Ave., NW, Washington, D.C. 20418-0001; tel: 202-334-2421; fax: 202-334-1597; INTERNET: `bms@nas.edu`

*26–27. **WOGDA'94 III Workshop de Otono: Geometria Diferencial y Sus Aplicaciones (III Autumn Workshop: Differential Geometry and its Applications)**, Granada, Spain.

TOPICS: The workshop consists of three parts: 1) mechanics and fields theory, 2) Lorentz geometry, and 3) symplectic geometry.
ORGANIZERS: C. Ruiz, A. Romero, M. Sanchez, M.A. Cañadas-Pinedo.
INFORMATION: C. Ruiz, Dpt. Geometria y Topologia, Univ. Granada, 18071 - Granada, Spain; tel:+34 58 24 3278; fax: +34 58 24 3281; e-mail: `ruiz@ugr.es`.

26–29. **Second International Conference on Theorem Provers in Circuit Design: Theory, Practice, and Experience**, Bad Herrenalb (Blackforest), Germany. (Feb. 1994, p. 144)

26–30. **Journees de Probabilites**, Marseille, France. (Jan. 1994, p. 58)

*26–30. **International Workshop on Total Positivity and its Applications**, Jaca, Spain.

PROGRAM: Total positivity has proved to be a powerful tool in many areas of pure and applied mathematics. The goal of the workshop is to draw together experts whose lectures will cover the principal areas of applications and participants whose research can benefit from these techniques. Among the planned topics are the applications of total positivity to probability and statistics, combinatorics, integral and differential equations, geometric modeling, matrix theory, approximation theory, complex analysis, numerical analysis, and wavelets analysis.
PARTIAL LIST OF INVITED SPEAKERS: B. Bojanov (Sofia), F. Brenti (Perugia), J. Carnicer (Zaragoza), J. Garloff (Konstanz), M. Gasca (Zaragoza), T.N.T. Goodman (Dundee), B. Heiligers (Augsburg), R-Q. Jia (Edmonton), S. Karlin (Stanford), K. Morken (Oslo), J.M. Pena (Zaragoza), A. Pinkus (Haifa), H. Pottman (Vienna), and R. Zalik (Auburn).
INFORMATION: IWTPA, Depto. Matematica Aplicada, Facultad de Ciencias, Edificio de Matematicas, Universidad de Zaragoza, 50009 Zaragoza, Spain; tel: (34)76 356617; fax: (34)76 356244; e-mail: `iwtpa@cc.unizar.es` or `gasca@cc.unizar.es`.

26–30. **Annual Conference of the European Association for Computer Science Logic (CSL '94)**, Kazimierz, Poland. (Feb. 1994, p. 144)

26–October 1. **4th International Conference on Evolution Equations and Semigroups**, Scuola Normale Superiore, Pisa, Italy. (Apr. 1994, p. 382)

26–October 1. **First International Workshop on Functional Analysis**, Trier University, near Luxembourg, Germany. (Oct. 1993, p. 1088)

28–30. **Thirty-second Annual Allerton Conference on Communication, Control, and Computing**, University of Illinois, Urbana-Champaign. (May/June 1994, p. 510)

28–30. **Third International Conference on Parallel and Distributed Information Systems**, Austin, Texas. (Jan. 1994, p. 58)

30–October 1. **22nd Annual Mathematics and Statistics Conference on Classical Analysis and General Topology in the Undergraduate Curriculum**, Miami University, Oxford, Ohio. (Apr. 1994, p. 383)

October 1994

1–2. **10th Anniversary Symposium**, Ottawa-Carleton Institute of Mathematics and Statistics, Ottawa, Canada. (May/June 1994, p. 510)

2–6. **International Conference/Workshop on Applications of Operator Theory**, Winnipeg, Manitoba, Canada. (May/June 1994, p. 510)

2–8. **Randelementmethoden: Anwendungen und Fehleranalysis**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

3–7. **Groupes Finis**, CIRM, Marseille, France. (Feb. 1994, p. 145)

*6–7. **Combustion, Environment, and Heating Technology–The Role of High-Performance Simulation**, Columbus, Ohio.

ORGANIZER: The Program for Computational Reactive Mechanics (PCRM) at the Ohio Supercomputer Center.
PROGRAM: Nationally recognized participants from academia, industry, and national laboratories will report on the state-of-the-art in combustion technology, heating equipment technology, environmental impact of combustion, and advances in high-performance computing. The participants will share ideas and explore the role of high-performance simulation to advance the technology for combustion, environment, and heating.

INVITED SPEAKERS (PARTIAL LIST): M.A. Krebs (Office of Energy Research), C.W. Garret (DOE Fossil Energy), D. Hardesty (Sandia Combustion Lab), L.A. Ruth (Pittsburgh Energy Technology Center), T. O'Brien (Morgantown Energy Technology Center), P.J. Smith (Univ. of Utah), R.H. Essenhigh (The Ohio State Univ.), C.W. Westbrook (LLNL), B. Alder (LLNL), W.A. Fiveland (Babcock & Wilcox), C.H. Koelbel (Rice Univ.), and Software Vendors for Reactive Mechanics.

HOW TO CONTRIBUTE: Contributed presentations in poster format are invited in areas consistent with the conference theme. A one-page abstract typed single-spaced on 8 1/2″ × 11″ bond paper must be submitted, including title of presentation, author(s) names and affiliations, postal and e-mail addresses, telephone and fax numbers.

INFORMATION: e-mail: `pcrm@osc.edu` or use the PCRM Mosaic Server (URL: `http://www.osc.edu/pcrm.html`). You may also call M. Mittal, 614-292-9248.

6–9. **Combinatorial Methods for DNA Mapping and Sequencing (DIMACS Workshop)**, Rutgers University, Piscataway, NJ. (May/June 1994, p. 510)

7–8. **The Twenty-third Annual Midwestern Differential Equations Conference**, University of Oklahoma, Norman, OK. (May/June 1994, p. 511)

9–15. **Arbeitsgemeinschaft mit Aktuellem Thema (Wird in den Mitteilungen der DMV Heft 3/1994 Bekanntgegeben)**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

10–14. **Journées d'Etude en Statistique**, CIRM, Marseille, France. (Feb. 1994, p. 145)

10–28. **School/Workshop on Variational and Local Methods in the Study of Hamiltonian Systems**, International Centre for Theoretical Physics, Trieste, Italy. (Jul./Aug. 1993, p. 715)

11–13. **IMA Tutorial on Wavelets, Multigrid and Other Fast Algorithms (Multipole, FFT), and Their Use in Wave Propagation**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 145)

* 13–14. **Numerical Analysis Colloquium (to honor the 60th birthday of Jean Descloux)**, Ecole Polytechnique Federale, Lausanne, Switzerland.

ORGANIZERS: G. Caloz, Universite de Rennes I, Institut de Mathematiques, and J. Rappaz, Ecole Polytechnique Federale, Departement de Mathematiques.

PROGRAM: Sessions of half-hour conferences are programmed each day from 10 a.m. to 5 p.m.

INFORMATION: J. Mosetti, tel: 41-21-693-25-55 (afternoons).

* 13–16. **Semi-annual Regional Workshop in Dynamical Systems and Related Topics**, Penn State University, State College, Pennsylvania.

ORGANIZERS: A. Katok, H. Weiss.

PROGRAM: A regular meeting dedicated to recent results in the theory of smooth dynamical systems, ergodic theory, symbolic dynamics, topological dynamics, Hamiltonian mechanics and related areas in differential geometry, differential equations, and Lie theory. Fifteen to twenty 1-hour and 45-minute talks are expected.

INFORMATION: A. Katok, tel: 814-865-2266; H. Weiss, tel: 814-863-2737; e-mail: `DynSystems@math.psu.edu`; or R. Manning, tel: 814-865-7527; Dept. of Math., Penn State Univ., University Park, PA 16802.

* 14–15. **Midwest Math History Conference V**, University of Indianapolis, Indianapolis, Indiana.

INVITED SPEAKER: N. Swerdlow, "Derivation of the Parameters of Babylonian Planetary Theory with Time as the Principal Independent Variable".

INFORMATION: A. Swett, Dept. of Math., Univ. of Indianapolis, 1400 E. Hanna Ave., Indianapolis, IN 46227; tel: 317-788-3320; e-mail: `swett@gandlf.uindy.edu`.

12–18. **CARI '94: Second African Conference on Research in Computer Science**, Ouagadougou (Burkina-Faso). (Nov. 1993, p. 1259)

14–15. **1994 Sixteenth Midwest Probability Colloquium**, Northwestern University, Evanston, IL. (May/June 1994, p. 511)

16–18. **Women in Probability**, Cornell University, Ithaca, NY. (Apr. 1994, p. 383)

16–22. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

17–18. **1994 Symposium on Volume Visualization**, Sheraton Premiere at Tysons Corner, VA (Washington, DC area). (May/June 1994, p. 511)

17–21. **Visualization '94 Conference**, Sheraton Premiere at Tysons Corner, VA (Washington, DC area). (May/June 1994, p. 511)

17–21. **IMA Workshop on Wavelets, Multigrid and Other Fast Algorithms (Multipole, FFT), and Their Use in Wave Propagation**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 145)

17–21. **Algèbre Différentielle**, CIRM, Marseille, France. (Feb. 1994, p. 145)

20–24. **First Slovenian Congress of Mathematics**, Cankarjev dom, Ljubljana, Slovenia. (May/June 1994, p. 511)

21. **Women in Mathematics and Computer Science**, Kean College of New Jersey, Union, NJ. (May/June 1994, p. 511)

21–22. **Fourteenth Annual Meeting of the Southeastern-Atlantic Regional Conference on Differential Equations**, University of Tennessee, Knoxville, Tennessee. (Apr. 1994, p. 383)

* 22–23. **Northeastern Operator Theory Seminar**, Vassar College, Poughkeepsie, NY.

INVITED SPEAKERS: C. Bishop (Stony Brook), P. Jones (Yale), B. Korenblum (Albany), V. Nistor (Penn State), and D. Sarason (Berkeley).

INFORMATION: B. Lotto, Dept. of Math., Vassar College, Box 349, Poughkeepsie, NY 12601; tel: 914-437-7180; fax: 914-437-7065; e-mail: `BeLotto@vassar.edu`.

23–29. **Wahrscheinlichkeitsmaße auf Gruppen und Verwandten Strukturen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1993, p. 715)

* 24–26. **International Symposium on Computational Molecular Dynamics**, University of Minnesota Supercomputer Institute, Minneapolis, Minnesota.

SPONSORS: Univ. of Minnesota Supercomputer Institute Computers in Chemistry Division, American Chemical Society Division of Computational Physics, American Physical Society Division of Physical Chemistry, and American Chemical Society.

PROGRAM: The coverage of the symposium will include all aspects of the dynamics of the molecular systems and the use of molecular dynamics simulations–quantum and classical, few-body and many-body, physics and chemistry. The organizing committee has developed a list of invited speakers that will insure that the program is at the forefront of the field. In addition to the invited talks, there will also be poster papers. Contributed poster papers are invited and strongly encouraged. Persons who wish to present a poster should send a one-page abstract by July 25, 1994. Late posters will be accepted on a space-available basis.

INFORMATION: To receive more information regarding the meeting, including a list of lecture titles, contact the symposium administrator: M.J. Olesen, Supercomputer Institute, Univ. of Minnesota, 1200 Washington Ave. South, Minneapolis, MN 55415; tel: 612-624-1356; fax: 612-624-8861; e-mail: `olesen@msi.umn.edu`.

24–November 11. **Fourth Autumn Course on Mathematical Ecology**, Trieste, Italy. (Jan. 1994, p. 58)

25–27. **Thirteenth Symposium on Reliable Distributed Systems**, Near Irvine, California. (Apr. 1994, p. 383)

26–29. **Sixth IEEE Symposium on Parallel and Distributed Processing**, Dallas, Texas.

(Mar. 1994, p. 251)

28–29. **1994 Mathematical Sciences Department Chairs Colloquium**, Arlington, Virginia. (Apr. 1994, p. 383)

28–29. **Central Section**, Oklahoma State University, Stillwater, Oklahoma.

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

28–30. **Hybrid Systems and Autonomous Control**, Cornell University, Ithaca, NY. (May/June 1994, p. 511)

30–November 5. **Finite Volume Methods**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

31–November 4. **Orthogonality, Moment Problems, and Continued Fractions: An International Conference in Honor of T.J. Stieltjes, Jr. (1856–1894)**, Delft, Holland. (Dec. 1993, p. 1453)

31–November 4. **International Conference of the Chilean Computer Science Society**, Concepcion, Chile. (Apr. 1994, p. 383)

November 1994

2–4. **Mathématique Informatique**, CIRM, Marseille, France. (Feb. 1994, p. 145)

4–5. **Ninth Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference**, St. Norbert College, De Pere, WI. (May/June 1994, p. 512)

7–9. **ISCIS IX (International Symposium on Computer and Information Sciences - 9)**, Antalya, Turkey. (May/June 1994, p. 512)

7–18. **2nd Workshop on Three-dimensional Modelling of Seismic Waves Generation, Propagation, and Their Inversion**, Trieste, Italy. (Feb. 1994, p. 145)

9–10. **IMA Tutorial on Waves in Random and Other Complex Media**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 145)

11–13. **Southeastern Section**, University of Richmond, Richmond, VA.

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

*12. **Southern California Matrix Theory Conference**, University of Utah, Salt Lake City, Utah.

ORGANIZING COMMITTEE: W. Barrett (Brigham Young Univ.), e-mail: `wayne@math.byu.edu`); L. Beasley (Utah State Univ.), e-mail: `lbeasley@usu.edu`); R. Horn (Univ. of Utah), e-mail: `rhorn@math.utah.edu`); K. Kidman, (Weber State Univ.), e-mail: `kkidman@wever.edu`).
INFORMATION: For further information, contact R. Horn at the above e-mail address.

13–17. **1994 International Symposium on Logic Programming**, MSI, Ithaca, NY. (Jul./Aug. 1993 p. 715)

13–19. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 417)

14–18. **International Conference on Mathematical Ecology**, Trieste, Italy. (Feb. 1994, p. 145)

14–18. **IMA Workshop on Waves in Random and Other Complex Media**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 145)

14–18. **Nouvelles Tendances et Approximation**, CIRM, Marseille, France. (Feb. 1994, p. 145)

14–18. **Supercomputing '94, the Seventh Annual High-performance Computing and Communication Conference**, Convention Center, Washington, DC. (Apr. 1994, p. 384)

16–18. **Envirosoft 94 (Development and Application of Computer Techniques to Environmental Studies)**, San Francisco, CA. (May/June 1994, p. 512)

20–26. **Mathematical Aspects of Computational Fluid Dynamics**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 417)

21–27. **Thanksgiving Workshop on Controlled Topology, Geometry and Algebra**, IMADA, Odense University, Odense, Denmark. (May/June 1994, p. 512)

27–December 3. **The Norbert Wiener Centenary Congress**, Michigan State University, East Lansing, MI (Preliminary Announcement (May/June 1994, p. 512)

27–December 3. **Mathematical Models for Infectious Diseases**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1993, p. 715)

December 1994

4–10. **Applied Probability**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1993, p. 715)

5–9. **20th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing**, Auckland, New Zealand. (Apr. 1994, p. 384)

*8–9. **Workshop on Mobile Computing Systems and Applications**, Santa Cruz, CA.

SPONSORS: Sponsored by the IEEE Computer Society TCOS (in cooperation with ACM SIGOPS and USENIX Association).
PROGRAM: A major challenge of this decade is the effective exploitation of two symbiotic technologies: portable computers and wireless networks. Harnessing these technologies will dramatically change the computing landscape. But realizing the full potential of the resulting mobile computing systems will require advances in many areas such as: hardware, communications, scalability, power management, security, data access, user interfaces, and location sensitivity. The goal of this workshop is to foster exchange of ideas in mobile computing among workers in the field. Attendance will be limited to about sixty participants, based on the position papers submitted. The workshop will also host a small number of novel hardware and software exhibits relevant to mobile computing.
SUBMISSIONS: Submissions of position papers should be no longer than five pages. Papers may expose a new problem, advocate a specific solution, or report on actual experience. Send to M. Satyanarayanan, School of Computer Science, Carnegie Mellon Univ., Pittsburgh, PA 15213; tel: 412-268-3743; fax: 412-681-5739; e-mail: `satya@cs.cmu.edu`. Exhibits may be research prototypes or commercial products. Interested parties should send technical descriptions of their exhibits to P. Honeyman, CITI, Univ. of Michigan, Ann Arbor, MI 48103-4943; tel: 313-763-4413; fax: 313-763-4434; e-mail: `honey@citi.umich.edu`.

12–14. **SIAM Conference on Inverse Problems**, Fish Camp, CA. (Dec. 1993, p. 1453)

12–16. **International Conference on Set-theoretic Topology and its Applications**, Ehime University, Matsuyama, Japan. (May/June 1994, p. 513)

12–17. **International Conference on Operator Theory for Complex and Hypercomplex Analysis**, Mexico City, Mexico. (May/June 1994, p. 513)

12–17. **Pacific Rim Geometry Conference**, National University of Singapore, Republic of Singapore. (Feb. 1994, p. 146)

16–19. **International Symposium on Methods and Applications of Analysis**, Hong Kong. (Mar. 1994, p. 251)

18–23. **Asymptotik Hochdimensionaler Statistischer Modelle**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 417)

27–31. **21st Holiday Mathematics Symposium on Gröbner Bases and Convex Polytopes**, New Mexico State University. (May/June 1994, p. 513)

1995

Second International Conference on Numerical Methods for Volterra and Delay Equations (A conference to celebrate the 100th anniversary of Volterra's birth.), Italy. (Mar. 1992, p. 251)

January 1995

January–June. **Financial Mathematics**, Isaac

Newton Institute for Mathematical Sciences, Cambridge, UK. (May/June 1994, p. 513)

4–7. **Joint Mathematics Meetings**, San Francisco, CA (including the annual meetings of the AMS, AWM, MAA, and NAM).

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

8–12. **8th Texas International Symposium on Approximation Theory**, College Station, TX. (May/June 1994, p. 514)

*14–21. **The 15th Winter School: Geometry and Physics**, Srni, Bohemian Forest, Czech Republic.

ORGANIZERS: The Union of Czech Mathematicians and Physicists and the Erwin Schroedinger Institute of Mathematical Physics in Vienna.
PROGRAM: There will be several series of plenary lectures devoted to quantum groups, conformally invariant operators, twister theory, and mirror mainfolds.
INVITED SPEAKERS: V. Kac (MIT) will deliver a series of plenary lectures on quantum groups. Other speakers will be announced later.
LECTURES: The lectures will be divided into invited (series of) lectures, lectures in sections, and communications in poster form. Plenary lectures will have expository character and will be held mostly in the morning; the lectures in sections will consist of research reports, both in geometry and mathematical physics, and will take place in the afternoon. Posters will be devoted to recent research work, not necessarily closely related to the main subjects of the school.
INFORMATION: J. Slovak, Dept. of Algebra and Geometry, Masaryk Univ., Janackovo nam. 2a, 662 95 Brno, Czech Republic; e-mail: `srni@math.muni.cz`.

15–17. **Random Partial Differential Equations, MSI**, Ithaca, NY. (May/June 1994, p. 514)

16–19. **First Asian Computational Fluid Dynamics Conference**, Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong. (Jan. 1994, p. 58)

17–20. **IMA Tutorial 1 on Inverse Problems in Wave Propagation**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 146)

*22–24. **Sixth ACM-SIAM Symposium on Discrete Algorithms**, San Francisco, CA.

SPONSORS: ACM Special Interest Group on Automata and Compatibility Theory and SIAM Activity Group on Discrete Mathematics.
ORGANIZER: K.L. Clarkson, AT&T Bell Laboratories.
INFORMATION: SIAM Conference Coordinator, 3600 University Science Ctr., Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; electronic mail: `meetings@siam.org`.

*22–25. **First International Symposium on High-Performance Computer Architecture**, Raleigh, N.C.

THEME: The symposium will provide a high quality forum for scientists and engineers to present their latest research findings in this rapidly changing field. Authors are invited to submit full papers on all aspects of high-performance computer architecture.
TOPICS OF INTEREST: Advanced uniprocessor architectures, parallel computer architectures, application-specific architectures, novel VLSI architectures, simulation and performance evaluation, cache and memory architectures, interconnection networks, fault-tolerant architectures, and benchmarking and measurements.
PAPER SUBMISSIONS: Authors are requested to submit six (6) copies of the full manuscript (including abstract, key words, and e-mail address, and not to exceed 25 double-spaced pages) and tutorial proposals to L.N. Bhuyan, Dept. of Computer Science, Rm. 301, H.R. Bright Bldg., Texas A&M Univ., College Station, TX 77843-3112; tel: 409-845-5534; fax: 409-847-8578; e-mail: `hpca@cs.tamu.edu`. Submission deadline is July 25, 1994.

23–27. **3rd International Symposium on the Development of Mathematics**, Havana, Cuba. (May/June 1994, p. 514)

30–February 3. **IMA Tutorial 2 on Inverse Problems in Wave Propagation**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 146)

February 1995

5–8. **The Joint Meeting of the Third Caribbean Congress on Fluid Dynamics and the Third Latin-American Symposium on Fluid Mechanics**, The University of Simon Bolivar, Caracas, Venezuela. (Apr. 1994, p. 384)

*8–11. **Third SIAM Conference on Mathematical and Computational Issues in the Geosciences**, San Antonio, TX.

SPONSORS: SIAM Activity Group on Geosciences.
CONFERENCE CHAIR: J.G. Glimm, State Univ. of NY, Stony Brook.
ABSTRACT DEADLINE: August 8, 1994.
INFORMATION: SIAM Conference Coordinator, 3600 University Science Ctr., Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; electronic mail: `meetings@siam.org`.

*15–17. **Seventh SIAM Conference on Parallel Processing for Scientific Computing**, San Francisco, CA.

SPONSORS: SIAM Activity Group on Supercomputing.
ORGANIZER: R.S. Schreiber, Research Institute for Advanced Computer Science.
INFORMATION: SIAM Conference Coordinator, 3600 University Science Ctr., Philadelphia, PA 19104-2688; tel: 215-382-9800; fax: 215-386-7999; electronic mail: `meetings@siam.org`.

19–25. **Applications of Interval Computations (First International Workshop)**, El Paso, TX. (May/June 1994, p. 514)

March 1995

4–5. **Eastern Section**, Hartford, Connecticut.

INFORMATION: W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

6–17. **IMA Workshop on Inverse Problems in Wave Propagation**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Apr. 1994, p. 384)

17–18. **Southeastern Section**, Orlando, FL.

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

19–22. **Colloquium Carolus Magnus on Arithmetic and Geometry (Celebrating 1200 Years of Science in Central Europe)**, Aachen, Germany. (May/June 1994, p. 514)

*20–21. **DIMACS Workshop on Global Minimization of Nonconvex Energy Functions: Molecular Conformation and Protein Folding**, DIMACS (Center for Discrete Mathematics and Theoretical Computer Science at Rutgers Univ.)

PROGRAM: One of the most significant and challenging problems in molecular biophysics and biochemistry is that of computing the native three-dimensional conformation (folded state) of a globular protein given its amino acid sequence, possibly in the presence of additional agents (e.g. drugs). This workshop will focus on this and related problems through an interdisciplinary effort that will be represented by computational groups in global optimization, computer science, and biochemistry.
KEYNOTE SPEAKER: The workshop will feature a keynote address by H.A. Hauptman, 1985 Nobel Prize Laureate in Chemistry.
INFORMATION: P.M. Pardalos (Univ. of Florida), e-mail: `pardalos@ufl.edu` and D. Shalloway (Cornell Univ.), electronic mail: `DISJ@CORNELLA.cit.cornell.edu`.

26–29. **IMS Eastern Regional Meeting and Biometric Society/ENAR Spring Meeting**, Birmingham, AL. (May/June 1994, p. 514)

24–25. **Central Section**, DePaul University, Chicago, IL.

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

*30–April 2. **Association for Symbolic Logic Annual Meeting**, University of California at Irvine.

CONFERENCE SCHEDULE: The meeting will begin on the morning of March 30 and end at noon on April 2.
PROGRAM COMMITTEE: C.A. Anderson, S. Buss, M. Lerman, M. Foreman, and C. Laskowski (chair).
LOCAL ORGANIZING COMMITTEE: P. Eklof (chair), M. Foreman, P. Maddy, and A. Nesin.
CONTRIBUTED PAPERS: Abstracts of contributed papers from ASL members should be sent by the deadline of January 13, 1995, to the program chair, C. Laskowski, Dept. of Math., Univ. of Maryland, College Park, MD 20742; e-mail: `mcl@math.umd.edu`.

April 1995

1–4. **International Conference on Survey Measurement and Process Quality**, Bristol, England. (May/June 1994, p. 514)

2–9. **7th International Conference on Geometry**, Nahsholim, Israel. (May/June 1994, p. 514)

4–6. **IMA Tutorial on Singularities and Oscillations**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Mar. 1994, p. 252)

*5–7. **International Conference on Rewriting Techniques and Applications (RTA-95)**, Kaiserslautern, Germany.

TOPICS: Term rewriting systems, symbolic and algebraic computation, constrained rewriting and deduction, equational programming languages, string and graph rewriting, completion techniques, rewrite-based theorem-proving, unification and matching algorithms, conditional and higher-order rewriting, constraint-solving, architectures for rewriting, and parallel/distributed rewriting and deduction.
SUBMISSIONS: Send six (6) copies of a full draft paper of no more than fifteen (15) double-spaced pages, to reach the program chair no later than October 7, 1994. Electronic submission in PostScript form is encouraged.
INFORMATION: J. Hsiang (program chair), RTA95, Dept. of Computer Science and Information Engineering, National Taiwan Univ., Taipei, Taiwan; tel: +886 2 362-2704; fax: +886 2 362-8167; Internet `rta95@csie.ntu.edu.tw`.

10–12. **International Conference on Typed Lambda Calculi and Applications (TLCA)**, Edinburgh, Scotland. (May/June 1994, p. 514)

10–14. **IMA Workshop on Singularities and Oscillations**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Mar. 1994, p. 252)

Spring 1995. **Workshop on Groups and Three-Manifolds**, Centre de Recherches Mathématiques, Université de Montréal. (Jan. 1994, p. 59)

Spring-Summer 1995. **Workshop on Gauge Theory and Applications to Low-dimensional Topology**, Centre de Recherches Mathématiques, Université de Montréal. (Jan. 1994, p. 59)

Spring-Summer 1995. **Workshop on Symplectic Geometry and Topology**, Centre de Recherches Mathématiques, Université de Montréal. (Jan. 1994, p. 59)

23–25. **Conference on Applied Statistics in Agriculture**, Manhattan, KS. (May/June 1994, p. 515)

23–26. **KdV '95**, Amsterdam, The Netherlands. (Dec. 1993, p. 1453)

*24–28. **Third International Conference on Mathematical and Numerical Aspects of Wave Propagation**, Juan-les-Pins, France.

SPONSORS: INRIA and SIAM.
PROGRAM: The conference will focus on new developments, in various domains, concerning methods for solving mathematical and numerical problems issuing from wave propagation phenomena. Original work, both mathematical and numerical, is solicited from mathematicians, scientists, and engineers.
TOPICS: Waves in homogeneous, heterogeneous, layered or random media, homogeneization; guided waves, surface waves, scattering, resonances; inverse problems and imaging, control theory, optimal control; high and low frequency asymptotic analysis, ray methods, paraxial methods; absorbing boundary conditions, artificial boundary conditions; finite difference methods, finite element methods, spectral methods; integral equations, boundary element methods; multigrid methods, domain decomposition, wavelets; vector and parallel processing; waves and kinetic equations; and linear algebra and fast algorithms.
INVITED SPEAKERS: P. Gerard, A. Kometch, D.J. Koury, P. Markowich, P.A. Martin, D.W. McLaughlin, C. Pichot, and J. Sylvester.
INFORMATION: Inria-Rocquencourt, Bureau des Cours-Colloques, B.P. 105, 78153 Le Chesnay Cedex, France.; tel: 33 (1) 39 63 56 00; fax: ee (1) 39 63 56 38; e-mail: `symposia@inria.fr`.

*27–29. **Third SIAM Conference on Control and Its Applications**, St. Louis, MO.

SPONSOR: SIAM Activity Group on Control and Systems Theory.
ORGANIZER: J.E. Lagnese, Georgetown Univ.
ABSTRACT DEADLINE: October 7, 1994.
INFORMATION: SIAM Conference Coordinator, 3600 University Science Ctr., Philadelphia, PA 19104-2688; tel: 215-382-9800; fax 215-386-7999; electronic mail: `meetings@siam.org`.

May 1995

11–13. **First International Conference on Nonlinear Problems in Aviation and Aerospace 1995**, Embry-Riddle Aeronautical University, Daytona Beach, FL. (Sep. 1993, p. 928)

14–20. **Mathematical Models in Phase Transitions**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

16–18. **IMA Tutorial on Quasiclassical Methods**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Mar. 1994, p. 252)

16–20. **Seventh International Conference on Random Structures and Algorithms**, Emory University, Atlanta, GA. (May/June 1994, p. 515)

*21–24. **Third SIAM Conference on Dynamical Systems**, Snowbird, UT.

SPONSOR: SIAM Activity Group on Dynamical Systems.
ORGANIZERS: J.D. Crawford, Univ. of Pittsburgh, and J.D. Meiss, Univ. of Colorado, Boulder.
ABSTRACT DEADLINE: November 7, 1994.
INFORMATION: SIAM Conference Coordinator, 3600 University Science Ctr., Philadelphia, PA 19104-2688; tel: 215-382-9800; fax 215-386-7999; electronic mail: `meetings@siam.org`.

22–26. **IMA Workshop on Quasiclassical Methods**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Mar. 1994, p. 252)

24–27. **Second International Conference on Dynamic Systems and Applications**, Atlanta, GA. (May/June 1994, p. 515)

25–June 5. **Summer School and International Conference on Combinatorics**, Hefei, China. (May/June 1994, p. 515)

28–31. **First International Conference on Neural, Parallel & Scientific Computations**, Atlanta, GA. (May/June 1994, p. 515)

29–June 1. **International Conference on Mathematical Modelling**, Universiti Brunei Darussalam, Brunei Darussalam. (Feb. 1994, p. 146)

*29–June 2. **Seventh International Confer-**

ence on Formal Power Series and Algebraic Combinatorics, Marne-la-Vallée, Paris, France.

TOPICS: Algebraic and bijective combinatorics and their relations with other parts of mathematics, computer science, and physics.
CONFERENCE PROGRAM: Invited lectures, contributed presentations, poster session, problem session, and software demonstrations.
CALL FOR PAPERS AND POSTERS: Authors are invited to send before November 15, 1994, four copies of an extended abstract of at most twelve pages to J.Y. Thibon, (chair of the program committee of FPSAC '95), Université de Marne-la-Vallée, IFI, 1, rue de Vaugirard, 93166 Noisy-le-Grand Cedex, France. The submitted papers should begin with a summary written in the English and French (translations will be provided if necessary). Authors should indicate the mode of presentation which they consider appropriate for their paper: lecture or poster session.
OPEN PROBLEM SESSION: Problems should be submitted in advance of conference dates to e-mail: `sfca95@mustang.ibp.fr`.
SOFTWARE DEMONSTRATIONS: People interested in giving a software demonstration are invited to send a short description (3/4 pages) of their software, including the hardware requirements, before January 15, 1995, to J.Y. Thibon at the above address.
INFORMATION: Information or requests regarding participant support should be sent in duplicate by January 15, 1995, to J. Désarménien, Université de Marne-la-Vallée, IFI, 1, rue de vaugirard, 93166 Noisy-le-Grand Cedex, France. All other questions should be referred to e-mail: `sfca95@mustang.ibp.fr`.

*31–June 3. **Tenth Biennial Conference of the Association of Christians in the Mathematical Sciences**, Taylor Univ., Upland, IN.

PROGRAM: The main speaker is D. Moore, Purdue Univ., with topics on the nature of statistics and the quality of education.
CALL FOR PAPERS: Abstracts deadline is December 1, 1994.
INFORMATION: D. Neuhouser, Math. Dept., Taylor Univ., Upland, IN 46989; tel: 317-998-5245; e-mail: `dvneuhous@tayloru.edu`.

June 1995

Model Oriented Data Analysis, Spetses, Greece. (May/June 1994, p. 515)

5–8. **International Conference on Optimization: Techniques and Applications (ICOTA '95)**, Chengdu University of Science and Technology, Chengdu, China. (May/June 1994, p. 515)

*6–10. **Symposium on Inertial Manifolds, Approximate Inertial Manifolds, and Related Numerical Algorithms**, Xi'an, China.

CONFERENCE THEMES: The themes of the symposium will range from basic theoretical research to scientific applications, including: theory of inertial manifolds and approximate inertial manifolds; numerical analysis of the nonlinear Galerkin method and of the incremental unknown method; implementation of the nonlinear Galerkin method and the incremental unknown method; implementation on parallel computer, domain decomposition; and applications to meteorology, slow manifolds.
FORMAT: About twenty invited lectures and a number of selected contributed lectures are anticipated.
HOW TO CONTRIBUTE: Potential contributors should submit, no later than February 1, 1995, an abstract of no more than one page to J. Shen, Dept. of Math., Penn State Univ., University Park, PA 16802; tel: 814-863-2036; fax: 814-865-3735; e-mail: `shen_j@math.psu.edu` or K. Li, Research Center for Applied Math., Xi'an Jiaotong Univ., Xi'an 710049, China; tel: (86) 29-335011 ext. 3116; Fax: (86) 29-3237910. Submission by e-mail is encouraged.
INFORMATION: Updated information may be obtained via anonymous ftp to `ftp.math.psu.edu (146.186.131.129)` in the directory `pub/shen_j/im-aim` or through World Wide Web at URL: `http://www.math.psu.edu/shen_j/im-aim.html`.

7–8. **IMA Tutorial on Multiparticle Quantum Scattering with Applications to Nuclear, Atomic, and Molecular Physics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Apr. 1994, p. 385)

*11–14. **Second IMACS International Symposium on Iterative Methods in Linear Algebra**, Blagoevgrad, Bulgaria.

ORGANIZERS: The International Assoc. for Mathematics and Computers in Simulation and The Center of Informatics and Computer Technology at Bulgarian Academy of Sciences (BAS).
LOCAL ORGANIZING COMMITTEE: S.D. Margenov and P.S. Vassilevski, Center of Informatics and Computer Technology at BAS.
SCOPE: The purpose of the symposium is to provide a forum for the presentation and the discussion of the recent advances in the analysis and implementation of iterative methods for solving large linear systems of equations and for determining eigenvalues, eigenvectors, or singular values of large matrices.
SPECIAL SESSIONS: "The influence of high non-normality on the reliability of iterative methods in computational linear algebra", organized by F. Chaitin-Chatelin, Univ. of Paris and V. Fraysse, CERFACS, Toulouse; "Krylov–subspace methods for nonsymmetric and indefinite linear systems", by R. Freund, AT&T Bell Labs; and "Iterative Monte Carlo methods", by I.T. Dimov, CICT, BAS, Sofia.
INFORMATION: P.S. Vassilevski, IMACS International Symposium, Center of Informatics and Computer Technology, Bulgarian Academy of Sciences, "Acad. G. Bontchev" St., Block 25A, 1113 Sofia, Bulgaria; electronic mail: `imacs95@bgearn.bitnet` or electronic mail: `panayot@bgearn.bitnet`.

12–16. **IMA Workshop on Multiparticle Quantum Scattering with Applications to Nuclear, Atomic, and Molecular Physics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Apr. 1994, p. 385)

July 1995

*3–7. **AMAST'95, Fourth International Conference on Algebraic Methodology and Software Technology**, Concordia University, Montreal, Canada.

CALL FOR PAPERS: Send six copies of original, previously unpublished papers, not to exceed fifteen pages, by November 15, 1994, to V.S. Alagar, Dept. of Computer Science, Concordia Univ., 1455 de Maisonneuve Blvd. West, Montreal, Quebec H3G 1M8, Canada; tel: 514-848-3022; fax: 514-848-2830.
TOPIC IDEAS: Algebraic and logical foundations, concurrent and reactive systems, software technology, and logic programming.
INFORMATION: On current bulletin: e-mail: `amast95-info@cs.concordia.ca`; on local arrangements: e-mail: `missaoui@larc.info.uqam.ca`; for subscribing to AMAST: electronic mail: `amast95-request@cs.concordia.ca`.

3–7. **The Third International Congress on Industrial and Applied Mathematics**, CCH Congress Centrum, Hamburg, Germany. (Jan. 1994, p. 59)

8–9. **Mathematica in Mathematics Research and Education**, University of Tasmania. (May/June 1994, p. 516)

10–12. **Conference on Linear Algebra and its Applications**, University of Manchester, England. (Jan. 1994, p. 59)

10–14. **7th Biennial Conference of the Computational Mathematics Group at Mel-**

bourne (CTAC 95), Melbourne, Australia. (May/June 1994, p. 516)

* 17–21. **International Conference on the Mathematics of Program Construction**, Kloster Irsee, Germany.

TOPICS: The emphasis is on the combination of conciseness and precision in calculational techniques for program construction. Typical areas are: formal specification of sequential and concurrent programs; constructing implementations to meet specifications. In particular, program transformation, program analysis, program verification, and convincing case studies. While this list is not exclusive, it is intended to show the focus of the conference.
SUBMISSION DEADLINE: Submissions are due by December 1, 1995.
INFORMATION: B. Möller (MPC '95), Institut für Mathematik, Universität Augsburg, D-86135 Augsburg, Germany; fax: +49 821 598 2200; e-mail: moeller@uni-augsburg.de.

August 1995

6–8. **MATHFEST**, University of Vermont, Burlington, Vermont (including the summer meetings of the AMS, AWM, MAA, and PME).

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

* 7–12. **Fourth Quadrennial International Conference on Abelian Groups and Modules**, Colorado Springs, CO.

ORGANIZERS: G. Abrams, J. Haefner, K.M. Rangaswamy.
PROGRAM: The program will include one-hour talks by invited speakers and twenty-minute contributed talks. Graduate students and postdocs are strongly encouraged to attend.
CALL FOR PAPERS: Abstracts for contributed talks should be submitted by June 5, 1995; late abstracts will be considered if possible.
INFORMATION: ICAGM 1995, Dept. of Math., Univ. of Colorado, Colorado Springs, CO 80933; tel: 719-593-3311; e-mail: abrams@vision.uccs.edu; haefner@vision.uccs.edu; kmranga@excel.uccs.edu.

* 10–17. **Logic Colloquium 1995**, Israel (Haifa or Jerusalem).

ORGANIZING COMMITTEE: A. Avron, N. Francez, V. Harnik, D. Lascar, A. Levy, J.A. Makowsky (chair), and M. Rubin.
PROGRAM COMMITTEE: J. Barwise, E. Bouscaren, E. Graedel, A. Hajnal, G. Jaeger, M. Magidor (chair), J.A. Makowsky, R. Shore, M.A. Taitslin, and M. Ziegler.
TOPICS: The conference will focus mainly, but not exclusively, on set theory, model theory, recursion theory and proof theory, and their mutual interaction; and on logical aspects of computer science and linguistics.
SUBMISSION DEADLINE: Submit contributed abstracts no later than April 30, 1995.
INFORMATION: Logic Colloquium 95, Y. Sagi, Dept. of Computer Science, Technion–Israel Institute of Technology, 32000 Haifa, Israel; e-mail: logics95@cs.technion.ac.il.

28–September 1. **A.C. Aiken Centenary Conference, incorporating the 3rd Pacific Statistical Congress and the annual meeting of the New Zealand Statistical Association**, University of Otago. (May/June 1994, p. 516)

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.

September 1995

* 3–9. **Function Spaces, Differential Operators, and Nonlinear Analysis**, Paesky, Krkonoše, Czech Republic.

ORGANIZER: Mathematical Institute of the Academy of Sciences, Praha.
SPEAKERS: To be announced.
INFORMATION: J. Rákosník, Mathematical Institute, Žitná 25, 11567 Praha 1, Czech Republic; fax (+42 2) 24227633,; e-mail: rakosnik@earn.cvut.cz.

* 17–21. **Symposium on Acoustics of Submerged Structures & Transduction Systems**, Boston, MA.

PURPOSE: As part of the ASME 15th Biennial Conference on Mechanical Vibration and Noise, in celebration of the 50th anniversary of the ASME Design Engineering Division, the purpose of this symposium is to provide a forum for basic and applied researchers as well as design engineers to discuss state-of-the-art advances in theoretical, computational, experimental and materials aspects of noise, vibration, and design of submerged structures and transduction systems. Enhancing the information flow between theoreticians and engineers, facilitating the technology transfer between government-sponsored research and industrial development, and encouraging interdisciplinary cross-fertilization are all vital functions of this symposium.
ABSTRACTS: Abstracts are due by November 15, 1994. They should be submitted to one of the symposium organizers, R.P. Daddazio, M.M. Ettouney, or N.N. Abboud, Weidlinger Associates, Inc., Applied Science Division, 333 Seventh Avenue, New York, NY 10001; tel: 212-563-5200; fax: 212-695-4186; e-mail: najib@wai.com.

October 1995

7–8. **Eastern Section**, Northeastern University, Boston, Massachusetts.

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

November 1995

3–4. **Central Section**, Kent State University, Kent, Ohio.

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

17–18. **Southeastern Section**, University of North Carolina, Greensboro, NC.

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

January 1996

10–13. **Joint Mathematics Meetings**, Orlando, Florida (including the annual meetings of the AMS, AWM, MAA, and NAM).

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

March 1996

22–23. **Central Section**, University of Iowa, Iowa City, Iowa.

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

April 1996

19–21. **Southeastern Section**, Baton Rouge, Louisiana.

INFORMATION: W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

August 1996

* 14–17. **International Linear Algebra Society Meeting**, Chemnitz, Germany.

INFORMATION: V. Mehrmann, Fakultaet fuer Mathematik, TU Chemnitz-Zwickau, PSF 964, D-09009 Chemnitz, FRG; tel: (409) (0)371-531-8367 (office); (049) (0)371-531-2659 (secretary); (049) (0)172-348-2395 (private); fax: (049) (0)371-531-2657;

electronic mail: mehrmann@mathematik.tu-chemnitz.de; or private address: Fichtestr. 18, D-09126 Chemnitz.

November 1996

1–3. **Central Section**, University of Missouri at Columbia, Columbia, Missouri.

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

January 1997

10–13. **Joint Mathematics Meetings**, San Diego, California (including the annual meetings of the AMS, AWM, MAA, and NAM).

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

January 1998

10–13. **Joint Mathematics Meetings**, Baltimore, Maryland (including the annual meetings of the AMS, AWM, MAA, and NAM).

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

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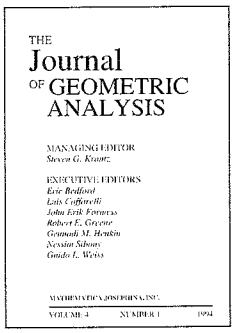

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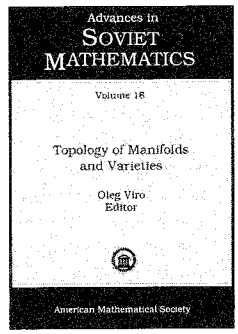

Topology of Manifolds and Varieties

Oleg Viro, Editor

Volume 18

This book contains recent papers by participants in the Rokhlin Topology Seminar, organized by V. A. Rokhlin in the 1960s, when he moved to Leningrad. Since then, the seminar has continued to be one of the main centers of research in topology in Russia. The topics presented here are concerned with, or are motivated by, topology of specific geometric objects, from classical knots to complex projective surfaces and configurations of subspaces in real projective spaces.

Contents

A. I. Degtyarev, *Cohomology approach to killing structures;* **A. I. Degtyarev**, *Classification of quartics having a nonsimple singular point.* II; **A. I. Degtyarev, S. Finashin, and G. Mikhalkin**, *Generalized Pin-structures and some applications to low dimensional topology;* **J. Drobotukhina**, *Classification of links in* $\mathbb{R}P^3$ *with at most six crossings;* **A. L. Felshtyn**, *Reidemeister and Nielsen zeta functions, and Reidemeister torsion in the theory of dynamical systems;* **S. Finashin**, *Variation of the Rokhlin function in higher dimensions;* **D. Fomin**, *Stiefel orientations.* I: *Existence and constructions;* **M. Gusarov**, *A new form of the Conway-Jones polynomial of oriented links;* **M. Gusarov**, *On n-equivalence of knots and invariants of finite degree;* **I. V. Itenberg**, *Rigid isotopy classification of curves of degree 6 with one nondegenerate double point;* **V. F. Mazurovskiĭ**, *Configurations of at most six* $(2n-1)$*-dimensional subspaces of* $\mathbb{R}P^{(4n-1)}$; **G. Mikhalkin**, *Congruences for real algebraic curves on an ellipsoid;* **N. Netsvetaev**, *Diffeomorphism criteria for simply connected even-dimensional manifolds;* **V. M. Nezhinskiĭ**, *Homotopy theory for the classification of singular links;* **O. Viro**, *Complex orientations of real algebraic surfaces.*

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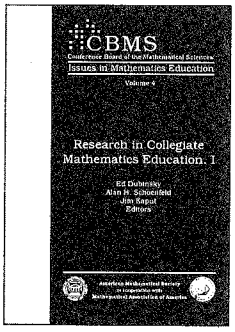
CBMS ISSUES IN MATHEMATICS EDUCATION



Research in Collegiate Mathematics Education. I

Ed Dubinsky, Alan H. Schoenfeld, and Jim Kaput, Editors

Volume 4

The field of research in collegiate mathematics education has grown rapidly over the past twenty-five years. Many people are convinced that improvement in mathematics education can only come with a greater understanding of what is involved when a student tries to learn mathematics and how pedagogy can be more directly related to the learning process. Today there is a substantial body of work and a growing group of researchers addressing both basic and applied issues of mathematics education at the collegiate level. This volume is testimony to the growth of the field. The intention is to publish volumes on this topic annually, doing more or less as the level of growth dictates. The introductory articles, survey papers, and current research that appear in this first issue convey some aspects of the state of the art. The book is aimed at researchers in collegiate mathematics education and teachers of college-level mathematics courses who may find ideas and results that are useful to them in their practice of teaching, as well as the wider community of scholars interested in the intellectual issues raised by the problem of learning mathematics.

Contents

A. H. Schoenfeld, *Some notes on the enterprise (research in collegiate mathematics education, that is);* **P. W. Thompson**, *Students, functions, and the undergraduate curriculum;* **T. Eisenberg and T. Dreyfus**, *On understanding how students learn to visualize function transformations;* **S. Frid**, *Three approaches to undergraduate calculus instruction: Their nature and potential impact on students' language use and sources of conviction;* **J. Bookman and C. P. Friedman**, *A comparison of the problem solving performance of students in lab based and traditional calculus;* **M. V. Bonsangue**, *An efficacy study of the calculus workshop model;* **S. Monk and R. Nemirovsky**, *The case of Dan: Student construction of a functional situation through visual attributes;* **M. M. Shoaf-Grubbs**, *The effect of the graphing calculator on female students' spatial visualization skills and level-of-understanding in elementary graphing and algebra concepts;* **R. Zazkis and H. Khoury**, *To the right of the "decimal" point: Preservice teachers' concepts of place value and multidigit structures;* **L. A. Steen**, *Twenty questions about research on undergraduate mathematics education.*

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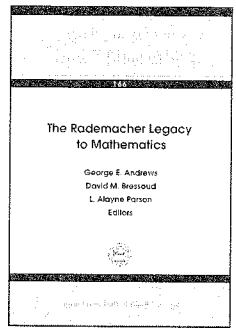

The Rademacher Legacy to Mathematics

George E. Andrews, David M. Bressoud, and L. Alayne Parson, Editors

Volume 166

This book contains papers presented at the Hans Rademacher Centenary Conference, held at Pennsylvania State University in July 1992. The astonishing breadth of Rademacher's mathematical interests is well represented in this volume. The papers collected here range over such topics as modular forms, partitions and q-series, Dedekind sums, and Ramanujan type identities. Rounding out the volume is the opening paper, which presents a biography of Rademacher. This volume is a fitting tribute to a remarkable mathematician whose work continues to influence mathematics today.

Contents

B. C. Berndt, *Hans Rademacher 1892–1969;* **B. C. Berndt and R. J. Evans**, *On Rademacher's multiplier system for the classical theta-function;* **H. Cohn and M. Knopp**, *Application of Dedekind eta-multipliers to modular equations;* **L. Ehrenpreis**, *Singularities, functional equations, and the circle method;* **J. Lehner and G. M. Wing**, *On Weyl's inequality of eigenvalues;* **D. B. Lieman**, *The $GL(2)$ Rankin-Selberg convolution for higher level non-cuspidal forms;* **K. Ono**, *Congruences on the Fourier coefficients of modular forms on $\Gamma_0(N)$;* **R. A. Rankin**, *Diagonalizing Eisenstein series* IV; **S. Robins**, *Generalized Dedekind η-products;* **K. Alladi and B. Gordon**, *Vanishing coefficients in the expansion of products of Rogers-Ramanujan type;* **G. E. Andrews**, *Schur's theorem, Capparelli's conjecture and q-trinomial coefficients;* **D. Bowman**, *Modified convergence for q-continued fractions defined by functional relations;* **K. W. J. Kadell**, *A simple proof of an Aomoto type extension of the q-Morris theorem;* **L. W. Kolitsch**, *Congruences for certain generalized Frobenius partitions modulo p^3;* **R. J. McIntosh**, *Some asymptotic formulae for Ramanujan's mock theta functions;* **R. W. Bruggeman**, *On the distribution of Dedekind sums;* **G. Almkvist**, *Wilf's conjecture and a generalization;* **T. Dokshitzer**, *An elementary proof of Wilf's conjecture;* **F. Garvan**, *Cubic modular identities of Ramanujan, hypergeometric functions and analogues of the arithmetic-geometric mean iteration;* **M. Grady and M. Newman**, *Residue periodicity in subgroup counting functions;* **X.-D. Jia and M. B. Nathanson**, *Addition theorems for σ-finite groups;* **W. Conn and L. N. Vaserstein**, *On sums of three integral cubes;* **J. B. Friedlander and H. Iwaniec**, *A note on character sums;* **D. W. Boyd**, *Large factors of small polynomials;* **S. Gurak**, *Factors of period polynomials for finite fields, I;* **L. Mai and M. R. Murty**, *The Phragmén-Lindelöf theorem and modular elliptic curves;* **R. J. Evans**, *Multidimensional beta and gamma integrals;* **K. B. Stolarsky**, *Rademacher, calculus of variations, inequalities and relative error.*

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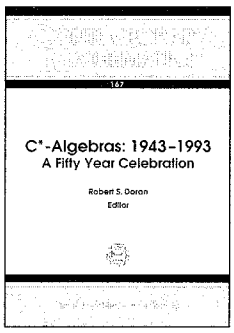

C^*-Algebras: 1943–1993

Robert S. Doran, Editor

Volume 167

This volume contains the proceedings of an AMS Special Session held at the Joint Mathematics Meetings in San Antonio in January 1993 to celebrate the first fifty years of C^*-algebra theory. The book contains carefully written expository and research articles by leaders in the field. Also included is a reprinting of the original 1943 paper on C^*-algebras by Gelfand and Neumark, which has had such a profound influence on the field. The volume covers a broad spectrum of topics, including the Gelfand-Neumark theorems, C^*-algebras and quantization, projections in C^*-algebras, Mackey's theory of group representations and their relation to C^*-algebras, transformation group C^*-algebras, the influence of algebraic topology on C^*-algebras, K-theory and index theory in operator algebras, exponential rank in C^*-algebras, and a survey of the development of type III von Neumann algebras. With historical perspectives and up-to-date overviews to orient readers new to the field, this book will interest mathematicians, physicists, and mathematical historians.

Contents

I. M. Gelfand and M. A. Neumark, *On the imbedding of normed rings into the ring of operators in Hilbert space;* **R. V. Kadison**, *Notes on the Gelfand-Neumark theorem;* **I. E. Segal**, *C^*-algebras and quantization;* **M. A. Rieffel**, *Quantization and C^*-algebras;* **E. G. Effros**, *Some quantizations and reflections inspired by the Gelfand-Naimark theorem;* **W. B. Arveson**, *The role of C^*-algebras in infinite dimensional numerical linear algebra;* **B. Blackadar**, *Projections in C^*-algebras;* **J. Rosenberg**, *C^*-algebras and Mackey's theory of group representations;* **J. Packer**, *Transformation group C^*-algebras: A selective survey;* **C. Schochet**, *Algebraic topology and C^*-algebras;* **M. Takesaki**, *Twenty-five years in the theory of type* III *von Neumann algebras;* **P. Baum, A. Connes, and N. Higson**, *Classifying space for proper actions and K-theory of group C^*-algebras;* **R. G. Douglas**, *Odd index theorems and operator algebras;* **H. Moscovici and F. Wu**, *Index theory without symbols;* **N. C. Phillips**, *A survey of exponential rank;* **Appendix**: **I. Gelfand and M. Neumark**, *On the imbedding of normed rings into the ring of operators in Hilbert space.*

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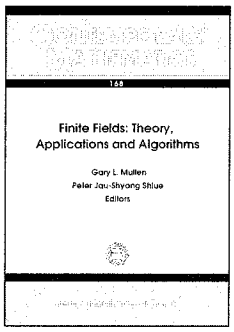

Finite Fields: Theory, Applications, and Algorithms

Gary L. Mullen and Peter Jau-Shyong Shiue, Editors

Volume 168

Because of their applications in so many diverse areas, finite fields continue to play increasingly important roles in various branches of modern mathematics, including number theory, algebra, and algebraic geometry, as well as in computer science, information theory, statistics, and engineering. Computational and algorithmic aspects of finite field problems also continue to grow in importance. This volume contains the refereed proceedings of a conference entitled Finite Fields: Theory, Applications and Algorithms, held in August 1993 at the University of Nevada at Las Vegas. Among the topics treated are theoretical aspects of finite fields, coding theory, cryptology, combinatorial design theory, and algorithms related to finite fields. Also included is a list of open problems and conjectures. This volume is an excellent reference for applied and research mathematicians as well as specialists and graduate students in information theory, computer science, and electrical engineering.

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P. Charpin, *Tools for coset weight enumerators of some codes;* **X. Chen, I. S. Reed, T. Helleseth, and T. K. Truong**, *Algebraic decoding of cyclic codes: A polynomial ideal point of view;* **S. D. Cohen**, *Polynomial factorisation, graphs, designs and codes;* **R. Evans**, *Character sums as orthogonal eigenfunctions of adjacency operators for Cayley graphs;* **M. Fellows and N. Koblitz**, *Combinatorial cryptosystems galore!;* **R. Figueroa, P. M. Salzberg, and P. Jau-Shyong Shiue**, *A family of cryptosystems based on combinatorial properties of finite geometries;* **M. D. Fried**, *Global construction of general exceptional covers;* **S. Gao and J. von zur Gathen**, *Berlekamp's and Niederreiter's polynomial factorization algorithms;* **R. Göttfert and H. Niederreiter**, *Hasse-Teichmüller derivatives and products of linear recurring sequences;* **S. Gurak**, *Factors of period polynomials for finite fields*, II; **N. Hamada and T. Helleseth**, *A characterization of some ternary codes meeting the Griesmer bound;* **J. W. P. Hirschfeld and R. Shaw**, *Projective geometry codes over prime fields;* **K. Huber**, *Codes over Eisenstein-Jacobi integers;* **H. Kiechle**, *Points on Fermat curves over finite fields;* **A. Knopfmacher, J. Knopfmacher, and R. Warlimont**, *Lengths of factorizations for polynomials over a finite field;* **J. Kuang**, *A note on Weil representation of* $SL_2(\mathbb{F}_q)$ *and Soto-Andrade sums;* **P. Langevin**, *Some sequences with good autocorrelation properties;* **H. Lu**, *Pellian equation conjecture and absolutely nonsingular projective varieties over a finite field—Hecke operator and Pellian equation conjecture* (IV); **R. Matthews**, *Strong pseudoprimes and generalized Carmichael numbers;* **O. Moreno and V. A. Zinoviev**, *Transformations of* 4*-regular graphs and equations over finite fields of Chevalley-Warning type;* **P. Müller**, *New examples of exceptional polynomials;* **H. Niederreiter**, *New deterministic factorization algorithms for polynomials over finite fields;* **A. M. Odlyzko**, *Discrete logarithms and smooth polynomials;* **V. Pless**, *Parents, children, neighbors and the shadow;* **M. Qu and S. A. Vanstone**, *The knapsack problem in cryptography;* **A. Scheerhorn**, *Iterated constructions of normal bases over finite fields;* **L. Somer**, *Periodicity properties of kth order linear recurrences whose characteristic polynomial splits completely over a finite field*, I; **H. Y. Song and S. W. Golomb**, *Generalized Welch-Costas sequences and their application to Vatican arrays;* **S. J. Suchower**, *Nonisomorphic complete sets of* F*-rectangles with varying numbers of symbols;* **S. Tezuka and M. Fushimi**, *A method of designing cellular automata as pseudorandom number generators for built-in self-test for VLSI;* **C. E. Trimble**, *Finite ring sums from p-adic* K*-Bessel functions;* **P. T. Young**, *On the Gross-Koblitz formula;* **J. Wolfmann**, *New results on diagonal equations over finite fields from cyclic codes;* **K. Huber, I. H. Morgan, G. L. Mullen, H. Niederreiter, A. Odlyzko, J. van Tilburg, and D. Wan**, *Open problems and conjectures.*

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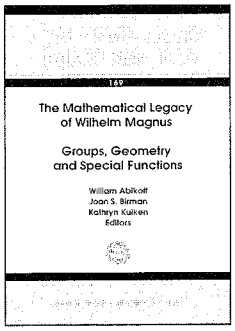

The Mathematical Legacy of Wilhelm Magnus: Groups, Geometry and Special Functions

William Abikoff, Joan S. Birman, and Kathryn Kuiken, Editors

Volume 169

Wilhelm Magnus was an extraordinarily creative mathematician who made fundamental contributions to diverse areas, including group theory, geometry, and special functions. This book contains the proceedings of a conference held in May 1992 at Polytechnic University to honor the memory of Magnus. The focus of the book is on active areas of current research where Magnus' influence can be seen. The papers range from expository articles to major new research, bringing together seemingly diverse topics and providing entry points to a variety of areas of mathematics.

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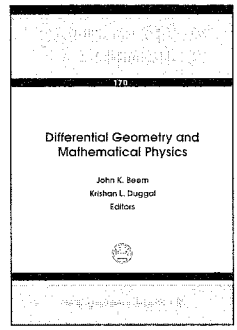

Differential Geometry and Mathematical Physics

John K. Beem and Krishan L. Duggal, Editors

Volume 170

This book contains the proceedings of the Special Session, Geometric Methods in Mathematical Physics, held at the joint AMS-CMS meeting in Vancouver in August 1993. The papers collected here contain a number of new results in differential geometry and its applications to physics. The major themes include black holes, singularities, censorship, the Einstein field equations, geodesics, index theory, submanifolds, CR-structures, and space-time symmetries. In addition, there are papers on Yang-Mills fields, geometric techniques in control theory, and equilibria. Containing new results by established researchers in the field, this book provides a look at developments in this exciting area of research.

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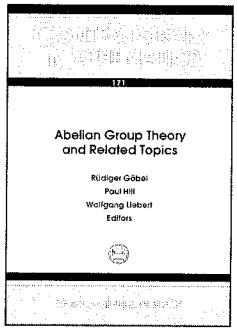

Abelian Group Theory and Related Topics

Rüdiger Göbel, Paul Hill, and Wolfgang Liebert, Editors

Volume 171

This volume contains the proceedings of a conference on abelian groups held in August 1993 at Oberwolfach. The conference brought together forty-seven participants from all over the world and from a range of mathematical areas. Experts from model theory, set theory, noncommutative groups, module theory, and computer science discussed problems in their fields that relate to abelian group theory. This book provides a window on the frontier of this active area of research.

Contents

C. Vinsonhaler, *Richard Scott Pierce;* **L. Bican**, *On B_2-groups;* **E. A. Blagoveshchenskaya and A. Mader**, *Decompositions of almost completely decomposable Abelian groups;* **A. Blass**, *On the divisible parts of quotient groups;* **W. D. Burgess**, *Minimal rings, central idempotents and the Pierce sheaf;* **A. L. S. Corner and B. Goldsmith**, *On endomorphisms and automorphisms of some pure subgroups of the Baer-Specker group;* **P. C. Eklof and S. Shelah**, *A combinatorial principle equivalent to the existence of non-free Whitehead groups;* **S. T. Files**, *Endomorphisms of local Warfield groups;* **A. A. Fomin**, *Finitely presented modules over the ring of universal numbers;* **L. Fuchs**, *A survey of Butler groups of infinite rank;* **L. Fuchs and K. M. Rangaswamy**, *Unions of chains of Butler groups;* **R. G. Göbel and R. M. Shortt**, *Some torsion-free groups arising in measure theory;* **H. P. Goeters, W. Ullery, and C. Vinsonhaler**, *Numerical invariants for a class of Butler groups;* **K. R. Goodearl**, *K_0 of regular rings with bounded index of nilpotence;* **D. Holley and R. Wiegand**, *Torsion in quotients of the multiplicative group of a number field;* **P. Keef**, *On p^α-injective Abelian groups;* **F.-V. Kuhlmann**, *Abelian groups with contractions* I; **R. S. Lafleur**, *Typesets and cotypesets of finite-rank torsion-free Abelian groups;* **A. Mader, O. Mutzbauer, and K. M. Rangaswamy**, *A generalization of Butler groups;* **W. May**, *Endomorphisms over incomplete discrete valuation rings;* **M. Magidor and S. Shelah**, *$Ext^2(G, T)$ can be nontrivial even assuming GCH;* **R. Mines, C. Vinsonhaler, and W. J. Wickless**, *Representations and duality;* **O. Mutzbauer and E. Toubassi**, *Extending a splitting criterion on mixed modules;* **J. D. O'Neill**, *Direct summands of Z^κ for large κ;* **A. T. Paras**, *Abelian groups as noetherian modules over their endomorphism rings;* **F. Richman**, *Isomorphism of Butler groups at a prime;* **C. M. Ringel**, *The braid group action on the set of exceptional sequences of a hereditary Artin algebra;* **C. Rotthaus and S. Wiegand**, *Direct limits of two-dimensional prime spectra;* **P. Schultz**, *When is an Abelian p-group determined by the Jacobson radical of its endomorphism ring?;* **J. Trlifaj**, *Similarities and differences between Abelian groups and modules over non-perfect rings;* **W. J. Wickless**, *A functor from mixed groups to torsion-free groups;* **P. D. Yom**, *A characterization of a class of Butler groups* II.

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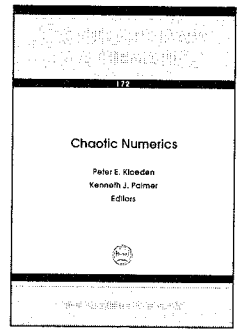

Chaotic Numerics

Peter E. Kloeden and Kenneth J. Palmer, Editors

Volume 172

Much of what is known about specific dynamical systems is obtained from numerical experiments. Although the discretization process usually has no significant effect on the results for simple, well-behaved dynamics, acute sensitivity to changes in initial conditions is a hallmark of chaotic behavior. How confident can one be that the numerical dynamics reflects that of the original system? Do numerically calculated trajectories always shadow a true one? What role does numerical analysis play in the study of dynamical systems? And conversely, can advances in dynamical systems provide new insights into numerical algorithms? These and related issues were the focus of the workshop on Chaotic Numerics, held at Deakin University in Geelong, Australia, in July 1993. The contributions to this book are based on lectures presented during the workshop and provide a broad overview of this area of research.

Contents

J. K. Hale, *Numerical dynamics;* **R. M. Corless**, *Error backward;* **M. P. Calvo, A. Murua, and J. M. Sanz-Serna**, *Modified equations for ODEs;* **H. C. Yee and P. K. Sweby**, *The dynamics of some iterative implicit schemes;* **S.-N. Chow and E. S. Van Vleck**, *Shadowing of lattice maps;* **B. A. Coomes, H. Koçak, and K. J. Palmer**, *Periodic shadowing;* **W.-J. Beyn**, *On well-posed problems for connecting orbits in dynamical systems;* **L. Debraux**, *Numerical computation of a branch of invariant circles starting at a Hopf bifurcation point;* **J. Lorenz**, *Numerics of invariant manifolds and attractors;* **P. Diamond, P. Kloeden, and A. Pokrovskii**, *Interval stochastic matrices and simulation of chaotic dynamics;* **C. M. Elliott, A. R. Gardiner, I. Kostin, and B. Lu**, *Mathematical and numerical analysis of a mean-field equation for the Ising model with Glauber dynamics;* **V. M. Gundlach**, *Attractors for weakly coupled map lattices;* **M. J. Ablowitz and C. M. Schober**, *Effective chaos in the nonlinear Schrödinger equation;* **X. Yu**, *Discretisation effect on a dynamical system with discontinuity.*

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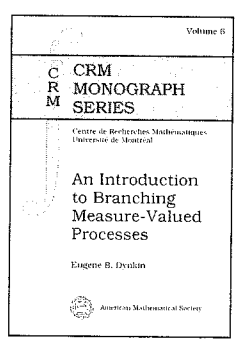

An Introduction to Branching Measure-Valued Processes

Eugene B. Dynkin

Volume 6

For about half a century, two classes of stochastic processes—Gaussian processes and processes with independent increments—have played an important role in the development of stochastic analysis and its applications. During the last decade, a third class—branching measure-valued (BMV) processes—has also been the subject of much research. A common feature of all three classes is that their finite-dimensional distributions are infinitely divisible,

allowing the use of the powerful analytic tool of Laplace (or Fourier) transforms. All three classes, in an infinite-dimensional setting, provide means for study of physical systems with infinitely many degrees of freedom. This is the first monograph devoted to the theory of BMV processes. Dynkin first constructs a large class of BMV processes, called superprocesses, by passing to the limit from branching particle systems. Then he proves that, under certain restrictions, a general BMV process is a superprocess. A special chapter is devoted to the connections between superprocesses and a class of nonlinear partial differential equations recently discovered by Dynkin.

Contents

Super-Brownian motion and partial differential equations; Introduction; Markov processes; Construction of superprocesses; General Feynman-Kac formula; Change of parameters in superprocesses; Structure of branching measure-valued processes; Historical notes and comments; Elements of stochastic calculus; References; Index; Index of notation.

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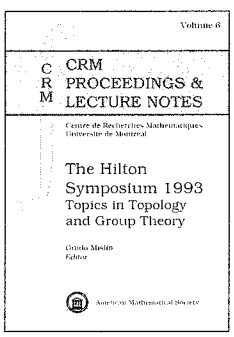

The Hilton Symposium 1993: Topics in Topology and Group Theory

Guido Mislin, Editor

Volume 6

This volume presents a cross-section of new developments in algebraic topology. The main portion consists of survey articles suitable for advanced graduate students and professionals pursuing research in this area. A great variety of topics are covered, many of which are of interest to researchers working in other areas of mathematics. In addition, some of the articles cover topics in group theory and homological algebra.

Contents

C. Casacuberta, *Recent advances in unstable localization;* **B. Eckmann**, *Hurwitz-Randon matrices revisited: From effective solution of the Hurwitz matrix equaitons to Bott periodicity;* **R. Geoghegan and A. Nicas**, *The first order Euler characteristic;* **I. M. James**, *On fibrewise homotopy theory;* **C. A. McGibbon**, *The Mislin genus of a space;* **G. Mislin**, *Mapping class groups, characteristic classes, and Bernoulli numbers;* **V. Giambalvo, N. H. V. Hung, and F. P. Peterson**, $H^*(\mathrm{RP}^\infty \times \cdots \times \mathrm{RP}^\infty)$ *as a module over the Steenrod algebra;* **J. Roitberg**, *Computing homotopy classes of phantom maps;* **D. Sjerve and M. Cherkassoff**, *On groups generated by three involutions, two of which commute;* **U. Stammbach**, *Types of projective resolutions for finite groups.*

1991 *Mathematics Subject Classification*: 55–02; 20J05
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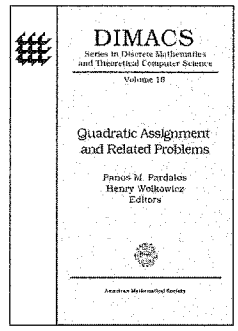

Quadratic Assignment and Related Problems

Panos M. Pardalos and Henry Wolkowicz, Editors

Volume 16

This book, the first dedicated to quadratic assignment problems, contains refereed papers presented at the Workshop on Quadratic Assignment and Related Problems, held at DIMACS in May 1993. Bringing together researchers from academia and industry, the workshop focused on recent computational approaches and applications. The methods described here include eigenvalue estimates and reduction techniques for lower bounds, parallelization, genetic algorithms, polyhedral approaches, greedy and adaptive search algorithms. The applications include graph bandwidth problems, telecommunications network design, load balancing, VLSI design, data association problems, and multidimensional assignment problems. In addition, this book contains a survey article with an extensive bibliography.

Contents

P. M. Pardalos, F. Rendl, and H. Wolkowicz, *The quadratic assignment problem: A survey and recent developments;* **W. Adams and T. A. Johnson**, *Improved linear programming-based lower bounds for the quadratic assignment problem;* **S. Areibi and A. Vannelli**, *Advanced search techniques for circuit partitioning;* **T. N. Bui and B. R. Moon**, *A genetic algorithm for a special class of the quadratic assignment problem;* **R. E. Burkard, E. Çela, and B. Klinz**, *On the biquadratic assignment problem;* **P. Carraresi and F. Malucelli**, *A reformulation scheme and new lower bounds for the* QAP*;* **J. Chakrapani and J. Skorin-Kapov**, *A constructive method to improve lower bounds for the quadratic assignment problem;* **C. Fleurent and J. A. Ferland**, *Genetic hybrids for the quadratic assignment problem;* **S. W. Hadley**, *Domination & separation applied to the quadratic assignment problem;* **S. E. Karisch, F. Rendl, and H. Wolkowicz**, *Trust regions and relaxations for the quadratic assignment problem;* **W.-J. Li and J. M. Smith**, *Stochastic quadratic assignment problems;* **Y. Li, P. M. Pardalos, and M. G. C. Resende**, *A greedy randomized adaptive search procedure for the quadratic assignment problem;* **T. Mautor and C. Roucairol**, *Difficulties of exact methods for solving the quadratic assignment problem;* **E. Medova**, *Using* QAP *bounds for the circulant* TSP *to design reconfigurable networks;* **B. Mirkin**, *Approximation of association data by structures and clusters;* **A. B. Poore and N. Rijavec**, *Partitioning multiple data sets: multidimensional assignments and lagrangian relaxation;* **H. D. Sherali and E. L. Brown**, *A quadratic partial assignment and packing model and algorithm for the airline gate assignment problem.*

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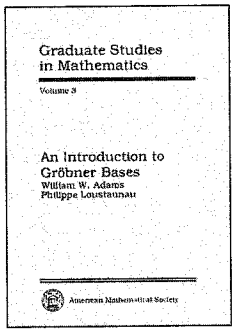
GRADUATE STUDIES IN MATHEMATICS



An Introduction to Gröbner Bases

William W. Adams and Philippe Loustaunau

Volume 3

As the primary tool for doing explicit computations in polynomial rings in many variables, Gröbner bases are an important component of all computer algebra systems. They are also important in computational commutative algebra and algebraic geometry. This book provides a leisurely and fairly comprehensive introduction to Gröbner bases and their applications. Adams and Loustaunau cover the following topics: the theory and construction of Gröbner bases for polynomials with coefficients in a field, applications of Gröbner bases to computational problems involving rings of polynomials in many variables, a method for computing syzygy modules and Gröbner bases in modules, and the theory of Gröbner bases for polynomials with coefficients in rings. With over 120 worked examples and 200 exercises, this book is aimed at advanced undergraduate and graduate students. It would be suitable as a supplement to a course in commutative algebra or as a textbook for a course in computer algebra or computational commutative algebra. This book would also be appropriate for students of computer science and engineering who have some acquaintance with modern algebra.

Contents

Basic theory of Gröbner bases; Applications of Gröbner bases; Modules and Gröbner bases; Gröbner bases over rings; Appendix A. Computations and algorithms; Appendix B. Well-ordering and induction; References; List of symbols; Index.

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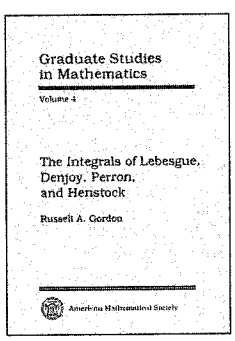

The Integrals of Lebesgue, Denjoy, Perron, and Henstock

Russell A. Gordon

Volume 4

This book provides an elementary, self-contained presentation of the integration processes developed by Lebesgue, Denjoy, Perron, and Henstock. The Lebesgue integral and its essential properties are first developed in detail. The other three integrals are all generalizations of the Lebesgue integral that satisfy the ideal version of the Fundamental Theorem of Calculus: if F is differentiable on the interval $[a, b]$, then F' is integrable on $[a, b]$ and $\int_a^b = F(b) - F(a)$. One of the book's unique features is that the Denjoy, Perron, and Henstock integrals are each developed fully and carefully from their corresponding definitions. The last part of this book is devoted to integration processes which satisfy a theorem analogous to the Fundamental Theorem, in which F is approximately differentiable. This part of the book is preceded by a detailed study of the approximate derivative and ends with some open questions. This book contains over 230 exercises (with solutions) that illustrate and expand the material in the text. It would be an excellent textbook for first year graduate students who have background in real analysis.

Contents

Lebesgue measure; Measurable functions; The Lebesgue integral; Bounded variation and absolute continuity; Darboux and Baire class one functions; Functions of generalized bounded variation; The Denjoy integral; The Perron integral; The Henstock integral; The McShane integral; Equivalence of integrals; Integration by parts; Convergence theorems; Approximate derivatives; The Khintchine integral; The approximately continuous Henstock integral; The approximately continuous Perron integral; Solutions to exercises; References; Notation index; Subject index.

1991 *Mathematics Subject Classification*: 26Axx, 28Axx
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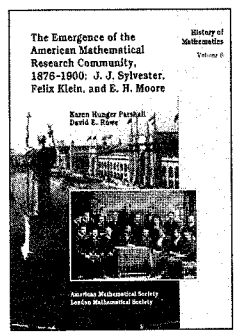
HISTORY OF MATHEMATICS



The Emergence of the American Mathematical Research Community, 1876–1900: J. J. Sylvester, Felix Klein, and E. H. Moore

Karen Hunger Parshall and David E. Rowe

Volume 8

This volume traces the transformation of the United States from a mathematical backwater to a major presence during the quarter-century from 1876 to 1900. Presenting a detailed study of the major figures involved in this transformation, it focuses on the three most influential individuals—the British algebraist James Joseph Sylvester, the German standard-bearer Felix Klein, and the American mathematician Eliakim Hastings Moore—and on the principal institutions with which they were associated—the Johns Hopkins University, Göttingen University, and the University of Chicago. This book further analyzes the research traditions these men and institutions represented, the impact these had on the second generation of American mathematical researchers, and the role of the American Mathematical Society in these developments. This is the first work ever written on the history of American mathematics during this period and one of the few books that examines the historical development of American mathematics from a wide perspective. By placing the development of American mathematics within the context of broader external factors affecting historical events, the authors show how the character of American research was decisively affected by the surrounding scientific, educational, and social contexts of the period. Aimed at a general mathematical audience and at historians of science, this book contains an abundance of unpublished archival material, numerous rare photographs, and an extensive bibliography.

Contents

An overview of American mathematics: 1776–1876; A new departmental prototype: J. J. Sylvester and the Johns Hopkins University; Mathematics at Sylvester's Hopkins; German mathematics and the early mathematical career of Felix Klein; America's wanderlust generation; Changes on the horizon; The World's Columbian exposition of 1893 and the Chicago Mathematical

Congress; Surveying mathematical landscapes: The Evanston Colloquium Lectures; Meeting the challenge: The University of Chicago and the American mathematical research community; Epilogue: Beyond the threshold: The American mathematical research community, 1900–1933; Bibliography.

1991 *Mathematics Subject Classification*: 01A55, 01A72, 01A73; 01A60, 01A74, 01A80
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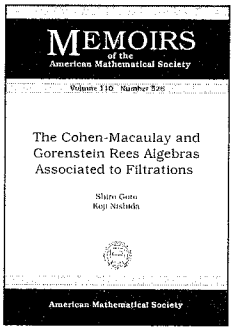

The Cohen-Macaulay and Gorenstein Rees Algebras Associated to Filtrations

Shiro Goto and Koji Nishida

Volume 110, Number 526

This monograph consists of two parts. Part I investigates the Cohen-Macaulay and Gorenstein properties of symbolic Rees algebras for one-dimensional prime ideals in Cohen-Macaulay local rings. Practical criteria for these algebras to be Cohen-Macaulay and Gorenstein rings are described in terms of certain elements in the prime ideals. This framework is generalized in Part II to Rees algebras $R(F)$ and graded rings $G(F)$ associated to general filtrations of ideals in arbitrary Noetherian local rings. Goto and Nishida give certain cohomological characterizations for algebras $R(F)$ to be Cohen-Macaulay or Gorenstein rings in connection with the corresponding ring-theoretic properties of $G(F)$. In this way, readers follow a history of the development of the ring theory of Rees algebras. The book raises many important open questions.

Contents

Part I. The Cohen-Macaulay symbolic Rees algebras for curve singularities: *Introduction; Preliminaries; The case of dimension 1; The case of dimension 2; The Cohen-Macaulay and Gorenstein properties of $G_s(\mathbf{p})$; The Cohen-Macaulay and Gorenstein properties of $R_s(\mathbf{p})$; Examples; References;* **Part II. Filtrations and the Gorenstein property of the associated Rees algebras**: *Introduction; Preliminaries; Proof of Theorem (1.1); Proof of Theorems (1.3) and (1.5); The Gorenstein property of Rees algebras $R(F)$ and the condition (S_2) for A; Graded rings $R^\dagger$; Examples for $R_s(\mathbf{p})$; Normalized Rees algebras $\overline{R}(I)$; Bad example; References.*

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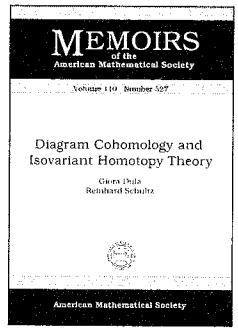

Diagram Cohomology and Isovariant Homotopy Theory

Giora Dula and Reinhard Schultz

Volume 110, Number 527

In algebraic topology, obstruction theory provides a way to study homotopy classes of continuous maps in terms of cohomology groups; a similar theory exists for certain spaces with group actions and maps that are compatible (that is, equivariant) with respect to the group actions. This work provides a corresponding setting for certain spaces with group actions and maps that are compatible in a stronger sense, called isovariant. The basic idea is to establish an equivalence between isovariant homotopy and equivariant homotopy for certain categories of diagrams. Consequences include isovariant versions of the usual Whitehead theorems for recognizing homotopy equivalences, an obstruction theory for deforming equivariant maps to isovariant maps, rational computations for the homotopy groups of certain spaces of isovariant functions, and applications to constructions and classification problems for differentiable group actions.

Contents

Introduction; Equivariant homotopy in diagram categories; Quasistratifications; Isovariant homotopy and maps of diagrams; Almost isovariant maps; Obstructions to isovariance; Homotopy groups of isovariant function spaces; Calculations with the spectral sequence; Applications to differentiable group actions; Index of selected terms and symbols; References.

1991 *Mathematics Subject Classification*: 55P91, 55S37, 55S91, 55T99, 57R91, 57S15, 57S17; 55N25, 55N35, 55P60, 55Q20, 55Q91, 57N80, 57Q91
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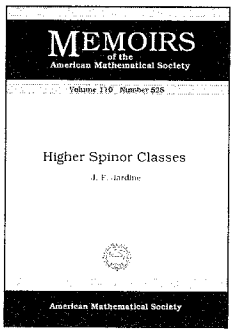

Higher Spinor Classes

J. F. Jardine

Volume 110, Number 528

This work defines the higher spinor classes of an orthogonal representation of a Galois group. These classes are higher-degree analogues of the Fröhlich spinor class, which quantify the difference between the Stiefel-Whitney classes of an orthogonal representation and the Hasse-Witt classes of the associated form. Jardine establishes various basic properties, including vanishing in odd degrees and an induction formula for quadratic field extensions. The methods used include the homotopy theory of simplicial presheaves and the action of the Steenrod algebra on mod 2 étale cohomology.

Contents

Introduction; The operation P_2; The cohomology of BO_n; The cohomological induction formula; Higher spinor classes; References.

1991 *Mathematics Subject Classification*: 12G05; 18F20
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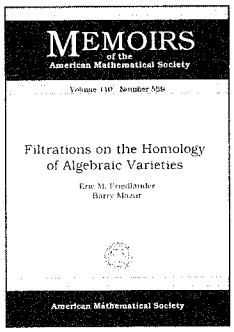

Filtrations on the Homology of Algebraic Varieties

Eric M. Friedlander and Barry Mazur

Volume 110, Number 529

This work provides a detailed exposition of a classical topic from a very recent viewpoint. Friedlander and Mazur describe some foundational aspects of "Lawson homology" for complex projective algebraic varieties, a homology theory defined in terms of homotopy groups of spaces of algebraic cycles. Attention is paid to methods of group completing abelian topological monoids. The authors study properties of Chow varieties, especially in connection with algebraic correspondences relating algebraic varieties. Operations on Lawson homology are introduced and analyzed. These operations lead to a filtration on the singular homology of algebraic varieties, which is identified in terms of correspondences and related to classical filtrations of Hodge and Grothendieck.

Contents

Introduction; Questions and speculations; Abelian monoid varieties; Chow varieties and Lawson homology; Correspondences and Lawson homology; "Multiplication" of algebraic cycles; Operations in Lawson homology; Filtrations; Appendix A. Mixed Hodge structures, homology, and cycle classes; Appendix B. Trace maps and the Dold-Thom theorem; Appendix Q. On the group completion of a simplicial monoid; Bibliography.

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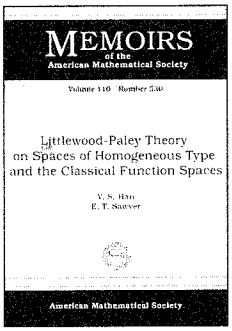

Littlewood-Paley Theory on Spaces of Homogeneous Type and the Classical Function Spaces

Y. S. Han and E. T. Sawyer

Volume 110, Number 530

In this work, Han and Sawyer extend Littlewood-Paley theory, Besov spaces, and Triebel-Lizorkin spaces to the general setting of a space of homogeneous type. For this purpose, they establish a suitable analogue of the Calderón reproducing formula and use it to extend classical results on atomic decomposition, interpolation, and T1 and Tb theorems. Some new results in the classical setting are also obtained: atomic decompositions with vanishing b-moment, and Littlewood-Paley characterizations of Besov and Triebel-Lizorkin spaces with only half the usual smoothness and cancellation conditions on the approximate identity.

Contents

Introduction; T_N^{-1} is a Calderón-Zygmund operator; The Calderón-type reproducing formula on spaces of homogeneous type; The Besov and Triebel-Lizorkin spaces on spaces of homogeneous type; The $T1$ theorems of $\dot{B}_p^{\alpha,q}$ and $\dot{F}_p^{\alpha,q}$; Atomic decomposition of $\dot{B}_p^{\alpha,q}$ and $\dot{F}_p^{\alpha,q}$; Duality and interpolation of $\dot{B}_p^{\alpha,q}$ and $\dot{F}_p^{\alpha,q}$; References.

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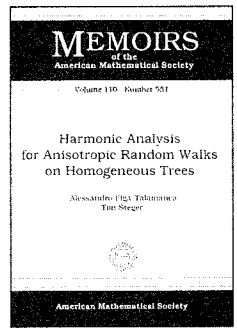

Harmonic Analysis for Anisotropic Random Walks on Homogeneous Trees

Alessandro Figà-Talamanca and Tim Steger

Volume 110, Number 531

This work presents a detailed study of the anisotropic series representations of the free product group $\mathbf{Z}/2\mathbf{Z} \star \cdots \star \mathbf{Z}/2\mathbf{Z}$. These representations are infinite dimensional, irreducible, and unitary and can be divided into principal and complementary series. Anisotropic series representations are interesting because, while they are not restricted from any larger continuous group in which the discrete group is a lattice, they nonetheless share many properties of such restrictions. The results of this work are also valid for nonabelian free groups on finitely many generators.

Contents

Introduction; The Green function; The Spectrum and the Plancherel measure; Representations and their realization on the boundary; Irreducibility and inequivalence; References.

1991 *Mathematics Subject Classification*: 22D10; 20E05, 22E40, 22E46, 43A65, 60B15
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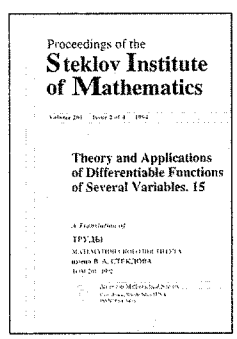
PROCEEDINGS OF THE STEKLOV INSTITUTE OF MATHEMATICS



Theory and Applications of Differentiable Functions of Several Variables

L. D. Kudryavtsev et al., Editors

Volume 201

This book is dedicated to Sergeĭ Mikhaĭlovich Nikol'skiĭ on the occasion of his eighty-fifth birthday. The collection contains new results on the following topics: approximation of functions, imbedding theory, interpolation of function spaces, convergence of series in trigonometric and general orthogonal systems, quasilinear elliptic problems, spectral theory of nonselfadjoint operators, asymptotic properties of pseudodifferential operators, and methods of approximate solution of Laplace's equation.

Contents

Sergeĭ Mikhaĭlovich Nikol'skiĭ (on the occasion of his eighty-fifth birthday); **E. I. Berezhnoĭ**, *Two-weight estimates for a class of integral operators;* **O. V.**

Besov, *Interpolation of spaces of differentiable functions defined on a domain;* **I. L. Bloshanskiĭ**, *On a sequence of linear operators;* **K. Kh. Boĭmatov**, *The asymptotic behavior of the Schwarz kernels of spectral projections of pseudodifferential operators with operator-valued symbols;* **S. V. Bochkarev**, *Almost-everywhere divergent rearrangements of Fourier series in multiplicative systems of functions in the classes H^{ω};* **Ya. S. Bugrov**, *Spaces with mixed norms, and Fourier transforms;* **V. I. Burenkov and P. M. Badzhrackariya**, *Approximation by infinitely differentiable vector-valued functions with preservation of range for various function spaces;* **E. A. Volkov**, *Approximate solution, by the block method, of the Laplace equation on polygons with analytic mixed boundary conditions;* **M. L. Gol'dman**, *An imbedding criterion for different metrics for isotropic Besov spaces with arbitrary moduli of continuity;* **V. A. Il'in and E. I. Moiseev**, *On systems consisting of subsets of root functions of two different boundary value problems;* **L. D. Kudryavtsev**, *On estimates of intermediate derivatives by means of moments of the highest derivative;* **P. I. Lizorkin and V. S. Guliev**, *Function spaces and questions of approximation on the Heisenberg group;* **S. M. Nikol'skiĭ**, *Approximation on a manifold by functions of exponential type and by polynomials;* **Yu. S. Nikol'skiĭ**, *Imbedding theorems for weighted anisotropic spaces of differentiable functions;* **S. I. Pokhozhaev**, *On quasilinear elliptic problems in $\mathbb{R}^N$ in the supercritical case.*

1991 *Mathematics Subject Classification*: 46E35, 41A10, 41A30; 46E15, 46E30
ISBN 0-8218-0338-7, ISSN 0081-5438
286 pages (softcover), 1994
Individual member $126, List price $210, Institutional member $168
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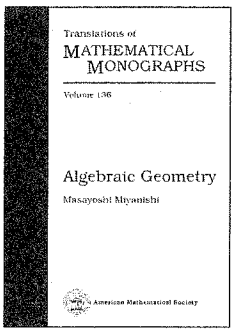
TRANSLATIONS OF MATHEMATICAL MONOGRAPHS



Algebraic Geometry
Masayoshi Miyanishi
Volume 136

Students often find, in setting out to study algebraic geometry, that most of the serious textbooks on the subject require knowledge of ring theory, field theory, local rings and transcendental field extensions, and even sheaf theory. Often the expected background goes well beyond college mathematics. This book, aimed at senior undergraduates and graduate students, grew out of Miyanishi's attempt to lead students to an understanding of algebraic surfaces while presenting the necessary background along the way. Originally published in the Japanese in 1990, it presents a self-contained introduction to the fundamentals of algebraic geometry. This book begins with background on commutative algebras, sheaf theory, and related cohomology theory. The next part introduces schemes and algebraic varieties, the basic language of algebraic geometry. The last section brings readers to a point at which they can start to learn about the classification of algebraic surfaces.

Contents
Part I. Preliminaries: *Theorem of Lüroth; Theory of sheaves and cohomologies;* **Part II. Schemes and algebraic varieties**: *Affine schemes and algebraic varieties; Schemes and algebraic varieties; Projective schemes and projective algebraic varieties; Nonsingular algebraic varieties;* **Part III. Algebraic surfaces**: *Algebraic curves; Intersection theory on algebraic surfaces; Pencils of curves; The Riemann-Roch Theorem for algebraic surfaces; Minimal algebraic surfaces; Ruled surfaces and rational surfaces; Solutions to problems; List of notation; Bibliography; Subject index.*

1991 *Mathematics Subject Classification*: 14–01; 13–01, 14A10, 14A15, 14J99
ISBN 0-8218-4615-9, LC 94-2018, ISSN 0065-9282
246 pages (hardcover), June 1994
Individual member $60, List price $100, Institutional member $80
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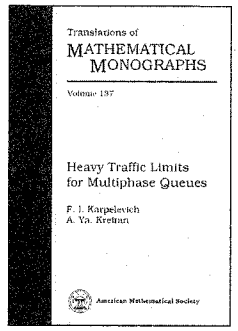

Heavy Traffic Limits for Multiphase Queues
F. I. Karpelevich and A. Ya. Kreinin
Volume 137

This book analyzes several types of queueing systems arising in network theory and communication theory. Karpelevich and Kreinin use numerous methods and results from the theory of stochastic processes. The main emphasis is on problems of diffusion approximation of stochastic processes in queueing systems and on results based on applications of the hydrodynamic limit method. The book will be useful to researchers working in the theory and applications of queueing theory and stochastic processes.

Contents
Introduction; Processes with reflection; Multiphase systems; Limit theorems for queue length and departure times processes; Appendix I. *Weak convergence in function spaces; Appendix* II. *Weak convergence of functionals of stochastic processes; Appendix* III. *Auxiliary results; Appendix* IV. *Tandem queues in heavy traffic; Appendix* V. *Joint distributions in Poissonian tandem queues; Bibliographical notes; Bibliograpy.*

1991 *Mathematics Subject Classification*: 60K25, 90B17
ISBN 0-8218-4597-7, LC 94-12418, ISSN 0065-9282
143 pages (hardcover), August 1994
Individual member $47, List price $79, Institutional member $63
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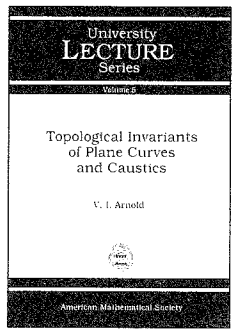
UNIVERSITY LECTURE SERIES



Topological Invariants of Plane Curves and Caustics
V. I. Arnold
Volume 5

This book describes recent progress in the topological study of plane curves. The theory of plane curves is much richer than knot theory, which may be considered the commutative version of the theory of plane curves. This study is based on singularity theory: the infinite-dimensional space of curves is subdivided by the discriminant hypersurfaces into parts consisting of generic curves of the same type. The invariants distinguishing the types are defined by their jumps at the crossings of these hypersurfaces. Arnold describes applications to the geometry of caustics and of wavefronts in symplectic and contact geometry. These applications extend the classical four-vertex theorem of elementary plane geometry to estimates on the minimal number of cusps necessary for the reversion of a wavefront and to generalizations of the last geometrical theorem of Jacobi on conjugated points on convex surfaces. These estimates open a new chapter in symplectic and contact topology: the theory of Lagrangian and Legendrian collapses, providing an

unusual and far-reaching higher-dimensional extension of Sturm theory of the oscillations of linear combinations of eigenfunctions.

Contents

Lecture1: Invariants and discriminants of plane curves: *Plane curves; Legendrian knots;* **Lecture 2: Symplectic and contact topology of caustics and wave fronts, and Sturm theory**: *Singularities of caustics and Sturm theory; Singularities of wave fronts and the tennis ball theorem.*

1991 *Mathematics Subject Classification*: 53A04, 57M25, 58F05
ISBN 0-8218-0308-5, LC 94-16254, ISSN 1047-3998
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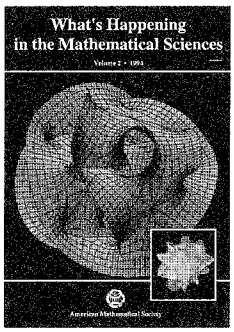
WHAT'S HAPPENING IN THE MATHEMATICAL SCIENCES



What's Happening in the Mathematical Sciences

Barry Cipra

Volume 2

After rave reviews for last year's issue of *What's Happening*, volume 2 has been eagerly awaited. "Very well written," said one reader of volume 1. "The writing is brilliant, positively brilliant." "A terrific publication," said another. "This is a wonderful tool for showing people what mathematics is about and what mathematicians can do." One reader called it "a must for all mathematics department reading and coffee lounges." Volume 2 of *What's Happening* features the same lively writing and all new topics. Here you can read about a new class of solitons, the contributions wavelets are making to solving scientific problems, how mathematics is improving medical imaging, and Andrew Wiles's acclaimed work on Fermat's Last Theorem. *What's Happening* is great for mathematics majors, graduate students, and mathematics clubs—not to mention mathematics faculty, who will enjoy reading about recent developments in fields other than their own. Highlighting the excitement and wonder of mathematics, *What's Happening* is in a class by itself.

Contents

"A truly remarkable proof"; From knot to unknot; New wave mathematics; Mathematical insights for medical imaging; Parlez vous wavelets?; Random algorithms leave little to chance; Soap solution; Straightening out nonlinear codes; Quite easily done; (Vector) field of dreams.

1991 *Mathematics Subject Classification*: 00A06
ISBN 0-8218-8998-2, ISSN 1065-9358
51 pages (softcover), July 1994
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To order, please specify HAPPENING/2N
Volume 1, 1993, Price $7
To order, please specify HAPPENING/1N
Order Volume 3, 1995 now and pay the Volume 2 price of $8! Offer expires 1/1/95. To order, please specify HAPPENING/3N
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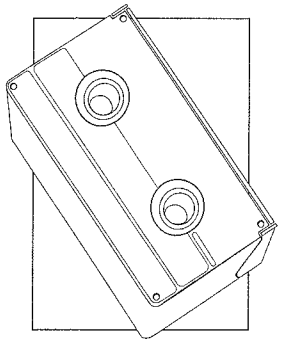
VIDEOTAPES



Optimization of Extended Surfaces for Heat Transfer

J. Ernest Wilkins, Jr.

J. Ernest Wilkins has worked on a wide variety of mathematical problems throughout his distinguished career. A member of the National Academy of Engineering who received his doctorate in mathematics from the University of Chicago at the age of nineteen, Wilkins has worked in academia, industry, and government. This videotape combines an interview with Wilkins and his Invited Address. In the interview, Wilkins describes some of the mathematical problems he has worked on and discusses some of the difficulties in trying to improve the participation of members of underrepresented groups in science and mathematics. His lecture explores a fascinating problem about heat transfer that arises in a variety of settings. With any heat engine, it is necessary to expel heat to the surroundings. One way to do this is to attach "fins" to the outer wall of the engine. The shape of the fins has a large impact on how efficiently they are able to expel heat. Wilkins examines the mathematical aspects of determining the optimal shape of such fins. The lecture is accessible to undergraduates with background in differential equations.

1991 *Mathematics Subject Classification*: 80, 49
ISBN 0-8218-8090-X
NTSC format on 1/2" VHS videotape; approx. 90 minutes, June 1994
Individual member $34.95, List price $54.95, Institutional member $44.95
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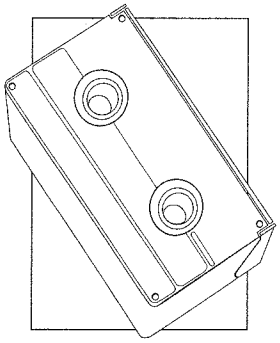
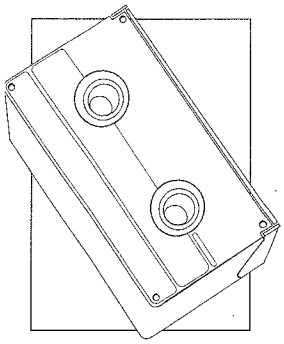


In Search of Symmetry

William Browder

William Browder served as President of the American Mathematical Society during 1990–1991. This videotape contains his Retiring Presidential Address—which combined short remarks about his presidency with a mathematical lecture—preceded by an informal interview in which he discusses a range of topics, including public awareness of mathematics and his interest in music. The lecture discusses the action of finite groups on manifolds, exploring the question of how large a finite group can effectively act on a given manifold (here, "effectively" means that there is no subgroup that fixes everything). A related question is, what kind of spaces have the given manifold as a covering space? Beginning with the historical roots of these questions, Browder concentrates on familiar examples such as the sphere, the n-sphere, or a product of spheres of different dimensions. The lecture is accessible to mathematics majors with background in algebraic topology. The interview segment provides a fine complement to the lecture.

1991 *Mathematics Subject Classification*: 55
ISBN 0-8218-8091-8
NTSC format on 1/2" VHS videotape; approx. 90 minutes, July 1994
Individual member $34.95, List price $54.95, Institutional member $44.95
To order, please specify VIDEO/93N



The Current Interface of Geometry and Elementary Particle Physics

I. M. Singer

This lecture covers three intriguing examples of interactions between physics and geometry: (i) the use of mirror symmetry in a conformal field theory to enumerate rational curves on a quintic, (ii) the Kontsevich matrix model that led to a solution of a conjecture of Witten, and (iii) the Jones-Witten knot invariant and Chern-Simons quantum field theory. The lecture is preceded by an interview with Singer, in which he discusses some of the historical background of these topics and reminisces a bit about how he got interested in mathematics and science. Providing insight on one of the hottest topics in mathematics, as well as a personal look at one of the leaders in the field, this videotape will interest students and researchers in mathematics, physics, and the history of science.

1991 *Mathematics Subject Classification*: 14, 58, 81
ISBN 0-8218-8092-6
NTSC format on 1/2" VHS videotape; approx. 90 minutes, July 1994
Individual member $34.95, List price $54.95, Institutional member $44.95
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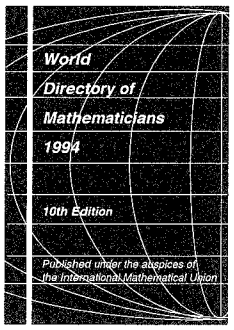

World Directory of Mathematicians 1994

This is the tenth edition of the *World Directory of Mathematicians*, which incorporates corrections and updates to the 1990 edition. Published by the International Mathematical Union, this valuable reference book contains the names and addresses of about 42,000 mathematicians from 69 countries. Listings for the directory are based on information supplied by National Committees for Mathematics (or corresponding organizations). Libraries and individuals alike will find this a useful directory to have on hand.

1991 *Mathematics Subject Classification*: 00
869 pages (softcover), July 1994
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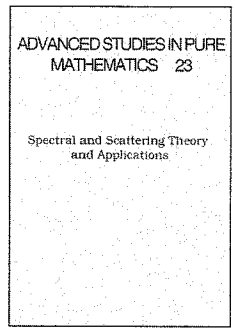
ADVANCED STUDIES IN PURE MATHEMATICS



Spectral and Scattering Theory and Applications

K. Yajima, Editor

Volume 23

This book contains the proceedings from a conference on Spectral and Scattering Theory, held in July 1992 at Tokyo Institute of Technology, in celebration of the sixtieth birthday of ShigeToshi Kuroda. The book is an up-to-date guide to recent results in spectral and scattering theory and applications to linear and nonlinear equations. Among the application areas covered are Schrödinger and wave equations, Boltzmann and MHD equations, and elliptic and parabolic equations. Abstract spectral theory is also discussed. This book presents many interesting and important new results as well as comprehensive surveys by leading experts in the field. This book is aimed at mathematicians and graduate students in operator theory, partial differential equations, mathematical physics, and applied mathematics, in addition to physicists and chemists working in such areas as atomic or molecular physics.

Advanced Studies in Pure Mathematics is published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

Contents

1991 *Mathematics Subject Classification*: 26D15, 34E99, 35B40, 35J05, 35J10, 35J60, 35J65, 35K10, 35K15, 35L05, 35L55, 35L67, 35L70, 35P05, 35P20,

35P25, 35P99, 35Q35, 35Q40, 35Q55, 35Q72, 41A60, 47A10, 47A60, 47B25, 58G25, 58G30, 65F10, 76W05, 81Q30, 81U10, 81U20, 82C40, 85A20
ISBN 4-314-10107-5
322 pages (hardcover), 1994
Individual member $50, List price $83, Institutional member $66
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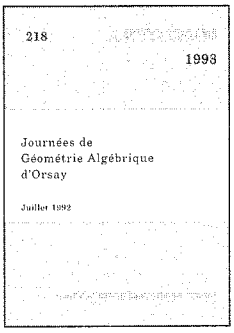
SOCIÉTÉ MATHÉMATIQUE DE FRANCE, ASTÉRISQUE



Journées de Géométrie Algébrique d'Orsay

Volume 218

This book contains the proceedings of the Orsay Algebraic Geometry Conference, held at Université de Paris-Sud in July 1992. The aim of the conference was to discuss the state of the art in complex algebraic geometry and to highlight the research directions which seem most promising today. Demonstrating the vitality of the subject, these papers reflect some of the main themes in complex geometry, including linear systems, vector bundles, algebraic cycles and cohomology, and "mirror symmetry" on Calabi-Yau manifolds.

Titles in this series are published by the Société Mathématique de France and distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, Case 916-Luminy, F-13 288 Marseille cedex 9, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France.

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Introduction; Résumés des textes; **V. Batyrev**, *Quantum cohomology ring of toric manifolds;* **A. Buium**, *A finiteness theorem for isogeny correspondences;* **F. Catanese and P. Frediani**, *Configurations of real and complex polynomials;* **L. Chiantini and C. Ciliberto**, *A few remarks on the lifting problem;* **I. Dolgachev and M. Kapranov**, *Schur quadrics, cubic surfaces and rank 2 vector bundles over the projective plane;* **R. Donagi**, *Decomposition of spectral covers;* **L. Ein and R. Lazarsfeld**, *Seshadri constants on smooth surfaces;* **D. Eisenbud, M. Green, and J. Harris**, *Some conjectures extending Castelnuovo theory;* **H. Esnault and M. Levine**, *Surjectivity of cycle maps;* **H. Esnault, V. Srinivas, and E. Viehweg**, *Decomposability of Chow groups implies decomposability of cohomology;* **D. Morrison**, *Compactifications of moduli spaces inspired by mirror symmetry;* **C. Voisin**, *Miroirs et involutions sur les surfaces $K3$.*

1991 *Mathematics Subject Classification*: 14M25, 14K02, 14P25, 14E25, 14J60, 14D20, 14J99, 14N05, 14C25, 14J30; 81T70, 14H35, 12E05, 14J26, 58F07, 13D40, 14H50, 14H45, 14C30, 14J15, 22E40, 32J05, 81T40, 14J28
ISSN 0303-1179
323 pages (softcover), March 1994
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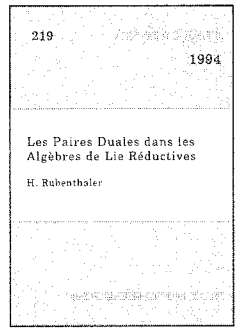

Les Paires Duales dans les Algèbres de Lie Réductives

H. Rubenthaler

Volume 219

Given a reductive Lie algebra $\mathfrak{g}$ over $\mathbb{C}$, a pair $(\mathfrak{a}, \mathfrak{b})$ of subalgebras of $\mathfrak{g}$ is called a dual pair if two conditions are satisfied: the adjoint representations of $\mathfrak{a}$ and $\mathfrak{b}$ on $\mathfrak{g}$ are completely reducible, and the subalgebra $\mathfrak{a}$ is the centralizer of $\mathfrak{b}$ in $\mathfrak{g}$ and vice versa. This work presents a complete classification of all dual pairs in any reductive Lie algebra, under a certain irreducibility condition called S-irreducibility on the pair $(\mathfrak{a}, \mathfrak{b})$, which means that the pair cannot be imbedded into a proper regular subalgebra. Rubenthaler's methods involve a formalism which gives, in a very natural way, many dual towers in the exceptional Lie algebaras (the notion of a dual tower is a straightforward generalization of see-saw pairs).

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Contents

Introduction; Notations et généralités; Les espaces préhomogènes de type parabolique; Les sous-algèbres admissibles et C-admissibles; Paires duales associées aux sous-algèbres C-admissibles; Principes de classification; Détermination des sous-algèbres admissibles qui sont des sous-algèbres de Howe. Etude de la S-irréductibilité; Les paires duales S-irréductibles dans les algèbres de Lie classiques; Enoncé et démonstration du théorème principal; Le cas du produit tensoriel de deux formes symétriques en dimension paire; étude détaillée; Constructions de tours duales; Paires duales associées aux orbites des espaces préhomogènes commutatifs; Bibliographie.

1991 *Mathematics Subject Classification*: 17B20, 17B25, 17B10
ISSN 0303-1179
121 pages (softcover), April 1994
AMS or SMF member $14, List price $20,
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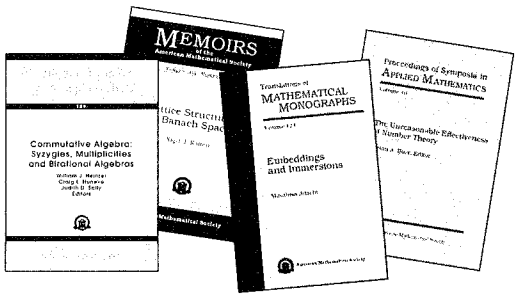

Publications of Continuing Interest

Following are some of our more popular books and videotapes as well as some with similar topics to those appearing in the New Publications section of this issue.

	List	Inst. mem.	Indiv. mem.
Algebraic Geometry for Scientists and Engineers, by Shreeram S. Abhyankar, 0-8218-1535-0, 295 pages (hardcover). To order, please specify SURV/35NP	$90	$72	$54
Deformation Theory and Quantum Groups with Applications to Mathematical Physics, edited by Murray Gerstenhaber and Jim Stasheff, 0-8218-5141-1, 377 pages (softcover). To order, please specify CONM/134NP	55	44	33
Different Perspectives on Wavelets, edited by Ingrid Daubechies, 0-8218-5503-4, 205 pages (hardcover). To order, please specify PSAPM/47NP	45	36	27
Fermat's Last Theorem–The Theorem and its Proof: An Exploration of Issues and Ideas, 0-9639903-0-6, To order, please specify VIDEO/90NP	29.95	29.95	29.95
Fixed Points, by Yu. A. Shashkin, 0-8218-9000-X, 77 pages (softcover). To order, please specify MAWRLD/2NP	24	19	14
Golden Years of Moscow Mathematics, edited by Smilka Zdravkovska and Peter L. Duren, 0-8218-9003-4, 271 pages (hardcover). To order, please specify HMATH/6NP	94	75	56
How to Teach Mathematics: a personal perspective, by Steven G. Krantz, 0-8218-0197-X, 76 pages (softcover). To order, please specify HTMNP	21	17	13
How to Write Mathematics, by N. E. Steenrod, P. R. Halmos, M. M. Schiffer, and J. E. Dieudonné, 0-8218-0055-8, 64 pages (softcover). To order, please specify HWMNP	17	14	10
The Joy of TEX, A Gourmet Guide to Typesetting with the $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX Macro Package, Second Edition, by M. D. Spivak, 0-8218-2997-1, 309 pages (softcover). To order, please specify JOYTNP	40	36	32
Mathematical Impressions, by Anatoliĭ T. Fomenko, 0-8218-0162-7, 184 pages (hardcover). To order, please specify MATIMPNP	47	47	38
Mathematicians and Education Reform 1990–1991, edited by Naomi D. Fisher, Harvey B. Keynes, and Philip D. Wagreich, 0-8218-3503-3, 185 pages (softcover). To order, please specify CBMATH/3NP	62	62	37*
Mathematics and Sports, by L. E. Sadovskiĭ and A. L. Sadovskiĭ, 0-8218-9500-1, 152 pages (softcover). To order, please specify MAWRLD/3NP	40	32	24
Mathematics into Type, Revised Edition, by Ellen E. Swanson, 0-8218-0053-1, 90 pages (softcover). To order, please specify MITNP	22	18	13
Modular Elliptic Curves and Fermat's Last Theorem, Kenneth A. Ribet, 0-8218-8087-X, To order, please specify VIDEO/89NP	49.95	39.95	29.95
Nonlinear Wave Equations, by Walter A. Strauss, 0-8218-0725-0, 91 pages (softcover). To order, please specify CBMS/73NP	23	23	14*
Orthogonal Polynomials, by Gabor Szegő, 0-8218-1023-5, 432 pages (softcover). To order, please specify COLL/23NP	49	39	29
Subfactors and Knots, by Vaughan F. R. Jones, 0-8218-0729-3, 113 pages (softcover). To order, please specify CBMS/80NP	43	43	26*
The Unreasonable Effectiveness of Number Theory, edited by Stefan A. Burr, 0-8218-5501-8, 125 pages (hardcover). To order, please specify PSAPM/46NP	37	30	22

* All individuals.

AMS Reports and Communications

Recent Appointments

Committee members' terms of office on standing committees expire on January 31 following the year given in parentheses after their names, unless otherwise specified.

Upon recommendation of the Editorial Boards Committee, the Council has elected Luis A. Caffarelli (1994) as chair of the **Colloquium Editorial Committee**. The other member of the committee is William Browder (1995) and a member to be elected in August.

President Ronald L. Graham has appointed Lance W. Small (1995) chair of the **Graduate Studies in Mathematics Editorial Committee**. Continuing members of the committee are James E. Humphreys (1995) and Robion C. Kirby (1995).

Nancy Anderson (1994) and Frank S. Quinn (1994) have been reappointed to the **Electronic Products and Services Committee** by President Ronald L. Graham. Continuing members of the committee are R. Keith Dennis (1995); John M. Franks (1994), chair; Maria M. Klawe (1994); David Rodgers, consultant; and William B. Woolf (*ex officio*).

Morton Lowengrub has been reappointed chair of the **Appeals Committee on Discounted Subscriptions** by Chair of the Board of Trustees M. Susan Montgomery. Continuing members of the committee are Carol-Ann Blackwood, consultant; Philip J. Hanlon, consultant; William H. Jaco (*ex officio*); M. Susan Montgomery; and Franklin P. Peterson.

Andrew M. Gleason (1996), Arthur M. Jaffe (1996), W. Ted Martin (1996), Cathleen S. Morawetz (1996), and T. Benny Rushing (1996) have been appointed by Chair of the Board of Trustees M. Susan Montgomery to the **Committee on Endowment and Planned Giving**. Professor Martin will serve as chair. This committee replaces the former **Committee on Endowment**.

D. J. Lewis (1996) and Edith N. Starr (1996) were appointed by then Chair of the Board of Trustees John C. Polking to the **Committee on Membership**. Continuing members of the committee are Roy L. Adler (*ex officio*); Carol-Ann Blackwood, consultant; Susan J. Friedlander (1995); Hugo Rossi, chair (1994).

Roy L. Adler (*ex officio*) was appointed by then Chair of the Board of Trustees John C. Polking to the **The Publication Program Committee**. Other members of the committee are Robert M. Fossum (*ex officio*), Eric M. Friedlander (1996), William H. Jaco (*ex officio*), Elliott H. Lieb (1994), M. Susan Montgomery (*ex officio*), David Morrison (1996), John C. Polking (*ex officio*), and B. A. Taylor (1996).

President Ronald L. Graham has appointed Fan R. K. Chung (1994), Robert K. Lazarsfeld (1996), Andrew M. Odlyzko (1996), and Norberto Salinas (1996); and Chair of the Board of Trustees M. Susan Montgomery has appointed herself with a term through 1996 to the **Committee on Publications**. Other members of the committee are Sheldon Axler (1994); Robert M. Fossum (*ex officio*); John M. Franks (1994); John R. Garrett (1995); Ronald L. Graham (*ex officio*); William H. Jaco (*ex officio*); Haynes R. Miller (1994); Richard S. Palais (1995), chair; and Frank S. Quinn (1995).

Frank Morgan (1996) and Sylvia Wiegand (1996) have been appointed and Ruth Williams (1996) has been reappointed by President Ronald L. Graham; D. J. Lewis (1996) has been appointed by Chair of the Board of Trustees M. Susan Montgomery to the **Committee on Meetings and Conferences**. Professor Wiegand has also been appointed chair. Continuing members of the committee are Bettye Anne Case (1994), Robert M. Fossum (*ex officio*), Ronald L. Graham (*ex officio*), William H. Jaco (*ex officio*), Linda Keen (1994), Peter W. K. Li (1995), Hugo Rossi (1994), David R. Scott (1995), Nancy K. Stanton (1996), D. L. Sulsky (1996), and William Yslas Velez (1994).

Hyman Bass (1996) has been appointed to the **Committee on Education** by President Ronald L. Graham. Continuing members of the committee are Jerry L. Bona (1995); Carl C. Cowen (1996); Ronald G. Douglas (1996), chair; Robert M. Fossum (*ex officio*); Ramesh A. Gangolli (1994); Ronald L. Graham (*ex officio*); Rebecca A. Herb (1996); Deborah Hughes Hallett (1995); William H. Jaco (*ex officio*); Harvey B. Keynes (1995); Maria M. Klawe (1994); John W. Morgan (*ex officio*); Judith Roitman (1995); Alan H. Schoenfeld (1995); and Alan C. Tucker (1996).

Dennis DeTurck (1996), Aparna W. Higgins (1996), Robert Sefton Smith (1997), and Elliot A. Tanis (1996) have been appointed by President Ronald L. Graham to the **Pi Mu Epsilon Liaison Committee**. De Witt Sumners (1994) has been appointed chair. Continuing members of the committee are Joseph P. Brennan (1995) and Mary B. Martin (1994).

President Ronald L. Graham has appointed Annalisa Crannell (1996) to the **Committee on Profession**. Other members of the committee are Roy L. Adler (1995); M. Salah Baouendi (1994), chair; Ruth M. Charney (1994); Robert M. Fossum (*ex officio*); Frank L. Gilfeather (1995); Ronald L. Graham (*ex officio*); Richard J. Griego (1995); William H. Jaco (*ex officio*); Joseph Lip-

man (1996); William A. Massey (1994); Donald E. McClure (1996); M. Beth Ruskai (1994); Ronald J. Stern (1995); and Steven H. Weintraub (1994).

John W. Morgan (1995) has been appointed chair of the **Committee on Science Policy** by President Ronald L. Graham. Continuing members of the committee are Ronald G. Douglas (*ex officio*), Richard Ewing (1995), Robert M. Fossum (*ex officio*), Eric M. Friedlander (1994), Ronald L. Graham (*ex officio*), William H. Jaco (*ex officio*), Raymond L. Johnson (1994), James I. Lepowsky (1996), William James Lewis (1994), Cathleen S. Morawetz (*ex officio*), Melvyn Nathanson (1995), Anil Nerode (1996), Linda Preiss Rothschild (1994), Jean E. Taylor (1995), and Susan Gayle Williams (1996).

Joan S. Birman, E. Christopher Lance, Andy R. Magid, and Marie-Paule Malliavin have been appointed by President Ronald L. Graham to the AMS-IMU **Joint Program Committee**. Robert M. Fossum and Lance W. Small will serve *ex officio*.

Presidents Donald L. Kreider (MAA) and Ronald L. Graham (AMS) have appointed Yousef Alavi, Joe Buckley, Jean B. Chan, William G. Chinn, Allan B. Cruse, Newman Fisher, Millianne Lehman, Don Lick, Tristan Needham, Peter Pacheco, Franklin Sheehan, Hwa Tsang Tang, S. Y. Tang, Maurice D. Weir, and Eileen T. Ling-Erl Wu to the joint AMS-MAA **Arrangements Committee for the San Francisco Meeting**. *Ex officio* members are William H. Jaco, Andy Roy Magid, Marcia P. Sward, and Donovan H. Van Osdol. Professor Chinn will serve as chair.

Michael G. Crandall (1996) has been appointed by President Ronald L. Graham to the joint AMS-MAA **Committee on Cooperation**. Continuing members of the committee are Gerald L. Alexanderson (MAA); Susan Forman (MAA); Robert M. Fossum (AMS); Ramesh A. Gangolli (AMS); Ronald L. Graham (AMS, *ex officio*), cochair; Deborah Tepper Haimo (MAA); William H. Jaco (AMS), staff; Donald L. Kreider (MAA, *ex officio*), cochair; M. Susan Montgomery (AMS); Mary Ellen Rudin (AMS); David A. Sanchez (AMS); Andrew Sterrett (MAA); Marcia P. Sward (MAA) staff; and Alan C. Tucker (MAA).

Richard P. Stanley (1997) has been reappointed as representative to the **Committee on the American Mathematics Competition** by President Ronald L. Graham. Term expires on June 30.

Ann K. Stehney (1996) has been appointed as representative to the **Commission on Professionals in Science and Technology** by President Ronald L. Graham.

Member Dianne Dulin represented the Society at the inauguration of Dr. Robert E. Shimp as the ninth president of McMurray University.

The Council Meeting in Cincinnati

The Council met at 1:00 p.m. on Tuesday, 11 January 1994, in Cincinnati, Ohio. There were thirty-five members in attendance. Several members-elect were also in attendance with privileges of the floor. President Graham presided and called the meeting to order.

The minutes of the August 1993 Council were approved with corrections that were noted by the Secretary.

The National Association of Mathematicians is celebrating its twenty-fifth year in 1994. The Council approved the following resolution, which has been sent to the president of the National Association of Mathematicians:

> The National Association of Mathematicians, founded in 1969 to promote excellence in the mathematical sciences and to promote the mathematical development of underrepresented American minorities, is celebrating the Twenty-fifth Anniversary of its founding in 1994. The Council of the American Mathematical Society extends congratulations to the National Association of Mathematicians (NAM) for its accomplishments during the past twenty-five years. The Council looks forward to continued cooperation with NAM to promote excellence and opportunities in the mathematical sciences for everyone.

The report of the Tellers for the 1992 election was approved. The results of this election have been reported earlier in the *Notices* and are not repeated here.

The members approved the amendment to the Bylaws proposed by the Council. The amendment affected the membership of the Council. The membership of the Council now consists of four officers appointed by the Council—namely, the treasurer, the associate treasurer, the secretary, and the associate secretary—and nine chairs of editorial committees also appointed by the Council. The president, president-elect (or ex-president), the three vice-presidents, and the fifteen members-at-large are elected in contested elections. (At times, holdover members of the Executive Committee and a former secretary are also members of the Council.)

There are thus thirteen (13) members appointed by the Council, twenty (20) members elected in contested elections, and holdovers, which can amount to at most four members (who may or may not have been elected in a contested election).

While meeting in executive session, the Council approved the recommendations of the Editorial Boards Committee and appointed members to several editorial committees as follows:

The Council appointed Georgia Benkart to the *Mathematical Surveys and Monographs* Editorial Committee, Blaine Lawson as chair of the *Journal* Editorial Committee, and Sergio Klainerman as the second AMS representative on the Editorial Board of the *American Journal of Mathematics*.

The Council, meeting in August 1993, approved a new structure for the *Notices* Editorial Committee, namely, an editor of the *Notices* who will appoint associate editors (after consultation with the EBC and approval by the Council), who will be remunerated for duties performed and who will have complete responsibility for the journal. A formal search was conducted. Members of the search committee were Robert Fossum, William Jaco (chair), Hugo Rossi, and Bhama Srinivasan. The committee was to report to the EBC, which in turn would report a recommendation to the Council. Fossum, Jaco, Rossi, and Srinivasan reviewed the nominations and applications received and then recommended

that the search be continued. They recommended that, as an interim measure, Rossi take on the position as editor of the *Notices*, beginning as soon as Council approval was obtained and at least until mid-1995.

The EBC agreed with the recommendation that Hugo Rossi be the interim editor of the new *Notices* from January 1994 through June 1995, that the search for an editor be reopened, and that a recommendation on a new editor be made to the Council early in 1995. The Council approved the appointment of Rossi as interim editor of the *Notices* and the recommendation that the search be continued.

The Executive Committee and Board of Trustees (ECBT) Nominating Committee, consisting of Paul Sally, Jr. (chair), Salah Baouendi, Joan Birman, Carol Wood, and William Jaco reported to the ECBT. The report consisted of recommending the reappointment of those officers whose terms end at the conclusion of 1994: namely, Secretary Fossum, Associate Secretaries Daverman and Sibner, Treasurer Peterson, and Associate Treasurer Taylor. The ECBT unanimously endorsed these recommendations and reported them to the Council.

The Council received the report while sitting in executive session, during which time Daverman, Fossum, Peterson, and Taylor absented themselves from the meeting. Small was appointed interim secretary. He reported:

> The Council unanimously approved the recommendation of the ECBT Nominating Committee to reappoint Associate Secretaries Daverman and Sibner, Secretary Fossum, Treasurer Peterson, and Associate Treasurer Taylor for terms ending on 31 January 1997.

The January 1971 Council received and acted upon an extensive review of Society activities. Recommendation 14 of this review stated: "The Executive Committee (EC) of the Council be charged to carry out a continuing program of review and appraisal of Society activities." The EC has carried out reviews on a six-year cycle. There are three general topics (Publications, Meetings, and Everything Else) that are reviewed over a two-year period. The last two topics that have been reviewed are Publications and Meetings.

The EC decided that this type of review should no longer be conducted by the EC, as it would duplicate efforts of the policy committees. The Council agreed and added to the charges of the policy committees the following language:

> The Council charges the committees on Education, Meetings and Conferences, Profession, Publication, and Science Policy to carry out at least every six years reviews and appraisals of Society activities in the areas of their charges and to report the results of these reviews to the Executive Committee and to the Council.

The Long Range Planning Committee (LRPC) was assigned by the ECBT to study the question of governance of the Society. This report recommended changes in the Bylaws, suggested modifications in the charges to the president, the secretary, the treasurer, and the executive director, and made recommendations for the operation of committees.

Amendments to the Bylaws

The report recommended amendments to the Bylaws as noted below. These were approved by the Council, and they will appear on the ballot in the 1994 election for approval by the membership.

These amendments concern Article VI in the Bylaws referring to the executive director. (The current text is given as "OLD Section". The recommended amendment then follows as "NEW Section".)

Article VI. Executive Director

> OLD Section 1. There shall be an Executive Director who shall be a paid employee of the Society. The Executive Director shall have charge of the central office of the Society, and shall be responsible for the general administration of the affairs of the Society in accordance with the policies that are set by the Board of Trustees and by the Council.
>
> NEW Section 1. There shall be an Executive Director who shall be a paid employee of the Society. The Executive Director shall have charge of the offices of the Society, except for the office of the secretary, and shall be responsible for the general administration of the affairs of the Society in accordance with the policies that are set by the Board of Trustees and by the Council.
>
> OLD Section 2. The Executive Director shall be appointed by the Board of Trustees with the consent of the Council. The terms and conditions of employment shall be fixed by the Board of Trustees.
>
> NEW Section 2. The Executive Director shall be appointed by the Board of Trustees with the consent of the Council. The terms and conditions of employment shall be fixed by the Board of Trustees and the performance of the Executive Director shall be reviewed regularly by the Board of Trustees.
>
> OLD Section 3 (first part). The Executive Director shall work under the immediate direction of a committee consisting of the president, the secretary, and the treasurer, of which the president shall be chairman ex officio.
>
> NEW Section 3. The Executive Director shall be responsible to and shall consult regularly with a liaison committee consisting of the president as chair, the secretary, the treasurer, and the presiding officer of the Board of Trustees.
>
> OLD Section 3 (second part). The Executive Director shall attend meetings of the Board of Trustees, the Council, and the Executive Committee, but shall not be a member of any of these bodies.
>
> NEW Section 4. The Executive Director shall attend meetings of the Board of Trustees, the Council, and the Executive Committee, but shall not be a member of any of these bodies.

The second part of the report of the LRPC recommended operating procedures that should be included in the "Manual of Information for the Board of Trustees, Council, and Executive Com-

mittee of the Council". It was also approved by the Council with one minor modification.

Operating Procedures in the Society

President

[A.] The president should be a research mathematician.

[B.] The president is the principal officer of the Society. The president should take an active leadership role in the policy-making process and in representing the Society.

[C.] In representing the Society or the office of the president, the president may be assisted by, and work closely with, the other officers of the Society, in particular with the vice-presidents, the president-elect, the ex-president, the secretary, and the treasurer.

[D.] The president is an ex-officio member of the Council, the Executive Committee of the Council, Board of Trustees, the Liaison Committee, the Agenda and Budget Committee, the Long Range Planning Committee, the Policy Committees, and the Joint Policy Board of Mathematics.

[E.] The president presides over meetings of the Council, the Executive Committee of the Council, joint meetings of the Executive Committee and Board of Trustees, and the Liaison Committee.

Secretary

[A.] The secretary should be a research mathematician.

[B.] The secretary is an ex-officio member of the Council, the Executive Committee, the Agenda and Budget Committee, the Liaison Committee, the Long Range Planning Committee, the Committee on Meetings and Conferences, and the Committee on the Profession. The secretary should be a nonvoting ex-officio member of the other policy committees.

[C.] The responsibility to organize and coordinate the Council and its committees shall lie with the secretary.

[D.] The secretary, together with the associate secretaries, oversees the scientific program of all meetings of the Society.

[E.] The secretary works closely with the president in coordinating and administering the activities of committees.

[F.] The secretary participates in formulating policy for the Society and plays an important role in maintaining its institutional memory.

Treasurer

[A.] The treasurer should be a research mathematician.

[B.] The responsibility for overview of the financial and business activities of the Society shall lie with the treasurer. This includes but is not limited to coordinating the work of the trustees.

[C.] The treasurer is an ex-officio member of the Council, the Board of Trustees, the Long Range Planning Committee, the Agenda and Budget Committee, and the Liaison Committee.

Executive Director

[A.] The Executive Director should be a research mathematician.

[B.] The Executive Director is the principal executive officer of the Society who is responsible for the execution and administration of policy.

[C.] All staff in the Society, with the exception of staff in the Office of the Secretary, report to the Executive Director.

[D.] The Executive Director shall serve as an ex-officio member of the Joint Policy Board for Mathematics, the Long Range Planning Committee, the Committee on Science Policy, and the Committee on Education. The Executive Director should be a nonvoting, ex-officio member of the other policy committees.

Modifications to Recent Practice

[A.] Candidates for election, or for appointment by the president, to various committees of the Society should be informed of their prospective duties. Those who are called on to assist the president in representing the Society should be briefed as specifically as possible about their task. (While a current procedure, this statement is a helpful reminder of something easily overlooked.)

[B.] The Liaison Committee will review the performance of the Executive Director and report to the Board of Trustees at least once a year. (Clarification of procedure in Article VI, Section 2 of proposed new Bylaws.)

[C.] The secretary should be part of the AMS delegation to the Joint Policy Board of Mathematics. The secretary should be invited to attend meetings, should be sent agendas, and should be sent minutes. (The secretary would not be the third voting AMS member. That member will, as at present, be elected by the Council.)

[D.] The Executive Director should not be a member of the Nominating Committees of the Executive Committee of the Council and the Board of Trustees, nor of the Committee on Committees.

Clarification of Procedures

In 1976 the Council adopted Sturgis' Rules for the meetings of the Council and for Business Meetings. The history of this is mentioned in "A History of the Second Fifty Years, American Mathematical Society, 1939-1988", by Everett Pitcher, published by the AMS in 1988.

Committee Procedures

The Society should have a "Manual on Committees". It should be included in the "Manual of Information for the Board of Trustees, Council, and Executive Committee of the Council". We refer to "this manual".

Rules for Inclusion in the Manual

Definitions concerning committees, charge to committees, and rules of procedures for committees will be published in this manual. Items for inclusion, or modifications to the manual, require approval by

the body to which the committee reports.

The following statement should appear in this manual: "Procedures for committees will in general follow A. Sturgis' 'Standard Code of Parliamentary Procedure, revised'. In case definitions, rules, or procedures in this manual differ from those in Sturgis, then this manual takes precedence."

Each committee must have a designated chair (or a procedure to choose a chair) and a designated body to which the committee reports. In the absence of specification of such a body, that body will be assumed to be the body which formed the committee.

The meeting of a committee may be presided over by a substitute chair appointed by the chair of the committee.

Responsibility during a meeting for the interpretation of the Rules for Committees lies with the chair of the meeting in question.

A guest at a committee meeting can only be invited by the chair of that committee.

The chair of a committee must follow instructions implied by votes of that committee.

Committees may have nonvoting members. (For example, the secretary and Executive Director are nonvoting members of certain policy committees.)

Two items about specific committees:

The Liaison Committee should report its deliberations to the Board of Trustees.

The Long Range Planning Committee reports to the Executive Committee of the Council and the Board of Trustees.

The Committee on the Profession proposed that the Council adopt a statement on employment of young mathematicians. The statement was amended by the Council and then passed unanimously so as to speak in the name of the Society. This statement appeared in the *Notices* (March 1994, page 202) and will not be repeated here.

The Committee on Publications considered, at the request of the Council, the question of Research Announcements (RAs). The Committee submitted a report that is on file with the secretary. The report recommended a policy regarding Research Announcements which was adopted by the Council.

> The American Mathematical Society should establish two electronic services:
> An electronic Research Announcements journal, with articles selected by an editorial board for interest and plausibility, with quality essentially that of current *Bulletin* research announcements, but not checked for correctness.
> A preprint database, server, and interface to other databases.
> The preprint database is envisioned as an evolving service. Care should be taken that it is as accessible as possible to the electronically disadvantaged, with the Ginsparg physics database as a possible model. Future developments might include a searchable database of abstracts.
> Details should be overseen by subcommittees of the Committee on Publications in cooperation with the Committee on Electronic Products and Services and the EBC in choosing the editorial committee for the Research Announcements journal.

In December 1992, then-President Artin appointed a subcommittee of the Committee on Science Policy for the purpose of preparing the first Federal Policy Agenda for the AMS. The National Policy Statement was submitted for consideration by the Council. Since the statement "speaks on behalf of the Society", the rules for speaking in the name of the Society apply to consideration of this document. A final vote on the proposed document was taken by mail ballot and passed. It is the intention of the Society to distribute the summary and statement to all members of the Society. It will also be published in the *Notices* and will not be repeated here.

The following resolution was moved, seconded, and passed unanimously so as to speak in the name of the Society:

> Mathematicians make heavy and frequent use of electronic mail for communication related to their scientific and professional activities. The American Mathematical Society is committed to working for wide and effective access to the Internet. This valuable tool would be threatened if universities were reduced to bargaining with private communications corporations for the rates to be charged. The Society and other organizations devoted to research should work to secure governmental guarantees of availability of e-mail services at an affordable rate.

The *Mathematical Reviews* Editorial Committee proposed that *Mathematical Reviews* inaugurate a new type of review called a "Featured Review". The proposal was adopted by the Council. Details will be announced.

The August 1993 Council passed procedures for the Committee on Professional Ethics. Current members of COPE were present at the meeting to deliver the committee's point of view. The Council rescinded those procedures and asked the president to appoint a special committee that includes at least one member from the special committee that produced the procedures adopted by the August 1993 Council and one current member of the Committee on Professional Ethics to prepare a new set of procedures for COPE for presentation to a future Council.

The Council received reports from several committees.

The report from the special Advisory Committee on Professional Ethics was considered. This report recommended ethical guidelines for adoption by the Council in the name of the Society. It was moved, seconded, and passed that the Council refer the guidelines to some appropriate committee. Further, it was moved, seconded, and passed that the draft guidelines be published in the *Notices* with a request that members send comments on them for use by the committee that will consider them. These guidelines were published in the April 1994 issue of the *Notices*.

The August 1993 Council consid-

ered the action by the Board on Mathematical Sciences (BMS) in which BMS dissolved the United States National Committee on Mathematics (USNCM) and constituted itself as the USNCM. The Council voiced itself as being quite disturbed by this action and passed a resolution on the matter. At the request of Shmuel Winograd, chair of BMS, Donald Richards, representing BMS, addressed the Council regarding that August 1993 resolution by the Council.

Ron Douglas, the newly appointed chair of the USNCM delegation to the General Assembly of the International Mathematical Union, addressed the Council on issues that the delegation may wish to bring to the General Assembly.

The Bylaws specify how the election to the Council's Executive Committee is to be held. The Council adopted the procedures below for implementing this election.

> Annually, the Secretary sends a notice to Council members requesting to know whether they are willing to serve as Executive Committee member and also asking for nominations for that office. The secretary is asked now to include the following explanation along with that request:
> Article VII, Sect. 4 of the Bylaws states that a mail ballot consisting of precisely two nominees will be sent to Council members for the election of each EC member. These two persons will be nominated by a committee selected by the president, and that committee will rely heavily on the information gleaned from responses to the present request.
> Along with a summary of the results of the mail ballot for EC member(s), the nominating committee will supply the list of responses (without attribution) quoted in 1. above.

The Council adjourned at 10:56 p.m.

This report includes all substantial business conducted by the Council. Some items of routine housekeeping, such as discharge of committees, that is conducted by the Council are not reported. The official minutes of the Council meeting can be ordered through the Society. Regular subscriptions are available at a price that covers the marginal cost to distribute them to the individual. Single copies can be requested from the secretary.

Robert M. Fossum
Secretary
Urbana, Illinois

The Business Meeting in Cincinnati

The Business Meeting of the Society was held at 12:10 p.m. on 14 January 1994 in Cincinnati, Ohio. President Graham presided.

The secretary presented an agenda for the meeting.

Agenda

Report of the Secretary.

Action on a motion by Saunders Mac Lane concerning the Society's Strategic and Operating Plan.

President Graham called on the secretary to report. The secretary announced the results of the 1993 Election by Members (reported in the January 1994 issue of the *Notices*). The secretary reported that the Council had passed a resolution "Supportive Practices and Ethics in the Employment of Young Mathematicians" (which also has appeared in these *Notices*). He announced that the Council had recommended the establishment of two new electronic services. He asked for and received permission to publish the remaining portion of his report in the *Notices*.

Upon recommendation of the Business Meeting of January 1993 (see *Notices*, April 1993, page 426), Saunders Mac Lane's resolution was on the floor.

> Resolved: That the AMS Strategic and Operating Plan be withdrawn for reconsideration, in particular, for inclusion in the plan of major attention to the support and encouragement of mathematical research.

It was defeated by a show of hands.

The secretary asked for and received unanimous consent to consider a resolution of thanks to the City of Cincinnati and the Local Arrangements Committee as follows:

> The American Mathematical Society has been very pleased to meet in Cincinnati. It appreciates the Proclamation issued by Mayor Qualls which declared 12 to 15 January 1994 as Mathematics Days in the City of Cincinnati.
> Furthermore, it thanks the members of the Local Arrangements Committee for the efforts its members have made to insure the success of this meeting.

The resolution carried unanimously.

The meeting adjourned at 12:50 p.m.

Robert M. Fossum
Secretary
Urbana, Illinois

The 891st Meeting in Manhattan, Kansas

The 891st meeting of the American Mathematical Society was held at Kansas State University in Manhattan, Kansas, on Friday, March 25, and Saturday, March 26, 1994. There were 238 registrants, including 185 members of the Society. There were 39 student registrants.

Invited Addresses. By invitation of the Program Committee for Central Section Meetings, there were four invited addresses; the speakers, their institutions, and titles follow:

MARILYN BREEN, University of Oklahoma, *Krasnosel'skii-type theorems in orthogonal polygons.*

MICHAEL C. CRANSTON, University of Rochester, *On coupling in applications of probability to analysis.*

DAVID M. GOSS, Ohio State University, *Zeta functions of characteristic p arithmetic.*

MEI-CHI SHAW, University of Notre Dame, *Solvability and estimates for the tangential Cauchy-Riemann operators.*

The speakers were introduced by Edward Cline, Rodrigo Banuelos, Michael Rosen, and A. Alexandrou Hinomas, respectively.

Special Sessions. By invitation of the same committee, there were twelve Special Sessions of selected papers. The titles of the sessions and the organizers are as follows:

Harmonic analysis and probability, ANDREW G. BENNETT and CHARLES N. MOORE, Kansas State University.

Groups and geometries, ANDREW L. CHERMAK and ALBERT L. DELGADO, Kansas State University.

Quantum topology, LOUIS CRANE and DAVID YETTER, Kansas State University.

Global fields, DAVID M. GOSS, Ohio State University; MICHAEL I. ROSEN, Brown University; and DINESH THAKER, University of Arizona.

Special functions, ROBERT A. GUSTAFSON, Texas A&M University.

Several complex variables and partial differential equations, A. ALEXANDROU HIMONAS, Institute of Advanced Study, and MEI-CHI SHAW.

Nonlinear topics and critical phenomena in partial differential equations, LEV KAPITANSKI and LIGE LI, Kansas State University.

Representations of algebraic groups and quantum groups, ZONGZHU LIN and DAVID B. SUROWSKI, Kansas State University.

Operator theory, GABRIEL NAGY, Kansas State University, and VLADIMIR V. PELLER, University of Hawaii.

Convergence problems in ergodic theory, JOSEPH M. ROSENBLATT, Ohio State University.

Dynamical systems and fluid dynamics, MISHA VISHIK, University of Texas at Austin.

Computational mathematics and numerical analysis, HUNAN YANG and QISU ZOU, Kansas State University.

Contributed Papers. There was also one session for contributed ten-minute papers, which was chaired by Willard Parker of Kansas Sate University. Two papers were delivered.

Committee. Local arrangements were handled by John McGuiness and David Yetter of Kansas State University.

Andy R. Magid
Associate Secretary
Norman, Oklahoma

The 892nd Meeting at Polytechnic University

The 892nd Meeting of the Society was held at Polytechnic University in Brooklyn, New York, from April 8 to April 10, 1994. There were 303 registrants, including 244 members of the Society.

Invited Address. By invitation of the Northeastern Section Program Committee, there were four invited speakers.

DAVID BAYER, Columbia University. Introduced by J. C. Lagarias of AT&T Bell Labs.

PETER B. KRONHEIMER, Merton College, Oxford University. Introduced by Tomasz Mrowka, California Institute of Technology.

DEBASIS MITRA, AT&T Bell Labs. Introduced by Alan Weiss, AT&T Bell Labs.

NICHOLAI RESHETIKHIN, University of California, Berkeley. Introduced by Arthur Jaffe, Harvard University.

Special Sessions. By invitation of the same committee there were thirteen Special Sessions, the topics and organizers of which follow:

Computational geometry, BORIS ARONOV, Polytechnic University.

Mathematical problems in molecular biology, CRAIG J. BENHAM, Mt. Sinai Medical Center.

Invariants of low dimensional manifolds, JOAN S. BIRMAN, Columbia University; SYLVAIN E. CAPPELL, NYU Courant Institute; EDWARD MILLER, Polytechnic University.

Geometric analysis, JOZEF DODZIUK and EDGAR A. FELDMAN, Graduate School & University Center (CUNY).

Combinatorial group theory and related topics, BENJAMIN FINE, Fairfield University; ANTHONY M. GAGLIONE, United States Naval Academy; KATHRYN KUIKEN, Polytechnic University.

Teichmuller theory and dynamical systems, FREDERICK P. GARDINER, Brooklyn College (CUNY) and JUNPING JIANG, Brooklyn College (CUNY).

Analytic number theory, DORIAN GOLDFELD, Columbia University.

Geometric convexity, JACOB E. GOODMAN, City College (CUNY), and ERWIN LUTWAK, Polytechnic University.

Topological methods; topological measure theory, PAOSHENG HSU, University of Maine, Orono, and L. NARISI, St. Johns University.

Partial differential equations, YANYAN LI, Rutgers University.

Discrete geometry, JANOS PACH, New York University, and WILLIAM STEIGER, Rutgers University.

Gauge theory and applications, ROBERT J. SIBNER, Brooklyn College (CUNY).

Models in telecommunications, ALAN A. WEISS, AT&T Bell Labs.

Contributed Papers. There were two sessions of contributed papers

Local Arrangements. These were most ably handled by Erwin Lutwak and Deane Yang, both of whom did a superb job of coordinating all the details of such a large sectional meeting.

Lesley M. Sibner
Associate Secretary
Brooklyn, New York

The Council Meeting in New York City

The Council of the American Mathematical Society met at 7:00 p.m. on Saturday, 09 April 1994, in New York City.

There were twenty members present. President Graham presided. Newly elected or appointed members of the Council took office on 01 February 1994. The president introduced all members of the Council.

It was announced that Member-at-large Gunther Uhlmann resigned from the Council as of 04 February 1994. There being no provision in the Bylaws to replace a member whose term is less than a full year, the Council will conduct its business until new members are elected and take office with fourteen, rather than fifteen, members-at-large.

After introductions were made, the Council immediately convened in executive session in order to consider the reports of its Nominating Committee and Editorial Boards Committee and other matters. The actions are reported below.

After the Council returned to open session the remaining items on the agenda were considered *seriatim*.

The minutes of the January 1994 Council were approved as corrected.

In Business by Mail, the Council elected Marc Rieffel to its Executive Committee, Jean Taylor as representative to the Joint Policy Board for Mathematics, and approved the Summary and

National Policy Statement so as to speak in the name of the Society.

The Council elected Luis Caffarelli as chair of the Colloquium Editorial Committee, Andrew M. Odlyzko to the Mathematics of Computation Editorial Committee, Peter Li to the Proceedings Editorial Committee, Irwin Kra as managing editor of the *Proceedings of the American Mathematical Society*, and Jonathan Alperin as a member of the Mathematical Reviews Editorial Committee.

The Council, acting on recommendations from its Nominating Committee and on petitions from members, made nominations for the fall 1994 election. These are reported elsewhere in these *Notices* and are not repeated here.

The Council approved Interim Editor Rossi's recommendations for appointment to the *Notices* Editorial Committee.

The Council approved a charge to the Committee on Publications.

The Committee on Publications had considered an affiliation with the *Electronic Journal of Combinatorics* and put consideration on the agenda of the Council. After some debate, the Council agreed to archive the journal but to await further developments before recommending an "affiliation".

It was noticed by some members of the Council that there was not a one-to-one correspondence between bullets in the National Policy Agenda and its Summary in that the Summary omitted a bullet for the item concerning undergraduate research. Some Council members believe that this bullet should be restored to the Summary or that mention should be made of the item in some other bullet in the Summary. The Council approved an amendment to the Summary so that the words "**including undergraduate research**" appear at the end of the second bullet on undergraduate education. The complete bullet now reads:

> Foster wider understanding and appreciation of mathematics as a creative discipline, in particular through its presentation in undergraduate mathematics instruction, including undergraduate research.

The executive director, William H. Jaco, gave his annual report to the Council.

The Committee on Women in the Mathematical Sciences has recommended that the AMS endorse the AAUP statement on sexual harassment, which is recorded here:

On sexual harassment[1]

It is the policy of this institution that no member of the academic community may sexually harass another. Sexual advances, requests for sexual favors, and other conduct of a sexual nature constitute sexual harassment when:

- **Any such proposals are made under circumstances implying that one's response might affect such academic or personnel decisions as are subject to the influence of the person making such proposals; or**
- **Such conduct is repeated or is so offensive that it substantially contributes to an unprofessional academic or work environment or interferes with required tasks, career opportunities, or learning; or**
- **Such conduct is abusive of others and creates or implies a discriminatory hostility toward their personal or professional interest because of their sex.**[2]

[American Association of University Professors, 1990]

The Council agreed that the statement should be sent to it by Business by Mail for endorsement in the name of the Society. The Council also agreed to endorse the statement on its own behalf.

The Council received reports from several committees. These are on file in the Office of the Secretary.

While meeting in Executive Session, the Council resolved itself into the Committee of the Whole. When the Committee of the Whole resolved itself back into the Council, President-elect Morawetz, chair of the Committee of the Whole, reported that the Committee of the Whole recommended that the Council consider the general question as to whether a chair of a committee should follow Council policy and, if a chair refused to do so, what actions should be taken. The Council agreed to consider this matter, which was not on the agenda.

The chair of the Committee of the Whole then reported that the Committee of the Whole recommended that chairs of Society committees should follow policy established by the Council. Furthermore, the Committee of the Whole, having learned that a committee chair was refusing to follow a policy established by the Council, recommended that the Council request the president to request of that chair either to follow the policy established by the Council or to resign. The Council agreed with this recommendation of the Committee of the Whole.[3]

(Subsequent to the Council meeting the president spoke with the chair in question by telephone. The chair agreed to resign and has done so.)

The meeting adjourned at 10:15 p.m.

Robert M. Fossum
Secretary
Urbana, Illinois

[1]For the state of the law as it pertains to sexual harassment in the employment context, see *Meritor Savings Bank, F.S.B. v. Vinson, 477* U.S. 57 (1986).

[2]Faculty members and staff are cautioned against entering romantic or sexual relationships with their students; so, too, is a supervisor cautioned against entering such relationships with an employee. Faculty and staff should be cautious in assuming professional responsibilities for those with whom they have an existing romantic relationship. (See also the AAUP statement on *Faculty Appointment and Family Relationships*.)

[3]According to *Sturgis' Standard Code of Parliamentary Procedure*, Third Edition, New and Revised, "officers, directors, or committee members can be removed by the same authority that selected them. The power to select carries with it the power to remove."

Miscellaneous

Personals

Mohammad Reza R. Moghaddam, of Ferdowski University of Masshad, Iran, was appointed to a full professorship at that institution, effective June 1993.

Deaths

Steven B. Bank, of the University of Illinois, died on April 10, 1994. He was born on March 14, 1939, and was a member of the Society for 33 years.

Robert W. Butcher, of West Hartford, CT, died on December 7, 1993. He was born on May 11, 1925, and was a member of the Society for 38 years.

R. Eliot Chamberlin, Professor Emeritus of the University of Utah, died on March 14, 1994. He was born on March 20, 1923, and was a member of the Society for 46 years.

Charles L. Dolph, Professor Emeritus of the University of Michigan, died on June 4, 1994. He was born on August 27, 1918, and was a member of the Society for 52 years.

Leonard E. Fuller, Professor Emeritus of Kansas State University, died on March 1, 1994. He was born on July 25, 1919, and was a member of the Society for 46 years.

James Hill, of Silver Spring, MD, died on September 3, 1993. He was born on January 21, 1922, and was a member of the Society for 39 years.

Mary Helen Infeld died on July 6, 1993. She was born in 1907 and was one of the first women to obtain a Ph.D. in mathematics at Cornell University in 1933 (under her maiden name of Helen Schlauch).

William H. L. Meyer, retired professor of Chicago, Illinois, died on November 17, 1993. He was born on July 27, 1915, and was a member of the Society for 53 years.

Raymond A. Mugele, of Los Altos, CA, died on April 9, 1994. He was born on April 13, 1914, and was a member of the Society for 37 years.

Yosio Muto of Yokohama, Japan, died on June 15, 1993. He was born on January 8, 1912, and was a member of the Society for 33 years.

Murray B. Ritterman, of East Meadow, NY, died on September 19, 1993. He was born on October 19, 1914, and was a member of the Society for 45 years.

B. M. Stewart, Professor Emeritus of Mathematics from Michigan State University, died on April 15, 1994. He was born on July 10, 1914, and was a member of the Society for 55 years.

William Rae Thompson, Emeritus Senior Research Scientist of the State University of New York at Albany, died on May 30, 1993. He was born on July 29, 1906, and was a member of the Society for 64 years.

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

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Connolly, Frank (U.S.A.)	University of Edinburgh, Scotland Max Planck Institute, Germany	Topology	6/94– 9/94 9/94– 6/95
Faybusovich, Leonid (U.S.A.)	Royal Institute of Technology, Sweden	Applied Mathematics	8/94– 5/95
Rosenthal, Joachim (U.S.A.)	Center for Mathematics and Computer Science, Amsterdam	Applied Mathematics	8/94– 5/95

Visiting Foreign Mathematicians

Auscher, Pascal (France)	Brown University	Harmonic Analysis	9/94– 6/95
Balog, Antal (Hungary)	University of Illinois at Urbana	Analytic Number Theory	1/95– 5/95
Billig, Yuly (Russia)	University of Notre Dame	Algebra	8/94– 5/95
Bohm, Michael (Germany)	University of Southern California	Nonlinear Partial Differential Equations, Nonlinear Functional Analysis	9/94– 6/95
Buyalo, Sergei (Russia)	University of Illinois at Urbana	Geometry	1/95– 5/95
Cai, Tianxin (China)	California State University, Fresno	Number Theory	6/94–12/94
Cellina, Arrigo (Italy)	University of Southern California	Analysis and Differential Equations	9/94–12/94
Guruprasad, K. (India)	McGill University	Geometry	8/94– 7/95
Janelidze, George (Russia)	McGill University	Category Theory	1/95– 5/95
Jorgensen, Murray (New Zealand)	McGill University	Statistics	7/94–12/94
Kovacs, Katalin (Hungary)	University of Illinois at Urbana	Number Theory	8/94– 5/95
Li, Haisheng (China)	University of California, Santa Cruz	Vertex Operator Algebras	7/94– 6/95
Maddaly, Krishna (India)	Brown University	Mathematical Physics	9/94– 6/95
Nagase, Teruo (Japan)	University of Illinois at Urbana	Geometry	8/94– 3/95
Rajan, C. S. (India)	McGill University	Number Theory	8/94– 7/95
Reinert, Gesine (Germany/Switzerland)	University of Southern California	Probability Theory and Stochastic Processes	9/94– 6/97
Schauenburg, Peter (Germany)	University of Southern California	Hopf Algebras and Quantum Groups	1/95– 6/95
Shnirelman, Alexander (Israel)	University of California, Santa Cruz	Mathematical Fluid Dynamics	1/95– 6/95
VanCliff, Michaela (England)	University of Southern California	Probability Theory and Processes	9/94– 6/97
Xie, Wenzheng (China)	University of California, Santa Cruz	Partial Differential Equations	7/94– 6/95
Zlatos, Pavol (Slovak Republic)	University of Illinois at Urbana	Logic	8/94– 1/95
Zograf, Peter (Russia)	University of Southern California	Geometry and Mathematical Physics	1/95–12/95

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 $56 for 1994 and $58 for 1995. 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

Egyptian Mathematical Society

Apply to: Mohamed Hussein Fahmy, Math. Dept., Faculty of Science, Al-Azhar Univ., P.O. Box 11884, Nasr-City, Cairo, Egypt.

Dues: U.S. $10 payable to Fayed F. Ghaleb, Ain Shams University, Faculty of Science, Dept. of Math., Abbaseia, Cairo, Egypt.

Privileges: Receive a 60% discount on the prices of ETMS publications, receive 50% discount on the publication charge per printed page in *ETMS Journal*, and reduced charge for participating at ETMS conferences.

Officers: A.-s.F. Obada (President), M. Asaad (Vice-President), F. F. Ghaleb (Treasurer), M. H. Fahmy (Secretary).

•Nigerian Mathematical Society*

Apply to: Christopher O. Imoru (Secretary), Nigerian Mathematical Society, Department of Mathematics, University of Ife, Ile-Ife, Nigeria.

Dues: U.S. $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: S.N. Lal, Secretary, Allahabad Mathematical Society, Jodhpur Colony, Banaras Hindu University, Varanasi-221005, India.

Dues: U.S. $60 (annual), U.S. $300 (life); payable to Allahabad Mathematical Society, S.N. Lal, at the above address.

Privileges: *Indian Journal of Mathematics* or *Communications in Theoretical Physics*. Other publications available at concession rates.

Officers: Pramila Srivastava (President), S. N. Bhatt, A. M. Vaidya (Vice-Presidents), S.C. Srivastava (Treasurer), S.N. Lal (Secretary), G. D. Dikshit (Editor, *Indian Journal of Mathematics*), V. Singh (Librarian).

Calcutta Mathematical Society*

Apply to: Dr. B.N. Mandal, Secretary, Calcutta Mathematical Society, AE-374, Sector-I, Salt Lake City, Calcutta 700 064, India.

Dues: U.S. $10 payable to Secretary, Calcutta Mathematical Society at above address.

Privileges: *Bulletin of the Calcutta Mathematical Society*, *News Bulletin* of the Calcutta Mathematical Society, and Library, Seminars, Conferences, etc.

Officers: M. Dutta (President), N.D. Sengupta, K.R. Unni, K. Ramachandra, T.K. Mukherjee, and D.K. Sinha (Vice-Presidents), U. Basu (Treasurer), B.N. Mandal (Secretary).

Indian Mathematical Society

Apply to: S. P. Arya, Administrative Secretary, Indian Mathematical Society, Department of Mathematics, Maitreyi College, Bapu Dham Complex, Chanakyapuri, New Delhi 110021, India.

Dues: U.S. $30, payable to M. K. Singal, Hony. Treasurer, IMS, A-1, Staff Residences, Meerut University, Meerut-250005, India.

Privileges: *Mathematics Student.*

Officers: H. P. Dikshit (President), U. P. Singh (Immediate Past President), M. K. Singal (Treasurer), H. P. Dikshit (Academic Secretary), S. P. Arya (Administrative 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: Bong Dae Choi, Secretary, Korean Mathematical Society, 538 Dowha Dong, Mapo Ku, Sung Ji Building, Room 706, Seoul 121-743, Korea.

Dues: U.S. $30, payable to the Korean Mathematical Society.

Privileges: Receive *Bulletin* and *Journal of the Korean Mathematical Society.*

Officers: Moo Ha Woo (President), Kyu Hyun Sohn, Kun Soo Chang (Vice-Presidents), Joo Sup Chang (Treasurer), Bong Dae Choi (Secretary).

Malaysian Mathematical Society

Apply to: Hon. Secretary, Malaysian Mathematical Society, c/o Department of Mathematics, University of Malaya, 59100 Kuala Lumpur, Malaysia.

Dues: U.S. $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), Abu Osman Md.Tap, Abdul Rahni Mt.Piah (Vice-Presidents), Suzeini Abdul Halim (Hon. Treasurer), K. Ratnavelu (Secretary).

•Mathematical Society of Japan

Apply to: Kazuyo Ezaki, Secretary, Mathematical Society of Japan, 25-9-203, Hongo 4-chome, Bunkyo-ku, Tokyo 113, Japan.

Dues: U.S. $60, payable to Mathematical Society of Japan.

Privileges: *Journal of the Mathematical Society of Japan*; *Sugaku* (in Japanese) for U.S. $12 additional dues.

Officers: Shigeru Iitaka (President), Yuko Mizutani (Treasurer), Kazuyo Ezaki (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: U.S. $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, c/o Department of Mathematics, Tamkang University, Tamsui, Taiwan 25137, Republic of China.

Dues: U.S. $20, payable to the Mathematical Society of the Republic of China.

Privileges: *Chinese Journal of Mathematics.*

Officers: Simon C. Hsieh (President), Jau-D. Chen (Treasurer), Liang-Chi Tsao (Secretary).

Nepal Mathematical Society

Apply to: S. R. Pant, Secretary, NMS, Central Department of Mathematics, T.U., Kirtipur, Kathmandu, Nepal.

Dues: U.S. $10, payable to Nepal Mathematical Society, Central Department of Mathematics, T.U., Kirtipur, Kathmandu, Nepal.

Privileges: All privileges enjoyed by an ordinary member.

Officers: R. P. Manandhar (President), H. N. Bhattarai (Vice-President), P. M. Bajracharya (Treasurer), S. R. Pant (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: U.S. $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, Director, RMS, Bharathidasan Institute of Management, P.O. Box 12, BHEL Complex,

Tiruchirapalli 620 014, Tamil Nadu, India.

Dues: U.S. $20 (annual), $200 (life); payable to C. V. Venkatachalam, Prof. of Math., Manipal Institute of Technology, Manipal 576 199.

Privileges: *Journal of Ramanujan Mathematical Society.*

Officers: J. Gopalakrishna (President), M. Rajagopalan (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: U.S. $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: U.S. $12 (annual), U.S. $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: U.S. $15 for members of the American Mathematical Society, payable to Asociación Matemática Española.

Privileges: *Boletin de la Asociación Matemática Española*; *Publicaciones de la Asociación Matemática Española* (at reduced prices).

Officers: Miguel de Guzmán, (President), Ireneo Peral (Treasurer), Maria T. Carrillo (Secretary).

•Berliner Mathematische Gesellschaft e.V.

Apply to: Dr. Heinrich Begehr, Fachbereich Mathematik FU, Arnimallee 2–6, D-14195 Berlin, Germany.

Dues: (Individual Members) DM 24, (Non-individual Members) DM 200 minimum; payable to Gerhard Preuss, Institut für Mathematik I, FU Berlin, Arnimallee 3, D-14195 Berlin, Germany.

Privileges: One free copy of *Sitzungsberichte der BMG.*

Officers: Heinrich Begehr (President), Erhard Behrends (Vice-President), Gerhard Preuss (Treasurer), Ernst J. Thiele (Secretary).

Croatian Mathematical Society

Apply to: Sanja Varošanec, Bijenička 30, 41000 Zagreb, Croatia.

Dues: U.S. $10, payable to Hrvatsko Matematičko Društvo, Zagrebačka banka d.d. Zagreb, HR 2x, 30101-620-16-25731-3688780.

Privileges: *Vjesnik HMD* (in Croatian) free of charge. The scientific journal *Glasnik Matematički* at the reduced rate of U.S. $15 per volume. All publications of the CMS reduced by at least 25%.

Officers: Salih Suljagić (President), Damir Bakić (Vice-President), Boris Guljaš (Treasurer), Sanja Varošanec (Secretary).

Dansk Matematisk Forening

Apply to: Mogens Esrom Larsen, Treasurer, Dansk Matematisk Forening, Universitetsparken 5, 2100 København Ø, Denmark.

Dues: DKr. 50; payable to Treasurer.

Privileges: *Mathematica Scandinavica* (DKr. 183 per volume), *Nord. Mat. Tidss.* (*Normat*) (NKr. 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: Christian Berg (President), Hans Plesner Jakobsen (Vice-President), Mogens Esrom Larsen (Treasurer), Hans-Jørgen Munkholm, Sten Markvorsen (Secretaries).

•Deutsche Mathematiker-Vereinigung e.V.

Apply to: Deutsche Mathematiker-Vereinigung e.V., Albertstraße 24, D-7800 Freiburg, Germany.

Dues: DM 30. plus costs for one of the publications; payable to Volksbank Freiburg 6955002 (BLZ 680 900 00), Postgiro Stuttgart 18517-706 (BLZ 600 100 70).

Privileges: *Mitteilungen der Deutschen Mathematiker-Vereinigung* and one of three publications: *Jahresbericht der Deutschen Mathematiker-Vereinigung*, DM 35; *Math. Semesterberichte*, DM 30; or *Surveys on Mathematics in Industry*, DM 80.

Officers: M. Grótschel (President), K. P. Grotemeyer (Treasurer), Dirk Ferus (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: U.S. $12 (preferably £5 sterling), payable to the Honorary Secretary.

Privileges: *Proceedings* at reduced rate of U.S. $20 (preferably £8 sterling) per annum.

Officers: A. D. D. Craik (President), A. C. McBride (Vice-President), A. D. Sands (Treasurer), P. Heywood, C. J. Smyth (Secretaries).

Gesellschaft für Angewandte Mathematik und Mechanik (GAMM)

Address for mail: E. Kreuzer, Meerestechnik II, Technische Universität Hamburg-Harburg, Eissendorfer Str. 42, D-21071 Hamburg, Germany.

Apply to: G. Szefer, Institute of Structures Mechanics, Cracow University of Technology, u. Warszawska 24, PL-31 155 Cracow, Poland.

Dues: DM 50 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: R. Mennicken (President), O. Mahrenholtz (Vice-President), G. Alefeld (Treasurer), E. Kreuzer (Secretary), G. Szefer (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: £2.50, plus £26.00 for *Journal*; payable to Glasgow Mathematical Association.

Privileges: *Glasgow Mathematical Journal* (see above).

Officers: P. Arter (President), E. West (Vice-President), K. A. Lindsay (Treasurer), I. McFarlane (Secretary).

•Hellenic (Greek) Mathematical Society (HMS)

Apply to: M. Georgoudi, Secretary, Hellenic Mathematical Society, 34 Panepistimiou Street, GR-10679 Athens, Greece.

Dues: U.S. $20; payable to Hellenic Mathematical Society at above address.

Privileges: The right to present articles at meetings and participate in activities and functions of the HMS; the right to receive, at no additional cost, *The Journal HMS/Bulletin*, *The News-Bulletin (ENIMEROSI)*; and the right to receive the same discounts which are available to individual members of HMS.

Officers: E.A. Lipitakis (President), N. Alexandris (Vice-President), P. Bourvaris (Treasurer), E. Ntziachristos (Secretary).

•Irish Mathematical Society

Address for mail: P. Mellon, Secretary, IMS, Mathematics Department, University College Dublin, Belfield, Dublin 4, Ireland.

Apply to: Michel Vandyck, Treasurer, Irish Mathematical Society, Physics Department, University College, Cork, Ireland.

Dues: U.S. $10, payable to Michel Vandyck, Treasurer, IMS, at above address.

Privileges: Free copy of the *Bulletin of the Irish Mathematical Society* (two times per year), free registration at IMS annual conference (September).

Officers: B. Goldsmith (President), D. Hurley (Vice-President), M. Vandyck (Treasurer), P. Mellon (Secretary).

Íslenzka stærðfræðafélagið

Apply to: Íslenzka stærðfræðafélagið, Raunvísindastofnun Háskólans, Dunhaga 3, IS-107 Reykjavik, Iceland.

Dues: U.S. $10, payable to Íslenzka stærðfræðafélagið.

Privileges: Reduced subscription rate on *Mathematica Scandinavica* and *Nordisk Matematisk Tidskrift* (*Normat*), subscription orders should be sent directly to the journals.

Officers: Hermann Thorisson (President), Rögnvaldur Möller (Treasurer), Jón Kr. Arason (Secretary).

János Bolyai Mathematical Society*

Apply to: Vice-Secretary General, Cecilia Szabados, János Bolyai Mathematical Society, Budapest, Fö utca 68., Hungary H-1027.

Dues: Are voluntary but should minimally cover duplication and mailing costs; for Reciprocity members (residing outside Hungary) suggested fee is 1/8 of one percent of the member's net income; sponsoring members pay at least U.S. $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 priviledges 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: Dr. Jiří Rákosník, Matematický ústav, Žitná 25, 115 67 Praha 1.

Dues: U.S.$20; payable to Jednota Českých Matematiků a fyziků.

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.

Officers: Štefan Zajac (President), Břetislav Novák (Vice-President), Miloš Růžička (Treasurer), Milada Kočandrlová (Secretary).

London Mathematical Society

Apply to: Miss S.M. Oakes, London Mathematical Society, Burlington House, Piccadilly, London W1V 0NL, United Kingdom.

Dues: £7.25 payable to London Mathematical Society. (New members should not send payment until elected.)

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INSTITUTIONS NOT SUBJECT TO U.S. LAWS may be required to execute and submit a copy of this form with the text of recruitment advertisements for the *Notices* (see Policy Statement below). Publication of recruitment advertisements not accompanied by the completed form may be delayed or denied.

Employment at _____

(Name of Institution) (City) (Country)

is offered without discrimination on grounds of age, color, race, religion, sex, or national origin.

_____

(Signature) (Date)

_____

Name (please print) (Title)

Please return this form to: Advertising Department
Notices of the American Mathematical Society
P.O. Box 6248
Providence, RI 02940, U.S.A.

AMS Policy on Recruitment Advertising

No listing for a position will be printed if it expresses or implies any preference, limitation, specification, or discrimination based on age, color, race, religion, sex, or national origin in contravention of any federal or state statute prohibiting discrimination in employment on the basis of these criteria. The publisher reserves the right to edit any listing prior to publication which does not conform with federal or state law on discrimination in employment.

All employers in the United States are required to abide by the requirements of Title VII of the Civil Rights Act of 1964, announcing a national policy of equal employment opportunity in private employment, without discrimination because of color, race, religion, sex, or national origin. All U.S. listings are accepted with the understanding that the employer complies with federal requirements. Advertisers not subject to U.S. laws may be required to sign a statement that they do not discriminate in employment on grounds of age, color, race, religion, sex, or national origin. *Applicants should be aware that institutions outside the U.S. may not be legally bound to conform to these or similar requirements and the AMS cannot assume responsibility for enforcing compliance. Applicants are advised to inform themselves of conditions that may exist at the institutions to which they apply.*

In particular, readers should note that the Equal Employment Opportunity Act (42 U.S.C., §§2000e et seq.), which prohibits discrimination in employment on the basis of race, religion, sex, or national origin, contains (in §2000e-1) an exception from the provisions of the Act for any religious corporation, association, educational institution, or society with respect to employment of individuals of a particular religion to perform work connected with the carrying on by such corporation, association, educational institution, or society of its activities.

The Age Discrimination Act of 1967 (29 U.S.C., §§621 et seq., as amended), makes it unlawful for an employer to discriminate against any individual between the ages of 40 and 70 because of age. Thus it is legal to seek as an employee someone who is "over 30," but not one "over 50"; neither is it legal to express a preference for someone who is "young," or is a "recent graduate," since the latter tend (on statistical grounds) to be young.

Classified Advertisements

SUGGESTED USES for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

THE 1994 RATE IS $70 per inch on a single column (one-inch minimum), calculated from the top of the type; $40 for each additional ½ inch or fraction thereof. No discounts for multiple ads or the same ad in consecutive issues. For an additional $10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Advertisements in other sections of the classified pages will be set according to the advertisement insertion. Headlines will be centered in boldface at no extra charge. Classified rates are calculated from top of type in headline to bottom of type in body copy, including lines and spaces within. Any fractional text will be charged at the next ½ inch rate. Ads will appear in the language in which they are submitted.

Prepayment is required of individuals but not of institutions. There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified advertising.

DEADLINES are listed on the inside front cover or may be obtained from the AMS Advertising Department.

U. S. LAWS PROHIBIT discrimination in employment on the basis of color, age, sex, race, religion or national origin. "Positions Available" advertisements from institutions outside the U. S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U. S. laws. Details and specific wording may be found near the Classified Advertisements in the January and July/August issues of the *Notices*.

SITUATIONS WANTED ADVERTISEMENTS from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada, or 401-455-4084 worldwide, for further information.

SEND AD AND CHECK TO: Advertising Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02904. Individuals are requested to pay in advance, institutions are not required to do so. AMS FAX 401-455-4004.

POSITIONS AVAILABLE

FLORIDA

UNIVERSITY OF FLORIDA

Applications are invited for a senior position in topology. Applicants should have an outstanding record of accomplishments in research, an international reputation, and the potential to lead a vigorous graduate research program, as well as dedication to teaching at the undergraduate and graduate levels. Applicants should forward a curriculum vitae and a list of publications to:

Chair of Search Committee
Department of Mathematics
201 Walker Hall
University of Florida
Gainesville, FL 32611-8000

Applicants should supply evidence of commitment to teaching and arrange for at least three letters of recommendation to be forwarded to the address above. Completed applications and supporting letters are due **September 2, 1994.**

The Department especially welcomes applications from women and minority candidates. The University of Florida is an EEO/AA institution. Anyone requiring special assistance in completing the application should contact the search committee chairperson.

MAINE

COLBY COLLEGE
Department of Mathematics and Computer Science
Waterville, Maine 04901

Carter Professor of Mathematics and Computer Science

Colby invites nominations and applications for Carter Professor of Mathematics and Computer Science, effective September 1, 1995. Necessary qualifications include: a Ph.D. in mathematics or computer science; a distinguished career as scholar and teacher; commitment to liberal arts, undergraduate mathematics, and computer science education.

The Carter Professorship is an endowed position for a nationally recognized scholar and teacher. The Carter Professor is expected to maintain a distinguished research program and teach undergraduate mathematics, statistics, and/or computer science classes and participate in the departmental programs. The Professorship includes funds for research and travel.

Colby is a highly selective college of 1,700 students and 165 faculty. Its Department of Mathematics and Computer Science has nine full-time and two part-time faculty members who are active researchers and teach courses in mathematics, computer science, and statistics. Normal annual teaching load is five courses, one of which may be during the January Program. Colby is an AA/EO employer and encourages applications from women and minorities.

The campus of 700 acres is on the outskirts of Waterville, a city of 20,000. Waterville is located on the Kennebec River in an area of lakes, forests, and farms. Mountains (including Saddleback and Sugarloaf ski areas) and seacoast (including Acadia National Park) are within a two-hour drive. Boston is approximately a three-hour drive.

Send nominations or applications in hard copy to Dale Skrien, chair, Department of Mathematics and Computer Science (djskrien@colby.edu.) Review of applications will begin on October 15, 1994, and will continue until the position is filled.

MARYLAND

INSTITUTE FOR DEFENSE ANALYSES SUPERCOMPUTING RESEARCH CENTER

Applications are invited from Ph. D. level mathematicians, statisticians, computer scientists, and electrical engineers for research positions on our technical staff. Initial appointment would be for one or two years, possibly leading to a permanent position. Wide interests, and the ability to motivate one's own work are more important than knowledge of specific technical areas.

Additionally, we also organize each year a summer program for which places are available in 1995.

Salaries will be competitive and commensurate with experience and qualification.

IDA/SRC is an equal opportunity/affirmative action employer, and encourages application from women and members of minority groups. Send reśumé and publication list to:

Dr. D.B. Heifetz
Deputy Director
IDA/SRC
17100 Science Drive
Bowie, MD 20715-4300

U.S. citizenship required.

JOHNS HOPKINS UNIVERSITY
Mathematics Department
Baltimore, MD

Applications are invited for a possible senior faculty position, professor of mathematics, in the area of partial differential equations in analysis. Outstanding research credentials and excellence in teaching are required. Minority and women candidates are encouraged to apply. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Applicants should submit a curriculum vitae and list of references or arrange for letters of recommendation to be sent to: Appointments Committee, Dept. of Mathematics, 404 Krieger Hall, Johns Hopkins University, Baltimore, MD 21218. Decisions will be made anytime after September 15.

NEW JERSEY

RUTGERS UNIVERSITY

Subject to budget constraints, Rutgers University - Camden expects to hire three computer scientists (at least one senior level) and one mathematician, to start fall 1995, rank negotiable. Those who can teach both math. and comp. sci. are expecially encouraged to submit letters of interest. Send a vita and arrange for three or four letters of recommendation to be sent directly to J. Gerver, Dept. of Mathematical Sciences, Rutgers University, Camden, NJ 08102.

PENNSYLVANIA

COMMUNITY COLLEGE OF PHILADELPHIA

Mathematics Dept. has a tenure track position starting January, 1995. Qualifications: Master's Degree in mathematics, commitment to quality teaching, both remedial and college level, and serious interest in curriculum development. Send resumé and three letters of recommendation by September 16, 1994, to: Mathematics Dept. Hiring Committee, Community College of Philadelphia, 1700 Spring Garden St., Philadelphia, PA 19130. As an affirmative action/equal opportunity employer, CCP eagerly encourages applications from women and minority candidates.

UNIVERSITY OF PITTSBURGH
Department of Mathematics

The Department of Mathematics of the University of Pittsburgh invites applications for the position of department chairperson, beginning fall 1995.

Located in urban Pittsburgh, the University of Pittsburgh is a research university with approximately 10,000 graduate and 18,000 undergraduate students. The department currently has thirty-five faculty members with research specialties including algebra, analysis, differential equations, differential geometry, discrete mathematics, foundations, mathematical biology, numerical analysis, scientific computing, and topology.

Candidates should have research and teaching credentials consistent with a tenured appointment at the rank of full professor, as well as a commitment to aggressive promotion of excellence in research and teaching at all levels. Administrative experience is also desirable. Interested parties should contact Professor Charles Hall, chairperson Search Committee, Department of Mathematics, University of Pittsburgh, Pittsburgh, PA 15260 (`hall@vms.cis.pitt.edu`, 412-624-8379).

Complete applications should include a curriculum vitae and the names and addresses of three references. For full consideration, inquiries should be received by October 15, 1994. Women and minorities are especially encouraged to apply. The University of Pittsburgh is an EO/AA employer.

CANADA

UNIVERSITY OF ALBERTA
Department of Mathematical Sciences
NSERC Women's Faculty Awards
in
Statistics and Mathematics

The Department of Mathematical Sciences at the University of Alberta invites outstanding applicants for nomination for Natural Sciences and Engineering Research Council of Canada Women's Faculty Awards. All areas of statistics and pure and applied mathematics will be considered. Successful applicants will receive an appointment at the assistant professor level with a reduced teaching load for five years from July 1, 1995. Candidates must be Canadian citizens or permanent residents by October 15, 1994, and be within five years of their Ph.D. degree at that date. Candidates should send a curriculum vitae, including a list of publications, and arrange for three letters of reference to be sent by August 31, 1994, to:

S. D. Riemenschneider, chairman
Department of Mathematical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1

The University of Alberta is committed to the principle of equity in employment. The University encourages applications from aboriginal persons, disabled persons, members of visible minorities, and women.

GERMANY

UNIVERSITÄT DES SAARLANDES

Im Fachbereich Mathematik der Universität des Saarlandes ist eine
C3-Professur für Mathematik
zu besetzen. Der/die künftige Stelleninhaber/in soll das Fach Mathematik mit Schwerpunkt **Algebra und Zahlentheorie** in Forschung und Lehre vertreten.

Zu den Dienstaufgaben gehört eine angemessene Beteiligung an den Lehrveranstaltungen des Fachbereichs einschließlich der Service-Leistungen für Studiengänge anderer Fachbereiche.

Die Universität des Saarlandes will eine Erhöhung des Frauenanteils dort erreichen, wo Frauen unterrepräsentiert sind, und fordert deshalb besonders Frauen auf, sich zu bewerben.

Bewerbungen mit den üblichen Unterlagen sind bis zum 31.8.1994 zu richten an den.

Dekan der Mathematisch-Naturwissenschaftlichen Fakultät der Universität des Saarlandes, Postfach 15 11 50, D-66041 Saarbrücken.

UNIVERSITÄT DES SAARLANDES

Im Fachbereich Mathematik der Universität des Saarlandes ist eine
C4-Professur für Mathematik
zu besetzen. Der/die künftige Stelleninhaber/in soll das Fach Mathematik in einem modernen Bereich der **Funktionalanalysis** in Forschung und Lehre vertreten.

Zu den Dienstaufgaben gehört eine angemessene Beteiligung an den Lehrveranstaltungen des Fachbereichs einschließlich der Service-Leis-
tungen für Studiengänge anderer Fachbereiche.

Die Universität des Saarlandes will eine Erhöhung des Frauenanteils dort erreichen, wo Frauen unterrepräsentiert sind, und fordert deshalb besonders Frauen auf, sich zu bewerben.

Bewerbungen mit den übilichen Unterlagen sind bis zum 31.8.1994 zu richten an den.

Dekan der Mathematisch-Naturwissenschaftlichen Fakultät der Universität des Saarlandes, Postfach 15 11 50, D-66041 Saarbrücken.

SOUTH AFRICA

UNIVERSITY OF CAPE TOWN
Senior Lecturer and Lecturer
Departments of Mathematics
and Applied Mathematics

We invite applications for the above two posts for appointment as soon as possible.

The departments are keen to strengthen their research and teaching interests in Formal Aspects of Computer Science, and in Industrial Mathematics. Applications would be particularly welcome from those whose fields of speciality are one of the above, or whose specialities are in areas which would complement activities in the above two fields.

A negotiable remuneration package includes attractive staff benefits such as medical aid, a pension scheme, and a housing subsidy in certain circumstances. The ranks of the successful incumbents will be decided upon the basis of qualifications and experience.

Please send your curriculum vitae (stating at which level you wish to be considered) together with the names, addresses, and telephone numbers of three contactable referees, not later than 1 August 1994, to the Appointments Officer, Personnel Department, University of Cape Town, Rondebosch 7700, Republic of South Africa. Tel: +2721 650-2192/2196; fax: +2721 650-2138; e-mail: `perappt@bremner.uct.ac.za` for further information.

The University of Cape Town is committed to policies of equal opportunity and affirmative action which are essential to its mission of promoting critical inquiry and scholarship.

MISCELLANEOUS

EXACT ANALYSIS by M. Basti (Notices, Feb. 1993 Issue). Please see the **exhibit** at the

AMS Summer Meeting, August 15-17, 1994, University of Minnesota, Minneapolis.

PUBLICATIONS FOR SALE

MATH SCI PRESS, 53 Jordan Rd., Brookline, MA 02146; 617-738-0307. Developing new mathematical ideas and technology for future Applications. (Differential Systems and Lie-Theoretic Numerical Analysis, Interacting Quantum Fields, Vortices and Turbulence via the COR Theory, Differential Form Variational Calculus for Generalized Maps, ...). **Interdisciplinary Mathematics**, by **Robert Hermann**. Vol. 29, **Lie-Theoretic ODE Numerical Analysis, Mechanics and Differential Systems**; Vol. 28, **Lie-Cartan-Ehresmann Theory**; Vol. 27; **Constrained Mechanics and Lie Theory**; Vol. 26, **Geometric Structures and Nonlinear Physics**; Vol. 25, **Geometric Computing Science: First Steps**. Each $95.

PUBLICATIONS WANTED

Wanted: Mathematical books, journals, reprints, ephemera. Contact R. K. Dennis, Math. Dept., White Hall, Cornell U., Ithaca, NY 14853-7901. Tel: 607-255-4027, FAX: 607-255-7149. e-mail: dennis@math.cornell.edu

SITUATIONS WANTED

Seeking full professorship with tenure and seniority since December 1975 with adjustments. Speciality: Algebraic Topology. Experience: 1967 to 1983. Research and creative work, more than a normal full professor with tenure, get practical burn, burn scar scarfree treatment, refill Canon PC-copier cartridges, extend Canon PC-copiers life, Jain spicy canned food. Vora, 609 Franklin St., Apt. 1, Johnstown, PA 15901.

Mathematics Professor, Ph.D. 1989. Specialty: Algebra. Two published articles. Five years teaching experience. Willing to retrain for industry. South or Midwest U.S. preferred. References and resumé available upon request. Available immediately. Timothy P. Keller, 2718 Luce, Cape Girardeau, MO 63701.

APPLIED MATHEMATICIAN, RESEARCH AND DEVELOPMENT OR TEACHING AND RESEARCH. Ph.D. Speciality: Analysis. Experienced in solving industrial and management problems as well as teaching and academic research. Excellent communication skills. Internal reports, published articles and book. Any location. Available August 1994. Robert Jolly, POB 2175, Kihei, HI 96753-2175.

Ph.D. 1980 India. Specialty: Numerical Analysis. Twenty-one years teaching experience. Desires appointment immediately anywhere in the U.S.; in the field of teaching, research, education, or relevant position; in two- or four-year colleges or universities. Contact: Dr. M. Shakil, 3 South Pine Island Road, Apt. 116, Plantation, FL 33324; phone: 305-472-2082.

NEMMERS PRIZES

NORTHWESTERN UNIVERSITY

THE FREDERIC ESSER NEMMERS PRIZE IN MATHEMATICS

$100,000 AWARD PRESENTED BY

NORTHWESTERN UNIVERSITY

NORTHWESTERN UNIVERSITY
IS PLEASED TO ANNOUNCE THAT

YURI I. MANIN
SCIENTIFIC MEMBER
MAX PLANCK INSTITUTE FOR MATHEMATICS
BONN, GERMANY

IS THE RECIPIENT OF THE FIRST
FREDERIC ESSER NEMMERS PRIZE
FOR OUTSTANDING ACHIEVEMENT IN MATHEMATICS

NORTHWESTERN UNIVERSITY WILL AWARD THE SECOND NEMMERS PRIZE IN MATHEMATICS IN 1996, WITH NOMINATIONS DUE ON DECEMBER 31, 1995. FOR FURTHER INFORMATION, PLEASE WRITE:

SECRETARY
SELECTION COMMITTEE FOR THE NEMMERS PRIZES
OFFICE OF THE PROVOST
NORTHWESTERN UNIVERSITY
633 CLARK STREET
EVANSTON, ILLINOIS 60208-1101

THE CHINESE UNIVERSITY OF HONG KONG

The University (founded 1963) offers comprehensive programmes up to PhD level in the Humanities, Business Administration, Education, Engineering, Medicine, Science, Social Science and Architecture. Student enrolment will be 11,000 full-time equivalent in 1994-95. The University is very active in promoting research and consultancies and in liaising with industry and the business sector worldwide. English and/or Chinese are used in teaching and administration.

The Department of Mathematics is responsible for teaching about 250 undergraduate majors and 30 postgraduates. The current establishment is 18 faculty members, with specialties in algebra, functional analysis, partial differential equations, geometric analysis and numerical analysis. The University has recently established an Institute of Mathematical Sciences. Research in the Institute will cover not only mathematics, but other mathematical sciences including statistics, theoretical physics and engineering. The Institute is directed by Prof. C.N. Yang, Prof. S.T. Yau, Prof. S.Y. Cheng and Prof. W.H. Wong.

Applications are invited for:-

Senior Lectureship/Lectureship in Mathematics (Ref. 46A/509/2/94)

The Department is seeking for outstanding candidates to fill two vacant teaching positions. The candidates should preferably specialize in PDE, Geometry, Numerical PDE or Numerical Linear Algebra. Applicants from other fields with outstanding publications are also encouraged to apply. Duties include teaching and research, and candidates are expected to demonstrate excellence in both. The two posts will be tenable in January 1995 and August 1995 respectively.

Annual Salary (currently under review) and Fringe Benefits

Senior Lecturer:	HK$586,080 -787,320 by 8 increments
Lecturer:	HK$377,220 - 630,180 by 10 increments

(approx. exchange rate in June 1994: US$1=HK$7.8)
Starting salary and grade will be commensurate with qualifications and experience.

Benefits for superannuable appointment include leave with full-pay, medical and dental care, education allowances for children, housing benefit for eligible appointee with an annual salary at HK$402,480 (with appointee contributing 7.5% of salary towards such provision) and superannuation scheme (University 15%, appointee 5%). Appointment made on fixed term contract will carry equivalent benefits including a contract-end gratuity (15% of basic salary) in lieu of the superannuation scheme, where applicable. The University may also consider more flexible terms for suitable candidates subject to mutual agreement.

Application Procedure

Send full resume in duplicate, including a recent photograph, and names and addresses of 3 referees, with copies of academic credentials (in duplicate) and recent publications, to the Personnel Office, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong (Fax: (852)603 5026) before **September 20, 1994**. Please quote the reference no. and mark "Recruitment" on cover.

AMERICAN MATHEMATICAL SOCIETY

Please read the reverse side of this form to determine what membership category you are eligible for. Then fill out this application and return it as soon as possible.

. . . . . .
Family Name ***First*** ***Middle***

Place of Birth . . . . . .
City ***State*** ***Country***

Date of Birth . . . . . .
Day ***Month*** ***Year***

If formerly a member of AMS, please indicate dates . . . . . .

Check here if you are now a member of either MAA ☐ or SIAM ☐

Degrees, with institutions and dates . . . . . .

. . . . . .

. . . . . .

Present position . . . . . .

Firm or institution . . . . . .

. . . . . .
City ***State*** ***Zip/Country***

Primary Fields of Interest (choose five from the list at right)

. . . . . .

Secondary Fields of Interest (choose from the list at right)

. . . . . .

. . . . . .

Address for all mail

. . . . . .

. . . . . .

. . . . . .

Telephone number(s) . . . . . .

Electronic address . . . . . .

. . . . . .
Signature

Prepayment Methods and Mailing Addresses

All payments must be in U.S. Funds.

Send checks, money orders, UNESCO coupons to American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904

To use VISA or MasterCard, fill in information requested and mail to American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248 or call (401) 455-4000 or 1-800-321-4AMS.

For Foreign Bank Transfers: The name and address of the AMS bank is State Street Bank and Trust Company, 22 Franklin St., ABA #011000028, Account #0128-262-3, Boston, MA 02110.

VISA ☐ *MasterCard* ☐ . . . . . .
Account number ***Expiration date***

M4NO

Application for Membership 1994

(January–December)

Date . . . . . 19 . . . . . .

Fields of Interest

If you wish to be on the mailing lists to receive information about publications in fields of mathematics in which you have an interest, please consult the list of major headings below. These categories will be added to your computer record so that you will be informed of new publications or special sales in the fields you have indicated.

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

Membership Categories

Please read the following to determine what membership category you are eligible for, and then indicate below the category for which you are applying.

*For **ordinary members** whose annual professional income is below $45,000, the dues are $84; for those whose annual professional income is $45,000 or more, the dues are $112.*

*The **CMS cooperative rate** applies to ordinary members of the AMS who are also members of the Canadian Mathematical Society and reside outside of the U.S. For members whose annual professional income is $45,000 or less, the dues are $71; for those whose annual professional income is above $45,000, the dues are $95.*

*For a **joint family membership,** one member pays ordinary dues, based on his or her income; the other pays ordinary dues based on his or her income, less $20. (Only the member paying full dues will receive the* Notices *and the* Bulletin *as a privilege of membership, but both members will be accorded all other privileges of membership.)*

*Minimum dues for **contributing members** are $168.*

*For either **students** or **unemployed individuals,** dues are $28, and annual verification is required.*

*The annual dues for **reciprocity members** who reside outside the U.S. and Canada are $56. To be eligible for this classification, members must belong to one of those foreign societies with which the AMS has established a reciprocity agreement, and annual verification is required. Reciprocity members who reside in the U.S. or Canada must pay ordinary member dues ($84 or $112).*

*The annual dues for **category-S members,** those who reside in developing countries, are $16. Members can chose only one privilege journal. Please indicate your choice below.*

*Members can purchase a **multi-year membership** by prepaying their current dues rate for either two, three, four or five years. This option is not available to category-S, unemployed, or student members.*

1994 Dues Schedule (January through December)

For any category of membership where more than one dues level is given, see the above for descriptions of Members' Categories.

Ordinary member ..... ☐ $84 ☐ $112

CMS Cooperative rate ..... ☐ $71 ☐ $95

Joint family member (full rate) ..... ☐ $84 ☐ $112

Joint family member (reduced rate) ..... ☐ $64 ☐ $92

Contributing member (minimum $168) ..... ☐

Student member (please verify)[1] ..... ☐ $28

Unemployed member (please verify)[2] ..... ☐ $28

Reciprocity member (please verify)[3] ..... ☐ $56 ☐ $84 ☐ $112

Category-S member[4] ..... ☐ $16

Multi-year membership ..... $ ..... for ..... years

1 Student Verification (sign below)

I am a full-time student at .....

..... *currently working toward a degree.*

2 Unemployed Verification (sign below) *I am currently unemployed and actively seeking employment. My unemployment status is not a result of voluntary resignation or of retirement from my last position.*

3 Reciprocity Membership Verification (sign below) *I am currently a member of the society indicated on the right and am therefore eligible for reciprocity membership.*

4 ☐ send NOTICES ☐ ***send BULLETIN***

Reciprocating Societies

- ☐ Allahabad Mathematical Society
- ☐ Asociación Matemática Española
- ☐ Australian Mathematical Society
- ☐ Berliner Mathematische Gessellschaft e.V.
- ☐ Calcutta Mathematical Society
- ☐ Croatian Mathematical Society
- ☐ Dansk Matematisk Forening
- ☐ Deutsche Mathematiker-Vereinigung e.V.
- ☐ Edinburgh Mathematical Society
- ☐ Egyptian Mathematical Society
- ☐ Gesellschaft für Angewandte Mathematik und Mechanik
- ☐ Glasgow Mathematical Association
- ☐ Indian Mathematical Society
- ☐ Iranian Mathematical Society
- ☐ Irish Mathematical Society
- ☐ Íslenzka StaerðfraeðafélagiÐ
- ☐ Israel Mathematical Union
- ☐ János Bolyai Mathematical Society
- ☐ Korean Mathematical Society
- ☐ London Mathematical Society
- ☐ Malaysian Mathematical Society
- ☐ Mathematical Society of Japan
- ☐ Mathematical Society of the Philippines
- ☐ Mathematical Society of the Republic of China
- ☐ Nepal Mathematical Society
- ☐ New Zealand Mathematical Society
- ☐ Nigerian Mathematical Society
- ☐ Norsk Matematisk Forening
- ☐ Österreichische Mathematische Gesellschaft
- ☐ Polskie Towarzystwo Matematyczne
- ☐ Punjab Mathematical Society
- ☐ Ramanujan Mathematical Society
- ☐ Real Sociedad Matemática Española
- ☐ Saudi Association for Mathematical Sciences
- ☐ Sociedad Colombiana de Matemática
- ☐ Sociedad de Matemática de Chile
- ☐ Sociedad Matemática de la Republica Dominicana
- ☐ Sociedad Matemática Mexicana
- ☐ Sociedade Brasileira Matemática
- ☐ Sociedade Brasileira de Matemática Aplicada e Computacional
- ☐ Sociedade Paranaense de Matemática
- ☐ Sociedade Portuguesa de Matemática
- ☐ Societat Catalana de Matemàtiques
- ☐ Societatea Matematicienilor din Romania
- ☐ Société de Mathématiques Appliquées et Industrielles
- ☐ Société Mathématique de Belgique
- ☐ Société Mathématique de France
- ☐ Société Mathématique Suisse
- ☐ Society of Associations of Mathematicians & Computer Science of Macedonia
- ☐ Southeast Asian Mathematical Society
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