NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY

1988 Annual AMS-MAA Survey page 533

MAY/JUNE 1989, VOLUME 36, NUMBER 5

Providence, Rhode Island, USA

ISSN 0002-9920

Calendar of AMS Meetings and Conferences

This calendar lists all meetings which have been approved prior to the date this issue of *Notices* was sent to the press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have been assigned. *Programs* of the meetings will appear in the issues indicated below. *First* and *supplementary* announcements of the meetings will have appeared in earlier issues.

Abstracts of papers presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the *Notices* which contains the program of the meeting. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of organizers of special sessions.

Meetings

Meeting #		Date	Place	Abstract Deadline	Program Issue
850	*	August 7–10, 1989 (92nd Summer Meeting)	Boulder, Colorado†	Expired	July/August
851	*	October 21–22, 1989	Hoboken, New Jersey	August 16	October
852	*	October 27–28, 1989	Muncie, Indiana	August 16	October
853		November 18–19, 1989	Los Angeles, California	August 16	November
854		January 17–20, 1990 (96th Annual Meeting)	Louisville, Kentucky	October 11	December
		March 16–17, 1990	Manhattan, Kansas		
		March 23–24, 1990	Fayetteville, Arkansas		
		April 21–22, 1990	University Park, Pennsylvania		
		August 8-11, 1990 (93rd Summer Meeting)	Columbus, Ohio		
		November 2–3, 1990	Denton, Texas		
		January 16–19, 1991 (97th Annual Meeting)	San Francisco, California		
		August 8-11, 1991 (94th Summer Meeting)	Orono, Maine		
		January 8-11, 1992 (98th Annual Meeting)	Baltimore, Maryland		
		June 29-July 1, 1992 (Joint Meeting with the London Mathematical Society)	Cambridge, England		
		January 13-16, 1993 (99th Annual Meeting)	San Antonio, Texas		
		January 5-8, 1994 (100th Annual Meeting)	Cincinnati, Ohio		

* Please refer to page 585 for listing of special sessions.
† Preregistration/Housing deadline is June 1

Conferences

June 3–August 5, 1989: Joint Summer Research Conferences in the Mathematical Sciences, Humboldt State University, Arcata, California

July 10–30, 1989: AMS Summer Research Institute on Several Complex Variables and Complex Geometry, University of California, Santa Cruz, California

August 6–7, 1989: AMS Short Course on Cryptology and Computational Number Theory, Boulder, Colorado

August 7, 1989: AMS-SIAM-SMB Symposium on Some Mathematical Questions in Biology, Sex Allocations and Sex Change: Experiments and Models, University of Toronto.

Deadlines

	July/August Issue	September Issue	October Issue	November Issue
Classified Ads*	June 12, 1989	July 31, 1989	Aug 28, 1989	Oct 3, 1989
News Items	June 12, 1989	Aug 3, 1989	Aug 29, 1989	Oct 5, 1989
Meeting Announcements**	June 5, 1989	July 27, 1989	Aug 22, 1989	Sept 26, 1989

* 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

533 The 1988 Annual AMS-MAA Survey (*Second Report*)

This report includes an update on the number of and the employment status of the 1987-1988 new doctorates, as well as information drawn from the surveys on Faculty Mobility and Enrollments and Departmental Size.

540 Setting Scientific Priorities *NSF Advisory Committee Examines the Issues*

Allyn Jackson reports on the recent meeting of the NSF Advisory Committee for the mathematical sciences. The Committee debated the tough question of setting priorities in research funding.

542 Is There a Role for Mathematicians in Math Education?

This article by Herb Clemens, based on a colloquium talk given by the author at the University of Utah, addresses the question of establishing a political base for mathematics education in the U.S.

FEATURE COLUMNS

545 Computers and Mathematics *Jon Barwise*

This month's column features Alex Feldman's article on "functional" programming languages, Rod Smart's description of the computational environment at the University of Wisconsin's mathematics department, John F. Sallee's review of **True BASIC**, Walter D. Neumann's review of **UBASIC**, and David Hartz' review of two Macintosh programs, **DEGraph** and **Phase Portraits**.

562 Inside the AMS

This month's column includes reports from the AMS Secretary, Robert M. Fossum, and Treasurer, Franklin P. Peterson, as well as a look at the Committee on Academic Freedom, Tenure and Employment Security by its chairman Barbara Osofsky.

566 Washington Outlook *Kenneth M. Hoffman*

Hans J. Oser examines the competition for the federal government's 1990 R & D budget and the effects this will have on support for science research and education.

DEPARTMENTS

531 Letters to the Editor

568 News and Announcements

579 Funding Information for the Mathematical Sciences

581 Meetings and Conferences of the AMS (Listing)

591 1989 AMS Elections (Nominations by Petition)

593 Mathematical Sciences Meetings and Conferences

604 New AMS Publications

614 AMS Reports and Communications
Recent Appointments, 614
Reports of Past Meetings, 614

616 Miscellaneous
Personal Items, 616
Deaths, 616

617 Visiting Mathematicians

620 Backlog of Mathematics Research Journals

623 New Members of the AMS

639 Classified Advertising

653 Forms

NOTICES
OF THE
AMERICAN MATHEMATICAL SOCIETY

SUBSCRIPTION INFORMATION
Subscription prices for Volume 36 (1989) are $108 list; $86 institutional member; $65 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—$10; to India—$20; expedited delivery to destinations in North America—$15; elsewhere—$38. Subscriptions and orders for AMS publications should be addressed to the American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-9930. All orders must be prepaid.

ADVERTISING
Notices publishes situations wanted and classified advertising, and display advertising for publishers and academic or scientific organizations.

The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability. ♾ Most of this publication was typeset using $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX, the American Mathematical Society's TEX macro system.

[*Notices of the American Mathematical Society* is published ten times a year (January, February, March, April, May/June, July/August, September, October, November, December) by the American Mathematical Society at 201 Charles Street, Providence, RI 02904. Second class postage paid at Providence, RI and additional mailing offices. POSTMASTER: Send address change notices to *Notices of the American Mathematical Society*, Membership and Sales Department, American Mathematical Society, P. O. Box 6248, Providence, RI 02940.] Publication here of the Society's street address, and the other information in brackets above, is a technical requirement of the U. S. Postal Service. All correspondence should be mailed to the Post Office Box, NOT the street address.

The Year of National Dialogue in Mathematics Education

Issues surrounding mathematics education and the talent flow into science, engineering, and mathematics are central topics of discussion in several groups within the mathematics community. This is the beginning of what is hoped to be an intense dialogue involving the entire community. To this end, the Mathematical Sciences Education Board has designated 1990 as "The Year of National Dialogue for Mathematics Education." A national dialogue means that there will be efforts by many groups to organize discussions of reports, activities and issues as they concern mathematics education. What is the role of the Society in this dialogue and, more generally, in addressing issues of mathematics education?

The Society has been asked by other professional mathematical organizations to provide descriptions of AMS programs related to mathematics education and of its future plans in this area. And, very directly, the Society has been challenged to provide *active* leadership on certain issues of mathematics education.

New things are happening at the Society relative to mathematics education. The Society has been represented at workshops and at public discussions concerning mathematics education. It has endorsed and supported in various ways actions of organizations within the Conference Board of Mathematical Sciences. The AMS co-sponsors UME TRENDS, which provides news and reports on undergraduate mathematics education. *Notices* brings important news items about mathematics education to the membership, as well as feature articles that address concerns of mathematics education. For example, this issue of *Notices* contains a thought-provoking article by Herb Clemens on the role of mathematicians in education reform. There is a new Society committee to liaison with other organizations in addressing the education issues before the community and to provide a focus for activities such as the Society's participation in the International Science and Engineering Fair and the "High School Lecture Series." The *most* direct challenge to the Society, however, may be in providing leadership on issues of graduate education.

Many of the issues before the Society in graduate education can be collectively addressed as "standards." These "standards" may be position papers addressing such matters as the maximum enrollment in a mathematics class or the number of course credit hours for designation as a full-time graduate student. Or these "standards" may be much broader and address curriculum standards or even accreditation of undergraduate/graduate programs.

These are important issues for the mathematics community. The Society will be developing plans and activities addressing mathematics education and meeting the challenge for leadership. The Year of National Dialogue will provide a unique opportunity for our community to bring these and other topics under wide discussion.

William H. Jaco
Executive Director

Letters to the Editor

Mathematizing the Notion of Similarity

In his discussion with Professor Gian-Carlo Rota (see *Notices* page 141 February 1989), Professor Ulam raised the question of mathematizing the notion of similarity ("as") or identity in context. Quine discussed this problem in his essay *Natural Kinds* (Ontological relativity and Other Essays, Columbia University Press, 1969, p. 125) where he writes:

"The brute irrationality of our sense of similarity, its irrelevance to anything in logic and mathematics, offers little reason to expect that this sense is somehow in tune with the world–a world which, unlike language, we never made."

Whereupon follow numerous pages of inquiry into the nature of "induction by similarity" and "measures of similarity."

More recently various attempts have been made to formalize the concept of "association" which is basic to our sense of similarity (See for instance: J. R. Anderson and G. H. Bowers, Human Associative Memory, V. H. Winston and Sons, 1973 or D. J. Willshaw, O. P. Buneman and H. C. Longuet-Higgins, Non-holographic Associative Memory, Nature 222, 1969). In particular my paper *Holographic or Fourier Logic*, (Pattern Recognition, 7, 1975) formalized some tentative notions of naming objects by similarity (association) in which an object is defined (recognized by holographic operations) by revealing its similarity to any parts it shares with other known objects in a given context.

As stated in a footnote in my paper, the notion of similarity has been much delved into by writers such as Virginia Woolf (the "*this is like this is like this* ...," in her words). I would also call attention to Susan Langer's extraordinary insights into the structure of mind (Mind: An Essay on Human Feeling, Johns Hopkins Press, 1980). It is perhaps in these areas (art, psychology, language development and disintegration or aphasia) in which brains do not operate as pure "thinking machines" (in Ulam's terms) that deeper insights into the concept of similarity might be gained.

Miriam Lipschutz-Yevick
Retired Associate Professor
of Mathematics
Rutgers University
(Received February 13, 1989)

Policy on Letters to the Editor

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

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

The committee reserves the right to edit letters.

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

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

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

Head, Office of Governmental and Public Affairs

(Open Position)

The Joint Policy Board for Mathematics (JPBM), representing the American Mathematical Society, Mathematical Association of America, and the Society for Industrial and Applied Mathematics, seeks candidates for the post of Head of the Office of Governmental and Public Affairs (OGPA).

OGPA was created in 1985 as the action arm of the three mathematical societies in Washington. Under the leadership of Professor Kenneth M. Hoffman, OGPA has been involved in a number of activities supporting the mathematical sciences such as the implementation of the David report, the establishment of MSEB, and the promotion of the public image of mathematics through the media including the development of Mathematics Awareness Week.

Specific goals for the activites of OGPA include

1. Maintaining interaction with all branches of government, including granting agencies, on matters of importance to the mathematical community.

2. Increasing the participation of mathematicians in Washington activities and also keeping the community informed of the developments on the Washington scene.

3. Promoting the national dialog on mathematics education and research.

The terms of appointment are flexible. We envisage either a full-time or a part-time position beginning as soon as possible after 1 January 1990. We expect that the initial appointment will be for at least two years with possible renewal. Salary will be commensurate with background and experience.

Applications or nominations should be sent to

Dean Hugo Rossi
Chairman of the Search Committee for OGPA
College of Science
University of Utah
Salt Lake City, Utah 84112

Names of suitable references should be provided. The selection process will begin 1 August 1989.

The JPBM organizations are affirmative action - equal opportunity employers.

For further information contact one of the following

I. E. Block, Managing Director, SIAM
W. H. Jaco, Executive Director, AMS
A. B. Willcox, Executive Director, MAA

1988 ANNUAL AMS-MAA SURVEY

(Second Report)

Vital Statistics in the Mathematical Sciences:
Distribution of Undergraduate Enrollments, Faculty Characteristics,
Update on New Doctorates, Fall 1988

Edward A. Connors

HIGHLIGHTS

1. *The final (spring) count of new doctorates in the mathematical sciences records 372 U.S. citizens among the 828 recipients of doctorates granted by U.S. institutions from July 1, 1987 through June 30, 1988. Thus the sum total of U.S. citizens receiving doctorates in the last two years is less than a single year total in the mid-1970's.*
2. *Respondents from Groups B, M and III (see box on this page for descriptions of the groupings used in this Survey) report that approximately 1-3/4% of their fall 1987 full-time faculty retired permanently or died by fall 1988. The comparable number for Groups I, II and III combined is slightly more than 1-1/2%.*
3. *Group I respondents (33 of 39 departments) report that 64% of the fall 1987 undergraduate enrollments are distributed as follows: 9% in remedial mathematics (arithmetic, high school algebra, and geometry); 17% in traditional pre-calculus; 38% in first-year calculus.*
4. *Women comprise 47% of the U.S. citizen graduate students in Group IV (statistics, biostatistics and biometrics). However, U.S. citizens comprise only 49% of all the graduate students in Group IV.*
5. *Women comprise 47% of the junior/senior mathematics majors in Group B in fall 1987, and 44% of those in Group M. In Groups I, II and III combined, women comprise 40% of the junior/senior mathematics majors.*

A first report of the 1988 Survey appeared in the November 1988 *Notices*, pages 1301-1332. It included a report on the 1987-1988 new doctorates, starting salaries, faculty salaries, and a list of the names and thesis titles of the 1987-1988 doctorates. A supplementary list of 1987-1988 doctorates appeared in the April 1989 *Notices*.

The 1988 Annual AMS-MAA Survey represents the thirty-second in an annual series begun in 1957 by the Society. The 1988 Survey was under the direction of the AMS-MAA Committee on Employment and Educational Policy (CEEP), whose members were: Morton Brown, Stefan A. Burr, Edward A. Connors (chair), Philip C. Curtis, Jr., David J. Lutzer, Donald C. Rung and James J. Tattersall. The questionnaires were devised by CEEP's Data Subcommittee whose members were: Edward A. Connors (chair), Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Charlotte Lin, Don O. Loftsgaarden, David J. Lutzer, James W. Maxwell (ex officio), Donald E. McClure, and Donald C. Rung. Comments or suggestions regarding this Survey may be directed to the subcommittee.

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 which report a doctoral program.

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

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

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

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

[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 *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 April 1988 *Notices*, pages 532-533.

I. INTRODUCTION

We report on several items of general and specific interest to the mathematical community, based on our analysis of the data compiled in the 1988 Annual AMS-MAA Survey. We begin with an update on the size and employment status of the 1987–1988 class of new doctorates, and then we direct our attention to the information provided by the departmental responses to the surveys on Faculty Mobility and Enrollments and Departmental Size.

In contrast to prior years' reports, we chose not to extrapolate from the raw data. Thus, for example, we do not provide estimates of various faculty populations or course enrollments, as was done in past survey reports. Instead, we focus on faculty retirement and death rates (Table 3A), enrollment distribution patterns (Table 4), faculty composition by sex (Tables 3B and 3C), and percentages of women among our junior/senior level mathematics majors and graduate students (Tables 5 and 7). Some of the data on the male/female distribution among mathematics faculty and students appear in this Survey for the first time. We leave it to the 1990 Conference Board on Mathematical Sciences (CBMS) Survey to provide the next best estimates on various faculty populations and student enrollments.

Table 0: Useable Responses (Percentage of Surveyed Departments)

	Groups							
	I	II	III	IV	V	VI	M	B
Enrollments and Departmental Size*	79	84	73	68	35	68	44	38
Faculty Mobility	69	65	70	59	35	64	43	35

*There are 4 parts to the Enrollments and Departmental Size form (Enrollments, Majors, Departmental Size, and Graduate Students). The number given is the number of returns with a useable response on the departmental size.

II. UPDATE ON THE 1987–1988 NEW DOCTORATES

In the First Report of this Survey (November 1988 issue of *Notices*, pages 1301–1332) we reported 804 new doctorates in the mathematical sciences granted by U.S. universities—this is the fall count. There were an additional 24 new doctorates from U.S. universities with a Group I, II, III, IV or Va classification. We now update tables from the First Report (New Doctorates, Fall and Spring Counts, and New Doctorates awarded by Groups I–Va, VI, see November 1988 *Notices*, page 1302) with this new information to produce the 1987–1988 spring counts: 828 new doctorates awarded by U.S. universities, 55 by Canadian universities, for a total of 883 (U.S. and Canada). Of the 828 new doctorates awarded by U.S. universities, 372 went to U.S. citizens (citizenship is known for 816 of the 828 new doctorates). Of the 372 U.S. citizen new doctorates, 294 were men, 78 women. The spring count for Canadian institutions is: 55 new doctorates–45 men, 10 women. Tables 1A, 1B and 1C give spring counts of new doctorates.

Table 1A: New Doctorates U.S. and Canadian Institutions, Fall and Spring Counts

	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988
Fall	792	789	769	801	845	856
Spring	840	827	807	827	874	883

Table 1B: New Doctorates U.S. Institutions, Spring Count

1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988
796	775	765	782	808	828

Table 1C: New Doctorates Awarded by Groups I-Va, VI, Spring Count

1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988
767	735	755	743	809	815

Employment data for new doctorates are updated in Tables 2A, 2B and 2C. We do not, however, include the additional new doctorates in our updated employment matrices.

For the fourth consecutive year approximately 20% of the new doctorates reported taking foreign academic or nonacademic employment (Table 2A).

Women comprise 18% of the new doctorates. 23% of the 153 new women doctorates found employment in the doctorate-granting institutions, Groups I–V. Although only 15.5% of the new doctorates hired by the doctorate-granting institutions I–V were women, this is 3 percentage points better than last year. Women accounted for 18% of the new doctorates hired by Group M, and 20% of the new doctorates hired by Group B.

Table 2A: Employment Status of 1987–1988 New Doctorates in the Mathematical Sciences

Type of Employer	PURE MATHEMATICS											
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Discrete Mathematics	Other	Total
Group I	15	18	25	3	3	3		2	11	1	6	87
Group II	10	10	8	1	3	2	1	1	5		1	42
Group III	11	6	3	1		8			21	2	1	53
Group IV		1			3	28	1				1	34
Group V								5	5		1	11
Masters	13	9	11	1	2	14	2	3	14	2	6	77
Bachelors	17	17	7	4	1	4			15	1	5	71
Two-year College or High School	1	2				1			1	1	1	7
Other Academic Departments	6	6	1	2	2	21	2	7	15		16	78
Research Institutes	3	2	1			5		1	3		3	18
Government		1				8		3	1		2	15
Business and Industry	3	5	4		2	32	3	14	21	1	10	95
Canada, Academic	6	14	4	2	2	6	1	1	4	1	3	44
Canada, Nonacademic			1			1						2
Foreign, Academic	25	24	15	8	3	34	4	16	17	1	10	157
Foreign, Nonacademic	2	2	3			2	1	4	3		3	20
Not seeking employment		3		1		1	1					6
Not yet employed	2		2	1		1			3	1	1	11
Unknown	5	8	3		1	2		2	6		1	28
Total	119	128	88	24	22	173	16	59	145	11	71	856

Table 2B: Employment Status of 1987-1988 New Doctorates in the Mathematical Sciences Females Only

Type of Employer	PURE MATHEMATICS											
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Discrete Mathematics	Other	Total
Group I	5		2					1	2		1	11
Group II	2	1	2	1	1		1	1	2			11
Group III	2	1		1								4
Group IV					1	7					1	9
Group V												
Masters	2		1		1	1	1		3	2	3	14
Bachelors	5	5				1			2	1		14
Two-year College or High School	1	1				1			1	1		5
Other Academic Departments	1			1		4		2			5	13
Research Institutes						2			1			3
Government		1				1		1				3
Business and Industry	2	1	1			9	1		4		3	21
Canada, Academic	1	3		1		1			1			7
Canada, Nonacademic						1						1
Foreign, Academic	4	4		1	1	10		1	1		2	24
Foreign, Nonacademic	1	1				1			1		1	5
Not seeking employment		1				1						2
Not yet employed									1			1
Unknown	1	2	1			1						5
Total	27	21	7	5	4	41	3	6	19	4	16	153

Table 2C: Fields of New Doctorates

	Year Surveyed					
	1982–1983	1983–1984	1984–1985	1985–1986	1986–1987	1987–1988
Number (Fall Count)	792	789	769	801	845	856
Specialty:						
Applied Math	103 (13%)	110 (14%)	115 (15%)	149 (19%)	142 (17%)	142 (17%)
Statistics	188 (24%)	173 (22%)	189 (25%)	171 (21%)	182 (22%)	173 (20%)
Operations Research	63 (8%)	66 (8%)	41 (5%)	62 (8%)	51 (6%)	59 (7%)
Computer Science	18 (2%)	20 (3%)	15 (2%)	16 (2%)	18 (2%)	16 (2%)
Total	372 (47%)	369 (47%)	360 (47%)	398 (50%)	393 (47%)	393 (46%)

The research fields of the new doctorates continue to have an applied flavor (see Table 2C). For the last five years half, or nearly half, of the new doctorates specialized in statistics, applied mathematics, operations research, or computer science. In fact, in each of the years in question between one-fifth and one-fourth of the degrees were in statistics.

Groups I–IV hired 214 new doctorates (23 more than last year) and Group M hired 77 (8 more than last year). The totals of new doctorates hired by business, industry or government, or appointed by research institutes, were down considerably.

Finally, we note that the names of the 1987–1988 new doctorates and their thesis titles were published in the *Notices* (November 1988 issue and a supplemental list in the April 1989 issue).

III. FACULTY CHARACTERISTICS

In Table 3A we provide the attrition rates of full-time faculty and full-time doctoral faculty by groups. The numbers we report are obtained from the departmental response to our request for the numbers of full-time faculty (doctorate and non-doctorate) in fall 1987 who had permanently retired or died by fall 1988. The 1989 AMS-MAA Survey will attempt to ascertain more information on age distribution of full-time faculty and thus better analyze the greying of the contemporary mathematical sciences faculty.

Table 3A: Faculty Attrition*

Group	Full-time Faculty	Full-time Doctoral Faculty
	%	%
I	1.26	1.27
II	1.65	1.69
III	1.76	1.62
I+II+III	1.57	1.52
IV	.99	1.03
V	.88	.9
B	1.72	1.52
M	1.73	1.19
B + M	1.72	1.34

*Percentage of full-time faculty who were in the department in fall 1987 but were reported to have retired (and not seeking employment) or died by fall 1988.

In Table 3B we provide percentages of women among the full-time doctoral faculty in Groups I–V, M and B and in Table 3C we give the percentages of women among full-time faculty in Groups M and B.

Table 3B: Percentage of Women among Doctoral Full-time Faculty

Groups							
I	II	III	I+II+III	IV	V	B	M
4.4%	6.5%	7.7%	6.2%	10.8%	3.4%	16.3%	12.7%

Table 3C: Percentage of Women among Full-time Faculty, Groups B and M

Group B	Group M
24%	20%

IV. UNDERGRADUATE ENROLLMENT PROFILE AND MAJORS

In Table 4A we give the percentage change from fall 1987 to fall 1988 in undergraduate enrollment in mathematical sciences.

In Table 4B we provide the undergraduate enrollment distributions in remedial mathematics (defined on our survey forms as arithmetic, high school algebra or geometry), traditional pre-calculus, and first-year calculus. We do not distinguish between hard core and soft core first-year calculus. It is somewhat startling, but by no means novel, that approximately 65% of the undergraduate enrollments in Groups I and II are in these three course groupings and, indeed, that 10% or nearly 10% is in remedial mathematics courses. Yet the 10% rate is only slightly more than half the comparable rate for the Group B respondents. As we wrote in last year's report, "remedial mathematics and 'pre-calculus' continue to consume a considerable chunk of collegiate mathematics education." Given the current state of K–12 mathematics, what will be the size of the chunk when this year's kindergarteners enter college at the dawn of the 21st century?

Table 4A: Percentage Change from fall 1987 to fall 1988 in Undergraduate Enrollments

Groups				
I	II	III	B	M
-3%	0%	+2%	+3%	+3%

Table 4B: Undergraduate Enrollments Distribution

Group	Remedial Math. (arith., h.s. alg., geometry) %	Remedial Math. + pre-calculus %	Remedial Math. +pre-calculus +1st-yr. calculus %
I	9	26	64
II	10	36	65
III	16	39	62
I+II+III	12	35	64
B	19	36	51
M	17	34	50
M+B	18	35	50

It is often thought, and sometimes expressed, that one of the reasons for the sizes of the cohort of women among the new doctorates in the mathematical sciences (roughly 20% among U.S. citizens for the past six years) is a correspondingly low rate among undergraduate mathematics majors. This misconception persists perhaps because the data are not so widely publicized as the doctoral data. In Table 5 we provide the percentages of women among junior/senior mathematics majors. Note that these percentages are 47% and 44% in Groups B and M respectively.

Table 5: Percentage of Women among Junior/Senior Majors (including double majors)

Groups							
I	II	III	I+II+III	IV	V	B	M
36%	39%	42%	40%	43%	34%	47%	44%

V. GRADUATE ENROLLMENTS IN THE MATHEMATICAL SCIENCES, SEX AND CITIZENSHIP

Table 6 provides the percentage change in enrollments in graduate courses in the mathematical sciences, from fall 1987 to fall 1988. In Table 7 we provide the percentage of women among the U.S. citizens in the graduate populations. Table 8 gives fall 1988 data on U.S. citizens in the graduate cohort.

Table 6: Graduate Enrollments
Percentage change fall 1987 to fall 1988

	Groups				
	I	II	III	I+II+III	IV
	%	%	%	%	%
First year, full-time	-8	-6	-1.2	-6	+2
All years, full-time	+5	-1	+4	+3	+6

Table 7: Percentage of U.S. citizen women among U.S. citizen graduate students

	Groups						
	I	II	III	I+II+III	IV	V	M
	%	%	%	%	%	%	%
First year, full time	27	30	42	33	48	40	40
All years, full-time	24	29	38	29	47	20	40

Table 8: Citizenship of Graduate Students (Percentage of U.S. Citizens among Graduate Students whose citizenship is reported as known) Fall 1988

	Groups				
	I	II	III	IV	M
	%	%	%	%	%
First year, full time	59	60	63	53	81
All years, full-time	54	53	61	49	74

Data drawn from the 1988 Survey on Faculty Salaries, Tenure and Women, show the following picture of the composition of doctoral faculty in the mathematical sciences. These data are based on responses slightly different from those responses providing the data presented in Tables 3B and 3C.

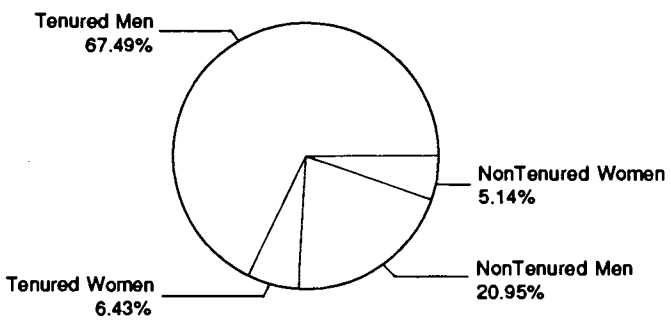


Fig. 1: Composition of Professorial Ranks with Ph.D., 1988-1989 (All Groups)

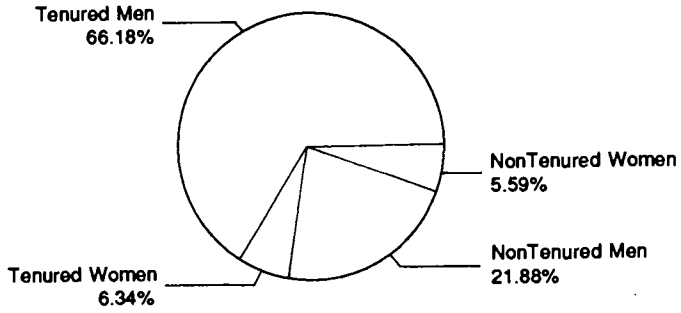


Fig. 2: Composition of faculty with Ph.D., 1988-1989 (All Ranks, All Groups)

ACKNOWLEDGEMENT

The Annual AMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical scene vital to the entire mathematical community. Yearly, collegiate departments in the United States, and the doctorate-granting departments in Canada, are provided the opportunity to respond. The quantity and quality of the responses directly determine the quality of the information in these reports. Without the dedicated cooperation of the secretarial and administrative support staff in the mathematical science departments we would not be able to conduct a survey, nor be confident in our analysis of its results. We are, unfortunately, unable to thank personally all the departmental assistants for their cooperation, but it is nonetheless appreciated. However, we are able to thank the administrative support staff of the AMS, especially Marcia Almeida, Monica Foulkes, and James W. Maxwell, whose efforts are acknowledged and appreciated.

BIBLIOGRAPHY

[1] *Nurturing Science and Engineering Talent: A Discussion Paper*, July 1987. The Government-University-Industry Research Roundtable, NAS, Washington, DC.

[2] *Undergraduate Science, Mathematics and Engineering Education*, NSB 86-100, March 1986. NSB Task Committee on Undergraduate Science and Engineering Education.

[3] *The Future Workforce Conference Proceedings*, September 10-11, 1986, Goddard Space Flight Center, Greenbelt, Maryland, NASA Office of Educational Affairs and NASA Office of Productivity Programs.

[4] National Science Foundation. *Science and Technology Data Book*, (NSF 88-332). National Science Foundation, Washington, DC, 1989.

[5] *Scientific Manpower–1987 and Beyond. Today's Budgets–Tomorrow's Workforce.* Proceedings of a Symposium, October 15, 1986, Washington, DC, sponsored by the Commission on Professionals in Science and Technology.

[6] *Foreign Citizens in U.S. Science and Engineering: History, Status and Outlook,* NSF 86-305 Revised, (Washington, DC, 1987).

[7] Rand Publication Series. Reports on teaching and education: *Beyond the Commission Reports: The Coming Crisis in Teaching.* R-3177-RC, July 1984. *Steady Work: Policy, practice and the reform of American education.* R-3574-NIE/RC, February 1988. *The Evolution of Teacher Policy.* JRE-01, March 1988. *Assessing Teacher Sypply and Demand.* R-3633-ED/CSTP, May 1988.

[8] *Teaching Assistants and Part-time Instructors: A Challenge,* MAA Notes, 1987.

[9] *Scientific and Technical Personnel in the 1990's: An Examination of Issues and Information Needs.* Proceedings of the May 9-10, 1985 Conference, Washington, DC (Prepared for the Scientific and Technical Personnel Studies Section, Division of Science Resources Studies, NSF, by the Council of Professional Associations on Federal Statistics, Katherine K. Wallmann, Executive Director).

[10] D. J. Albers, R. D. Anderson, and D. O. Loftsgaarden, *Undergraduate Programs in the Mathematical and Computer Sciences. The 1985-1986 Survey,* MAA Notes, 7.

[11] *The Science and Engineering Pipeline,* Policy Research Analysis Report NSF PRA 87-2, April 1987.

[12] *The Underachieving Curriculum: Assessing U.S. School Mathematics from an International Perspective,* Stipes Publishing Co., Champaign, Illinois, January 1987.

[13] *Competition for Human Resources in the 1990s,* Proceedings of a Symposium, Commission on Professionals in Science and Technology, May 1988.

[14] *Science and Engineering Doctorates: 1960-86,* NSF 88-309, Washington, DC 1988.

[15] *Educating Scientists and Engineers: Grade School to Grad School,* U.S. Congress, Office of Technology Assessment, OTA-SET-377, Washington, DC, June 1988.

[16] *Boon or Bane - Foreign Graduate Students in U.S. Engineering Programs,* Institute of International Education Research Report Series, Number 15, 1988.

[17] National Research Council. *Summary Report 1986, Doctorate Recipients from United States Universities,* National Academy Press, Washington, DC, 1987.

[18] Edward A. Connors, *A Decline in Mathematics Threatens Science–and the U.S.,* The Scientist, November 28, 1988.

[19] Edward A. Connors, *America's Scientific Future is Threatened by the Decline in Mathematical Education,* The Chronicle of Higher Education, January 11, 1989.

[20] National Research Council. *Everybody Counts: A Report to the Nation on the Future of Mathematics Education.* National Academy Press, Washington, D.C., 1989.

[21] *Elementary and Secondary Education for Science and Engineering.* U.S. Congress, Office of Technology Assessment, OTA-TM-SET-41. Washington, D.C., December 1988.

[22] *Higher Education for Science and Engineering: a background paper.* U.S. Congress, Office of Technology Assessment, OTA-BP-SET-52. Washington, D.C., March 1989.

[23] *Changing America: The New Face of Science and Engineering.* Interim Report, Task Force on Women, Minorities, and the Handicapped in Science. September 1988.

[24] Commission on Professionals in Science and Technology. Occasional Papers, prepared by Betty M. Vetter. *Look Who's Coming to School* (89-0), December 1988. *Women in Science. Progress and Problems* (89-1), February 1989. *Recruiting Doctoral Scientists and Engineers* (89-2), February 1989. CPST, Washington, D.C.

SETTING SCIENTIFIC PRIORITIES

NSF Advisory Committee Examines the Issues

The Advisory Committee for the Mathematical Sciences is one of the many panels providing the National Science Foundation (NSF) with advice on the Foundation's policies and strategies. The Committee meets twice a year at NSF headquarters in Washington, DC. The meetings are open to the public. This article reports on the discussion of the Committee's meeting on April 6-7, 1989. The next meeting will be held November 6-7, 1989.

Committee members

David Blackwell, University of California at Berkeley
James Cannon, Brigham Young University
Jerome Goldstein, Tulane University
Julia Knight, University of Notre Dame
Thomas Kurtz (Chairman), University of Wisconsin, Madison
M. Susan Montgomery, University of Southern California
Frank Morgan, Williams College
Alan C. Newell, University of Arizona
Andrew M. Odlyzko, AT&T Bell Laboratories
Michael C. Reed, Duke University
David Sanchez, Lehigh University
Lynn Arthur Steen, St. Olaf College
Stephen M. Stigler, University of Chicago
Chuu-Liang Terng, Northeastern University
Mary Wheeler, Univeristy of Houston
Floyd L. Williams, University of Massachusetts at Amherst

"Setting scientific priorities" may be rivaling "economic competitiveness" as the most popular science policy buzzword. Various policymakers and high-level committees have recently expounded on the importance of having the scientific community set priorities in science, before Congress does it for them. (See, for example, in *Notices*, "The Dilemma of the Golden Age," by Frank Press, July/August 1988, page 822; and "Report from NAS on Setting Priorities in Science," February 1988, page 152).

Setting priorities was the centerpiece of the April meeting of the Advisory Committee for the Division of Mathematical Sciences (DMS) at the NSF. The more visible debates over scientific priorities have centered on big-ticket items such as the space station or mapping the human genome. Of course, the $900 million to be spent this year on the space station dwarfs the DMS budget of about $66 million. Still, the larger issue of priorities is likely to affect the mathematical sciences community, and not just the fortunate few who hold NSF grants. Indeed, one of the Committee's principal concerns was the need to spread NSF support over a broader segment of the community.

The discussion boiled down to basically one question: to what extent should the DMS support activities outside the traditional, individual investigator mode? In the past year or so, since Judith S. Sunley was appointed Division Director, the Committee has made more substantive contributions to planning issues than in the past and has consistently supported the idea that the NSF research divisions should be involved in educational activities; indeed, the Committee recommended continued and expanded interactions with the NSF education directorate. But it seems that the meager 3% increase in this year's DMS budget brought home the hard choices that have to be made among meritorious suggestions.

Geometry Initiative

A case in point is the new geometry initiative (see the Funding Information section in this issue of *Notices*). One component of the initiative involves regional institutes integrating research, education at the university, college, and precollege levels, and retraining and scientific stimulus for mid-career mathematicians and high school teachers. Frank Morgan said the subcommittee working on the idea felt that while it deserved support, it should not divert funds from individual investigators. Yet over the past year, the Committee enthusiastically embraced the idea of the geometry initiative as a top priority. "If it's high priority, and it involves vertical integration [of research and education], why can't you divert the money?" asked Lynn Arthur Steen. "What you mean is that it's not really the top priority." The Committee did, however, recommend that the institutes be funded at least as a pilot program regardless of the size of the increase the DMS receives for 1990.

In discussing the involvement of research mathematicians in education, Michael C. Reed pointed to the "spectacular success" of the American mathematical research community, noting that compelling reasons are needed to justify DMS support of non-research activities. "The 1500 researchers supported by the DMS is a small population already," he said, "so when you speak of involving them in activities for high school students, you have to remember that these people are already overworked." Steen questioned the success of the current system, which he says "produces papers but not people." Bolstering his point, Sunley noted that the individual investigator system developed in the 1950s, when the size of the community was half what it is now and research dollars went farther. With the fierce competition for research grants lowering the morale of the community, "is this the only mode of funding we should be considering, given the changed circumstances of people and dollars?" she asked.

Small Travel Grants

The subject of small travel grants also fueled the debate on priorities. Andrew Odlyzko chaired a subcommittee that recommended the DMS form a program to award 200 small travel grants of about $2000 apiece to broaden the pool of researchers funded by the NSF. At least initially, the program would be restricted to those between 5 and 15 years from the Ph.D. The subcommittee also recommended that the program go forward even if no new funds are appropriated for it. Though strongly supported by the Committee, the proposal raised questions about how the program would be administered and whether or not the awards would be perceived as "second-class" NSF grants. Much of the mathematical community would support this idea, but it may be difficult to implement at the NSF, especially if it is perceived as simply "spreading the wealth," as opposed to pinpointing the most crucial scientific directions the nation's tax dollars should support. Still, the Committee felt the idea should be pursued and decided to discuss particulars of the program with the DMS staff at the next Committee meeting.

Setting Priorities Within the Field

Perhaps the most uncomfortable topic was the question of setting priorities among areas of mathematics. The general consensus seemed to be that no one has a sufficiently broad understanding of all fields of mathematics to set funding priorities among different areas of research. At present, the way research funds are allocated to the various DMS programs (such as Algebra and Number Theory, Geometrical Analysis, and so on) is based mostly on tradition, though other considerations can come into play. For example, the Computational Mathematics program was established in 1986 and has received large increases in the past few years to bring it up to a steady-state funding level in balance with the rest of the DMS programs.

Alan C. Newell suggested that members of the Advisory Committee could provide written reports on the most exciting developments in their areas of mathematics, to guide the DMS in choosing areas to emphasize. Julia Knight objected to this idea, saying that the areas emphasized would be those that happen to have a persuasive spokesman on the Committee. The obvious barometer of proposal pressure is not a reliable indicator of scientific activity in a given area, Sunley pointed out. For example, a decision in another agency to stop supporting, say, control theory, may produce an increase in the number of control theory proposals the NSF receives, so that the increase is unrelated to a scientific development. The Committee could reach no consensus on this matter, but did agree that the DMS should be open to suggestions from the mathematical community about various areas that could be emphasized.

NSF Director Erich Bloch told the Committee he was impressed with their work. "I'm glad you're taking the question of priorities seriously. I give you high marks for that," he said, adding, with his usual sense of humor, "But that doesn't get you any money!" Kidding aside, Bloch recognized the difficulty of setting priorities and appreciated the Committee's attempts to grapple with this issue.

For several members, this was the last meeting in a three-year term: Julia Knight, Alan Newell, Lynn Steen, Susan Montgomery, Chuu-Liang Terng, and Floyd Williams. Their contributions to the Committee were useful and important to the DMS and the mathematical sciences community as a whole. Thomas Kurtz will be stepping down as chair of the Committee, after contributing a tremendous amount of effort to the Committee's activities over the past year. Michael Reed was elected as next year's chair.

Allyn Jackson
Staff Writer

Is There A Role For Mathematicians In Math Education?

Herbert Clemens, University of Utah

This article is based on a colloquium talk presented by the author in the Department of Mathematics at the University of Utah in February 1988.

Is primary and secondary mathematics education in trouble in the U.S. today? We mathematicians might differ somewhat in our responses, but I don't think the following quote from a foreign mathematician who emigrated to the U.S. some years ago goes too far beyond what some of the rest of us might say:

> "In Russia, my colleagues and I liked to complain about a deteriorating level of mathematical preparedness of high school graduates, but I had to come to this country to see what I could not imagine in my wildest dreams. ... When I talk before conventions of high school principals and show them standard math textbooks used all over the USSR ... they are angry with me. They tell me that it is a scientifically established fact that not more than [the] 5% of 'mathematically gifted' kids can study such stuff. Well, everybody in Russia who is not medically certified [learning disabled] masters these texts."

So maybe there's a problem. The issue I would like to address is whether we mathematicians should attend to the problem and try to become a part of the solution? I want to put before you the case against, and the case for, our participation.

First the case against. Why don't mathematicians from universities and industry belong in math education? The first reason is that it is self-destructive. The quickest way to be relegated to the intellectual dustbin in the mathematics departments of most research universities today is to demonstrate a continuing interest in primary or secondary mathematics education. Colleagues smile tolerantly to one another in the same way family members do when grandpa dribbles his soup down his shirt. Math education is certainly an *acceptable* form of retiring as a mathematician, like university administration (unacceptable forms being the stock market, EST, or a mid-life love affair). But you don't do good research and think seriously about education.

A second reason we don't belong in education is that we are arrogant. The one time you do see university mathematicians devote some emotional energy to primary and secondary education is when they are complaining about the talents of their undergraduate students. The remedies we propose to the problems of math education are often naive and self-serving—better books, more drill on rules, more homework, more explaining, more intelligent school teachers—in short, more of something that doesn't involve any sacrifice from us.

Another reason we mathematicians should stay out of math education is that, despite our indifference, we, of all the users of elementary mathematics, already have perhaps the largest influence on mathematics education of any group. Schools of education, curriculum committees and textbook writers, and teachers themselves are by and large far more attentive to us than they are to the other users of mathematics in our society. So maybe we've said enough already, and should yield the floor to others, perhaps those from industry, government, or schools of psychology.

The final reason to stay out of all this education business is the danger of being used. Mathematicians who have sat on a "committee of experts" or "distinguished advisory committee" will recognize this danger—such a committee can be a thinly disguised effort by some agency or some individual who is not a "distinguished expert" to acquire collective professional prestige in order to promote a preplanned agenda. The mathematician's role is not so much to learn or help decide as to endorse something which, because of our own naiveté, we cannot effectively criticize.

The Politics of Education

Well, I've finished listing reasons why we should stay out. I may not have convinced you, but at least you must be wondering by now why anyone who thinks like that is giving a math education talk. In fact it is not

my purpose to convince mathematicians to stay out of primary and secondary education altogether. Rather I want to try to convince all of us to get more involved, but in a *different way*, to involve ourselves less in the methods of education, at least for now, and more in the *politics* of education.

When I say politics I'm not talking about Republicans and Democrats or even about merit pay, career ladders, teachers unions or school boards and state legislatures. I'm talking about grappling with the fundamental forces in our society that make our education system what it is. What are the expectations that we have of our schools—and how do we express these expectations? It seems to me that our educational system is producing exactly what we as a society ask of it—no more and no less. Every quarter century or so we beat our breasts about the shortcomings of our educational system, and then make extraordinary and sometimes brilliant attempts to change textbooks or teacher training and teaching methods. The plastic mass we call our educational system is perturbed, but we can feel in our fingers as we push that the minute we let go, old patterns return.

In fact, I would say that the more some of us have gotten into the elementary or secondary classroom, the less sure we are of what, if anything, can be done to change the educational system in a fundamental, permanent way. By this I mean change which does not disappear when the extraordinary forces producing it are withdrawn. So one thing I'm worried about, and am wanting you to worry about, is the question of continuity and permanence.

To make changes that will last, we must analyze the social, intellectual, and economic forces that have made education in general, and math education in particular, what it is in the U.S. today. It seems that those forces will have to change somewhat, and change permanently, before there can be lasting improvement in math education.

Leverage for Change

To find a political base for improved math education, the fundamental question we must answer is a *political* one: Which forces in our society have a permanent interest in the quality of mathematics education, and which of these have the economic, social, or political leverage to effect and sustain change?

In answer to this question, two candidates come to mind immediately. The first is our colleges and universities. At a time when almost half the credit hours in mathematics at many universities are taken up with algebra, trigonometry, and other *remedial* courses, there is little need to argue the universities' self-interest in quality primary and secondary mathematics education. Another obvious interest group is business and industry. It has been widely reported that the training and education budgets of U.S. corporations is fast approaching the budgets of all colleges and universities combined. Again we don't need to argue self- interest!

There may be other political bases for lasting educational reform, but they seem to me to have major drawbacks. The schools and the teachers themselves are one possibility, but their resources are thinly stretched by the enormous task they are already accomplishing. Parents or government are other possibilities, but we have already experienced the roller-coaster effect produced by their periodic intense interest hyphenated with extended periods of relative indifference.

A more serious possibility is the group we might call the "educational establishment," the loose network of educational experts in government, university schools of education, and private foundations. At the risk of offending some or of betraying my own ignorance in these things, I would venture to say that this group should *not* be looked to for leadership in initiating change in mathematics education. My reasons for this conclusion are, I admit, arguable, and need careful scrutiny.

I am *not* saying that this group is marginal to the process of educational reform and renewal. In fact, it is the instrument of most educational reform. The studies and statistics, the new materials, the changes in teacher preparation—all of these fundamental ingredients of successful reform fall within the purview of this group. But the "educational establishment" cannot lead the reform of math education for several reasons:

- This group does not, and probably cannot, fully understand the goals of reform in mathematics education. That understanding belongs to the makers and users of mathematics *per se*: the appliers, adapters, and creators of mathematics, and the problem solvers in science, technology, business, and industry.
- It is the role of government and, to a lesser extent, the foundations to support, document, and criticize education and its reform. But in our decentralized, democratic way of doing things, they are denied the power to decide future directions.
- Schools of education lack political power, inside and outside universities. The reason is clear—they do not attract enough of the best and brightest students. Their public, especially when it comes to mathematics, is not a particularly well-prepared one. I'm sure that they, more than anyone else, want to change that state of affairs, and I think there is evidence of improvement in the last few years, but the problem remains a major one.

Bridging the Gap

So I propose that we look to industry and to university schools of science and engineering for energetic, knowledgeable people to take the lead in bridging the

gap and initiating change in mathematics education, and not on a one-time basis. Clearly we need to change the ways that higher education currently interacts with the schools. On one side of the room, universities and industry are explaining in exasperated tones what skills they want their apprentices to possess, and even, on occasion, what changes in curriculum and teaching methods might possibly enhance some of those skills. On the other side of the room, our teachers are saying that the expectations are fine but often unrealistic, at least given the human and financial resources available. This gap can be bridged, but the initiative must come from the side that has the resources to do so, namely business, industry, and universities.

To bridge the gap, we need a mechanism which produces energetic, knowledgeable people, on a continuing basis, and which drives them to participate in the process of elementary and secondary education. Of course, for some of us, the language of the classroom is an impossibly esoteric dialect, but I am convinced that there are many others who, given the proper opportunity and inducement, could become quite knowledgeable about the classroom and its needs—those who, in another life, might even be quite good schoolteachers.

But is there sufficient inducement for us to involve ourselves? A sense of public service is not enough—our corporations or universities must provide paid released time and add the full weight of their prestige to the effort, in the institution's own self-interest if for no other reason. Professional societies, government agencies, and foundations also need to support the effort with money and honors. To be meaningful, there must be a very substantial commitment of time—for example, you probably have to take charge of a math class in a school yourself for an extended period of time to begin to understand the process. But to do much more than that is potentially too damaging to one's professional life and too costly to one's employer to be realistic. So there must also be built-in protection against exploitation and destruction of one's research career.

Suppose every year we did have a few of our scientists, engineers, and technological whizzes from universities and industry teaching school for an hour a day in communities around the country. So what? My guess is that, with very little prodding, many good things would follow. I think that the regular teachers who worked with the visiting teachers would learn a lot from them, and vice versa. This interchange would automatically produce new opportunities, such as access for teachers to summer experiences in industry or universities. Ideas about improving math education would become more sophisticated and more realistic without losing a creative edge. And I think most participants would gain a new sense of their home institutions' role in promoting quality in the schools.

A Political Base for Math Education

Most important in all of this would be the creation, over the years, of a political base for math education in universities, business, and industry, one that is realistic, experienced, and sophisticated, and one that, in time, would accede to the levers of power in the intellectual and economic life of the community. Where that will lead, what changes will occur, are impossible questions at this point. The fundamental thing is the process, and the challenge is for business and academia to take its place in that process.

I admit that what I am proposing may sound just a trifle unrealistic. For instance, why would people, in the midst of a very demanding and competitive professional career, take time out to teach school? And why would their employers pay them to do it? I've given the reasons, but I don't know really whether they are compelling enough to convince very many people.

However, one thing does seem quite clear to me, namely that those of us who can listen and talk to kids need to spend time visiting schools to find out what's going on. We need to get in touch with our common basic inspiration so that teachers and students can share it with us. Let us not relegate our children and grandchildren to a third-class intellectual future in the frenzy of our own current intellectual pursuits.

Computers and Mathematics

Edited by Jon Barwise

Editorial notes

The emphasis in this month's column is on programming languages, especially programming languages suitable for use in mathematics. The column contains an article by Alex Feldman on "functional" programming languages, languages like Miranda, FP, ML and the like. The article explains just what makes a language a functional language, discusses the advantages of such languages, and compares some of them. In addition, this month's column contains reviews of two forms of BASIC, TrueBASIC and UBASIC, and their advantages.

The column also contains a description, by Rod Smart, of the computational environment in place in the mathematics department at the University of Wisconsin, and how it was achieved. This is part of a continuing series of articles on computational environments in mathematics institutions, both academic departments and research centers. Earlier installments appeared in the March issue of this year, pages 243–251.

In addition to the above, the column contains a comparative review by David Hartz of two Macintosh programs for graphing solutions to differential equations, **DEGraph** and **Phase Portraits**.

Several people have written asking how you *do* get a single page without a page number, using LaTeX. Here's how: put "/\thispagestyle{empty}" in the list of instructions that come before the beginning of the document.

If you have comments on or suggestions for this column, please get in touch. And if you have suggestions for software you would like to see reviewed, send me the name and address of the distributor.

Professor Jon Barwise
Center for the Study of Language and Information
Ventura Hall
Stanford University
Stanford, CA 94305

Computers in the University of Wisconsin, Madison Mathematics Department

*Rod Smart**
University of Wisconsin, Madison

In this article, we trace the path we took to computerize the Mathematics Department at the University of Wisconsin, Madison.

Madison has 67 full-time-equivalent faculty. These are augmented by visitors and joint appointments, bringing the total to between 90 and 100 FTEs. There are also 200 graduate students and 15 support staff. We teach 16,500 students per year in various courses. Some of the larger lecture courses, such as Calculus, can have as many as 280 students. We have two separate computing facilities: an undergraduate computer laboratory with a small separate section for faculty and graduate student use, and the computers in the office tower which are used primarily for research and administrative tasks.

Understanding the choices we made requires some background information. Before we obtained our own computing facilities, we had to rely on computers located in other departments on campus. Faculty members who were affiliated with either the Computer Science Department or the Mathematics Research Center (now called the Center for the Mathematical Sciences) could use the computers located in those departments. Another small group used the main campus computing center for computing. The Madison Academic Com-

*Rod Smart is Professor of Mathematics at the University of Wisconsin, Madison. His research interests are in the field of modular forms. Since 1981, he has overseen the development of the computational facilities in the Mathematics Department.

puting Center (MACC) is funded largely through user fees, so using that facility is expensive. Both graduate students and faculty were able to apply for a one-time grant of $500 for computing services (word processing was frowned on). Additional computing services had to be paid for from grant funds. One could also get money for instructional computing at MACC. When MATLAB, a program for matrix calculations, was put on the Sperry 1100 at MACC, several Linear Algebra classes used it. It had a very user unfriendly interface – a misplaced comma in the login process could bring tears of frustration!

There were three main reasons for developing our own computing facility. These were the desire for high-quality technical typing, the arrival of easy-to-use personal computers with good graphics, and the perception that the central computing facility was too expensive and difficult to use. These issues go back 10 years but they are still important to us today. More recently, electronic mail has become as important as the other three reasons.

The Situation at Present

Office

We have a microcomputer or terminal in the office of every staff member who wants one, including graduate students. These machines vary in quality from upgraded IBM-PCs to several 386-compatible PCs. The terminals range from surplus $50 Visual terminals to some good graphics terminals. We are responsible for 87 computers and 36 terminals located in 3 different buildings. We do not have any Sun 3/50 quality workstations yet. More than half the faculty members have a personal computer at home. Many of these are Macintoshes, often purchased with personal funds.

We have an AT&T 3B15 computer to run large programs such as CAYLEY and REDUCE. It has the standard language compilers. We have also started to build libraries of scientific programs. The 3B15 also has the statistical package S and INFORMIX, a database program. It has 12Mb of RAM and 810Mb disk space. Van Vleck has 7 floors of offices, 6 of which contain 12 faculty offices and 4 TA offices (each TA office holds 5–6 people). The terminal or computer in each office is connected by a serial line to an AT&T 3B2/400 computer on the same floor. Each 3B2/400 has 4Mb RAM and 144Mb of hard disk. They each have the standard compilers and two technical text processing programs, TEX and AT&T's documenter's workbench (eqn, tbl, grap, pic, and troff). There is an HP LaserJet Series II printer located in the hallway on each floor. There are 36 logins on each 3B2/400. As computer usage has increased, we have noticed crowding, and are contemplating setting some disk usage limits. The AT&T computers are all connected by an ethernet running TCP/IP. Our Local Area Network, in turn, is connected to the campus-wide Wisconsin IP network, which allows us access to other campus computers. We have recently added a DEC VaxStation 2000 to our network. The sole purpose of the VaxStation is to run MACSYMA. It allows two simultaneous logins.

Classrooms

We have two small classrooms, each of which is equipped with a SONY video projector capable of showing IBM Color Graphics images, and one large lecture hall with a SONY of EGA quality. This lecture hall holds 320 students. The SONY projects onto a 10 × 14 foot screen which is easily visible from the back of the room. It makes a great sketching surface! We have plans next year to replace a COLOR compatible SONY with a VGA quality projector and add another VGA projector. Instructors complain about the slowness of the PCs which are attached to the SONY projectors. We shall probably have to replace them with faster machines.

Computer Staff

The staff responsible for this computer equipment is headed by Dr. Yvonne Nagel, who has a half-time appointment in the Mathematics Department and a half-time appointment at CMS. Until recently she had the help of a half-time Systems Administrator (who actually worked more than full-time). Presently there are two undergraduate students and one graduate assistant who each work from 5–10 hours per week. A faculty member helps supervise and maintain the system as his committee assignment. This group of people keeps the system up and running, makes backups, teaches people how to use the software, makes software upgrades, and even makes hardware repairs when possible. The breadth of their duties is very wide. The educational aspects of running the system are important and never-ending. The staff must first learn to use the software, then teach other members of the department to use it.

Our experience with our first two Systems Administrators, who were undergraduates finishing degrees in CS, was very favorable. We don't have a position for a replacement. The initial appointment was for one year only, but we managed to stretch it to almost two years.

Mathematics Laboratory

The Mathematics Computer Lab, which opened in the spring of 1986, is a separate facility run by Prof. Howard Conner. It consists of 20 AT&T 6300 computers, each of which has a color monitor and a 20M hard disk. We have the following software available for courses: GASP for probability, locally written Logic software for the undergraduate logic course, and PC-MATLAB and MINIMAT for the linear algebra courses. The machines also have MICROCALC and TURBO PASCAL. The computers in this section of the lab are not connected to the campus ethernet.

Inside the Math Computer Lab, is a small section for faculty and graduate students. It contains the VaxStation 2000, two 3B2/310s, two ATs and six terminals connected to the 310s. The computers in this room are connected to the campus ethernet.

This lab has its own staff. They keep it open, maintain their machines and help students with the use of computers and software. The lab is open about 50 hours per week. Between 300 and 400 students use it every semester. We have restricted its use to courses beyond calculus, but this is being relaxed to get more usage.

The Path that Led us Here

Most of our computers were donated to the Mathematics Department by AT&T; however, IBM donated some machines at a crucial time. The Mathematics Computer Laboratory was funded by the state as a laboratory improvement program.

Here is a brief summary of how we acquired our computers together with remarks which we feel may be useful to other departments that are considering building a computing facility from scratch.

Our computerization began with the purchase of an Apple II followed a little later by a TERAK. Our aim at this time was to get acquainted with computers and build a small computing facility in our department. One of our graduate students, Mike Slattery, ported MATLAB to the TERAK, which was quite a feat at the time. It gave us a real computational tool in an easy-to-use form, and it was used with classes and for research. We obtained a technical typing program from New Mexico – the forerunner of TCI's T^3. It came with a font editor so we could make up characters as needed.

A proposal to the Dean's office to purchase computers for technical word processing was turned down, but was countered with an offer to purchase dedicated office equipment. This made sense to the Administration because they wanted to standardize office equipment across the college, but it held up progress on computerization and real improvements in technical typing. The equipment they recommended was limited to 196 characters – a severe restriction for Mathematical text processing. This proved too limiting, so two years later we purchased IBM-XTs for our technical typists, a 24-pin dot matrix printer, and we used the commercial version of T^3. Later we purchased a QMS Laser Graphics 800 printer – a big improvement over our dot matrix printers! *The desire of mathematicians for high-quality preprints should never be underestimated; it has been one of the main driving forces for computerization and remains so even now.*

In the early days some faculty members explained that the reason they were not learning to use the computers was that they needed to learn in private. We tried a small office full of computers just for faculty, but, in fact what was really needed *was a computer in every office*. However, it was unthinkable at that time.

In 1983 we made a request for instructional computing facilities. This meant equipping a classroom with a computer and displaying the output on a screen. This was turned down. Then fifteen faculty members requested and got an interview with two of the appropriate associate deans. We each explained what it was we wanted in terms of equipment and why. They decided then and there to help us, but no promises were made. One of the deans wanted to see the capability of the TERAK; he asked if we could invert a 10 by 10 matrix. Matlab did it instantly, and he responded that we would eventually get what we needed. We got 3 IBM-PCs immediately, which we put under the stairway in the Mathematics Library since there was no other available public, but safe, room. The next year we got 5 IBM-XTs and a Sony video projector for a classroom.

In 1984 and 1985 three developments accelerated the pace of computerization in our department. The first was the IBM-funded TROCHOS project, which was designed to aid in the development of course materials using IBM-PC computers. Several projects from the Mathematics Department were proposed and, eventually, three were funded – one each in logic, probability and linear algebra. Twelve faculty members received IBM-ATs, each with an EGA graphics monitor and a printer. This was a major factor in moving us forward at this time; it helped build a base of knowledgeable users. The second development was a legislative initiative to modernize laboratories on campus. We obtained funding for 15 IBM-PCs and 4 IBM-ATs plus all the other things needed for

our lab, including the remodeling of a reading room. The third development was that AT&T approached the university to find out which departments were interested in computing. AT&T assigned to us an account executive who was also a student (in CS and Business). He sat down with us to review our plans and helped us consider the many options available. We came up with new plans that would allow us to have 18 PCs in the undergrad lab and 7 in the grad-faculty area (three donated by AT&T). The account executive taught us how to add memory and hard disks and even spent one day helping with the process. AT&T donated 3 3B2/300 computers and 12 terminals. *This knowledgeable manufacturer's representative significantly improved our computer installation both in the lab and in the office tower. His willingness to take time to understand our needs made these projects much more successful.*

Later we added a video projector in a small classroom and in one of the lecture halls. We chose a lecture hall because it was the only way we could give calculus students an experience with computer graphics. We made a mistake when we chose a CGA compatible projector for the small room. Our next projectors will be VGA compatible.

In 1986 AT&T asked us to make a proposal for more computing equipment to be targeted at research applications. We made plans based on a 3B15, but in conversations with the CS staff in charge of hardware we modified our plans to fit the shape of Van Vleck Hall – the Mathematics building. Their suggestion was that we should ask for a midsized computer to be placed on each floor in addition to the 3B15. AT&T agreed to the 3B2/400s and in addition gave us 20 6300Plus computers for faculty offices. *Talk over your plans with competent, unbiased professionals. They will see at a glance how your plans fit with your needs.*

Our decision to put Laser printers on each floor was one of our better moves. Now if a printer goes down, we can give a command to send a file to a printer on another floor; it gives us a reliable backup system.

Make plans for the type of computing capability you want. Be prepared to take small steps toward your goal, perhaps even some away from it, but persist. If an opportunity comes up take advantage of it, adjust your sights higher and continue on. We never would have dreamt that we could have the system that we now have, but as events unfolded we raised our sights. We were fortunate in having a number of interested colleagues who backed our computerization plans with their knowledge or influence.

Probably the most serious mistake we made was in underestimating how much it takes to run a computer system like ours. We were indeed fortunate to have our first two undergraduate system administrators. They worked above and beyond the call of duty to give us a working system. Perhaps what is worse we deceived ourselves and the administration as to what it would take to run our system. We're attempting to live up to our agreements but it makes heavy demands on our time. A system as large as ours needs at least one and one-half full-time administrators plus student help. This is our next goal.

The future

We read this column, and think it performs a useful service – it helps us know what is possible. We are considering computers which will be replacing the donated equipment when the time for that comes. We would like to replace the aging equipment in faculty offices with "scientific workstations": machines with enough memory and speed to run symbolic manipulation programs and with high-quality color graphics. We would like to have some of the same kind of computers available in our lab for students. We see this also as a way to involve undergraduate students in our mathematical life, which seems hard at a big midwestern university. Initially there seemed to be more enthusiasm about the use of computers in undergraduate instruction, but this seems to have cooled. However, instructors who regularly use computers in their courses believe that it has significantly improved their teaching. To many of us it seems obvious that today's students will be using these kinds of workstations as soon as they start working. We think we ought to show them how to effectively use such tools. The new computers and software tools that run on them (like Mathematica) may put back the excitement so that more of them will use them for instruction. The idea has been raised that we should start labs for students which will permit them to do coursework independent of any instructor. We haven't started that yet.

I want to thank Yvonne Nagel for her comments; she improved the readability of this article. Either one of us would be willing to answer questions. Our Email addresses are ynagel@math.wisc.edu, smart@math.wisc.edu, or by regular mail: Department of Mathematics, 480 Lincoln Dr., University of Wisconsin, Madison, WI 53706.

Functional Programming Languages

*Alex Feldman**

Boise State University

The purpose of this article is to introduce mathematicians to a relatively new class of programming languages, the Functional or Applicative languages, and present some reasons why these languages are particularly appropriate for mathematicians... both as environments in which to do programming, and as a research topic within the field of computer science.

Traditional programming languages like Basic and Fortran have been the mainstay of programming for many years, even though languages such as Lisp and APL which admitted of a nontraditional programming style (one which we will call "functional") have existed since the early 60s. While most programmers were happily writing their code in these traditional languages, a few people, most of them researchers in the area of programming languages, criticized the traditional languages as inappropriate, inadequate, cumbersome, rigid, unfriendly, and many other unflattering things. Many people have attempted to address some of these deficiencies (or perceived deficiencies ... I don't want to insult the Fortran enthusiasts who I know are out there) and they have given us PL/1 (which is very flexible), Pascal (which is certainly not cumbersome), Smalltalk (very friendly) and a host of others. These newer languages have often added important features which have affected the way various data structures are programmed, for example, pointer types and dynamic allocation of variables, but it has until recently been unusual for a language to affect the way that algorithms within the program are structured. Generally, any programmer in any language knows what a loop is, what an assignment is, and what a guarded branch is. In textbooks, programs are often presented in some sort of pseudo code, and only rarely is there any ambiguity regarding what the program means, or how to translate it into a real language.

It was just such a criticism, namely the Turing Award Lecture by John Backus [Backus] in 1977 (Backus, incidentally, is one of the original developers of Fortran), which is generally credited with sparking much of the recent development work in functional languages. In that paper, Backus suggested a new kind of programming language which depended on evaluation of expressions rather than on execution of commands. One of the principal reasons that he thought such languages would be useful was to change the way computer designers thought about the basic architecture of their machines. It is not that aspect of functional languages which will be discussed here, but rather the fact that these languages have the "look and feel" of mathematical proofs and definitions.

What is a functional language? Unfortunately, the answer to this question depends on who is answering it. There are several languages, or families of languages, which can lay claim to being functional languages given the broadest definition of the term. I will use a relatively narrow definition, the one promulgated by D. A. Turner. This leaves out some of the older and most widely used languages (like Lisp and ML), but those will be treated briefly at the end of the article. By using this definition, we limit ourselves to a class of languages that for the most part are quite similar to each other, so examples of code convey easily from one language to another. Moreover, these languages look the most like standard mathematics, both in terms of syntax and semantics.

Turner uses the principle of referential transparency (which is due to Quine) as the defining notion of a functional language. Briefly stated, this means that the value of an expression depends only on the values of its subexpressions. This may sound innocuous, but it really turns programming upside down - some of the consequences of referential transparency are:

- Two expressions with the same values are absolutely interchangeable. In order for this notion to be well defined, every expression must always have a value, and that value must not change.
- The subexpressions of an expression can be evaluated in any order. This has interesting implications for the construction of concurrent programs.
- Because of this interchangeability, the statements in the program could be arranged in any order, and the program would still compute the exact same thing.

This last point will surely surprise some people. It must mean (and does mean) that loops cannot work in a functional language, and that the old question of using goto's suddenly becomes moot. This is probably

*Alex Feldman received a Ph.D. in Mathematics as well as an M.S. in Computer Science from the University of Wisconsin-Madison. After leaving there in 1985, he spent three years on the technical staff at Odyssey Research Associates in Ithaca, N.Y., before moving to his present position as Assistant Professor of Mathematics at Boise State University. He is interested in functional languages and mathematical logic.

a good point to give a few examples, and therefore to introduce a genuine functional language.*

Miranda was developed by D. A. Turner and announced in 1985. It was based on two other languages that he developed , SASL and KRC, and is quite similar to a number of other functional languages, including Hope [Burstall], Ponder [Fair], and Clean [Brus], to name just a few. One reason that Miranda is being used as a sort of canonical language here is that I am familiar with it, and one reason for that is that Turner has made it easy for most people to get a hold of the language and use it. [Tur86] and [Tur87] provide an introduction to the language, and one can get information about obtaining a license (for a UNIX system) by writing to: Research Software, 23 St. Augustines Rd., Canterbury, Kent CT1 1XP, England; or email to mira-request@ukc.ac.uk.

Because of the absence of any standard kind of a notion of flow of control, Miranda programmers do not call their programs programs — they call them scripts. Here is an example of a Miranda script:

```
x = y + 3

y = 7.
```

This script could be loaded into the Miranda environment, and no output would result. However, the input "x" would result in the output "10", thus giving us the value that is bound to x. If the script above were expanded to include the line

```
x = 2
```

then the script would fail to compile.

Functions can also be defined in this way. Thus the script

```
    sq a = a * a
comb n k = product[k+1..n] /
           product[1..n-k], n>=k

         = 0               , n<k
```

permits us to type "$sq8$" or "$comb135$" and get the appropriate results. The definition of comb introduces some new syntax. First, it is an example of a guarded definition, the "guard" being the binding on n which occurs in the definition of comb. This is really quite similar to the guard in an IF THEN ELSE sequence, and can be understood in the same way. "Product" is a library function on lists (which defines the product of the empty list as 1, which suits our purpose here), and $[k..n]$ is the list of integers between k and n inclusive. Lists are an important data type in Miranda (and in all functional languages), as we shall see.

At this point, some readers may be thinking "Well this is all very cute, and certainly functions on integers can be defined but, without loops and assignments, how can one expect to write a real computer program? Surely this language does not have all the computing power of a standard, imperative language." Well, in fact, it does, and the theorems that show this were proved back in the 1930s. Essentially, it comes down to the fact that an imperative language can be modeled by a Turing Machine, while a functional language can be modeled by the Lambda Calculus, and these and other theories of computable functions were all shown to be equivalent before the ENIAC was developed. This article is not an appropriate place for an introduction to the Lambda Calculus, but the reader wishing to pursue that may want to start with the article by Barendregt in [Barwise], or a complete treatment can be found in [Baren]. It does not require very much in the way of programming constructs to reach this threshold of computability, known as "Turing Completeness", and once there it is essentially impossible to go any further, since the low-level instruction set of a computer is no more than Turing Complete. Thus, all of these languages have the same computational power.

This article is not intended to be a primer in Miranda, but it is worthwhile to see some of the language in order to appreciate the way functional languages work. One thing that Miranda shares with most of the newer computer languages, imperative or functional, is that it is strongly typed. Every expression has a type, and the type of an expression is determined by the types of its subexpressions. In Miranda, there are no formal type declarations - the type of an identifier is inferred from its defining equation. Thus, the *comb* function defined above has type integer, since *product*$[k..n]$ is of type integer, and assumes that k and n are of type integer. In fact, if *comb* is given noninteger arguments, Miranda will try to coerce them into integer type if it can, e.g., by truncating a real.

An additional feature of Miranda and many other functional languages, but not many imperative languages, is that it admits polymorphic types.

* "Miranda" is a trademark of Research Software, Ltd. "Unix" is a trademark of AT&T.

Here is an example of polymorphic types: Miranda contains a library function called map, which takes as arguments a unary function *f* and a list of arguments for the function *f*, and outputs a list of values of *f* applied to the list of arguments. Consider the *sq* function defined above. The type of this function could be (and is, in Miranda) represented as

```
sq :: num -> num
```

Then the input

```
map sq [1..5]
```

yields

```
[1,4,9,16,25 ]
```

So the Miranda shorthand syntax for a list of consecutive integers has been used again, and the output is the Miranda longhand syntax for a list. It is also clear what map does: it applies its first argument to every element in its second argument. But map can do this with any (unary) function, and any list of arguments (we will see later that every function in Miranda is really a unary function). Thus the type of map is:

```
map :: (* -> **) -> ([*] -> [**])
```

where * and ** denote any types,[ ] denotes a list, and ( ) denotes association. This gives an example of polymorphic typing, which is a familiar concept for mathematicians: addition of matrices is an example of a polymorphic function, as are many other algebraic functions. This example of applying a function to a list of arguments can be used to point out some of the nice, math-like syntax which is part of Miranda, as well. The following input:

```
map (comb 9) [12,3,5]
```

yields

```
[0,84,126]
```

which shows how "comb 9" is treated as a function of one variable. But if combinations for different values of *n* are required, then the following input:

```
[comb x y | (x,y) <- [(9,2),(12,5),(3,7)]]
```

yields

```
[36,792,0]
```

as it should, and note that the expression which is Miranda code is remarkably similar to a mathematical expression for the same thing.

Incidentally, the input

```
[comb x y | x <- [9,12,3]; y <- [2,5,7]]
```

yields a list with 9 elements, and the order in which it takes its arguments is (9,2),(9,5),(9,7),(12,2),(12,5),(12,7),(3,2),(3,5),(3,7). This ordering that Miranda chooses is important, as we will see in the example of *twinprimes* below.

Another feature of Miranda, and of many other functional languages, is that it is lazy. The formal definition of lazy evaluation is a bit oblique, but informally a language is lazy if no expression is evaluated before it has to be. This makes it possible to work with infinite objects, and the standard example for this is the Sieve of Eratosthenes, viz:

```
primes      = sieve [2..]
sieve(p:L) = p:sieve [n:n <- L ; n mod p > 0]
```

This script defines the (infinite) list of all the primes, and it defines it in such a way that the first *n* primes can be computed without knowing any of the other primes. Miranda contains a library routine, take, where "take *n L*" will form a list out of the first *n* elements of *L*. Thus,

```
take 10 primes
```

yields

```
[2,3,5,7,11,13,17,19,23,29].
```

But if we then try to compute

```
twinprimes = [(x,y) | x,y <- primes;
        y = x + 2] take 5 twinprimes
```

Miranda will compute forever, since it will first try to find all primes y which twin with $x = 2$. This behavior mimics that of a nested loop, which might be appropriate in some places, but is not what is wanted here. Miranda includes a "diagonalization" construct, so

```
twinprimes = [(x,y) // x,y <- primes;
        y = x + 2]
```

creates the (infinite?) list that we want. This construct yields the Cantor diagonalization, which is used to (among other things) map the rationals into the integers. Thus, given our two infinite lists of primes, it will look at them in the order (2,2),(2,3),(3,2),(2,5), (3,3),(5,2),(2,7),(3,5),(5,3),(7,2)...

This evaluation of *twinprimes* brings up an important point: although the expression given above is a nice, mathematical way to write down a definition of the set of all twin primes, it is not necessarily a very efficient way to do the computation ... it would make much more sense to generate the list of all $(p, p+2)$ where p is prime, and test $p+2$ for primality. It is fairly easy to write down a Miranda script that will do just that, but if one is trying to write a program that looks like mathematics, one may not wind up with a very efficient algorithm.

Many features of Miranda, such as its type handling facility, will not be treated in this article, but there is one more notion that must appear in any overview of functional programming, and that is higher-orderness.

An alternate definition for "functional language" is that it is higher order, i.e., that it treats procedures as first class objects, in the same way that it treats variables. Functions can be passed as parameters to other functions, and returned as values. ML, a language that will be discussed briefly at the end of this article, is favored by many programmers who want to make use of this "functional" facility, so even though Turner does not consider ML to be a functional language, others consider the use of higher-orderness to be the test of a functional style of programming.

One concept that computer scientists make much of is "currying". All this is is a way of rewriting a function that was a function of several variables into a function of one variable, and which then "outputs" another function. For example, if $f(x,y)$ is addition on the integers, the type of f is $Z \times Z \to Z$. We could just as well consider fxy to be of type $Z \to (Z \to Z)$. This permits us to define every function as a function of one variable, and it is how one programs in ML or Miranda. As a result of this, function application is left associative in these languages, so fxy parses as $(fx)y$.

For Example: The *comb* function defined earlier can be partially parameterized by only giving it one argument. So *comb* 6 is not only a perfectly legitimate object to carry around in a program or script, it is what will be computed first in the computation of *comb* 6 3. Thus, function application should be thought of as left associative, so *comb* 6 3 is really (*comb* 6) 3 and not *comb* (6 3). A nice exercise (which appeared in [Tur86]) is to compute the value of "answer" in the following Miranda script:

```
answer = twice twice twice suc 0
twice f x = f (f x)
suc x = x + 1.
```

If you attempt this by hand, you will very quickly gain an appreciation for how useful computers can be in keeping track of higher-order functions.

One can use higher-order functions to define combinators, and write programs that way. This leads to a very mathematical style of programming, even though it is a branch of mathematics that many mathematicians avoid. For example, one can define the fixed-point combinator, Y, in Miranda as follows:

```
Y f = f (Y f)
```

and if you object to this style of definition for a combinator, then Y can be defined as (TT), where $Txy = y(xxy)$. Either way, we get the combinator Y, which can be used to define recursive (inductive) constructs. For example, we can use Y to define a recursive factorial script as follows:

```
g f = h
      where
      h 0 = 1
      h (n + 1) = (n + 1)*(f n)
fact n = Y g n.
```

As was mentioned at the beginning of this article, there are other programming languages which are not necessarily referentially transparent, but still lay claim to the title "functional". A brief introduction to some of these other languages is in order.

FP: The rudiments of FP are discussed in [Backus], so it is one language whose existence has coincided with the new interest in this style of programming. FP is referentially transparent, but it is not lazy. There are several spin-offs from FP (FP+, FL and more) which have been introduced to enhance the expressive power of the language, and these extensions (and the definition of FP itself) involve some nice mathematics. Unfortunately, FP as a programming language is only available to (some) employees of IBM, so it is not likely that many of you will have a chance to use it.

Lisp: Lisp is one of the grand old languages of computer science, announced in 1960 by J. McCarthy and the Artificial Intelligence group at MIT [McCarthy]. Its unusual syntax is well known, and primers on Lisp are widely available. It was, however, the first widely distributed programming language which could handle a declarative semantics. In fact, it contains a construct called "lambda" which permits the direct construction of expressions from the lambda calculus. For many years Lisp and APL were the only languages with this kind of a structure, though both contained many imperative constructs to go along with the declarative ones. There was (and is) some effort made, however, to do nonimperative programming in Lisp, and since the functional subset of Lisp is Turing complete, this is a reasonable thing to do ... all programming languages have some sort of functional subset, but very few of them have one which is Turing complete.

ML: It would be unfair to say that ML is just a flavor of Lisp with a more familiar syntax, but that is really how most people seem to think of it. ML was developed as a specialized language, namely the specification language for a verification system, but it can be used to write programs just like any other language. Moreover, since the original description of ML, a number of programmers have taken an interest and the language has been rewritten several times. Nonetheless, ML was intended as a programming language in which one could write mathematical proofs, and that is still reflected in the style of programs that result. In that sense, the code that is written in ML is usually more in the functional style than is code that is written in Lisp. Still, it is not referentially transparent and is not lazy, so one loses the ability to write programs that look so much like mathematical formulas and to reason about infinite objects that one has in the Miranda-like languages.

This article is something of a throwback, in that it deals with using computers to do mathematics, rather than using them for file transfer, document preparation, and all the other wonderful things that have really brought computers into wide use in mathematics departments. There are several reasons for this. One is that I do not know enough about software development in general to feel comfortable writing an article that contrasts one language with another for the purpose of writing (say) a windowing system. Another reason is that, while I expect mathematicians to use electronic mail and typesetting software, I rather doubt that there is a lot of interest within the community in actually writing the software to do these things. I may be wrong about that, but my own interest in functional languages is based on their declarative semantics.

Functional languages have a great deal to offer mathematicians, some of whom are very comfortable with computers, while others like to stay as far away from the beasts as possible. For the former group, there is a whole new kind of programming that gives the programmer a different style of expression. It is the latter group, however, that may have the most to gain, since now it is possible to write programs in a very natural (for mathematicians) way.

References

[Backus] J. Backus. "Can Programming be Liberated from the von Neumann Style? A Functional Style and its Algebra of Programs." In *Communications of the ACM*, vol. 21, no. 8 (1978)

[Baren] H. Barendregt. *The Lambda Calculus : Its Syntax and Semantics.* North Holland (1977)

[Barwise] J. Barwise, ed. *Handbook of Mathematical Logic.* North Holland (1977)

[Brus] T. Brus, M. van Eekelen, M. van Leer, and M. Plasmeijer. "Clean : A Language for Functional Graph Rewriting." Univ. of Nijmegen Dept. of Comp. Sci. Technical Report (1987)

[Burstall] R. Burstall, D. MacQueen, and D. Sanella. "Hope: An Experimental Applicative Language." Edinburgh Dept. of Comp. Sci. Tech. Report CSR 62-80. (1980)

[Fair] J. Fairbairn. "Ponder and its Type System," Cambridge University Comp. Lab. Tech. Report 31 (1982)

[Field] A. Field and P. Harrison. *Functional Programming.* Addison-Wesley (1988)

[McCarthy] J. McCarthy. "Recursive Functions of Symbolic Expressions." In *Communications of the ACM,* vol. 3, no. 4 (1960)

[Tur85] D. Turner. Miranda : *A non-strict Functional Programming Language with Polymorphic Types.* In Springer Lecture Notes in Comp. Sci., vol. 201 (1985)

[Tur86] D. Turner. "An Overview of Miranda." In SIGPLAN Notices, December 1986 (1986)

Reviews of Mathematical Software

True BASIC

*Reviewed by John F. Sallee**

Introduction

We live in very exciting times for mathematics, perhaps the most exciting ever. The variety and power of both computers and software are increasing dramatically. There is almost a corresponding decrease in the prices of each, which makes computers within the reach of almost everyone who wants one.

Over the last twenty years, software scientists and engineers have made great progress in understanding the design and development of software. In addition to the wide variety of special purpose programs which have been developed, they have created new languages and updated the old languages such as FORTRAN, COBOL and BASIC. These updates usually include the addition of the structured language constructs, plus various built-in functions which have been discovered over the years to be useful. For those new to computing, the structured language constructs are those seen in the typical pseudo-code one encounters in text book algorithms.

There are a number of good reasons to decide to spend a little time to learn a programming language and write programs to do mathematics. Cost, timeliness and flexibility are three of the best reasons to consider using a programming language. A programming language might initially cost slightly more than some other software; however, as one can use a language to do many things, it may be cheaper than buying several separate software packages. As to timeliness, often it is faster to write a simple program to test out ideas than it is to find a particular program that will do what the user wants to do. As to flexibility, this is obvious. An additional bonus in writing simple programs is that one is often more interested in the process and seeing the logic of the program than in specific answers.

This reviewer spent eight years as a programmer with the Boeing Company in Seattle before earning his Ph.D. in mathematics at the University of Washington in Seattle. During that time he learned that a good program is correct, allows the user to solve the problem the user wants to solve, and is easy to use. A language is merely a program; hence it should meet the criteria above. This review will discuss how well True BASIC, as a program, meets these criteria. Unfortunately, since the reviewer buys his own software, the review will not cover other language packages. This does not at all imply that other languages are inferior; it will merely point out the features of True BASIC, which will be denoted as TB in the rest of this article.

True BASIC

True BASIC is available on PC-type machines, MacIntoshes, Ataris and Amigas. For users familiar with structured FORTRAN, the only way one realizes that TB is being used is the LET statement and slightly different IO commands. TB is an up-to-date structured language. It automatically uses double precision arithmetic (16 place accuracy) on most machines, has external subroutine calls, interfaces automatically with whatever graphics board the machine possesses, and program size is limited only by the available memory. Those familiar with structured FORTRAN will find it difficult to realize that they are using BASIC. The only clues are the LET statement and the different IO calls. TB shares FORTRAN's advantage (and disadvantage) of being able to introduce variables as one needs them (or thinks of them). There are also a number of special purpose packages available for those who want them.

Ease of Use

TB has a distinct advantage over other programming languages I have used. This advantage is simply the very best user's manual I have ever seen. Every software manufacturer should take a gander at TB's manuals and either take notes or hire the technical writers responsible for these documents. These manuals are worth the price of the program itself. The User's Guide has an extensive tutorial. Every language construct and every keyword in the language is illustrated by being used in a complete small program.

*John F. Sallee is a Professor of Mathematics at Angelo State University.

In addition, TB comes with a set of programs that illustrate its various features. These programs are very helpful as one can learn a lot about program style by reading, much as one learns to write well by both writing and reading good literature.

The Reference Manual is also well written. By using these two manuals, one can do interesting things in TB almost at once. After all, the idea behind the original BASIC language was to develop a language which is simple to use. At times it is annoying to use two manuals as one is constantly shifting between them; all in all though it is a logical split of the information.

The other features that add to the ease of use of TB are its excellent full-screen editor. One can easily delete lines, move lines and blocks of code, duplicate blocks of code and merge files. It is a competent editor and one can use it to write memos and short letters if one wanted. I have noticed that on lines longer than eighty characters it sometimes shows an extraneous character in the rightmost column. This character is not part of the program and is distracting. When one runs a program, the editor is used to point out the location of likely errors. TB does have a command DO FORMAT which capitalizes keywords and automatically formats the program in the currently accepted indented style.

It is rather disconcerting trying to explain in total what a language can do as with the flexibility of a language, one can do most anything. However, in an attempt to show the flavor of a program written in TB, the following examples are given. These examples were chosen because they exhibit the graphics interface and the use of the function statement and subroutines. The programs also exhibit the ease of use of the error trap in TB. The programs are almost self explanatory. The subroutine ticks draws the axes with tick marks.

```
LIBRARY ''graphlib.trc''

DEF f(x) = (x^2-4*x+3)/(x^2-6*x-8)

LET xmin=-12

LET xmax=12

LET ymin=-10

LET ymax=10

LET h=(xmax - xmin)/750

SET WINDOW xmin,xmax,ymin,ymax

CALL ticks (1,1)

LET x = xmin

DO while (x <= xmax)

     WHEN error in

          PLOT x,f(x);

     USE

     END WHEN

     LET x = x + h

LOOP

END
```

This program illustrates the uses of the function definition statement and subroutine calls. It graphs a function, draws rectangles for approximating the integral by the right Riemann sum, and adds up the area of these rectangles.

```
DECLARE DEF f

CALL main

END

DEF f(x) = sin(x)^2

SUB main

     LET n = 2000

     LET a_value = -pi

     LET b_value = pi

     CALL graph(a_value, b_value,xmin,xmax,h)

     CALL graph_sum(a_value,b_value,n)

     CALL add_rsum(a_value,b_value,n,rsum)

     PRINT rsum

END SUB
```

```
SUB graph(a_value,b_value,xmin,xmax,h)
  DECLARE DEF f
  LET xmin=a_value - (b_value - a_value)/10
  LET xmax=b_value + (b_vlaue - a_value)/10
  LET ymin=-1.1
  LET ymax=1.1
  LET h = (xmax - xmin)/750
  SET WINDOW xmin,xmax,ymin,ymax
  PLOT xmin,0;
  PLOT xmax,0
  PLOT 0,ymin;
  PLOT 0,ymax
  LET x = a_value
  DO while (x < b_value+.0001)
       WHEN error in
           PLOT x,f(x)
       USE
       END WHEN
       LET x = x + h
       LOOP
END SUB
```

```
SUB graph_sum(a_value,b_value,n)
    DECLARE DEF f
    LET h = (b_value - a_value)/n
    LET x = a_value
    FOR i = 1 to n
    PLOT x,0;
    PLOT x,f(x+h);
    PLOT x + h,f(x+h);
    PLOT x+h,0;
    LET x = x+h
    NEXT i
END SUB
SUB add_rsum(a_value,b_value,n,rsum)
     DECLARE DEF f
     LET h = (b_value - a_value)/n
     LET x = a_value
     LET rsum = 0
     FOR i = 1 to n
          LET rsum = rsum + f(x) * h
          LET x = x+h
     NEXT i
END SUB
```

As a pedagogical device, I feel that it is helpful for students to see the programs which do calculations. In this way they can clearly see the use of the formulas in their books. For mathematicians whose interests and work are not in the teaching field, perhaps TB would prove to be a good language for writing models of algorithms and testing ideas before writing large programs in languages which are more efficient than the particular machine in use.

In addition to the programs above, I have written a program to draw arbitrary Dirichlet (or Voronoi) diagrams and implemented various programs from the computer column in *Scientific American*, among other things. While a visiting professor at the University of Montana, I suggested that Josef Crepeau generate nontrivial examples of Karmarkar's algorithm converging for his senior thesis project. Joe used TB and succeeded admirably. I had the fun of seeing examples of the algorithm converging before such examples became common.

Since TB was designed by mathematicians, it has a nice set of built-in elementary mathematical functions. In addition, it allows matric arithmetic using one operator per MAT statement. For example, MAT $a = b + c$ or MAT a = INV(b) are allowed.

Defects. The program has few defects which I have discovered. It does have some small annoyances, for example, if a printer fault occurs when one issues a formatted listing of a program, TB will quit and one must start over. TB also loses count of the number of lines printed whenever the program contains lines longer than 80 characters. It would also be useful if there were a line continuation character such as FORTRAN has since it is easier to be able to read a whole line than it is to shift the screen to read just eighty characters.

Conclusions. TB is a rather powerful program for doing mathematics. It has excellent built-in features. It is easy to learn. The fact that TB is available on such a wide variety of machines means that, with minor modifications, a program written on one machine will run on the other types of microcomputers. Mathematicians who are just getting familiar with microcomputers may just want to take a good look at TB. Mathematicians who already are familiar with microcomputers may just want to come back and take a second look at these new structured BASICs which are now available. Do I intend to continue using TB? You betcha!

Price and availability. True BASIC is a product of True BASIC, Inc., 39 South Main Street, Hanover, NH 03755, Ph 800-TR BASIC. TB is available from many of the mail-order software dealers for about $60. There is also sometimes a discount direct from the manufacturer. There is also a variety of special purpose packages which are available separately and typically cost $35 from the mail-order firms. They include a Developer's Toolkit, a Mathematician's Toolkit, Communications Support, the Runtime Package, a Forms Management Library, A Btrieve Interface, Sorting and Searching, an Advanced String Library and a 3-D Graphics package.

UBASIC: a Public-Domain BASIC for Mathematics

*Walter D. Neumann**

UBASIC is an excellent public-domain high-precision BASIC for IBM compatible PCs, written by the Japanese number theorist Yuji Kida. It has become my language of choice, with speed and conveniences languages that I spent money on do not have. It has little competition for very high-precision numerical computation outside of computer algebra packages such as MAPLE, REDUCE, MATHEMATICA, etc. Although UBASIC is not as capable as such a package, it is more capable (even disregarding its high-precision capabilities) than most traditional computer languages, especially traditional BASIC. Moreover, it does its job fast, in a familiar language, with a minimal hardware requirement, and at zero software cost.

The first version of UBASIC resulted from Yuji Kida's frustration at the lack of good languages for number theory in 1980. It has evolved to the current version 7.04 (March, 1989), with the following features:

- fast multi-precision complex arithmetic (up to 2600 digits for integers and real numbers, 2600 digits total for the real and imaginary parts of complex numbers);
- good support for structured programming, including line labels, program control constructs (multiline IF... THEN... ELSE, WHILE... WEND, DO... UNTIL, FOR... NEXT, etc.), and both local and global variables in subroutines and user-defined functions;
- subroutines and functions can have parameters, including arrays, passed by value or address;
- functions and subroutines can be passed to other functions or subroutines by address;
- very good built-in editing and debugging facilities.

Some of these features are standard in many languages, including modern versions of BASIC, but others are rare or unique to UBASIC. The fast high-precision arithmetic is of course a main selling point, but the ability to pass functions to functions is also unusual and powerful: one can write general routines

*Walter D. Neumann is Professor of Mathematics at Ohio State University. He received his Ph.D. in 1969 from Bonn University and was long affiliated with the University of Maryland. He is a former Topology Editor for *Memoirs* and *Transactions* of the American Mathematical Society and is an editor of the new Walter de Gruyter monograph series "Expositions in Mathematics."

to operate on functions—for numerical equation solving, for numerical integration, etc. For example, a sample function for Simpson's rule is included that will compute a "typical" definite integral to 10-digit accuracy in a couple of seconds.

UBASIC provides the standard elementary transcendental functions (of both real and complex variables), Bessel functions, many number-theoretic functions (e.g. Euler and Moebius functions, quadratic reciprocity symbol, next prime, i-th prime, inverse and n-th power of x modulo n, etc.), and some rudimentary matrix functions. The user can supplement these by writing additional user-defined functions and subroutines to "APPEND" to his or her programs.

The full-screen editor is convenient and intuitive. "EDIT" will put you on the current line after a program break (due e.g. to an error condition), and you can scroll by line or screen through your program. Cross-reference and tracing tools are built in to UBASIC.

UBASIC is an interpreter, not a compiler, with all the conveniences of a good interpreter. When a program asks for input, you may input formulae involving functions and variables from your program (any good interpreter should allow this, but many don't). You can also input anything that is still on screen by moving to it and prefixing it with a question mark. In addition, the variables, functions, and subroutines of the current program are available in direct mode. Thus UBASIC is both a programming language and a convenient interactive computational environment. During long computations you can "FREEZE" the current environment (e.g. an interrupted program) to disk, and "MELT" to continue later.

I have mentioned UBASIC's speed, which is indeed remarkable for an interpreted language, so I should describe the evidence. The on-disk manual invites the user to run an included program "PI". On my NEC laptop (all speeds quoted here are on this machine, which is a little slower than an IBM PC/AT), this program takes 4 and 12 seconds to compute π to 1000 and 2000 digits respectively, plus 1 to 3 seconds to display the answer. It uses the formula $\frac{\pi}{4} = 4\arctan\frac{1}{5} - \arctan\frac{1}{239}$ and the following function to compute $\arctan\frac{1}{x}$ by the standard power series:

```
fnAtnsub(X)
local D,K,W,A
W=4*X: D=X^2: A=0: K=1
while W
  W=W/D: A=A+W/K: K=K+2
  W=W/D: A=A-W/K: K=K+2
wend
return(A)
```

This program is, of course, just for illustration—the numbers "π", "e", and Euler's constant are instantly available as system constants to over 2500 decimals.

For a more independent view of UBASIC's speed one can run the benchmarks of Simon and Wilson that do not involve graphics from this column of September 1988; the results compare favorably with the languages discussed in that column. For example, UBASIC computes gcd(15652431911123, 442677773754356) = 7 in .005 seconds, the program

```
for i=1 to 8000 : s+=i^(-2) : next i
```

takes about 6 seconds to compute $\sum_{i=1}^{8000}\frac{1}{i^2}$, and an analogous program takes about 42 seconds to compute $\sum_{i=1}^{10000}\frac{\sin(2i-1)}{(2i-1)}$. In all cases accuracy was set to 4 words—about 19 digits—after the decimal point.

Of course, the real test is how UBASIC performs in "real life." One of my own programs computes invariants of hyperbolic 3-manifolds obtained by Dehn surgery on the Whitehead link complement. This program has migrated through various versions of Basic to UBASIC, getting faster and much simpler in the process. The simplification comes from the availability of complex functions and good program structure. For given data, the program solves four simultaneous logarithmic equations in four complex unknowns by Newton approximation and then computes four complex values of the dilogarithm function (and other stuff). It does this to 55-digit accuracy in about 15 seconds. Another real life example from recent work: using the Lenstra-Lenstra-Lovasz bilinear form reduction algorithm (now included in the UBASIC distribution), UBASIC can quickly find the coefficients of a moderate-sized irreducible polynomial equation $f(z) = 0$ over the integers, given one of its roots z to sufficiently high precision; for a polynomial of degree 10 with coefficients up to about 1000 this takes less than a minute. In the case at hand, the given complex number z came from numerically solving simultaneous algebraic equations in several unknowns, and it would be hard to find the minimal polynomial directly, even using a symbolic algebra package. How confident can one be of the answer by such a "numerical best fit" procedure?—extremely confident: the computation needed the root z to about 30 decimals, so we can recompute z to 100 (or 1000) decimals and check that it still fits the polynomial. (This procedure raises a philosophical issue related to the slightly absurd debate about validity of computer proofs. Without a logical proof, may we accept that f is indeed the correct polynomial? The probability of a spurious fit to 100 decimals is absurdly lower than the

chance of error in any humanly generated proof—in fact, erroneous published proofs have been known to stand for years. One might ask tendentiously: do we primarily search for knowledge or do we just play a game of proof according to strict rules?)

Several programs to illustrate features of UBASIC are included in the distribution package, as well as many more serious applications. Among them are the most recent primality-testing and prime-factorization methods, including a multiple-quadratic-sieve routine which factors 55-digit numbers in several hours, the Fermat number $2^{128} + 1$ (or any other number of comparable size) in a few minutes, the number 2666382004787 (mis-)printed in this column's November 1988 review of Mathematica in about 13 seconds (23 seconds was quoted for Mathematica). Prime factors up to about 20 digits of much larger numbers can be found using the included elliptic-curves routine, and primality of numbers up to 300 digits can be proven with the included primality-testing program.

Of course, UBASIC has limitations: it cannot manipulate text (it is for doing mathematics, not for writing mailing list programs), and it does not do graphics (but the assembly-language interface is quite well documented, so a very enterprising user could write her own). The previous version, UBASIC 6.22, does not have complex numbers, local variables, or argument passing, but it has over twice as many digits of precision and it requires less memory (512K is recommended for Version 7, though it runs in less than half that), so it can still be useful.

UBASIC is written by Yuji Kida, Faculty of Science, Kanazawa University, 1-1 Marunouchi, Kanazawa 920 Japan. He has been most generous in sending disks to those who asked, but if you want a copy and cannot get one through a friend or colleague then contact me for help (Department of Mathematics, O.S.U., Columbus, OH 43210; E-Mail: TS2534@OHSTVMA.BITNET). Until a better distribution method is found (the A.M.S. is currently discussing setting up a bulletin board) I will send a copy in exchange for an appropriate blank formatted disk if I cannot help you find a local source.

DEGraph and Phase Portraits

*Reviewed by David Hartz**

Two differential equations graphing programs for the Macintosh, **DEGraph** by Henry C. Pinkham and **Phase Portraits** by Herman Gollwitzer, both available from Kinko's Academic Courseware Exchange, draw vector fields and integral curves for systems of differential equations of the form $dx/dt = f(x,y,t); dy/dt = g(x,y,t)$. I have found the programs to be a valuable addition to my differential equations class by presenting to the students the vector field of an equation far more quickly and more accurately than I am able to do by hand. The students were able to visualize the flow and bends of the solutions fairly readily and were able to see that a first-order normal equation describes a collection of curves which do not intersect. I also used these programs to illustrate the existence and uniqueness of solutions and my students were able to hypothesize what is required for a unique solution. This ready supply of examples would not have been available without this type of program.

These two programs are quite similar in many respects but they seem to accommodate different audiences. **Phase Portraits** is very well suited for classroom use and seems to have been designed to facilitate and encourge the exploration of different systems and initial conditions. The graphing capabilities are quick, easy to use, and easy to change. **DEGraph**, on the other hand, seems intended more as a detailed drawing program, as it has a number of MacPaint-like tools, such as arrows, a text writer, a line drawer, a pencil, an eraser, and a magnifier for fine editing. However, the graphing capabilities are not as quick and easy—several mouse clicks are needed to draw the integral curve in both directions. Before looking at the specific differences in the programs let us look at the similarities.

Both programs draw the solutions of systems of two dependent variables, x and y, and one independent variable, t. The system is entered by selecting one of the classic systems from the Equations Menu. **DEGraph** comes with 16 systems with fixed parameters and **Phase Portraits** has 14 of the classic systems, each of which allows the parameters to be changed. Some of these systems include Predator Prey, Duffing, Nonlinear Pendulum, and the Van der Pol systems. If none of these classic systems are of interest, the

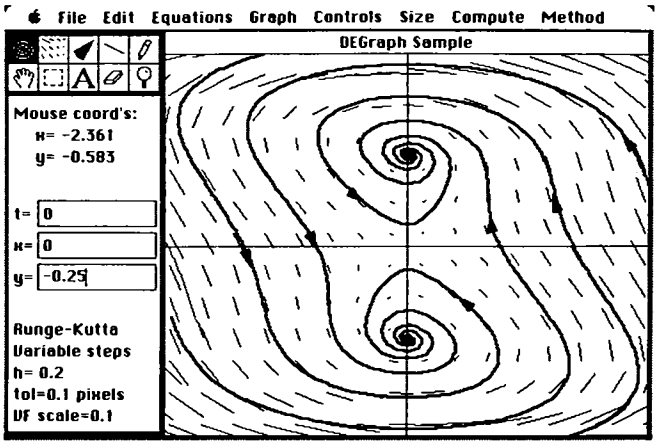
*David Hartz is a Professor of Mathematics at the College of Wooster.

"Enter a Differential Equation" or "Build Your Own" option allows entering the functions for dx/dt and for dy/dt. DEGraph allows the entering of more complicated functions. Over 32 operations can be entered in **DEGraph** while **Phase Portraits** only allows 15 operations. However, I have not found this limitation to be a problem.

After the system is entered, integral curves are drawn in any of the three coordinate planes (for **Phase Portraits**, y against x, y against t, or x against t; for **DEGraph** y against x, y against t, or t against x). To draw an integral curve the initial value is specified by entering the values for x, y, t in the boxes indicated on the screen, or by clicking the mouse anywhere on the graph [this only specifies the 2 variables in the chosen coordinate plane]. This can be very addictive; upon first receiving the programs I spent several hours entering systems and clicking at various points on the screen to draw the solution through that point. I had a lot of fun and learned more about the relationship between the coefficients of the system and the shape of the integral curves. Each program has several different ways of drawing the curves so that the solutions satisfying different initial conditions or different systems can be distinguished. **DEGraph** has three different pen sizes and two colors (black and gray). **Phase Portraits** has two different pens and options to represent the solutions by lines, dots, or lines connecting dots.

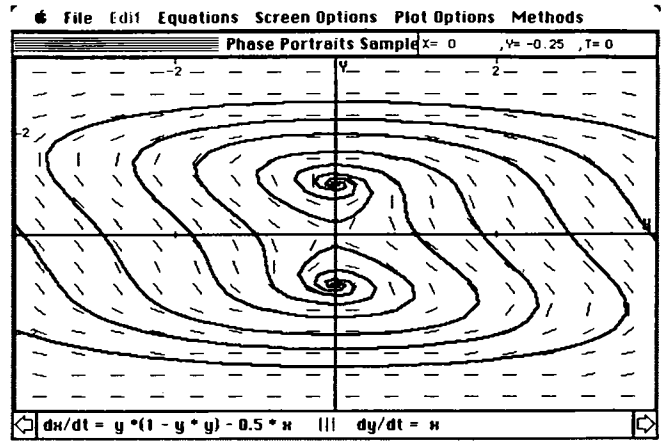
The numerical method used to calculate the integral curves can be selected from the Euler method, the Heun or Modified Euler method, or a Runge-Kutta method [**Phase Portraits** allows several other options]. The step size can also be specified. By comparing the graphs drawn by the programs with the known solutions of the equation the accuracy of the methods can be compared [say, for example $x'1, y' = \cos(x); y'(0) = 0$ which gives $y = \sin(x)$ as solution or $x' = -\sin(t), y' = \cos(t)$ which has circles centered at the origin as solutions].

Phase Portraits, as mentioned above, is the easier of the two programs to use. In the example "Phase Portraits Sample", a form of the duffing equation was entered: $dx/dt = y * (1 - y * y) - .5 * x, dy/dt = x$. The example shows the vector field and the integral curves through the points $(\pm 1, 0)$ and $(0, \pm .25)$ in the (x, y)-plane. As the drawing shows, a major drawback with **Phase Portraits** is that the horizontal and vertical scales are not the same. This can be quite disconcerting at times, especially when the above system whose solutions are circles is drawn and the curves come out as ellipses. The problem with the scale can be corrected by choosing the Grid Bounds option in the Screen Options menu and changing bounds on y to Y-Min -2.25 and Y Max 2.25.



DEGraph Sample showing the vector field and integral curves

The same system and initial conditions drawn by **DEGraph** is seen in the "DEGraph Sample". Here the horizontal and vertical scales are the same and the solution is less squashed than in the **Phase Portraits** example. As can be seen in the example, **DEGraph** has screen options which allow the integral curve, the tangent vector, or an arrow illustrating the direction of flow to be drawn at any point by clicking. The most aggravating thing about **DEGraph** is that when a point is entered and the integral curve is drawn, the drawing only progresses in one direction from that point, either in the direction of increasing or decreasing t. To get the opposite direction, the reverse option must be selected from the Controls menu, or by typing "<control> −". Then the same point must be entered. This one feature makes **DEGraph** less useful for playful exploration of different systems and initial values.



Phase Portraits Sample showing the vector field and integral curves

Another major difference between **DEGraph** and **Phase Portraits** is how the two programs handle the vector field. In **DEGraph** the field marks are dependent on the functions $f(x,y,t)$ and $g(x,y,t)$. The larger these functions the longer the field mark. This has the result that the vector field is often very busy and hard to read. This problem is compounded by the fact that the only way to remove the vector field is to erase the whole page. The field marks are also available in all three perspectives. In **Phase Portraits** the vector field is only available in autonomous (no t) systems and only on the (x,y) plane. The length of the field mark is constant throughout the graph. **Phase Portraits** allows the vector field to be drawn or hidden without affecting the integral curves.

One very nice feature of **DEGraph** which **Phase Portraits** lacks is the Compute Menu. This menu has two options: Evaluate, which performs calculations much like a hand calculator; and Integrate, which performs numerical integration and gives the value of the integral, number of steps needed, and the time elapsed during the calculation. This allows comparison between the different numerical methods. Another nice feature of **DEGraph** is the fact that the program draws graphs which are the size of a page. By moving the position of the window on the page, the entire page can be drawn. When an integral curve reaches the end of the window and the drawing stops, by moving the window and pressing "return" one can start the curve up where it left off and draw it in the same direction. This feature and the drawing tools available make **DEGraph** very valuable in the presentation of accurate graphics. However, one feature which **DEGraph** lacks which limits its value is an "undo". Many times while trying to move the window I inadvertently clicked on the screen and drew an integral curve. The only way to get rid of this unwanted graph is to use the eraser or the magnifier. An undo command would have been handy.

The other improvements I would like to see in **DEGraph** is a command which would allow the drawing of solutions in both directions with only one click, and a command to remove the vector field without erasing the whole page. I have found **DEGraph** to be a very fine graphics program for drawing the solutions of a system of differential equations. It can be used for class presentations and for individual exploration but does not seem to be as well suited for this use.

Phase Portraits is much better suited for use in a classroom or for individual explorations. The graphing is quick and easy. However, I do wish the default setting had the axes to the same scale. At least until a new version of **DEGraph** comes out with the improvements suggested above I will continue to use **Phase Portraits** for teaching purposes.

Inside the AMS

Committee on Academic Freedom, Tenure and Employment Security

Barbara Osofsky

One of the committees of the American Mathematical Society is the Committee on Academic Freedom, Tenure, and Employment Security (CAFTES). The chairman of CAFTES would like to be sure that AMS members are aware of the existence of this committee and communicate some of its policies.

CAFTES is prepared to consider cases of individuals who believe they have been wronged in regard to some academic freedom or employment situation. The main function of CAFTES is to determine the facts of the case, rather than becoming a party to the dispute. There are certain guidelines which the committee follows. If a case is better handled by some other organization such as the AAUP or a government agency, CAFTES will guide the aggrieved person to that organization. The committee will only consider cases brought by members of the American Mathematical Society. CAFTES also cannot respond to anonymous complaints, although they will make every effort not to violate confidentiality for those aggrieved members who request it. The committee requests a complete vita of the complainant, details of the complaint including copies of all available documentation, and names of individuals whom CAFTES could contact for additional information on the institutional procedures on appointments and promotions or for verification of undocumented claims.

Complaints and other correspondence should be directed to the chair of CAFTES,

Professor Barbara Osofsky, Chair
AMS Committee on Academic Freedom,
Tenure, and Employment Security
Department of Mathematics
Rutgers University
New Brunswick, NJ 08903

or to the Secretary of the Society who will forward the material to the committee.

Report of the Secretary

Robert M. Fossum

In 1988 the Society celebrated its centennial with meetings, seminars, and special publications. Now, as the Society is preparing to enter its 102nd year, celebration and retrospection are replaced by planning and introspection. The goal of this brief report is to indicate the cause of the anxiety and the barest elements of forward planning. Fortunately most of the details have appeared in the *Notices* or will appear soon.

The Society has offices in Providence and Ann Arbor that administer the day-to-day affairs such as maintaining membership data, publishing the monographs and journals of the Society, organizing and running the meetings, and supporting these and other activities of the Society. The most recent activities of the Providence and Ann Arbor offices will be reviewed by the Executive Director in a future issue of the *Notices*.

The Board of Trustees of the Society, of whom there are the President, the Treasurer, the Associate Treasurer, and five other elected members, is responsible for the financial affairs of the Society. The Treasurer's report immediately follows in this section of *Notices*.

The scientific policy of the Society rests in the hands of the Council which meets usually three times a year to consider the elements of this policy. The Council has delegated some routine business to its Executive Committee, and it has established many committees that separately handle specific details of policy.

For example there are many Editorial Boards, some even specified in the Bylaws, that carry out the publishing policy established by the Council. In the most

recent election by the membership, the manner in which these editorial boards are chosen was changed. The members adopted Bylaws that put into place an Editorial Boards Committee. The Committee will be elected by the membership just as the Nominating Committee is elected. It will recommend to the Council persons to fill positions on the various editorial boards. The Council will consider these recommendations when filling these positions. (In the past the positions have been filled by direct election by the membership. It had been the tradition that candidates ran un-opposed for the vacancies.)

Other changes in the election process are being considered by the Council. If the Council decides to change any of the current election procedures and such changes require amendments to the bylaws, the suggested amendments will be presented to the membership. Regular readers of the *Notices* have seen several articles in recent issues concerning the recommendations. The Council will be considering these proposed changes at its next few meetings.

The Council has just completed electing its representative to the Joint Policy Board of Mathematics. The AMS is represented on this Board by the President, the Executive Director and a third person. In the past this has been the Secretary. This third representive is now elected by the Council from among its members.

The few things mentioned above are examples of introspection. An examination of the minutes of the Council will show that self examination has been continuous, so this current examination is not a new phenomenon.

There are purely domestic aspects of scientific policy and activity of the American Mathematical Society. Currently the Society and some of its members are engaged in the renewal of U.S. mathematics. These efforts have been adequately reported within recent issues of the *Notices* and need no further amplification here. The Society is actively supporting MSEB and BMS and their projects, it has supported the National Council of Teachers of Mathematics Standards, it is encouraging increased funding for the teaching of and research in the mathematical sciences. In these endeavors it does not stand alone, but is cooperating with the many other scientific and professional organizations that are attempting to stem the degradation of quality of science and mathematical education and in fact improve it so that the general population, the technicians, the teachers, and the researchers will be prepared for the future technical society that they will face.

The Society continues to publish a number of mathematical research journals, monographs, and Mathematical Reviews. It is expanding its translation program and is soliciting manuscripts in many areas of mathematics. The Society recognizes that increased journal prices cause problems for library budgets and is making every effort to hold its prices down.

The activities mentioned above represent but a small part of the ongoing projects of the Society.

Report of the Treasurer

Franklin P. Peterson

I. Introduction

Last year I reported to you that while the stock market crash of 1987 had a serious impact on the Society's income for the year, it was not a devastating blow. In spite of the crash, the Society's investments produced a return about equal to the annual inflation rate. The Investment Committee continues to monitor the performance of the Society's investment managers, and for 1988, the Society's average return on its investment was about 8%. This return is about half of that achieved by the S&P 500, and is indicative of a more conservative approach adopted after the crash.

During the first five years of this decade (1980–1984), the Society incurred losses totaling $2,548,000. At December 31, 1984, the Society's fund balances (excluding endowments) had declined to $1,688,000, or 17.7% of the Society's total assets (excluding endowments) of $9,555,000. At December 31, 1979, fund balances were about 44% of total assets (excluding endowments) of $6,891,000. Since 1984, the Society has experienced three very good years of earnings, and at the end of 1988, the Society's fund balances (excluding endowments) had increased to $8,493,000 or 43.10% of total assets (excluding endowments). Included in these fund balances is the Future Operations Fund. The Long Range Planning Committee and the Board of Trustees have recommended that the Society build this fund to an amount equal to one year's operating budget. At December 31, 1988, the Future Operations Fund was $4,748,000 about 35% of one year's budget.

The recent improvement in the Society's financial health can be only partially attributed to cost cutting and fiscal restraint. The Society's finances are very greatly affected by the general economy, library budgets, and even foreign exchange rates. These and other factors are very difficult to predict and the Society often finds itself in the position of reacting to these factors. The Future Operations Fund is an attempt

to prepare for the inevitable deterioration in these environmental factors.

II. Summary Financial Statements

The Treasurer this year again presents to the membership summary financial statements of the Society. 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 wish to put to him concerning the financial affairs of the Society.

SUMMARY STATEMENT OF ACTIVITY
For the Year Ended December 31, 1988
(Dollars in thousands)

Revenue		
Journals	$ 8,889	60%
Books	1,409	9%
Dues	1,358	9%
Membership Activities	224	2%
Meetings	520	4%
Grants and Contracts	930	6%
Investment Income	812	5%
Other	715	5%
Total revenue	$14,857	100%
Expense		
Journals	$ 8,171	61%
Books	987	7%
Marketing	429	3%
Membership Records	300	2%
Membership Activities	314	3%
Meetings	903	7%
Grants and Contracts	1,069	8%
Other	1,264	9%
Total expense	$13,437	100%
Excess of Revenues over Expenses	$ 1,420	

SUMMARY BALANCE SHEET
December 31, 1988
(Thousands of Dollars)

Assets	
Cash and temporary investments	$ 4,619
Other short-term investments	6
Receivables - members and others (less allowance for doubtful accounts)	698
Deferred prepublication costs	594
Inventory of completed books and back volumes of journals	722
Prepaid expenses and deposits	1,209
Property and equipment (less accumulated depreciation)	5,272
Total operating assets	13,120
Investments	7,658
Total assets	$20,778
Liabilities and fund balances	
Accounts payable	$ 945
Subscriptions, dues, and other revenues received in advance	8,138
Other miscellaneous liabilities	1,080
Total liabilities	10,163
Operating fund balance	2,957
Total operating funds	13,120
Invested fund balances:	
Endowment funds:	
The Endowment Fund	100
Robert Henderson	548
Joseph Fels Ritt	23
Prize funds	169
Barbara G. Trjitzinsky	189
Centennial Research Fellowship	1
Pooled Income Fund	5
Eliakim Hastings	3
Undistributed net gains on investment transactions	1,084
Funds other than endowments:	
Future operations	4,748
Friends of Mathematics	124
Other	664
Total liabilities and fund balances	$20,778

III. Operations

I now turn to a discussion of the Society's 1988 operations.

Journals. Journals provide the largest fraction of the Society's revenues and expenses. In the past, journals have operated at a net loss. Since 1985, journals have operated in the black and provided a very significant portion of the Society's surplus (the excess of revenues over expenses in the summary financial statements above). This improvement is the result of a decrease in the rate of attrition in subscribers and a variety of cost-cutting procedures implemented by Society management.

Books. Included in this category are not only books (monographs or collections of articles) but review volumes and indexes to journals. Books, exclusive of the latter, continue to be financially sound, and selling prices of AMS books compare very favorably with other mathematical books.

Review volumes and indexes are very costly to produce, resulting in high prices. Each such planned

publication is scrutinized very carefully from both scientific and financial perspectives, and prices are set accordingly. In 1988, indexes and review volumes together produced a small surplus.

Dues, Membership Activities, and Membership Records. The Society has about 490 institutional members and 21,400 individual members. Of the latter, about 8,000 pay no dues because they are student nominees, emeritus members, or reviewers without convertible currency. Individual member dues are two-tiered to provide some relief to lower paid members. 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. The 1988 meetings deficit was larger than normal due to the more extensive activities which were planned for the Centennial Meeting.

Grants and Contracts. The amount of money available from the federal government has declined substantially over the years. Currently, support is mainly for travel and subsistence for participants in research conferences, institutes, and seminars, plus the Society's cost in preparing and running these conferences. The money received from government agencies is reimbursement only, with no profit to the AMS. The Society also has contracts to perform services for other nonprofit organizations, and this helps to recover some fixed costs.

Other Revenues and Expenses. The principal components of other revenues and expenses are MathSci (by far the single largest item), TEX related products, and the AMS support of the Joint Policy Board on Mathematics.

IV. Assets and Liabilities

So far, this report has dealt with sources of revenue and applications of expense. 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 quasi-endowment funds (those funds set aside by the Board of Trustees for designated purposes). Most of the quasi-endowment funds have been designated for future operations.

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 fiscal year-end, December 31. This amounted to about $4,619,000 for 1988. The recorded liability for the revenues received in advance was about $8,138,000 on the same date. 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. This is a common practice in the publishing industry and allows the Society to maintain a very low amount of bank debt, which was zero throughout 1988.

The Society's property, plant and equipment includes land, buildings and improvements, and office furniture, equipment and software. The Society also owns a small amount of transportation equipment. The land, buildings, and improvements include the Society's headquarters building in Providence and the Mathematical Reviews offices in Ann Arbor. The appraised value of these facilities currently exceeds $3,000,000. The largest part of the Society's office equipment is its investment in computer facilities.

Washington Outlook

Kenneth M. Hoffman

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

Science policy matters receive top attention in Washington during the month of April. Congress is getting into high gear for the fiscal year 1990 appropriations. The White House completed a budget plan with the leaders of the House and Senate to clear the way for a joint budget resolution that will steer the appropriations process over the next few months. Before 1 May, the 11 subcommittees of the Senate and House appropriations committees will have their targets assigned to them and their deliberations will begin in earnest.

The attention of the mathematics community is primarily focused on the two subcommittees that deal with the NSF budget. As we all know, that means competing with the budgets for the Department of Veterans Affairs, the Department of Housing and Urban Development (HUD), and the National Aeronautics and Space Administration.

Over the years, the federal budget has become more and more rigid, as payments for the national debt and mandated increases for entitlement programs have constricted the "discretionary" part of the budget more and more. We are now at a point where the civilian R&D budget has reached 25% of the discretionary part, up from 10% about a decade ago. This represents a highly visible target for all to see.

The message repeated over and over again at the 14th Science and Technology Colloquium, held in Washington by the American Association for the Advancement of Science during the second week in April, was that there is a great deal of competition for the highly visible R&D budget of the federal government. Not only has the President in his budget message on 9 February endorsed a number of large projects, such as the Space Station and the Superconducting Supercollider, but there is also the proposed doubling of the NSF budget over the next five years that we care about. As we all know, that plan was in the 1989 budget but it was felled by the budget axe in late August last year. Two new elements have entered into the budget debate for 1990: a strong HUD Secretary who wants to put money into the U.S. inner cities, and the newly created Veterans Affairs Department, where the Secretary can be expected to fight for an increase at the start of his mission.

This means that a tough fight is ahead for the science budget. And worse yet, should Congress be unable to pass a budget that stays within the Gramm-Rudman-Hollings limits, the law requires the Office of Management and Budget (OMB) to determine how much of an across-the-board cut will have to be applied to the discretionary budget in order to keep the deficit from exceeding the $100 billion limit. This cut would hit everything indiscriminately with no exemptions granted. Depending on whom you believe (OMB and the Congressional Budget Office have widely different assumptions about revenues and spending), the civilian part of the budget could face a 10% to 20% across-the-board cut.

If you know any of the Senators or Congressmen on the appropriations subcommittees, it would not hurt to let them know how you feel about support for science research and education. Remember, these representatives worry about the big picture, and not about the balance within a particular field of science. Their concerns center on "big" science versus "little" science, how to fix our educational system so that we can compete better internationally, and on infrastructure support for our universities to maintain buildings and equipment. If you have a contribution to that debate, please let them hear from you—and soon!

Members of the Committees on Appropriations in the House of Representatives and the Senate (listed in order of rank)

House of Representatives H-218 Capitol Building, Washington, DC 20515; telephone 202-225-2771

Majority Members (Democrats)
Jamie L. Whitten, MS, (Chair); William H. Natcher, KY; Neal Smith, IA; Sidney R. Yates, IL; David Obey, WI; Edward R. Roybal, CA; * Louis Stokes, OH; Tom Bevill, AL; Bill Alexander, AR; John P. Murtha, PA; **Bob Traxler, MI; Joseph D. Early, MA; Charles Wilson, TX; *Lindy Boggs, LA; Norman D. Dicks, WA; Matthew F. McHugh, NY; William Lehman, FL; Martin Olav Sabo, MN; Julian C. Dixon, CA; Vic Fazio, CA; W. G. (Bill) Hefner, NC; Les AuCoin, OR; Daniel K. Akaka, HI; Wes Watkins, OK; William H. Gray III, PA; Bernard J. Dwyer, NJ; Steny H. Hoyer, MD; Bob Carr, MI; Robert J. Mrazek, NY; Richard J. Durbin, IL; Ronald D. Coleman, TX; *Alan B. Mollohan, WV; Lindsay Thomas, GA; *Chester G. Atkins, MA; *Jim Chapman, TX.

Minority Members (Republicans)
Silvio O. Conte, MA (Ranking Minority Member); Joseph M. McDade, PA; John T. Myers, IN; Clarence E. Miller, OH; *Lawrence Coughlin, PA; C. W. Bill Young, FL; Ralph Regula, OH; Virginia Smith, NE; Carl D. Pursell, MI; Mickey Edwards, OK; Bob Livingston, LA; *Bill Green, NY; *Jerry Lewis, CA; John Edward Porter, IL; Harold Rogers, KY; Joe Skeen, NM; Frank R. Wolf, VA; Bill Lowery, CA; Vin Weber, MN; Tom DeLay, TX; Jim Kolbe, AZ; Dean A. Gallo, NJ.

* Member of the HUD-Independent Agencies Subcommittee in the House of Representatives

** Chairman of the Subcommittee

Senate SD-136 Dirksen Senate Office Building, Washington, DC 20510; telephone 202-224-3471

Majority Members (Democrats)
Robert C. Byrd, WV (Chair); Daniel K. Inouye, HI; Ernest F. Hollings, SC; *J. Bennett Johnston, LA; Quentin N. Burdick, ND; *Patrick J. Leahy, VT; Jim Sasser, TN; Dennis DeConcini, AZ; Dale Bumpers, AR; *Frank R. Lautenberg, NJ; Tom Harkin, IA; **Barbara A. Mikulski, MD; Harry Reid, NV; Brock Adams, WA; *Wyche Fowler, Jr., GA; *Bob Kerrey, NE.

Minority Members (Republicans)
Mark O. Hatfield, OR; (Ranking Minority Member), Ted Stevens, AK; James A. McClure, ID; *Jake Garn, UT; Thad Cochran, MS; Robert W. Kasten, Jr., WI; *Alfonse M. D'Amato, NY; Warren Rudman, NH; Arlen Specter, PA; Pete V. Domenici, NM; *Charles E. Grassley, IA; *Don Nickles, OK; *Phil Gramm, TX.

* Member of the HUD-Independent Agencies Subcommittee in the Senate

** Chairman of the Subcommittee

News and Announcements

Qi-Ming Wang 1941–1989

Professor Qi-Ming Wang died in a tragic car accident on April 7, 1989 at the age of 49. He was visiting Harvard University from the Institute of Mathematics of Academia Sinica (IMAS), where he was a senior researcher and deputy director.

Professor Wang graduated from the University of Science and Technology of China in 1965 under the guidance of Professor Wen-Tsün Wu and continued working there. His research fields are in differential geometry and symmetric spaces. He did much good research in these subjects. In recent years he made some important contributions in isoparametric functions and minimal submanifolds. From 1978 on, Professor Wang visited the Institut des Hautes Etudes Scientifiques, the Max-Planck-Institut, and the CIMS in Italy as well as several schools in the United States including the University of California at Berkeley and the University of Texas at Austin.

He was recognized as one of the best differential geometers in China. We will remember his warm and generous personality as well as his many contributions in both research and education in the subject he loved—mathematics. (See the advertising section in this issue of *Notices* for information about a memorial fund initiated by Harvard's Mathematics Department).

–The Chinese Students Association of Harvard University

AMS Centennial Research Fellowships Awarded

The Society has awarded three Centennial Research Fellowships for 1989-1990. The recipients are Isaac Efrat of Columbia University; John M. Lee of the University of Washington; and Ralf J. Spatzier of the State University of New York at Stony Brook.

Isaac Efrat

ISAAC EFRAT received his Ph.D. in 1983 from the Courant Institute of Mathematical Sciences, New York University, with Peter Sarnak. He was at the Massachusetts Institute of Technology from 1983 to 1985, and since 1985 has been at Columbia University. He has also been a member of the Mathematical Sciences Research Institute in Berkeley (1986), is the recipient of a Sloan Foundation Fellowship (1987-1989), and is a regular summer visitor at Stanford University. He plans to spend his AMS Centennial Fellowship over a period of two years, continuing his research in the theory of automorphic forms.

John M. Lee

After spending 5 years away from mathematics between college and graduate school, JOHN M. LEE attended first Tufts University and then M.I.T., where he studied with Richard Melrose and received his Ph.D. in 1982. He taught at Harvard from 1982 to 1987 and is currently Assistant Professor of mathematics at the University of Washington (Associate Professor beginning September 1989).

Professor Lee's main research interest is differential geometry,

especially applications of partial differential equations to global curvature questions on Riemannian and CR (Cauchy-Riemann) manifolds. The main problems he has worked on recently are the Yamabe problem for CR manifolds (with D. Jerison), Einstein metrics with prescribed conformal infinity (with C. R. Graham), and deformations of 3-dimensional CR structures (with J.-H. Cheng).

Ralph Spatzier

RALPH SPATZIER received his Ph.D. in 1983 from the University of Warwick under the direction of Professor C. Series. He subsequently has worked at the University of North Carolina at Chapel Hill, the University of Maryland, the Mathematical Sciences Research Institute, the Institut des Hautes Etudes Scientifiques and the State University of New York at Stony Brook, where he has been an assistant professor since 1984. He was an NSF Research Fellow in 1983-1984 and 1989 and was awarded a Sloan Foundation Fellowship in 1988.

He plans to use his AMS Fellowship over a period of two years. His primary research interests are differential geometry, dynamical systems and Lie groups and their discrete subgroups.

Information about the competition for the 1990-1991 AMS Centennial Research Fellowships will be published in the Funding Information in the Mathematical Sciences section of the next issue of *Notices*.

Presidential Young Investigator Awards Announced

The National Science Foundation has announced the selection of 197 academic scientists and engineers to receive the Presidential Young Investigator (PYI) awards. The awards, which fund research by faculty members near the beginning of their careers, are intended to help universities attract and retain outstanding young Ph.D. scientists who might otherwise pursue careers outside teaching.

Each young investigator can receive up to $100,000 per year for five years in a combination of federal and matching private funds. The NSF provides base funding of $25,000 and will match private sector funding of up to $37,500.

Any U.S. institution that awards a baccalaureate, master's, or doctoral degree in a field supported by the NSF is eligible to participate in the program. Institutions may nominate faculty members who are holding or have been offered tenure-track positions.

The following lists the names, affiliations, and research areas of those PYI awardees in the areas of mathematics, statistics, and theoretical computer science.

GREG W. ANDERSON, University of Minnesota, Number Theory/Algebraic Geometry; RODRIGO BANUELOS, Purdue University, Brownian Motion, Martingales, and Applications; RICHARD BEIGEL, Johns Hopkins University, Complexity Theory; FRANCIS BONAHON, University of Southern California, Low-Dimensional Topology; PHILLIP COLELLA, University of California, Berkeley, Scientific Computing; ANTHONY DEROSE, University of Washington, Computer Aided Design; LANE A. HAMACHANDRA, Columbia University, Complexity Theory; SUSAN HORWITZ, University of Wisconsin, Programming Environments; EHUD HRUSHOVSKI, Massachusetts Institute of Technology, Model Theory; MING-DEH HUANG, University of Southern California, Computational Complexity; FANG HUA LIN, University of Chicago, Applied Analysis, Differential Geometry; KESHAV K. PINGALI, Cornell University, Programming Languages; CONSTANTINE POLYCHRONOPOULOS, University of Illinois, Urbana, Parallel Processing; JOSEPH P. ROMANO, Stanford University, Mathematical Statistics; LESLIE D. SAPER, Duke University, Differential Geometry; PHILIP B. STARK, University of California, Berkeley, Geophysical Inverse Problems; MARK A. STERN, Duke University, Differential Geometry; ALLEN VAN GELDER, University of California, Santa Cruz, Logic Programming; GERALD W. YOUNG, University of Akron, Modeling of Materials, Processing Systems.

NSF Announces Mathematical Sciences Postdoctoral Research Fellowships

The Division of Mathematical Sciences of the National Science Foundation (NSF) has offered Mathematical Sciences Postdoctoral Research Fellowships to 30 recent recipients of doctoral degrees in the mathematical sciences.

Awards are made to U.S. citizens or nationals based on their demonstrated ability, and on the significance of career improvement the fellowship would potentially provide. Recipients may choose research environments at fellowship institutions that will best assist them in their scientific development. The fellowship program is in its tenth year.

A panel of mathematical scientists, chosen by the American Mathematical Society, the Institute for Mathematical Statistics, and the

Society for Industrial and Applied Mathematics, evaluated 106 applications. Final selections were made by NSF.

The stipend of $66,000 provides support for two nine-month academic years and three two-month summers. Each awardee has two options for receiving the academic year support: as full-time support for any eighteen academic year months in a three-year period, in intervals not shorter than three consecutive months (the Research Fellowship option), or as a combination of full-time and half-time support over a period of three academic years, usually one academic year full-time and two academic years half-time (the Research Instructorship option).

The recipients are listed below (institutions in parentheses are the current institutions, those outside the parentheses are those at which the fellowship will be held): IRIS L. ANSHEL (Columbia University), Columbia University; TODD J. ARBOGAST (Purdue University), University of Houston; DAVID M. AUSTIN (University of Utah), Institute for Advanced Study; ANDREW J. BERNOFF (University of Arizona), University of California, Berkeley; AARON J. BERTRAM (University of California, Los Angeles), Harvard University; ELISE E. CAWLEY (University of California, Berkeley), City University of New York, Graduate Center; THOMAS C. HALES (Harvard University), Institute for Advanced Study; MARK E. HARTMANN (Johns Hopkins University), University of North Carolina, Chapel Hill; JAY A. JORGENSON (Stanford University), Institute for Advanced Study and Yale University; SEAN M. KEEL (University of Chicago), University of Utah; JOE J. KILIAN (Massachusetts Institute of Technology), University of California, Berkeley; PETER B. KLEIDMAN (California Institute of Technology), University of Southern California and Rutgers University; RAMA R. KOCHERLAKOTA (Harvard University), Mathematical Sciences Research Institute and University of California, Berkeley; EDWARD S. LETZTER (University of Utah), University of Utah; RICHARD C. LIU (University of California, Los Angeles), Cornell University; JEFFERY D. MCNEAL (Princeton University), Princeton University; BARRY L. MERRIMAN (University of Chicago), University of California, Los Angeles; TERRENCE J. NAPIER (University of Chicago), Massachusetts Institute of Technology; ALEC NORTON (Boston University), University of Texas, Austin; VALLORIE J. PERIDIER (Lehigh University), Temple University; DOUGLAS M. PICKRELL (University of Arizona), Yale University; MICHAEL J. SHELLEY (University of Chicago), University of Chicago; RICHARD K. SKORA (State University of New York at Stony Brook), Columbia University; NATHAN SMALE (University of Utah), Stanford University; MARK SPIVAKOVSKY (Harvard University), Harvard University; CHRISTOPHER R. STOVER (University of Chicago), University of Chicago; JOHN A. STRAIN (New York University), Institute for Advanced Study; GARRETT STUCK (University of Maryland, College Park), University of Maryland, College Park and University of California, Berkeley; ROBERT D. THOMPSON (Northwestern University), Northwestern University; HOWARD N. WEISS (California Institute of Technology), California Institute of Technology.

Information about the NSF Mathematical Sciences Postdoctoral Research Fellowship program for 1990 will be published in the Funding Information for the Mathematical Sciences section of a future issue of *Notices*.

NSF Graduate Fellowships Announced

The National Science Foundation (NSF) has announced the award of 760 fellowships for graduate study in the natural and social science, mathematics, and engineering.

The NSF Graduate Fellowships provide a stipend of $12,300 per year for three years of full-time graduate study. The fellowships may also be used over a five-year period to permit students to incorporate teaching or research assistantships into their education during periods in which they are not receiving fellowship stipends. NSF Graduate Fellows may attend any appropriate non-profit U.S. or foreign institution of higher education. In addition to student stipends, the NSF provides an annual cost-of-education allowance of $6,000 to the institutions in lieu of all tuition and fees.

The more than 5000 applications submitted in a nationwide competition were evaluated by panelists assembled by the National Research Council. Awards were made in all 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, and Guam, and 271 awards were made to women.

The awards include 52 in the mathematical sciences and 50 in computer science. The recipients in the mathematical sciences are listed below, together with their baccalaureate institutions (in parentheses) and the institutions where they will pursue graduate studies.

SEAN MICHAEL BATES (University of California, Berkeley), University of Bonn; JOHN DAVID BOLLER (Washington & Lee University), Princeton University; DOUGLAS CRAIG BOWMAN (California State University, Los Angeles), University of California, Los Angeles; JACKSON ALLAN BROSS (Massachusetts Institute of Technology), Harvard University; JIM ARTHUR BRYAN (Stanford University), Harvard University; MEGHAN ANNE BURKE (Brown University), Oxford University; RAYMOND JUIMONG CHEN (Princeton University), Stanford University; TANYA JULIE CHRISTIANSEN (Rice University), University of California,

Berkeley; DAVID COOK (Harvard University), University of California, Berkeley; JORDAN ALLEN DRACHMAN (Massachusetts Institute of Technology), Dartmouth College; BENSON STANLEY FARB (Cornell University), Princeton University; ANDREW MARK FEDORCHEK (US Military Academy), Stanford University; BETHEL ANN FETTERMAN (Pennsylvania State University), University of North Carolina at Chapel Hill; ALYSON ROSE GABBARD (Rice University), Harvard University; PAUL EDWARD GUNNELLS (Stanford University), Princeton University; THOMAS RANDOLPH HAGEDORN (Princeton University), Harvard University; BRIAN CHARLES HALL (Cornell University), Cornell University; BRIAN THOMAS HAYES (California Institute of Technology), University of Arizona; PATRICK THOMAS HEADLEY (Case Western Reserve University), University of Michigan; MARK STANTON HILLIER (Swarthmore College), Stanford University; MARY HORN (Pennsylvania State University), University of Virginia; THERESA MARY HULL (St. Olaf College), Cornell University; WILLIAM DAVID KALIES (Ohio State University), Rutgers University; MARKUS ROBERT KEEL (University of Chicago), Harvard University; HAROLD KILOH KNIGHT, JR. (University of Maryland), University of Maryland; DAVID RUSSELL KOHEL (Texas A&M University), University of California, Berkeley; NADINE KOWALSKY (Harvard University), Massachusetts Institute of Technology; CLIFFORD DALE KRUMVIEDA (Texas A&M University), Cornell University; KENNETH EDWARD KUDRAK (Indiana University, Bloomington), Cornell University; ROBERT SCOTT MANNING (Yale University), Cornell University; TODD MICHEL MCCOMB (Rensselaer Polytechnic Institute), Rensselaer Polytechnic Institute; ROGER BRENT MILNE (University of South Carolina), University of California, Berkeley; DAVID JOHN MOEWS (Harvard University), University of California, Berkeley; DAVID PETRIE MOULTON (University of California, Berkeley), University of California, Berkeley; DARRYL KENT NESTER (Bluffton College), Purdue University; PETER STEVEN OZSVATH (Stanford University), Princeton University; KEITH AARON PARDUE (Columbia University), Columbia University; MICHAEL DOWNES PETERSON (Princeton University), Massachusetts Institute of Technology; BJORN MIKHAIL POONEN (Harvard University), University of California, Berkeley; DANIEL NOAH ZAPHOD PORT (University of California, Los Angeles), California Institute of Technology; DANIEL PATRICK POWERS (University of Texas, Austin), Stanford University; DANIEL SIMON SAGE (Harvard University), Princeton University; CHARLES FREDERICK SHEFFIELD (Virginia Polytechnic Institute & State University), Ohio State University; JEFFREY SCOTT SILVER (Massachusetts Institute of Technology), Harvard University; BECKY STEPHENS (Bryn Mawr College), Harvard University; FRANCIS EDWARD SU (University of Texas, Austin), Princeton University; JOHN RICHARD SWALLOW (University of the South), Harvard University; MARK A. TAYLOR (University of Michigan), New York University; ALICE MARY UNDERWOOD (University of Texas, Austin), Princeton University; DANIEL RAY UPPER (Rice University), University of California, Berkeley; PAMELA HATCH VANCE (Georgia Institute of Technology), Georgia Institute of Technology; and CRAIG LEE ZIRBEL (Illinois Wesleyan University), Yale University.

For more information about applying for the NSF Graduate Fellowships, please see the listing in the Stipends for Study and Travel section of *Notices*, December 1988, page 1604.

NSF Awards Minority Graduate Fellowships

The National Science Foundation (NSF) has announced the award of 100 fellowships to minority students of outstanding ability for graduate study in the sciences, mathematics, and engineering.

Each new fellowship provides a stipend of $12,300 per year for full-time graduate study. An annual cost-of-education allowance of $6,000 is also provided to the U.S. institution by NSF in lieu of all tuition and fees.

Applications submitted by 797 minority students were evaluated by panels of scientists assembled by the National Research Council of the National Academy of Sciences, and the grants were awarded by the NSF on the basis of merit.

Mentoring Assistantships are available this year to Minority Fellows for up to three initial months of summer support to help them develop mentoring relationships at their institutions. The summer support will be in addition to their regular Fellowhships, and will provide research participation and other opportunities.

A $1,000 Incentive for Excellence Scholarship Prize is made available to each Fellow's undergraduate department, to be awarded to one or two other minority undergraduate students in the same department in recognition of their scholastic excellence.

NSF Minority Graduate Fellows may attend any appropriate nonprofit U.S. or foreign institution of higher education. Three years of graduate study are supported by each fellowship. The fellowships may be used over a five-year period, so students can incorporate teaching or research assistantships into their education during periods in which they are not receiving their fellowship support.

The new Minority Fellows represent 24 states, the District of Columbia, and Puerto Rico. Of the

100 awards, 42 were made to women, and are distributed among American Indians, Blacks, Hispanics, and Pacific Islanders. There were 28 awards in the behavioral and social sciences, 23 in engineering, 26 in life sciences, 23 in mathematics and physical sciences (including chemistry, physics, and earth sciences).

The 1989 recipients in the mathematical and computer sciences are listed below, together with their baccalaureate institutions (in parentheses) and the institutions where they will pursue graduate studies.

CESAR ALFREDO ALVAREZ (University of California at Berkeley), Stanford University; DANIELLE DENISE CARR (Beloit College), Duke University; MARK CASSORLA (University of Pennsylvania), Harvard University; DAVID V. CRUZ-URIBE (University of Illinois at Chicago), Princeton University; JOHN EDWARD GONSALVES (Whittier College), University of California at Berkeley; SONIA ESTER MARX (Johns Hopkins University), Stanford University; TERENCE CASALS RITZMAN (Colorado State University), University of California at Berkeley; GERALD ARNELL WILLIAMS (California State University at Long Beach), University of California at Los Angeles.

A new NSF publication, "Legacy to Tomorrow," presents a collection of sketches about current and past Minority Graduate Fellows, including several in the mathematical sciences. To receive the booklet, send a self-addressed, gummed mailing label to: Legacy, SEE/RCD, National Science Foundation, 1800 G Street, N.W., Washington, DC 20550.

Guggenheim Fellowships Awarded

The John Simon Guggenheim Memorial Foundation has announced the award of 198 Fellowships in its sixty-fifth annual competition. The new Guggenheim Fellows were appointed on the basis of unusually distinguished achievement in the past and exceptional promise for future accomplishment. This year's list of awards includes six in the mathematical sciences.

The names of these recipients, their positions, institutional affiliations, and their proposed studies are: SYLVAIN EDWARD CAPPELL, Professor of Mathematics, Courant Institute of Mathematical Sciences, New York University (Studies in Topology); LOUIS GORDON, Professor of Mathematics, University of Southern California (The Detection of Change-points in Sequences); PETER LI, Professor of Mathematics, University of Utah (Analytical Methods in Differential Geometry); DONALD A. MARTIN, Professor of Mathematics and Philosophy, University of California, Los Angeles (Studies in Mathematical Logic); STEVEN A. ORSZAG, Hamrick Professor of Engineering and Professor of Mechanical and Aerospace Engineering, Princeton University (Studies of Turbulent Flows); KATEPALLI R. SREENIVASAN, Harold W. Cheel Professor of Mechanical Engineering, Yale University (The Origin, Dynamics and Control of Fluid Turbulence).

Rollo Davidson Trust

The Trustees of the Rollo Davidson Trust have announced the award of the Rollo Davidson Prizes for 1989 to GEOFFREY R. GRIMMETT of the University of Bristol, United Kingdom, and RÉMI LÉANDRE of the University of Besançon, France.

Dr. Grimmett was cited for his work on random fields, percolation theory, random graphs, and related topics. Dr. Léandre was cited for his contributions to Atiyah-Singer theory, and for his work on small-time asymptotics for the densities of degenerate diffusions.

1989 Spring Prize of the Mathematical Society of Japan Awarded

The Spring Prize of the Mathematical Society of Japan in 1989 was awarded to Yoichi Miyaoka, Professor of Tokyo Metropolitan University, for his "contribution to algebraic geometry, particularly, the theory of relations among Chern numbers and their applications".

1989 Geometry Prizes Awarded by the Mathematical Society of Japan

The Geometry Prizes for the year 1989 were awarded to Yosio Muto, Professor Emeritus of Yokohama University, and Kenji Fukaya, Associate Professor of the University of Tokyo, by the Mathematical Society of Japan. The award to Professor Muto was made in recognition of his outstanding works for more than a half century, some of which have been ahead of his times. The award to Professor Fukaya was for a series of his remarkable works on the collapsing theory of Riemannian manifolds and its applications.

1988 Asahi Prize Awarded

Hirotugu Akaike, Director General of the Institute of Statistical Mathematics, has won a 1988 Asahi Prize awarded by the Asahi Shimbun for his "contribution to statistics, particularly the theory and application of AIC".

The Asahi Shimbun is one of the major newspapers in Japan.

1988 Inoue Prize for Science Awarded

The Inoue Prize for Science in 1988 was awarded to Shigefumi Mori, Professor of Nagoya University for his outstanding work in the theory of higher dimensional algebraic varieties and in particular for the proof of existence of minimal models for 3-dimensional algebraic varieties.

The Inoue Prize for Science is presented by the Inoue foundation for Science in Japan.

Marcia Sward Named New MAA Executive Director

Marcia P. Sward, currently Executive Director of the Mathematical Sciences Education Board (MSEB) of the National Research Council, will leave that post in August to assume the top position of Executive Director at the Mathematical Association of America (MAA). Sward will succeed Alfred B. Willcox, who has been Executive Director since 1968. No stranger to the MAA, Sward served as Associate Director of the Association from 1980 to 1985.

Marcia P. Sward

In her role as the first Executive Director of the MSEB, she guided the growth of the Board to its current status as an influential national advocate for excellence in mathematics education. "Marcia Sward served as MSEB's Executive Director since its inception in 1985, and under her leadership that Board has grown into a highly effective national force for reform in mathematics education at all levels," said National Academy of Sciences President Frank Press, in an announcement from the Academy. "With no assured funding and minimal staff, the Board has grown into an enterprise approaching $2 million in program level. The Board has stayed with the goals it set out for itself in 1985, with the most recent product of its efforts being the report 'Everybody Counts,' done jointly with the Board on Mathematical Sciences and the Committee on Mathematical Sciences in the Year 2000."

Marcia Sward obtained her B.A. degree (summa cum laude) from Vassar College with a major in mathematics and Russian, and she received her masters and doctoral degrees in mathematics from the University of Illinois. She served as assistant professor and associate professor at Trinity College in Washington, DC from 1968 to 1980 and also served as chairperson of the mathematics department (1979–1980). In addition, she held a position as assistant professor at Catholic University during the summers of 1968–1971. In September 1980 she was appointed Associate Director of the MAA. During 1982–1985, she also served in a part-time capacity as Administrative Officer of the Conference Board of the Mathematical Sciences, located in MAA headquarters, until she moved to the MSEB position at the end of 1985.

Hoffman Named Director of NRC Education Board

In April, Frank Press, President of the National Academy of Sciences, announced the appointment of Kenneth M. Hoffman as Executive Director of the Mathematical Sciences Education Board (MSEB) of the National Research Council (NRC), the operating arm of the Academy. Hoffman will succeed Marcia P. Sward, who will become Executive Director of the Mathematical Association of America (see accompanying news item). He will assume the position in September.

For the past few years, Hoffman has been head of the Washington, DC-based Office of Governmental and Public Affairs (OGPA) of the Joint Policy Board for Mathematics, which handles issues and projects of common interest to the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. OGPA keeps abreast of science policy matters for that Board.

Hoffman was deeply involved in the preparation of the well-known David Report ("Renewing U.S. Mathematics: Critical Resource for the Future"). He has been appointed to the new committee that will produce an update of the David Report, which is to be released before the end of the year. In addition, Hoffman was involved with the NRC report "Everybody Counts," released last January. Because he has had close ties with the MSEB since its founding, his appointment will assure a smooth transition as well as the continuation of the tasks the Board has set for itself.

Kenneth M. Hoffman

In his new position at MSEB, Hoffman will continue to hold his position as professor of mathematics at the Massachusetts Institute of Technology, where he has been on the mathematics faculty since 1956. He also chaired the mathematics department there from 1971 to 1979.

He received his Ph.D. from the University of California at Los Angeles in 1956, and was a Sloan Foundation Fellow, 1964–1966. Hoffman has served on the Council of the AMS and of the American Association for the Advancement of Science. He served on several AMS committees, including a tenure as chair of the Committee on Science Policy (1982–1984). In addition, he was chair of the Advisory Committee for Science and Engineering Education for the National Science Foundation (1984–1985).

Hoffman has written numerous articles on function algebras and is the author of three books: *Banach Spaces of Analytic Functions* (1961), *Fundamentals of Banach Algebras* (1962), and *Analysis in Euclidean Space* (1975). He is co-author, with Ray Kunze, of the basic undergraduate text, *Linear Algebra* (1961, 1970).

Yale Physicist Named as Science Adviser

In mid-April, the White House announced the appointment of D. Allan Bromley as science adviser to President Bush. Bromley is a professor of nuclear physics at Yale University and has been active in science policy circles.

In response to calls from the scientific community to upgrade the influence of the science adviser, the appointment installs Bromley as a member of the President's "inner circle" of advisers, on the level with the national security adviser. His title will be Assistant to the President for Science and Technology.

Succeeding the former science adviser, William R. Graham, Jr., Bromley will also serve as director of the Office of Science and Technology Policy. Bromley is said to have close ties to President Bush and to have advised him on science issues during the presidential campaign.

Bromley is known for his influential work on the so-called "Packard-Bromley Report," issued by the White House Science Council in 1986. It was this report that prompted the Reagan Administration to call for a doubling of the budget of the National Science Foundation and spawned the idea of the Foundation's science and technology centers. The report also recommended substantially increased federal support for universities.

Bromley was a member of the White House Science Council throughout the Reagan Administration. He has also served on the advisory panels for the Department of Energy and the National Academy of Sciences, and is currently a member of the National Science Board, the policymaking body for the National Science Foundation. In addition, he is past president and former chairman of the American Association for the Advancement of Science and former president of the International Union of Pure and Applied Physics. Last year, he received the National Medal of Science, the highest scientific honor conferred by the government.

Born in Canada in 1926, Bromley received his doctorate at the University of Rochester. He joined the faculty of Yale in 1961 and was chairman of the physics department there from 1970 to 1977. Also the director of the Arthur W. Wright Nuclear Structure laboratory, he is internationally known for research in which atoms are bombarded with heavy ions to disclose the structure of the nuclei. Bromley's thesis adviser was also a science adviser to the President, George A. Keyworth, who served during the first term of the Reagan Administration.

National Academy of Engineering Council Elections

Members of the National Academy of Engineering (NAE) have re-elected three councillors to the Academy's governing Council. They will serve as councillors for three-year terms effective July 1, 1989. One of those re-elected is mathematical scientist Ralph E. Gomory, senior vice president for science and technology at IBM Corporation, Armonk, N.Y.

The Council is the governing body of the NAE and is composed of the president, chairman, vice-president, home secretary, foreign secretary, treasurer, and 12 other councillors–all elected by the membership.

Electronic Submission of Abstracts

Many members have requested that the AMS allow for electronic submission of abstracts for talks given at Society meetings. Currently, speakers must send to the AMS Providence office paper copies of their abstracts, which are then used for camera copy to produce the publication *Abstracts*.

The Society has now made it possible for speakers to submit their abstracts electronically in a form suitable for use in publishing *Abstracts*. This new service will prove a great convenience to the many who use the TEX typesetting system, and will also make the production of *Abstracts* faster and more efficient. Users may submit their abstracts in files that have been coded in plain TEX or *AMS*-TEX. In the near future, the AMS will also have the capability to accept abstracts coded in LATEX.

In order to submit abstracts electronically, individuals will need a package of four computer files, obtainable from the AMS office. Two of the files contain documentation explaining how the electronic submission system works. Another file consists of TEX macros which allow the user to TEX the abstract. The last file is essentially a "template" into which the user inserts the TEX-coded text of his or her abstract, together with other, non-TEX information (such as the speaker's affiliation, the place and date of the meeting, the type of lecture, etc.) used for office-processing of the abstracts.

Once the template file is complete and has been successfully processed with TEX, the user sends it to the AMS either in electronic mail or on an IBM or Macintosh diskette.

This service is now available, and can be used with abstracts of papers to be presented at the autumn sectional meetings of the AMS. Requests to obtain the package of files may be sent electronically on Internet to abs-request@math.ams.com. Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Rosanne Granatiero, American Mathematical Society, Publications Division, P.O. Box 6248, Providence, RI 02940, USA.

When requesting the Abstracts package, users should be sure to specify whether they want the plain TEX or the $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX package.

Algebra Conference to be Held in USSR

On August 21–26, 1989, an International Conference on Algebra will be held at the Institute of Mathematics at the Siberian Branch of the Soviet Academy of Sciences. The conference is in honor of the 80th anniversary of the birth of one of this century's distinguished algebraists, Academician A. I. Mal'tsev (1909–1967).

About 250 foreign participants from 30 countries are expected, along with about 500 Soviets. The largest foreign delegation will be from the U.S. (69 people). Among the American participants are Nathan Jacobson, Saunders Mac Lane, Victor Kac, Maurice Auslander, Michael Aschbacher, Hyman Bass, and Garrett Birkhoff. The list of paricipants includes: L. D. Faddeev, P. Cohn, I. M. Gel'fand, S. P. Novikov, V. P. Platonov, G. A. Margulis, J. Thompson, V. I. Arnol'd, M. Gromov, Yu. I. Manin, A. A. Suslin, I. R. Shafarevich, G. Gratzer, N. Gupta, A. I. Kostrikin, J. Los, Yu. G. Resbetnyak, D. K. Faddeev, B. Neumann, M. M. Lavrent'ev.

The conference will cover the following topics: group theory; ring theory; model theory and algebraic systems; algebraic methods in geometry, analysis, and theoretical physics; and applied and computer algebra. Considering its high scientific level, this conference promises to be an unprecedented event in algebra in the Soviet Union and may be the first all-world conference on the subject.

For more information, contact: Yu. L. Ershov, Chairman of the Organizing Committee; USSR Academy of Sciences; Order of Lenin; Siberian Branch; Institute of Mathematics; 630090 Novosibirsk, 90; University Avenue, 4; telephone 35-44-50.

News from the Mathematical Sciences Institute Cornell University

Wahlbin Appointed Associate Research Director

Cornell University mathematics Professor Lars B. Wahlbin has been appointed associate director of research for the Mathematical Sciences Institute (MSI).

The appointment, which is effective July 1, establishes a new position at a time when MSI is reorganizing at the recommendation of an advisory review committee. Wahlbin will assist and advise the director of MSI on research aspects of the institute, monitor the progress of funded projects and represent the director at meetings and on visits to Army installations.

Wahlbin, whose professional specialty is numerical analysis of partial differential equations, received his Ph.D. from the University of Goteborg, Sweden, in 1971 and became a Cornell professor in 1983. He also is the associate editor of *Mathematics of Computation.*

Wahlbin was acting director of the Center for Applied Mathematics from 1984 to 1985 and helped develop the proposal to bring MSI from the University of Wisconsin at Madison (where it was known as the Mathematics Research Center) to the Cornell campus. With the formal establishment of MSI here, he served as the coordinator of the Numerical Analysis and Computing program from 1985 to 1987 and has been named co-director of that program for the academic year 1989-1990.

Summer Workshops

The Mathematical Sciences Institute (MSI) at Cornell University plans an active summer centering around four major workshops.

The first workshop, "The Packing and Mechanics of Aggregates of Spheres," is scheduled for June 15–19 at Cornell and is organized by R. Connelly and J. T. Jenkins, Cornell. This workshop will bring together researchers working in the geometry and rigidity of regular and random packing of spheres, the numerical simulation of arrays of hard or elastic spheres, and the modeling of the mechanical behavior of idealized granular materials. The aim of the workshop is to explore possible applications of the geometry of frameworks, to indicate what has been proved and what is likely to be provable, and to attempt a more precise understanding of the process by which discrete mechanical systems can be modeled as continuous systems.

A workshop of "Feasible Mathematics," organized by S. Buss, University of San Diego and P. J. Scott, University of Ottawa, is scheduled for June 26–28. This workshop focuses on investigations of the logical and mathematical consequences of "bounded complexity" mathematics, for example, polynomial-time logic, algebra, and analysis.

From July 5–7, MSI will host a workshop on "Hardware Specification, Verification, and Synthesis: Mathematical Aspects." This workshop will present current research

into formal methods for hardware design, the goal of which is to develop methods for improving the design process and the quality of the resulting designs. The workshop is organized by M. Leeser and G. Brown, Cornell.

The last workshop of the summer will be on "Mathematical Theory of Modern Financial Markets" from July 19–22, and it will focus on how mathematical research can contribute to the understanding of financial markets. New mathematical approaches to understanding financial markets, which will be of interest primarily to researchers involved in probability and financial theory, will be addressed. Topics for discussion include: optimal consumption, portfolio management, and mathematical models of financial markets, including arbitrage and martingale measures. The workshop is organized by D. Heath, R. Jarrow, and K. Shell of Cornell and P. Artzner, Strasbourg.

CBMS Workshop Examines Math Education

In March, the heads of fifteen mathematics organizations met in Washington, DC to discuss the mathematics education system, from kindergarten through graduate school. "One of the most important things we can do is clean house internally and change the attitudes of members of our professional societies," said a draft report from the meeting. "We need to put more emphasis on the importance of teaching within our profession and improve attitudes of college mathematics departments toward teacher training."

The workshop was sponsored by the Conference Board of the Mathematical Sciences (CBMS), an umbrella organization linking a broad range of mathematics organizations, including the AMS, the Mathematical Association of America, the Society for Industrial and Applied Mathematics (as well as several other applied mathematics organizations), the Association for Women in Mathematics, the Association for Symbolic Logic, two statistical organizations, councils of mathematics teachers and supervisors, and several others. The intention of the workshop was to begin a discussion about what these organizations can do, individually or collectively, to promote excellence in mathematics education at all levels.

Part of the workshop focused on pipeline issues and explored ways to make mathematics an attractive course of study. "Business and industry and government agencies all concur that students need more math background," the report says. "They are the ones that can and should design [a] P.R. campaign." In discussing the issue of increasing the participation of women and minorities in mathematics, the report speaks of the subtle messages of discouragement that are sometimes sent to women students. "A well-meaning teacher [may give] a female student much less time to struggle with a solution to a problem or answer a question than he/she gives a male student," the report said. "Chivalry is not dead, but chivalry can kill self-esteem and confidence." The report also recommends various mechanisms for promoting greater participation of women and minorities in mathematics, such as "networking workshops" to connect women and minority students to prevent isolation, and an "aggressive speakers' bureau" to provide role models.

The workshop discussion of curricula was divided into three levels. At the school level, the participants discussed the School Mathematics Standards, recently released by the National Council of Teachers of Mathematics (see *Notices*, April 1989, page 380). The participants recommended that the CBMS member societies conduct discussions on the vision of school mathematics embodied in the Standards and promote the Standards among teachers, parents, educational policymakers, and the general public. Recommendations for curricula at the college level emphasized flexibility to allow for variation among different kinds of schools and among student needs. In addition, the report calls upon mathematical sciences departments and national organizations to "look outward and take aggressive initiatives" to influence policy decisions, communicate with other disciplines, and advertise the "variety and value" of mathematical study.

The discussion of curricula at the graduate level was divided between those who believe it needs revision and those who do not. However, it became clear in the discussion that there are a number of problems in the Ph.D. program in mathematics, such as narrowness, little emphasis on historical content and the uses of mathematics, and inadequate preparation for teaching. The participants were divided on whether these problems could be addressed through curricular change and felt hampered by the lack of data about graduate education in the mathematical sciences. They suggested that CBMS member societies obtain programmatic information on graduate education.

The workshop also included sessions on teaching methods, teachers, and the use of technology in mathematics education. AMS Executive Director William H. Jaco, one of the participants in the workshop, said that he found it very informative. "Despite the diversity of constituencies represented, there was a synergy of purpose and a very clear focus in the workshop," he said. He noted that it was useful for the various organizations to learn what the others were doing so that they could coordinate their programs and avoid duplication and conflict of effort.

According to CBMS Executive Director Ron Rosier, "One of the best things that came out of the workshop was to get people from the

research community more interested and involved in school mathematics," he said. "Getting to know those who are the movers in school mathematics is useful for the research community." "Certainly research mathematicians learned about what's going on in school mathematics and had an opportunity to meet some of the leaders from the related professional societies," said Jaco. "But it works the other way too. My impression is that those involved in school mathematics also gained by meeting interested research mathematicians and seeing that the research community can contribute to mathematics education at all levels."

The main product of the workshop will be the revised report, which should be available from the CBMS by the end of the summer. Inquiries should be directed to: Conference Board of the Mathematical Sciences, 1529 Eighteenth Street, N.W., Washington, DC 20036.

NSF-CBMS Regional Conferences in the Mathematical Sciences

In the announcement of these conferences in the March 1989 issue of *Notices*, it was indicated that further information on a tenth conference at the University of Miami would be announced at a future date. This conference has been cancelled.

Bernoulli Society Gift

At the beginning of the Business Meeting of the Society held in Phoenix in January 1989, the Soviet Committee of the Bernoulli Society for Mathematical Statistics and Probability, whose Chairman is Academician Yu. V. Prokhorov, presented the Society with one of the memorial medallions struck in commemoration of the First World Congress of the Bernoulli Society that was held in Tashkent, USSR, in 1986. This medallion was presented to the Society by the Secretary of the Soviet Committee, Boris Stechkin, member of the Steklov Institute, in honor of the Society's Centennial.

The Bernoulli Society for Mathematical Statistics and Probability, the only international society in its field, was founded in 1975 as a successor to the International Association for Statistics in the Physical Sciences. It is a section of the International Statistics Institute, which itself was established in 1885.

According to the brochure that accompanies the medallion, "the aim of the Bernoulli Society is the furtherance, by means of international contacts and international cooperative work, of the theory of probability, mathematical statistics, and their practical applications in all aspects of human activity, leading to the broadening of knowledge of nature and improvement of the condition of mankind."

The activity of the Bernoulli Society is carried out through a collection of standing active committees. The Society had 1368 members from 60 countries in 1986.

On the obverse side of the medallion, struck in bronze, is the likeness of Jacob Bernoulli (1654–1705), to whom is credited the establishment of the initial stages of probability theory. Associated with his name are not only the widely known results such as Bernoulli's formula and the law of large numbers in Bernoulli form, but also the classical definition of probability, the explicit formulation of the statistical definition of probability, the scheme of sequences of trials, the formula for computation of probability of complementary events, and some results in combinatorics which were necessary for the development of computational tools of probability. On the reverse side of the 11 cm in diameter medallion is the seal of the Bernoulli Society and (in Russian) the words: "1st International Congress of the Society of Mathematical Statistics and Probability Theory, Tashkent 1986, Bernoulli Society ISI."

The American Mathematical Society extends its thanks to the Soviet Committee of the Bernoulli Society for the beautiful medallion, to the Chairman of the Society Committee, Academician Prokhorov, and to Secretary Boris Stechkin for his personal presentation of the medallion to the Society. Currently the medallion graces the office of the Secretary, where members of the Society may view it.

–Robert Fossum, Secretary

Junior High School Math Exam

On December 1, 1988, almost 3700 schools and 243,000 students across the nation participated in the fourth annual American Junior High School Mathematics Examination (AJHSME).

The examination is designed to test not simply basic skills but also problem solving ability in a number of areas. In addition, the test is intended to stimulate interest in mathematics and to encourage mathematically talented students.

The average score on the AJHSME was 8.5 out of 25 possible points, and there were 44 perfect scores. Some of the top students were invited to participate in the American High School Mathematics Examination, which was held in late February. The high school test is the first of a sequence of examinations leading to the International Mathematical Olympiad, which will be held in West Germany in July.

This year's AJHSME will be held on November 30, 1989. For more information about the examination, contact Walter Mientka, Executive Director of AJHSME, Department of Mathematics and Statistics, University of Nebraska, Lincoln, NE 68588-0322.

Pizza Chain Expands Math Program

Domino's Pizza has announced an expanded version of its elementary and high school program, "Count on Domino's." The program was developed in conjunction with the National Council of Teachers of

Mathematics (NCTM) in response to the Standards for School Mathematics, released by the NCTM in March.

"Count on Domino's," now three years old, is a supplemental mathematics program targeting the development of students' problem solving and thinking skills. In the program, students participating in the program use sets of double-six dominoes to create and solve interesting mathematical problems. This year, the program will also include activities designed to emphasize the students' application of mathematics to real-life situations and to encourage the use of calculators.

"Math is very important in everyday life as well as in the functioning businessworld," said Tom Monaghan, founder and president of Domino's Pizza. "We are excited about Domino's Pizza's partnership with education and feel the private sector should contribute to the future of America."

Primary (K-7) and secondary (8-12) kits are available on a first-come, first-served basis to all mathematics teachers free of charge by calling 1-800-654-MATH. After students have completed their activities, teachers are encouraged to submit them to NCTM to be considered for publication in a "Count on Domino's" booklet, which will contain the best activities submitted.

Errata

The announcement of the NSF-CBMS Regional Conferences in the March 1989 issue of *Notices*, page 269, contained incorrect dates for the conference on Harmonic Analysis, Real Function Spaces and Related Areas at Auburn University. The correct dates are July 3–7, 1989. The conference was listed in the Mathematical Sciences Meetings and Conferences section in the March issue, and the subsequent April issue, under both dates.

Because of incorrect information provided to *Notices*, the article "National Science Foundation Budget Request for Fiscal Year 1990" (April 1989, page 359) incorrectly attributed some mathematical research funded by the Division of Mathematical Sciences at the NSF. The research was described in the Scientific Overview section of the budget request for the Division (page 362). The research centers on regions with fractal boundaries and utilizes computer experimentation to gain further intuition. The main result rigorously demonstrated that the dimension of the boundary can be recovered directly from analytic information. The NSF text incorrectly stated that this research is being carried out at the Georgia Institute of Technology. The research is the work of Michel L. Lapidus of the Department of Mathematics at the University of Georgia in Athens.

Funding Information for the Mathematical Sciences

NSF Geometry Initiative

In its fiscal 1990 Budget Request to Congress, the National Science Foundation (NSF) includes the following for the Division of Mathematical Sciences (DMS): "There has been a rapid expansion of the role of geometric ideas throughout mathematics and its applications. Within a planned increment of $1.25 million, particular attention will be paid to the critical need for increased training at all levels to support the integration of deep knowledge of geometry with that of other fields."

Although the disposition of this Budget Request is still unknown, the DMS is in the final stages of developing plans for a pilot project that would make use of the requested increase in funding in new ways. These new activities, tentatively entitled "Regional Geometry Institutes" (RGIs), will provide for a critical mass of research and educational activity within a framework that alerts participants to particularly important opportunities in the field and allows for frequent interaction with major research figures.

The RGIs are expected to incorporate two components, one aimed primarily at college and university-level faculty and graduate students, the other aimed at undergraduates, secondary school teachers and/or high school students. Participants will learn about the exciting geometric ideas relevant to the main theme of the RGI through lectures by leading research figures and strong expositors of mathematics. Self-organized seminars, interaction across the two components of the RGI, and individual or group research efforts may be part of the project.

More definitive information on the nature of this activity and a formal solicitation for proposals should be available sometime this summer. This activity represents the first formal venture into "vertical integration," an idea that has been under discussion by the Advisory Committee for the Mathematical Sciences and the DMS staff for the past three years. (See the article at the beginning of this issue of *Notices* for a synopsis of the Committee's last meeting.)

New Centers Competition Opens at NSF

The National Science Foundation (NSF) has announced a second competition in its Science and Technology Centers (STC) program. In the first round of awards, made late last year, two of the 11 STCs funded were in areas in the mathematical and computer sciences (see News and Announcements, *Notices*, February 1989, page 154; see also "NSF Budget Request for Fiscal 1990," *Notices*, April 1989, page 371). In its 1990 budget request to Congress, the NSF has asked for an increase for the STC program from the present level of $25 million to $45 million to fund an additional 8–10 centers.

The goal of the STC program is to fund research that requires the advantages of scale, duration, facilities, equipment, or collaboration that can only be provided by a campus-based research center. The program also seeks to address the nation's human resources needs in science and technology by promoting links between research and education. In addition, the STCs are designed to strengthen ties between academic institutions and industry in order to speed knowledge transfer.

Because of the range of research areas involved, the STCs vary in size and mode of operation. However, the NSF has developed certain guidelines for the organization of the STCs. Each Center must:

- have a unifying intellectual theme (multidisciplinary or within a single discipline)
- be based in an academic institution;
- be directed by academic faculty and integrated into academic programs;
- have tangible resource commitments from the home institution and collaborating institutions;
- provide a variety of education and research opportunities for students and faculty;
- promote significant intellectual exchanges among various institutions (e.g., government laboratories, industry, nonprofit organizations, state and local governments) to facilitate knowledge transfer.

Any U.S. academic institution with significant research and education programs in areas normally supported by the NSF is eligible for the program. Proposals

involving multi-institutional arrangements are encouraged, but a single institution must accept the overall management responsibility in dealing with the Foundation. The Center Director and the institution are responsible for developing an administrative structure that will enable the Director to provide scientific leadership and continue research and teaching.

The STC awards will be made as cooperative agreements with an initial commitment of 5 years but a potential life cycle of 11 years. The size of the Foundation's investment in each Center will depend upon the needs, plans, and opportunities of the Center as well as the availability of NSF funds. Proposed annual budgets for the STCs may range from $500,000 to $5 million. Though the NSF made several planning grants in the first competition, planning grants will not be made in the new round of awards.

To facilitate proposal processing, the NSF requests that the proposed STC Director send a letter notifying the NSF of his or her intent to submit a proposal. The letter, no more than 2 pages long, should contain the title, a brief summary describing the proposed research, and an indication of the major research fields involved in the proposed Center and the major participating institutions. The letters should be received at the NSF by **June 1, 1989**. Proposals must be received at the NSF by **5 p.m., August 4, 1989**.

Inquiries about the STC program may be addressed to: Office of Science and Technology Centers Development, National Science Foundation, 1800 G Street, N.W., Washington, DC 20550; telephone 202-357-9808; electronic addresses stc@note.nsf.gov (Internet) or stc@nsf (Bitnet); FAX number 202-357-9802.

NOMINATIONS FOR THE 1990 WIENER PRIZE

This prize of $4000, in honor of Norbert Wiener, is normally awarded every five years by the American Mathematical Society and the Society for Industrial and Applied Mathematics for an outstanding contribution to applied mathematics in the highest and broadest sense. The recipient must be a member of one of these societies and a resident of the U. S., Canada, or Mexico.

Nominations and suggestions by members of the mathematics community are eagerly sought. Please send them (hopefully with supporting documentation) to *each* of the following three people: I. M. Singer, Mathematics Department, Massachusetts Institute of Technology; E. H. Lieb, Mathematics Department, Princeton University; S. Smale, Mathematics Department, University of California, Berkeley.
The letters should arrive by *August 15, 1989.*

Meetings and Conferences of the AMS

FUTURE MEETINGS

Boulder, Colorado
August 7–10 583

Invited Speakers and Special Sessions 585

MAA Contributed Paper Sessions at Louisville 588

FUTURE CONFERENCES

Symposium on Some Mathematical Questions in Biology
University of Toronto, August 7 590

A New Way to View Mathematics

AMS-MAA Invited Addresses and ICM-86 Plenary Addresses
now on videotape!

Today's eminent mathematicians...

The AMS is now offering a selection of important mathematics lectures on videotape: Joint AMS-MAA Invited Addresses, presented at the January Joint Mathematics meetings, and Plenary Addresses presented at the International Congress of Mathematicians in August, 1986. The lecturers in these two series are among the world's most distinguished mathematicians.

...bring the subject to life

Because these lectures are intended to be expository and to appeal to a wide audience, the videotapes make excellent teaching tools. This medium communicates the excitement and enthusiasm for mathematics in a way that written material cannot. Students, teachers, and researchers will all appreciate these videotapes not only for their important mathematical content, but also for the historical perspective and personal touches the speakers bring to them.

Joint AMS-MAA Invited Addresses
VHS Format, approx. one hour,
Price $59 each

- ☐ *The European Mathematicians' Migration to America*, by Lipman Bers, Code VIDBERS/NA
- ☐ *Zoll Surfaces*, by Victor Guillemin, Code VIDGUILLEMIN/NA
- ☐ *Matrices I Have Met*, by Paul R. Halmos, Code VIDHALMOS/NA
- ☐ *Episodes in the Origins of the Representation Theory of Lie Algebras*, by Thomas Hawkins, Code VIDHAWKINS/NA
- ☐ *How Computers Have Changed the Way I Teach*, by John G. Kemeny, Code VIDKEMENY/NA
- ☐ *The Flowering of Applied Mathematics in America*, by Peter D. Lax, Code VIDLAX/NA
- ☐ *Oscar Zariski and His Work*, by David Mumford, Code VIDMUMFORD/NA

ICM-86 Plenary Addresses
VHS Format, approx. one hour,
Price $49 each

- ☐ *Geometry of four-manifolds*, by Simon K. Donaldson, Code VIDDONALDSON/NA
- ☐ *Underlying concepts in the proof of the Bieberbach conjecture*, by Louis de Branges, Code VIDDEBRANGES/NA
- ☐ *Recent progress in arithmetic algebraic geometry*, by Gerd Faltings, Code VIDFALTINGS/NA
- ☐ *Soft and hard symplectic geometry* by Mikhael Gromov, Code VIDGROMOV/NA
- ☐ *Efficient algorithms in number theory*, by Hendrik W. Lenstra, Code VIDLENSTRA/NA
- ☐ *New developments in the theory of geometric partial differential equations*, by Richard M. Schoen, Code VIDSCHOEN/NA
- ☐ *Classifying general classes*, by Saharon Shelah, Code VIDSHELAH/NA
- ☐ *Complexity aspects of numerical analysis*, by Stephen Smale, Code VIDSMALE/NA
- ☐ *Problems in harmonic analysis related to oscillatory integrals and curvature*, by Elias M. Stein, Code VIDSTEIN/NA
- ☐ *Representations of reductive Lie groups*, by David A. Vogan, Jr., Code VIDVOGAN/NA
- ☐ *String theory and geometry*, by Edward Witten, Code VIDWITTEN/NA
- ☐ Also available from ICM-86: Addresses on the Work of the 1986 Fields Medalists and Nevanlinna Prize Winner (These four talks are on one tape.) Code VIDMEDAL/NA

  On the work of Simon K. Donaldson, Fields Medalist, by Michael F. Atiyah; *On some of the mathematical contributions of Gerd Faltings*, Fields Medalist, by Barry Mazur; *On the work of Michael Freedman*, Fields Medalist, by John W. Milnor; *On the work of Leslie G. Valiant*, Nevanlinna Prize Winner, by Volker Strassen

PREPAYMENT REQUIRED. Order from American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571 USA or call (800) 556-7774 in the continental U.S. to charge on VISA or MasterCard. All prices are subject to change without notice. Please add shipping & handling: 1st video $2, each add'l $1, max. $25; by air, 1st video $5, each add'l $3, max. $100.

Boulder Meetings
August 7 – 10, 1989

Supplement to Announcement in April Notices

Please refer to the Preliminary Announcement for this meeting which appears on pages 439 – 476 of the April 1989 issue of *Notices*. The Table of Contents and Important Deadlines from the preliminary announcement are reproduced below for convenience. The forms for Preregistration/Housing, MAA Minicourses, and the Summer List of Applicants are located at the back of this issue.

WHERE TO FIND IT	PAGE
HOW TO PREREGISTER	447
HOW TO OBTAIN ACCOMMODATIONS	448
AMS-MAA-ΠME INVITED ADDRESS	439
AMS-MAA INVITED ADDRESSES	439
SUMMER MEETING OF THE AMS	440
Progress in Mathematics Lectures, Colloquium Lectures, Prizes, Invited Addresses, Special Sessions, Contributed Papers, Council, Business Meeting	
OTHER JOINT AMS-MAA SESSIONS	441
AMS SHORT COURSE	473
SUMMER MEETING OF THE MAA	441
Hedrick Lectures, Invited Addresses, Minicourses, Contributed Papers, Student Papers, Other Sessions, Business Meeting, Board of Governors, Section Officers, Banquet for 25-Year Members	
OTHER ORGANIZATIONS	446
AWM, JPBM, ΠME	
TIMETABLE	463
OTHER EVENTS OF INTEREST	446
Book Sales, AMS Information Booth, Exhibits, Handout Table, Petition Table, Summer List of Applicants	
REGISTRATION AT THE MEETINGS	456
Fees, Dates, Times, Services	
MISCELLANEOUS INFORMATION	458
Athletic Facilities, Camping and RV Facilities, Car Rental, Child Care, Handicapped, Libraries, Local Information, Medical Services, Parking, Smoking, Social Events, Tour, Travel, Weather	
MAPS	450, 451, 455

AMS Short Course

The timetable published in the April issue of *Notices* had incorrect information for the AMS Short Course schedule on Monday, August 7. It should have been as follows:

8:00 a.m. – 9:15 a.m. KEVIN S. MCCURLEY, *Discrete logarithms*

9:30 a.m. – 10:45 a.m. ANDREW M. ODLYZKO, *The rise and fall of knapsack cryptosystems*

2:30 p.m. – 3:45 p.m. JEFFREY C. LAGARIAS, *Pseudo-random number generators in cryptography and number theory*

3:45 p.m. – 4:15 p.m. Discussion Period

AMS Special Sessions

The special session on *Computational number theory and applications* will now meet on Tuesday 8:00 a.m.,

IMPORTANT DEADLINES

AMS Abstracts	
For consideration for special sessions	**Expired**
Of contributed papers	**Expired**
MAA Abstracts	
Of contributed papers	**Expired**
Summer List of Applicants	**June 1**
Preregistration and Housing	**June 1**
MAA Minicourse Preregistration	**June 1**
Motions for AMS Business Meeting	**July 7**
MAA Banquet (50% refund)	**July 14**
Western Hoe Down (50% refund)	**July 14**
ΠME Banquet (50% refund)	**July 14**
Rocky Mountain National Park Tour (50% refund)	**July 14**
Hotel Changes and Cancellations	**July 17**
Residence Hall Package Cancellation (90% refund)	**July 17**
Preregistration Cancellations (50% refund)	**July 31**

Wednesday 8:00 a.m. and 1:15 p.m., Thursday 8:00 a.m. and 3:00 p.m.

The special session on *Free boundary problems and partial differential equations* will now meet on Tuesday 8:00 a.m., Wednesday 8:00 a.m. and 1:15 p.m., Thursday 8:00 a.m. and 4:30 p.m.

MAA Invited Address

LINDA KEEN has changed the title of her invited address to *Iterating rational maps and automorphisms of the Bernoulli shift.*

MAA Video

On Tuesday, August 8, at 2:30 p.m. a 30-minute video by LORRAINE L. FOSTER, California State University, North Ridge, will be shown. The video is titled *Finite symmetry groups in three dimensions.*

Rocky Mountain National Park Tour

Please note that since the Rocky Mountain Tour will take place before the Meeting Registration Desk opens, tickets cannot be distributed. A staff member will be present at the boarding location for the bus to check off participants as they board. **The bus leaves from the UMC building at 9:00 a.m.** Please call the AMS office if you have any further questions.

Those participants who plan to go on the tour who have a Golden Eagle Passport do not have to pay the $2 admission fee to the park for themselves or for members of their immediate family. A Golden Eagle Passport can be purchased at any U.S. National Park and entitles the holder, while it is valid, to free admission to all National Parks.

Accommodations

The university room and board rates given in the Preliminary Announcement include the correct amount of tax. The tax rates as stated in the Preliminary Announcement, however, are incorrect. The rate on the board portion is 6.43% and on the room portion 9.4%.

The Holiday Inn reports that it has a restaurant, lounge, indoor recreation center that includes indoor swimming, pool, jacuzzi, sauna, game room, and exercise room.

Andy Roy Magid
Associate Secretary
Norman, Oklahoma

Invited Speakers and Special Sessions

Invited Speakers at AMS Meetings

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

Boulder, August 1989

Maury D. Bramson
Haim Brezis
(Progress in Mathematics Lecture)
John H. Conway
(AMS-MAA)
Persi Diaconis
(Hedrick Lecture)
Joseph A. Gallian
(AMS-MAA-PME)
Shizuo Kakutani
(AMS-MAA)
Serge Lang (AMS-MAA)
Howard A. Masur
Dusa McDuff
(Progress in Mathematics Lecture)
Jean E. Taylor
(AMS-MAA)
William P. Thurston
(Colloquium Lectures)

Hoboken, October 1989

Russel Caflisch
Fang Hua Lin
Bruce P. Kitchens
Sheldon E. Newhouse

Muncie, October 1989

Laszlo Lempert
Kenneth R. Meyer
Paul S. Muhly
Steven Sperber

Los Angeles, November 1989

Burton I. Fein
Nicolas Spaltenstein
Stephen M. Gersten
Thomas H. Wolff

Louisville, January 1990

Sun-Yung Alice Chang
George B. Dantzig
(Gibbs Lecture)
Israel C. Gohberg
Mike Hopkins
Henryk Iwaniec
Janos Kollar
Israel M. Sigal
Shlomo Sternberg
(Colloquium Lectures)

Organizers and Topics of Special Sessions

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

August 1989 Meeting in Boulder
Associate Secretary: Andy Roy Magid
Deadline for organizers: Expired
Deadline for consideration: Expired

Richard A. Askey, *History of orthogonal polynomials*
George J. Fix and Rangabhary Kannan, *Mathematical questions in computational geometry*
Kirk E. Lancaster and Edward W. Stredulinsky, *Free boundary problems and partial differential equations*
Howard A. Masur and John Smillie, *Dynamics and moduli space*
Kevin S. McCurley, *Computational number theory and applications*

October 1989 Meeting in Hoboken
Eastern Section
Associate Secretary: W. Wistar Comfort
Deadline for organizers: Expired
Deadline for consideration: July 26, 1989

Prabir Bhattacharya and Robert A. Melter, *Geometry related to computer vision*
Stephen L. Bloom, *Algebraic semantics*
Russel Caflisch, *Mathematical fluid dynamics*
Mark E. Feighn, Lee D. Mosher and Ulrich Oertel, *Low-dimensional topology*
Bruce P. Kitchens and Sheldon E. Newhouse, *Smooth dynamical systems*
Richard N. Lyons and Richard O'Nan, *Finite groups*
Charles C. Sims, *Computational algebra*
Marvin D. Tretkoff, *Algebraic geometry, p-adic aspects*

October 1989 Meeting in Muncie
Central Section
Associate Secretary: Andy Roy Magid
Deadline for organizers: Expired
Deadline for consideration: July 26, 1989

Alan Adolphoson and Steven Sperber, *Number theory and algebraic geometry*
David E. Barrett and Laszlo Lempert, *Complex analysis*
Ananda Gubbi, *Extremally disconnected spaces and their applications*
Darrell E. Haile, *Noncommutative algebra in geometry and arithmetic*
David R. Larson, *Triangular operator algebras*
Ali Masoom, *Statistics and probability*
Kathryn Frost Porter, *Function spaces and topology*
John F. Porter and T. K. Puttaswamy, *Differential equations*

November 1989 Meeting in Los Angeles
Far Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: July 26, 1989

Roger C. Alperin and Karen Vogtmann, *Geometric methods in combinatorial group theory*
James P. Lin, *Algebraic topology*
David J. Saltman and Murray M. Schacher, *Quadratic forms and simple algebras*
Thomas H. Wolff, *Harmonic analysis*

January 1990 Meeting in Louisville
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: September 21, 1989

Sun-Yung Alice Chang, *Geometry and analysis*
Robert S. Doran, *Group representations and operator algebra*
Bruce R. Ebanks, *Functional equations and applications*
Israel C. Gohberg, *Linear operators, matrix functions and control*
Mike Hopkins, *To be announced*
Henryk Iwaniec, *To be announced*
Gary D. Jones, *Oscillation theory in ordinary differential equations*
Victor J. Katz, *History of mathematics*
Janos Kollar, *The structure of algebraic threefolds*
Ralph D. Kopperman, *Topology in computer graphics and image processing*
Suzanne Marie Lenhart, *Control of infinite dimensional systems*
Peter A. McCoy, *Semi-group theory*
Paul S. Muhly, *Multivariable operator theory*
Israel M. Sigal, *The Schrodinger Equation*
Ted J. Suffridge, *Geometric function theory in one and several complex variables*
Jay S. Treiman, *Optimization and nonlinear analysis*
W. Wiley Williams, *Function theoretic methods in differential equations*

March 1990 Meeting in Fayetteville, Arkansas
Southeast Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: June 22, 1989
Deadline for consideration: To be announced

March 1990 Meeting in Manhattan, Kansas
Central Section
Associate Secretary: Andy Roy Magid
Deadline for organizers: June 15,1989
Deadline for consideration: To be announced

April 1990 Meeting in University Park, Pennsylvania
Northeast Section
Associate Secretary: W. Wistar Comfort
Deadline for organizers: July 14, 1989
Deadline for consideration: To be announced

August 1990 Meeting in Columbus
Associate Secretary: W. Wistar Comfort
Deadline for organizers: November 15, 1989
Deadline for consideration: To be announced

November 1990 Meeting in Denton
Central Section
Associate Secretary: Andy Roy Magid
Deadline for organizers: February 15, 1990
Deadline for consideration: To be announced

Information for Organizers

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

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

Each Invited Speaker is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the Program Committee or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an *ex-officio* member of the committee and whose address may be found below). These proposals must be in the hands of the Program Committee well in advance of the meeting and, in any case, at least nine (9) months prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Proposals that are sent to the Providence office of the Society, to *Notices*, or directed to anyone other than the Associate Secretary will have to be forwarded and may not be received in time to be considered for acceptance.

It should be noted that Special Sessions must be announced in *Notices* in such a timely fashion that any member of the Society who so wishes may submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration. This deadline is usually three (3) weeks before the Deadline for Abstracts for the meeting in question.

Special Sessions are very effective at Sectional Meetings and can usually be accommodated. They are selected by the Committee to Select Hour Speakers for the Section. The processing of proposals for Special Sessions for Sectional Meetings is handled by the Associate Secretary for the Section, who then forwards the proposals to the Committee to Select, which makes the final selection of the proposals. Each Invited Speaker at a Sectional Meeting is invited to organize a Special Session. Just as for national meetings, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline, after which members can no longer send abstracts for consideration for presentation in that Special Session.

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

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

Send Proposals for Special Sessions to the Associate Secretaries

The programs of sectional meetings are arranged by the Associate Secretary for the section in question:

Far Western Section (Pacific and Mountain)

Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
(Telephone 619-534-3590)

Central Section

Andy Roy Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
601 Elm PHSC 423
Norman, OK 73019
(Telephone 405-325-2052)

Eastern Section

W. Wistar Comfort, Associate Secretary
Department of Mathematics
Wesleyan University
Middletown, CT 06457
(Telephone 203-347-9411)

Southeastern Section

Joseph A. Cima, Associate Secretary
Department of Mathematics
University of North Carolina, Chapel Hill
Chapel Hill, NC 27599-3902
(Telephone 919-962-1050)

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

Information for Speakers

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

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Editorial Department, American Mathematical Society, P. O. Box 6248, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline

for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Number of Papers Presented
Joint Authorship

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

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

MAA Contributed Paper Sessions at Louisville

This early preliminary announcement of the Louisville meeting is made to encourage members' participation and to provide lead-time for organizing the sessions on contributed papers. The meeting will be held January 17–20 (Wednesday–Saturday), 1990. Past President Leonard Gillman will give his Retiring Presidential Address at this meeting. In addition, there will be other invited addresses, Joint AMS-MAA addresses, minicourses and various panel discussions.

Contributed papers are being accepted on several topics in collegiate mathematics. The topics, organizers, their affiliations, and the days they will meet are:

- *Prognostic and diagnostic testing: Helping high school students get ready for college-level mathematics*, sponsored by the Committee on Placement Examinations–BERT K. WAITS, Ohio State University. Wednesday and/or Thursday. Papers are invited that describe local, regional, or statewide projects that give college mathematics placement tests to high school students (like the Ohio Early College Mathematics Placement Testing Program–EMPT), or projects that give high school students diagnostic tests to help them prepare for college-level mathematics (like the California Mathematics Diagnostic Testing Project), or other programs or projects designed to improve the mathematics articulation from high school to college.
- *Recent developments in placement*–ELIZABETH J. TELES, Montgomery College, Maryland and RAY E. COLLINGS, Tri-County Technical College, South Carolina, Friday and/or Saturday. Papers are sought describing placement procedures in colleges and universities for entry level mathematics courses beyond local efforts. The focus of the session will be on regional, state, and national initiatives.
- *Discrete mathematics: Has the bubble burst?*–MARTHA J. SIEGEL, Towson State University, Maryland, Wednesday and/or Thursday. Presentations on the teaching of discrete mathematics in the first two years are welcome. Special consideration will be given to papers which emphasize innovative and successful courses for freshman or sophomore mathematics and computer science majors. Curricula integrating the discrete component into the calculus sequence or courses emphasizing discrete models are of special interest. The organizers will aim for diversity in choosing the program.
- *Classic classroom calculus problems*–ANTHONY BARCELLOS, American River College, California, Friday and/or Saturday. Every calculus teacher has favorite examples that he or she manages to present in an interesting way. We invite you to share your examples and insights with us.
- *A core in mathematics*–KAY B. SOMERS, Moravian College, Pennsylvania, Friday and/or Saturday. This session will focus on approaches taken to provide a base in mathematics for college undergraduates. Information on particular courses and ways to present specific topics are encouraged. Topics to be discussed can include, but are not limited to, the following: quantitative problem solving, interdisciplinary courses incorporating mathematics, introductory mathematical

modeling, historical perspectives in mathematics, graphical presentations across disciplines, the role of data analysis in a mathematics core.

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes. Individuals wishing to submit papers for any of these sessions should send the following information to the MAA Washington office at 1529 Eighteenth Street, NW, Washington, DC 20036 **by September 28**:

1. Title
2. Intended session
3. A one-paragraph abstract (for distribution at the meeting)
4. A one-page outline of the presentation

Rooms where sessions of contributed papers will be held are equipped with overhead projector and screen. Blackboards are not available. Persons having other equipment needs should contact the secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403) as soon as possible, but in any case prior to **November 1**. Upon request, the following will be made available: one additional overhead projector/screen, 35mm carousel slide projector, 16mm film projector, or VHS video cassette recorder with one color monitor.

Symposium on Some Mathematical Questions in Biology
Toronto, Canada
August 7, 1989

The twenty-third annual Symposium on Some Mathematical Questions in Biology on *Sex allocation and sex change: Experiments and models* will be held on August 7, 1989, during the annual meeting of the American Institute of Biological Sciences (AIBS), August 6–10, 1989. The symposium is sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics, and the Society for Mathematical Biology.

The AMS-SIAM Committee on Mathematics in the Life Sciences serves as the Organizing Committee for the symposium. The committee consisted of Kenneth L. Lange, Michael C. Mackey, Marc Mangel (Organizer), Hans G. Othmer, Alan S. Perelson, Richard E. Plant (Chairman), and John Rinzel.

The theme of the symposium is *Sex allocation and sex change: Experiments and models.* There will be two half-day sessions, each including one-hour lectures.

For further information, contact Betty Verducci, Conference Coordinator, AMS, P.O. Box 6248, Providence, RI 02940, E-mail: BAV@MATH.AMS.COM.

Program

Chairman: Marc Mangel

9:00 a.m.–Presiding: MARC MANGEL, University of California, Davis

The adaptive advantage of sexual reproduction in plants. PAULLETTE BIERZYCHUDEK, Pomona College

Natural selection and allocation to sexual reproduction in flowering plants. MAUREEN STANTON, University of California, Davis

Population genetics of sex allocation. SABIN LESSARD, University of Montreal

2:00 p.m.–Presiding: MARC MANGEL, University of California, Davis

Sex change in terrestrial slugs: Social and ecological factors. DONNA FERNANDES, University of Liverpool

Dynamics of sex change in Capitellid polychaetes. PETER PETRAITIS, University of Pennsylvania

Sex allocation in simultaneous hermaphrodites. CHRIS PETERSEN, Friday Harbor Laboratories and University of Toronto

Male allocation and the cost of sex under local family competition. CURT LIVELY, Rutgers University

1989 AMS Elections

Council Nominations

Vice-Presidents and Members-at-Large

Two vice-presidents and five members-at-large of the Council will be elected by the Society in a contested election in the fall of 1989.

Vice-presidents will serve for a term of two years effective January 1, 1990. The Council has nominated four candidates for the two positions, namely:

James G. Arthur	James B. Serrin
Phillip A. Griffiths	Dennis P. Sullivan

The five members-at-large will serve for a term of three years. The Council nominated seven candidates. They are:

Joan S. Birman	Edwin E. Floyd
Frank H. Clarke	Carl Pomerance
Charles Herbert Clemens	Shing-Tung Yau
Amassa G. Fauntleroy	

The Council plans to name additional candidates for member-at-large to bring their number to at least ten.

The deadline for petitions proposing additional nominations is July 6. Such proposals will not reach the Council for action by mail ballot until after that date.

President's Candidates

Nominating Committee

Three members of the Nominating Committee are to be elected in the fall of 1989 to serve for a term of three years. Continuing members are:

Joan S. Birman	Victor Klee
James E. Humphreys	Alan D. Weinstein

Two members to be named by the President.

President William Browder has named five of the six candidates for the other three places. They are:

Sylvain E. Cappell	Ray A. Kunze
Robert M. Hardt	Paul C. Roberts
Barbara Lee Keyfitz	

If nominations by petition have not appeared bringing the total number of candidates to at least six, it will be brought up to six by the President.

Editorial Boards Committee

Two members of the Editorial Boards Committee are to be elected in the fall of 1989 to serve for a term of three years. Continuing members are:

Haynes R. Miller	Daniel Zelinsky
Richard M. Schoen	

President William Browder has named two of the four candidates for the other two places. They are:

Andrew M. Odlyzko	Barry Simon

If nominations by petition have not appeared bringing the total number of candidates to at least four, it will be brought up to four by the President.

Robert M. Fossum
Secretary
Urbana, Illinois

Nominations by Petition

Vice-President or Member-at-Large

Nominations by petition for the positions of vice-president and member-at-large of the Council, in the manner described in the rules and procedures, are acceptable.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions. The Council of 20 January 1987 established a policy that, beginning with the interval 1987–1996, the Council intends to approve no more than two nominations by petition of the same individual in any ten year period.

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

Nominating Committee or Editorial Boards Committee

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

Rules and Procedures

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

1. To be considered, petitions must be addressed to Robert M. Fossum, Secretary, P.O. Box 6248, Providence, Rhode Island 02940, and must arrive by 6 July 1989.

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

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

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

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

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

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

NOMINATION PETITION FOR 1989 ELECTION

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

_____

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

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

of the American Mathematical Society for a term beginning 1 January, 1990; or 1 September, 1990, in the case of member of the Nominating Committee.

Name and Address (printed or typed, or *Notices* mailing label)	Signature
	Signature
	Signature
	Signature
	Signature
	Signature
	Signature

Mathematical Sciences Meetings and Conferences

1988-1989. **Academic Year Devoted to Operator Algebras**, Mittag-Leffler Institute, Djursholm, Sweden. (Feb. 1988, p. 307)

October 1988–August 1989. **Symposium on Singularity Theory and Its Applications**, University of Warwick, Coventry, United Kingdom. (May/June 1988, p. 724)

1989. **40th Anniversary of Kansas Gamma of Pi Mu Epsilon**, Wichita State University, Wichita, KS. (Jan. 1989, p. 63)

1989. **Concentration Year on Fluid Dynamical Aspects of Combustion Theory**, Instituto Per Le Applicazioni Del Calcolo, Rome, Italy. (Jan. 1989, p. 63)

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

January 1–December 23, 1989. **Mathematisches Forschungsinstitut Oberwolfach** (Weekly Conferences), Federal Republic of Germany. (Apr. 1988, p. 629 and Nov. 1988, p. 1381)

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

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

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

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

June 1989

* **IMACS International School on Lyapunov Functions**, Irkutsk, USSR.

INFORMATION: V. M. Matrosov, Director of the Irkutsk Computing Center, Siberian Branch, Union of Soviet Socialist Republics Academy of Sciences, Lermontov Str. 134, 664033 Irkutsk, USSR.

NSF-CBMS Conference on Function Estimation in the Context of Independent and Dependent Observations, University of California, Davis, CA. (Apr. 1989, p. 489)

1–3. **Annual Summer Meeting of the Canadian Mathematical Society**, University of Windsor, Windsor, Ontario, Canada. (Mar. 1989, p. 306)

1–10. **Third Annual Meeting of the International Workshop In Analysis and Its Applications**, Dubrovnik-Kupari, Yugoslavia. (Oct. 1988, p. 1243)

2–5. **Seminar on Fractional Calculus**, Nihon University, Koriyama, Japan. (Feb. 1989, p. 177)

3–August 5. **Joint AMS-IMS-SIAM Summer Research Conferences in the Mathematical Sciences**, Humbolt State University, Arcata, CA.

INFORMATION: C. Kohanski, AMS, P.O. Box 6248, Providence, RI 02940.

4–8. **1989 IEEE International Conference on Computer Vision and Pattern Recognition**, San Diego, CA. (Oct. 1988, p. 1243)

4–9. **Geometrical and Algebraical Aspects in Several Complex Variables**, Cetraro (CS), Italy. (Nov. 1988, p. 1385)

4–30. **1989 Complex Systems Summer School**, Santa Fe, NM. (Jan. 1989, p. 67)

5–7. **An International Symposium on Asymptotic and Computational Analysis**, Winnipeg, Manitoba, Canada. (Sept. 1988, p. 1059)

5–8. **International Colloquium on Complex Analysis and Sixth Romanian-Finnish Seminar**, University of Bucharest, Romania. (Dec. 1988, p. 1588)

5–8. **Fourth Annual Symposium on Logic in Computer Science (LICS)**, Asilomar, CA. (Oct. 1988, p. 1244)

5–9. **International Symposium on Bayesian Decision Theory**, Sherbrooke, Canada. (Jan. 1989, p. 67)

5–9. **Chaos and the Microcomputer**, Salisbury State University, Salisbury, MD. (Jan. 1989, p. 67)

5–9. **Conference in Mathematical Analysis in Honor of the Memory of Jose Luis Rubio de Francia**, El Escorial, Spain. (Feb. 1989, p. 178)

5–10. **Colloque International sur La Theorie du Point Fixe et Ses Applications**, France. (Apr. 1989, p. 489)

5–10. **Analytic Number Theory**, Centre de recherches mathématiques, Université de Montréal, Montréal, Quebec, Canada. (Please note date change from Sept. 1988, p. 1059)

5–10. **William H. Roever Lectures in Geometry, and Algebraic Geometry Conference**, Washington University, Saint Louis, MO. (Mar. 1989, p. 306)

5–10. **Theorie du Point Fixe et Applications**, Marseille, France. (Feb. 1989, p. 178)

5–16. **Workshop on the Geometry of Hamiltonian Systems**, Mathematical Sciences Research Institute, Berkeley, CA. (Apr. 1988, p. 638)

6–8. **Fourth International Conference on Boundary Element Technology**, Windsor, Ontario, Canada. (Sept. 1988, p. 1059)

7–9. **Canadian Applied Mathematics Society Tenth Annual Meeting**, Winnipeg, Canada. (Sept. 1988, p. 1059)

7–10. **International Conference on Differential Equations: Theory and Applications in Stability and Control**, University of Colorado at Colorado Springs and The Colorado College, Colorado Springs, CO. (Nov. 1988, p. 1385)

8–10. **1989 NCGA Arts Conference**, San Jose University, San Jose, CA. (Apr. 1989, p. 489)

8–16. **Singapore Probability Conference**, National University of Singapore, Republic of Singapore. (Nov. 1988, p. 1385)

11–14. **SRCOS-ASA Summer Research Conference**, Unicoi State Park, GA. (Jan. 1989, p. 67)

*12–16. **CAL: Mathematics Teaching and Learning Environment**, Messiah College, Grantham, PA.

SPONSORS: Messiah College and the Eastern Pennsylvania and Delaware Section of the MAA.
INVITED SPEAKER: J. White, Kenyon College.
INFORMATION: M. Brubaker, Department of Mathematics, Messiah College, Grantham, PA 17027, 717-766-2511.

12–16. **NSF-CBMS Conference on Projection Pursuit and Related Computationally Intensive Techniques for Analyzing Mulitivariate Data**, George Washington University, Washington, DC. (Mar. 1989, p. 307)

12–16. **Greco Calcul Formel**, Marseille, France. (Feb. 1989, p. 178)

12–16. **Decision Making and the Microcomputer**, Salisbury State University, Salisbury, MD. (Jan. 1989, p. 67)

12–16. **Computers and Mathematics**, MIT, Cambridge, MA. (July/Aug. 1988, p. 894)

12–17. **Conference on the Geometry of Banach Spaces**, Strobl on Wolfgangsee, Austria. (Oct. 1988, p. 1244)

*12–23. **Summer School on Numerical Analysis**, Centre d'Etudes du Breau-sans-Nappe, Ablis, France.

INVITED SPEAKERS: G. Gouesbet; V. H. Ransom; P. J. O'Rourke.
INFORMATION: Secretariat Général des Ecoles d'Eté, E.D.F., 1, avenue du Général de Gaulle, 92140 Clamart, France. Telephone: (1) 47 65 43 06.

12–July 8. **Summer Conference on Complex Analysis**, Bordeaux, France. (Feb. 1989, p. 178)

13–15. **Third Chico State Western States Topology Conference**, California State University, Chico, Chico, CA. (Feb. 1989, p. 178)

13–17. **Mathematical Modeling**, Northern Illinois University, DeKalb, IL. (Mar. 1989, p. 307)

14–17. **International Conference on Dynamical Systems, Control Theory, and Applications**, Wright State University, Dayton, OH. (Oct. 1988, p. 1244)

15–17. **Northeast Conference on General Topology and Applications**, CUNY, The College of Staten Island, Staten Island, NY. (Jan. 1989, p. 67)

15–18. **Third Boston Workshop for Mathematics Faculty**, Wellesley College, Wellesley, MA. (Feb. 1989, p. 178)

15–19. **Workshop on the Packing and Mechanics of Aggregates of Spheres**, Cornell University, Ithaca, NY. (Mar. 1989, p. 307)

15–23. **CIME Course on Methods of Nonconvex Analysis**, Villa Monastero, Varenna Lake (Lake of Como), Italy. (Jan. 1989, p. 67)

18–22. **Research Application Conference on Scientific Issues in Quantitative Cancer Risk Assessment**, Societal Institute of the Mathematical Sciences, New Canaan, CT. (Apr. 1989, p. 490)

18–24. **Reelle Analysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1989, p. 178)

18–24. **Conference on Nonlinear Analysis**, Academia Sinica, Taiwan, Republic of China. (Feb. 1989, p. 179)

19–20. **IFAC/IMACS Workshop on Computer-Aided Control Systems Design**, Alma-Ata, USSR. (Mar. 1989, p. 307)

19–21. **Bar-Ilan Symposium on the Foundations of Artificial Intelligence**, Bar-Ilan University, Ramat Gan, Israel. (Feb. 1989, p. 179)

19–22. **Fourth Annual Conference on Structure in Complexity Theory**, University of Oregon, Eugene, OR. (Dec. 1988, p. 1588)

*19–23. **Short Course on Chaos and Dynamical Systems**, University of Maine, Orono, ME.

SPONSORS: The Conferences and Institutes Division, University of Maine, and the Northeast Section of the MAA.
CONFERENCE TOPICS: Chaos; iteration; Julia Sets; the Mandelbrot set; fractals; attractors; elementary bifurcation theory.
INFORMATION: C. W. Dodge, Mathematics Department, University of Maine, Orono, ME 04469, 207-581-3908.

19–23. **1989 International Symposium on the Mathematical Theory of Networks and Systems (MTNS-89)**, Amsterdam, The Netherlands. (Oct. 1988, p. 1244)

19–24. **Harmonizable Fields and Related Topics**, Marseille, France. (Feb. 1989, p. 179)

19–July 14. **US-USSR Algebraic Geometry Symposium**, The University of Chicago, Chicago, IL. (Mar. 1989, p. 308)

20–22. **1989 National Educational Computing Conference (NECC '89)**, Boston, MA. (Oct. 1988, p. 1244)

21–23. **Thirty-second Meeting of the Society for Natural Philosophy on Geometrical and Toplogical Methods in Mechanics**, Calgary, Canada. (Dec. 1988, p. 1588)

25–28. **Western Regional Meeting of the Biometric Society (WNAR) and the Institute of Mathematical Statistics**, Davis, CA. (Jan. 1989, p. 68)

25–30. **1989 MAA North Central Section Summer Conference on the Mathematics**

of Computer Graphics, Carleton College, Northfield, MN. (Apr. 1989, p. 490)

25–30. **NSF-CBMS Conference on Circuit Complexity**, University of Chicago, Chicago, IL. (Mar. 1989, p. 308)

25–July 1. **18th Conference on Stochastic Processes and Their Applications**, University of Wisconsin-Madison, Madison, WI. (Jan. 1989, p. 68)

26–28. **Workshop on Feasible Mathematics**, Cornell University, Ithaca, NY. (Mar. 1989, p. 308)

26–28. **Qualitative Theory of Vector Fields**, Centre de Recherches Mathématiques (CRM) Université de Montréal, Montreal, Quebec, Canada. (Jan. 1989, p. 68)

26–29. **IFAC/IMACS/IFIP Symposium on Control of Distributed Parameter Systems**, Perpignan, France. (Mar. 1989, p. 308)

26–29. **ICOSAHOM '89: International Conference on Spectral and High Order Methods for Partial Differential Equations**, Como, Italy. (Feb. 1989, p. 179)

26–30. **NSF-CBMS Conference on Scientific Computation**, Butler University, Indianapolis, IN. (Mar. 1989, p. 308)

26–30. **Short Course on the Mathematics of Computer Graphics**, Carleton College, Northfield, MN. (Mar. 1989, p. 308)

26–30. **AAECC-7 International Conference**, P. Sabatier University, Toulouse, Toulouse, France. (Mar. 1989, p. 308)

26–30. **Centenaire Halpen**, Marseille, France. (Feb. 1989, p. 179)

26–30. **Workshop on Symbol Manipulation**, Institute for Mathematics and its Applications, Minneapolis, MN. (Feb. 1989, p. 179)

*26–July 7. **Summer School on Computer Science**, Centre d'Etudes du Breau-sans-Nappe, Ablis, France.

INVITED SPEAKERS: F. Bancilhon; R. Brachman; L. Henschen.
INFORMATION: Secretariat Général des Ecoles d'Eté, E.D.F., 1, avenue du Général de Gaulle, 92140 Clamart, France. Telephone: (1) 47 65 43 06.

27–30. **Second Conference of the International Federation of Classification Societies (IFCS)**, Charlottesville, VA. (Oct. 1988, p. 1244)

*29–30. **Workshop on Number Theory and Cryptography in Telecommunications**, Macquarie University, Sydney, Australia.

INVITED SPEAKERS: J. Asenstorfer; H. Lenstra; J. Snare; H. Williams.
INFORMATION: J. H. Loxton, School of Mathematics, Macquarie University, NSW 2109 Australia.

July 1989

***Logic at Botik '89: A Seminar on Logical Foundations of Computer Science**, Pereslavl-Zalessky, USSR.

INFORMATION: Logic at Botik '89, P.O. Box 11, Program Systems Institute of the USSR Academy of Sciences, 152140 Pereslavl-Zalessky, USSR.

*2. **Conference on Matheamatics Education**, Macquarie University, Australia.

INFORMATION: J. Mack, Department of Pure Mathematics, University of Sydney, NSW 2006.

2–7. **Fourth Gregynog Symposium on Differential Equations**, Gregynog Conference Center, University of Wales, United Kingdom. (Dec. 1988, p. 1588)

2–8. **Twelfth International Conference on General Relativity and Gravitation**, Boulder, CO. (Feb. 1989, p. 179)

2–16. **Fifth Workshop on Nonlinear Evolution Equations and Dynamical Systems**, Kolymbari near Chania, Crete. (Nov. 1988, p. 1386)

3–7. **IFAC/IMACS/IFORS International Symposium on Advanced Information Processing in Automatic Control**, CRAN, Nancy, France. (Mar. 1989, p. 309)

3–7. **NSF-CBMS Regional Research Conference in the Mathematical Sciences: Harmonic Analysis and Real Function Spaces**, Auburn University, Auburn University, AL. (Feb. 1989, p. 179)

3–7. **Annual General Meeting of the Australian Mathematical Society**, Macquarie University, Sydney, NSW, Australia. (Dec. 1988, p. 1589)

3–7. **The Third Hungarian Colloquium on Limit Theorems in Probability and Statistics**, Sopron, Hungary. (Nov. 1988, p. 1386)

3–7. **Computational Ordinary Differential Equations**, London, England. (Apr. 1988, p. 638)

3–7. **Fourteenth IFIP Conference on System Modelling and Optimization**, Leipzig, German Democratic Republic. (Nov. 1988, p. 1386)

3–7. **International Category Theory Meeting 1989**, Bangor, Wales, United Kingdom. (Nov. 1988, p. 1386)

3–7. **Fourth International Conference on the Teaching of Mathematical Modeling and Applications**, Roskilde University Centre, Denmark. (Nov. 1988, p. 1386)

3–7. **Twelfth British Combinatorial Conference**, Norwich, England. (Nov. 1988, p. 1386)

3–7. **International Symposium on Approximation, Optimization, and Computing**, Dalian University of Technology, Dalian, China. (Nov. 1988, p. 1386)

3–11. **CIME Course on Microlocal Analysis and Applications**, Villa "La Querceta," Montecatini Terme (Pistoia), Italy. (Jan. 1989, p. 68)

3–13. **Surfaces Minimales**, Marseille, France. (Mar. 1989, p. 309)

3–21. **SMS-NATO ASI: Fractal Geometry and Analysis**, Université de Montréal, Montréal, Canada. (Jan. 1989, p. 68)

5–7. **Workshop on Hardware Specification, Verification and Synthesis: Mathematical Aspects**, Cornell University, Ithaca, NY. (Mar. 1989, p. 309)

5–19. **Microprogram on Noncommutative Rings**, Berkeley, CA. (Feb. 1989, p. 180)

6–9. **Third Mathematicians and Education Reform Network Workshop**, University of Minnesota, Minneapolis, MN. (Mar. 1989, p. 309)

10. **Tutorial Short Courses**, Trinity College, Dublin, Ireland. (Nov. 1988, p. 1386)

*10–12. **International Conference on Computational Techniques and Applications**, Brisbane, Australia.

INFORMATION: School of Australian Environmental Studies, Griffith University, Nathan, Queensland 4111, Australia.

*10–14. **Conference on Mathematical Physics**, Australian National University, Canberra, Australia.

CONFERENCE THEMES: Conformal invariance; Yang-Baxter equations and integrability in statistical mechanics and field theory.
INFORMATION: M. Barber and R. Baxter, Centre for Mathematical Analysis, Australian National University, GPO Box 4, Canberra, ACT 2601.

10–14. **Fifteenth Australasian Conference on Combinatorial Mathematics and Computing**, University of Queensland, Brisbane, Australia. (Nov. 1988, p. 1386)

10–21. **NATO Advanced Study Institute: Computation of Curves and Surfaces, Puerto de la Cruz**, Canary Islands, Spain. (Feb. 1989, p. 180)

10–21. **Microprogram on Noncommutative Rings**, Mathematical Sciences Research Institute, Berkeley, CA. (May/June 1988, p. 731)

10–30. **AMS Summer Research Institute on Several Complex Variables and Complex Geometry**, University of California, Santa Cruz, CA.

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

10–September 1. **IMA Summer Program in Robustness, Diagnostics, Computing and Graphics in Statistics**, Institute for Mathematics and its Applications, Minneapolis, MN. (Dec. 1988, p. 1589)

11–14. **The Sixth International Conference on Numerical Analysis of Semiconductor Devices and Integrated Circuits**, Trinity College, Dublin, Ireland. (Nov. 1988, p. 1387)

12–14. **Robotics: Applied Mathematics and Computational Aspects**, Loughborough, England. (Feb. 1989, p. 180)

16–29. **1989 NATO Advanced Study Institute: Fourier Analysis and its Applications**, Tuscany, Italy. (Feb. 1989, p. 180)

* 17–19. **International Conference on Computer Algebra**, Portland, OR.

INFORMATION: B. Jensen, Local Arrangements Chairman, Department of Mathematics, Portland State University, P.O. Box 751, Portland, OR 97207.

* 17–21. **Third International Workshop on Computer-Aided Software Engineering**, Imperial College, London, UK.

INFORMATION: E. J. Chikofsky, Index Technology Corporation, One Main Street, Cambridge, MA 02142, 617-494-8200, Extension 1989.

17–21. **NSF-CBMS Conference on Algebraic Ideas in Ergodic Theory**, University of Washington, Seattle, WA. (Mar. 1989, p. 309)

* 17–21. **SIAM 1989 Annual Meeting**, San Diego, CA. (Apr. 1989, p. 491)

17–22. **Journées Arithmétiques**, Marseille, France. (Mar. 1989, p. 310)

17–August 4. **Conference on Matrix Theory for Applications**, University of Wyoming, Laramie, WY. (Dec. 1988, p. 1589)

19–22. **Workshop on Mathematical Theory of Modern Financial Markets**, Cornell University, Ithaca, NY. (Mar. 1989, p. 310)

23–24. **Conference on Logic and Linguistics**, University of Arizona, Tucson, AZ. (Mar. 1989, p. 310)

* 23–28. **Eighth Latin American Symposium on Mathematical Logic**, Joao Pessoa City, Brazil.

INFORMATION: M. de Lucena, Rua Flodoardo da Silveira, No. 116, Connunto Joao Agriptino, 58000, Joao Pessoa, Paraiba, Brazil.

24–27. **Gauss Symposium on Mathematics and Theoretical Physics**, Guarujá, SP, Brazil. (Nov. 1988, p. 1387)

24–29. **NSF-CBMS Conference on Heat Equations in Geometry**, University of Hawaii, Honolulu, HI. (Mar. 1989, p. 310)

* 24–August 4. **Cornell National Supercomputer Facility Advanced Summer Institute in Supercomputing**, Ithaca, NY.

CONFERENCE TOPICS: Computational physics; computational fluid dynamics; computational mathematics; computational chemistry.
INFORMATION: R. Feldman, Education and Training, Cornell National Supercomputer Facility, Campus Road and Central Avenue, Ithaca, NY 14853-8301, 607-255-3985.

24–August 5. **1989 European Summer Meeting of the Association for Symbolic Logic**, West Berlin, Germany. (Mar. 1989, p. 310)

25–August 6. **International Summer School on Logic, Algebra, and Computation**, Marktoberdorf, Germany. (Apr. 1989, p. 492)

* 26–28. **MAA Ohio Section Summer Short Course on Topics in Additive Number Theory**, Findlay College, Findlay, OH.

INVITED SPEAKER: G. Andrews, Pennsylvania State University.
INFORMATION: A. Albert, Division of Mathematics and Computer Science, Findlay College, Findlay, OH 45840, 419-424-4543.

27–29. **Sixth Annual Western Geometric Topology Workshop**, Brigham Young University, Provo, UT. (Apr. 1989, p. 492)

27–29. **International Symposium on Cauchy and the French Mathematical World**, Paris, France. (Nov. 1988, p. 1387)

28–September 1. **Homologie des Groupes et K-Theorie: Applications Geometriques**, Marseille, France. (Mar. 1989, p. 310)

29–August 12. **Conference on Groups–Saint Andrews 1989**, Saint Andrews, Scotland. (Dec. 1988, p. 1589)

30–August 12. **Harmonic Analysis on Reductive Groups**, Bowdoin College, Brunswick, ME. (Apr. 1989, p. 492)

31–August 4. **Sixteenth Annual Conference on Computer Graphics and Interactive Techniques**, Boston, MA. (Dec. 1988, p. 1590)

31–August 4. **Thirty-ninth Gordon Research Conference on Statistics in Chemistry and Chemical Engineering**, New Hampton, NH. (Oct. 1988, p. 1245)

August 1989

* 1–5. **Harbin Symposium on Univalent Functions and its Applications**, Heilongjiang University, Harbin, People's Republic of China.

INFORMATION: L. Liu, Department of Mathematics, Heilongjiang University, Harbin, People's Republic of China or S. Owa, Department of Mathematics, Kinki University, Higashi-Osaka, Osaka, Japan.

1–9. **Eighteenth International Congress of the History of Science**, Hamburg, 1–5; Munich, 6–9, Federal Republic of Germany. (Apr. 1988, p. 639)

1–11. **Annual CMS Seminar: Lie Theory, Differential Equations and Representation Theory**, Centre de Recherches Mathématiques (CRM) Université de Montréal, Montreal, Quebec, Canada. (Please note date change from Jan. 1989, p. 69)

2–5. **Seventh International Congress on Mathematical and Computer Modeling**, Chicago, IL. (Mar. 1989, p. 310)

* 4–14. **Workshop on New Trends and Applications of Distributed Parameter Control Systems**, Institute for Mathematics

and its Applications, University of Minnesota, Minneapolis, MN.

ORGANIZERS: G. Chen; E. B. Lee; W. Littman; L. Markus.
INFORMATION: E. B. Lee, Center for Control Sciences and Dynamical Systems, University of Minnesota,109 Vincent Hall, 206 Church Street S. E., Minneapolis, MN 55455, 612-625-8883.

6–7. **AMS Short Course on Cryptology and Computational Number Theory**, Boulder, CO.

INFORMATION: M. Foulkes, AMS, P.O. Box 6248, Providence, RI 02940.

6–10. **1989 Joint Statistical Meetings**, Washington, DC. (Mar. 1988, p. 466)

6–12. **Kommutative Algebra Und Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 310)

7. **AMS-SIAM-SMB Symposium on Some Mathematical Questions in Biology: Sex Allocation and Sex Change, Experiments and Models**, University of Toronto, Toronto, Ontario, Canada. (Feb. 1989, p. 181)

7–10. **Joint Mathematics Meetings**, Boulder, CO. (including the summer meetings of the AMS, AWM, MAA and PME.) This is the Diamond Jubilee of PME.

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

7–11. **Symposium on Combinatorics and Geometry**, Royal Institute of Technology, Stockholm, Sweden. (Apr. 1989, p. 492)

7–11. **Thirteenth Johns Hopkins Mathematical Sciences Summer Lecture Series**, Johns Hopkins University, Baltimore, MD. (Mar. 1989, p. 310)

7–11. **Fourth International Seminar on Random Graphs and Probabilistic Methods in Combinatorics and Computer Science**, Poznan, Poland. (Nov. 1988, p. 1387)

10–12. **International Conference on Computational Techniques and Applications**, Brisbane, Australia. (Feb. 1989, p. 181)

13–18. **Fifth International Conference on Stochastic Programming**, University of Michigan, Ann Arbor, MI. (Mar. 1989, p. 311)

13–19. **Kombinatorische Und Reell Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 311)

13–19. **Combinatorical Convexity and Algebraic Geometry**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 311)

13–19. **Colloquium on Universal Algebra**, Szeged, Hungary. (Nov. 1988, p. 1387)

13–19. **Fourth Conference on Differential Equations and Applications**, Rousse, Bulgaria. (May/Jun. 1988, p. 731)

* 14–September 2. **Third Workshop on Representation Theory of Lie Groups and Their Applications**, Córdoba, Argentina.

INVITED SPEAKERS: B. Kostant, MIT; G. Lusztig, MIT; R. Moody, University of Saskatchewan; W. Schmid, Harvard University; D. Vogan, MIT; N. Wallach, Rutgers University; J. Wolf, University of California, Berkeley.
INFORMATION: J. A. Tirao, FAMAF, Ciudad Universitaria, 5032 Córdoba, Argentina. Telephone: 54-51-604015 (602751).

* 15–18. **Fourth Korea Institute of Technology Workshop**, Korea Institute of Technology, Taejon, Korea.

PROGRAM: The program will consist of a series of lectures by invited speakers, and some one-hour talks on analysis and geometry.
INVITED SPEAKERS: J. A. Goldstein, Tulane University; W. Y. Hsiang, University of California, Berkeley; V. J. Mizel, Carnegie-Mellon University; J. L. Kazdan, University of Pennsylvania.
CALL FOR PAPERS: Papers are solicited in all areas of analysis and geometry. Small amounts of financial support will be available to a limited number of speakers. The deadline for paper submission is July 15, 1989.
INFORMATION: Y. Y. Oh, Director, Mathematics Research Center, Korea Institute of Technology, Taejon 305-701, Korea.

16–September 2. **Nineteenth Summer Session on Probability Theory**, Saint-Flour (Cantal), France. (Mar. 1989, p. 311)

* 18–20. **Workshop for College Faculty on Using Technology in Precalculus Mathematics**, Ohio State University, Columbus, OH.

INFORMATION: F. Demana and B. Waits, 1989 Summer College Workshop, Department of Mathematics, Ohio State University, 231 West 18th Avenue, Columbus, OH.

* 18–23. **The Arthur Prior Memorial Conference**, University of Canterbury, New Zealand.

PURPOSE: This international joint session of the Australasian Associations of Philosophy and Logic will be held to mark the 20th anniversary of Arthur Prior's death.
CALL FOR PAPERS: Papers are invited on Prior, his work, and the subjects on which he wrote. Conference proceedings will be published in a memorial volume.
INFORMATION: J. Copeland, Philosophy Department, University of Canterbury, Private Bag, Christchurch 1, New Zealand.

20–24. **Ninth Annual Crypto Conference**, University of California at Santa Barbara, Santa Barbara, CA. (Feb. 1989, p. 181)

20–25. **Second Conference of the Canadian Number Theory Association**, University of British Columbia, Vancouver, Canada. (Dec. 1988, p. 1590)

20–26. **Eleventh International Joint Conference on Artificial Intelligence**, Detroit, MI. (Oct. 1988, p. 1245)

20–September 6. **Nineteenth Ecole d'ete de Calcul des Probabilities**, Saint-Flour, Cantal, France. (Mar. 1988, p. 466)

21–24. **International Conference on Recent Developments in Statistical Data Analysis and Inference In Honor of C. R. Rao**, Neuchâtel, Switzerland. (Nov. 1988, p. 1387)

* 21–25. **Workshop on Advances in Scientific Computing (With Emphasis on Linear Problems)**, Espoo, Finland.

INFORMATION: O. Nevanlinna, Helsinki University of Technology, Institute of Mathematics, 02150 Espoo, Finland. Telephone: +358-0-4513034.

21–25. **EQUADIFF 7**, Prague, Czechoslovakia. (Feb. 1989, p. 181)

21–25. **First Canadian Conference on Computational Geometry**, McGill University, Montreal, Quebec, Canada. (Feb. 1989, p. 181)

*21–26. **International Conference on Algebra in Memory of A. I. Mal'tsev**, Novosibirsk, USSR. (Please note changes from Mar. 1989, p. 311)

CONFERENCE TOPICS: Group theory; ring theory; model theory and algebraic systems; algebraic methods in geometry, analysis, and theoretical physics; applied and computer algebra.

INFORMATION: Academy of Sciences of the USSR, Order of Lenin, Siberian Branch, Institute of Mathematics, 630090 Novosibirsk, 90. Telephone: 35-44-50. (For further information, see the News and Announcements section of this issue of *Notices*.)

*23–27. **Annual Georgia Topology Conference**, University of Georgia, Athens, GA.

INFORMATION: N. Habegger, University of Georgia, Department of Mathematics, Athens, GA 30602.

24–26. **Twenty-fourth Actuarial Research Conference**, Concordia University, Montréal, Canada. (Mar. 1989, p. 311)

24–September 1. **NSF-CBMS Conference on Singular Integral Operators**, University of Montana, Missoula, MT. (Mar. 1989, p. 311)

*28–29. **Second Annual Meeting of SIAM Nordic Section**, Espoo, Finland.

INFORMATION: O. Nevanlinna, Helsinki University of Technology, Institute of Mathematics, 02150 Espoo, Finland. Telephone: 358-0-4513034.

28–31. **IFAC/IFORS/IMACS Symposium on Large Scale Systems: Theory and Application**, Berlin, German Democratic Republic. (Mar. 1989, p. 311)

28–September 1. **Homologie des Groupes et K-Theorie: Applications Geometriques**, Marseille, France. (Mar. 1989, p. 311)

28–September 1. **International Conference on Symplectic Geometry and Computational Hamiltonian Dynamics**, Beijing, China. (Jan. 1989, p. 69)

28–September 1. **NSF-CBMS Regional Research Conference in the Mathematical Sciences: Singular Integral Operators**, University of Montana, Missoula, MT (April 1989, p. 490).

28–September 1. **IFIP 89: Eleventh World Computer Conference**, San Francisco, CA. (Apr. 1988, p. 639)

28–September 2. **Second International Conference on Function Spaces**, Poznań, Poland. (Nov. 1988, p. 1387)

28–September 8. **Topical Meeting on Variational Problems in Analysis**, Trieste, Italy. (Oct. 1988, p. 1245)

29–September 6. **Forty-seventh Session of the International Statistical Institute**, Paris, France. (Apr. 1988, p. 639)

September 1989

1–10. **Summer School of Algebra and Ordered Sets**, The Jeseniky Mountains, Czechoslovakia. (Jan. 1989, p. 69)

4–8. **Twelfth CNMAC Brazilian Congress on Computational and Applied Mathematics**, São José Do Rio Preto, São Paulo State, Brazil. (Mar. 1989, p. 312)

4–8. **Centenary Workshop of Heun's Equation: Theory and Applications**, Rottach-Egern, Federal Republic of Germany. (Nov. 1988, p. 1388)

4–8. **Colloquium on Computational Number Theory**, Debrecen, Hungary. (Nov. 1988, p. 1388)

5–8. **Third European Simulation Congress**, Edinburgh, Scotland. (Mar. 1989, p. 312)

5–15. **Opening Workshop: An Introduction to Dynamical Systems**, Institute for Mathematics and its Applications, Minneapolis, MN. (Dec. 1988, p. 1590)

6–8. **Fourteenth Symposium on Operations Research**, Universität Ulm, Federal Republic of Germany. (Jan. 1989, p. 70)

8–14. **COSMEX '89: International Conference on Stochastic Methods in Experimental Sciences**, Technical University of Wroclaw, Poland. (Nov. 1988, p. 1388)

11–13. **Supercomputers: Emerging Applications in Manufacturing**, Minneapolis, MN. (Mar. 1989, p. 312)

11–14. **Analyse des Donnes**, Antibes, France. (Mar. 1989, p. 312)

11–15. **Journées de Probabilités**, Marseille, France. (Mar. 1989, p. 312)

11–15. **Fifth International Conference on Numerical Methods in Engineering**, Lausanne, Switzerland. (Nov. 1988, p. 1388)

11–16. **Trends in Functional Analysis and Approximation Theory**, Acqua Fredda di Maratea (Potenza), Italy. (Feb. 1989, p. 182)

12–15. **National Computer Graphics Association Conference on CAD/CAM/-CAE/CIM Aerospace and Electronics**, Santa Clara, CA. (Apr. 1989, p. 494)

*15–20. **Sino-French Colloquium on Probability and Statistics**, Centre sino-francais de Mathématiques et d'Informatique, Université de Wuhan, 430072 Wuhan, People's Republic of China.

INFORMATION: L. Han-ping, le Centre ci-dessus a Wuhan, G. Oppenheim, Mathématiques, Bat.425, Université de Paris-Sud, 91405 Orsay, France.

16–October 20. **Sixth World Congress on Medical Information**, Beijing, China. (Apr. 1988, p. 639)

17–22. **The ICME Conference on the Popularization of Mathematics**, Leeds, England. (Jan. 1989, p. 70)

18–21. **Traffic Theories for New Telecommunications Services**, Adelaide, Australia. (Nov. 1988, p. 1388)

18–21. **SIAM Conference on Mathematics of Geophysical Sciences**, Houston, TX. (Nov. 1988, p. 1388)

18–22. **Bifurcations et Orbites Periodiques des Champs de Vecteurs du Plan**, Marseille, France. (Mar. 1989, p. 312)

18–23. **Conference on Integral Equations and Inverse Problems**, Varna, Bulgaria. (Nov. 1988, p. 1388)

19–23. **1830–1930: A Century of Geometry, from C. F. Gauss and B. Riemann to H. Poincaré and E. Cartan; Epistemology, History, and Mathematics**, Institut Henri Poincaré, Paris, France. (Apr. 1989, p. 494)

21–22. **Mathematics in the Car Industry**, Warwick, England. (Nov. 1988, p. 1388)

24–30. **Kryptographie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 312)

24–October 6. **Extrapolation et Approximation Rationelle**, Marseille, France. (Mar. 1989, p. 312)

25–27. **SSA-IMACS 1989 Biennial Conference on Modelling and Simulation**, Canberra, Australia. (Mar. 1989, p. 312)

25–28. **SIAM Conference on Mathematical and Computational Issues in Geophysical Fluid and Solid Mechanics**, Houston, TX. (Mar. 1989, p. 312)

25–29. **Third International Conference on the Theory of Groups and Related Topics**, Australian National University, Canberra. (May/June 1988, p. 732)

26–28. **Third International Workshop on Distributed Algorithms**, La Colle-sur-Loup, France. (Feb. 1989, p. 182)

29–October 1. **Sixth IFAC/IFIP/IFORS/IMACS Symposium on Information Control Problems in Manufacturing Technology**, Madrid, Spain. (Mar. 1989, p. 313)

October 1989

2–6. **IMACS-GAMM International Symposium on Computer Arithmetic and Self-Validating Numerical Methods**, University of Basel, Basel, Switzerland. (Mar. 1989, p. 313)

2–6. **Third Workshop on Computer Science Logic**, Kaiserslautern, West Germany. (Apr. 1989, p. 494)

2–6. **Symposium on Applied and Industrial Mathematics**, Island of San Servolo, Venice, Italy. (Apr. 1989, p. 494)

4–6. **Geometry and Mathematical Physics: John H. Barrett Memorial Lectures**, The University of Tennessee, Knoxville, TN. (Mar. 1989, p. 313)

6–7. **Conference on Issues in the Teaching of Calculus**, Miami University, Oxford, OH. (Apr. 1989, p. 494)

* 9–13. **Workshop on Geometric Phases in Geometric Phases in Mechanics**, Mathematical Sciences Institute, Cornell University, Ithaca, NY.

CONFERENCE TOPICS: Holonomy via reconstruction of dynamics; adiabatic processes; averaging; rotating and coupled structures; nonlinear stability and control.
INVITED SPEAKERS: A. Pines, University of California at Berkeley (one-hour talk); F. Wilczek, Institute for Advanced Study, Princeton (one-hour talk); R. Jackiw; A. Shapere; R. Chiao; M. Levi; P. S. Krishnaprasad; J. Koiller.
INFORMATION: MSI, 201 Caldwell Hall, Cornell University, Ithaca, NY 14853-2602, 607-255-7740, 8005, or 7763.

12–14. **Second Interdisciplinary Conference on Natural Resource Modeling and Analysis**, Florida State University, Tallahassee, FL. (Apr. 1989, p. 494)

* 13–14. **Ninth Annual Southeastern-Atlantic Regional Conference on Differential Equations**, University of North Carolina at Charlotte, Charlotte, NC.

INVITED SPEAKERS: S. N. Chow, Georgia Institute of Technology; P. Fife, University of Utah; G. Sod, Tulane University.
INFORMATION: J. D. Avrin or D. S. Shafer, Department of Mathematics, University of North Carolina at Charlotte, Charlotte, NC 28223, 704-547-4929.

15–18. **Fourth International Workshop on High-Level Synthesis**, Kennebunkport, ME. (Dec. 1988, p. 1590)

16–18. **Second International Conference on Data and Knowledge Systems for Manufacturing and Engineering**, National Institute of Standards and Technology, Gaithersburg, MD. (Apr. 1989, p. 495)

* 16–20. **Workshop on Set Theory and the Continuum**, Mathematical Sciences Research Institute, Berkeley, CA.

PROGRAM: This is the first of three workshops planned as part of MSRI's yearlong 1989-1990 program on logic.
ORGANIZER: H. Woodin.
INFORMATION: I. Kaplansky, Director, MSRI, 1000 Centennial Drive, Berkeley, CA 94720.

16–20. **Sixth World Congress on Medical Informatics**, Beijing, China. (Feb. 1989, p. 182)

16–20. **Workshop: Patterns and Dynamics in Reactive Media**, Institute for Mathematics and its Applications, Minneapolis, MN. (Feb. 1989, p. 182)

* 19–20. **Workshop on Large-Scale Numerical Optimization**, Mathematical Sciences Institute, Cornell University, Ithaca, NY.

PROGRAM: This workshop will discuss recent algorithmic and software developments in numerical optimization with a special focus on large-scale problems. Approximately 18 half-hour invited addresses will be delivered by leading researchers in the field.
INFORMATION: T. Coleman or Y. Li, Department of Computer Science, Cornell University, Ithaca, NY 14853, 607-255-9203.

20–26. **Hamiltonian Systems, Transformation Groups and Special Transform Methods**, Centre de Recherches Mathématiques (CRM) Université de Montréal. (Please note date change from Jan. 1989, p. 70)

21–22. **Eastern Section Meeting of the AMS**, Stevens Institute of Technology, Hoboken, NJ.

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

23–26. **Beijing International Conference on System Simulation and Scientific Computing**, Beijing, China. (Mar. 1989, p. 313)

* 25–28. **Workshop on Numerical Methods for Elliptic Systems**, Espoo, Finland.

INFORMATION: J. Pitkäranta, Helsinki University of Technology, Institute of Mathematics, 02150 Espoo, Finland. Telephone: 358-0-4513024.

26–28. **The Riccati Equation In Control, Systems and Signals**, Villa Gallia, Como, Italy. (Jan. 1989, p. 70)

27–28. **Central Section Meeting of the AMS**, Ball State University, Muncie, IN. (May/June 1988, p. 732)

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

29–November 4. **Computational Methods in Solid Mechanics**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 313)

30–November 2. **Workshop on Homotopy Theory**, Mathematical Sciences Research Institute, Berkeley, CA. (Mar. 1989, p. 313)

30–December 1. **College on Differential Geometry**, Trieste, Italy. (Mar. 1989, p. 313)

November 1989

2–4. **Second Annual Conference on Technology in Collegiate Mathematics**, Ohio State University, Columbus, OH. (Mar. 1989, p. 313)

* 2–5. **Third International Conference on Expert Systems in Law**, Florence, Italy.

CONFERENCE TOPICS: The conference will focus on various aspects of logic and logic programming.
INFORMATION: Secretariat of the Congress, ENIC, via S. Caterina d'Alessandra 12, 50129 Florence, Italy.

* 4–8. **Workshop on Geometric and Algebraic Integration Algorithms**, Mathematical Sciences Institute, Cornell University, Ithaca, NY.

CONFERENCE TOPICS: Hamilton Jacobi theory and numerical integrators; mixed numeric/symbolic integration algorithms; trees and integration algorithms.
INFORMATION: R. Grossman, Department of Mathematics, M/C 249, Box 4348, University of Illinois at Chicago, Chicago, IL 60680, 312-413-2164.

6–9. **International Conference on Computer-Aided Design**, Santa Clara, CA. (Apr. 1989, p. 495)

6–10. **SIAM Conference on Applied Geometry**, Tempe, AZ. (Nov. 1988, p. 1388)

6–10. **SIAM Conference on Geometric Design**, Tempe, AZ. (Mar. 1989, p. 314)

10–11. **Eighteenth Midwest Differential Equations Conference**, Southern Illinois University, Carbondale, IL. (Apr. 1989, p. 495)

12–15. **National Computer Graphics Association Mapping and Geographic Information Systems**, Los Angeles, CA. (Apr. 1989, p. 494)

*13–17. **Workshop on Logic Related to Computer Science and Programming Language Theory**, Mathematical Sciences Research Institute, Berkeley, CA.

PROGRAM: This is the second of three workshops planned as part of MSRI's yearlong 1989-1990 program on logic.
ORGANIZER: Y. Moschovakis.
INFORMATION: I. Kaplansky, Director, MSRI, 1000 Centennial Drive, Berkeley, CA 94720.

13–17. **Workshop: Dynamical Issues in Combustion Theory**, Institute for Mathematics and its Applications, Minneapolis, MN. (Dec. 1988, p. 1591)

*17–20. **Workshop on Classical and Quantum Transport in Hamiltonian Systems**, Mathematical Sciences Institute, Cornell University, Ithaca, NY.

CONFERENCE TOPICS: Development and applications (physical and chemical) of recent advances in theory of Hamiltonian systems (lobes and turnstiles, cantori); extensions to many degrees of freedom; incorporation of quantum effects; adiabatic invariance and separatix crossing.
INVITED SPEAKERS: J. Cary; S. Chiang; M. Davis; R. Easton; S. Gray; M. Kellman; I. Kevrekedis; R. de la Llave; R. Littlejohn; R. MacKay; J. Meiss; E. Ott; E. Pollak; R. Skodje; M. Tabor.
INFORMATION: G. S. Ezra, Department of Chemistry, Baker Laboratory, Cornell University, Ithaca, NY 14853, 607-255-3949.

18–19. **Far Western Section Meeting of the AMS**, University of California, Los Angeles, CA.

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

December 1989

*4–6. **1989 Winter Simulation Conference**, Washington, DC.

PROGRAM: Sessions will address topics in discrete event and combined discrete/continuous simulation.
INFORMATION: P. Heidelberger, Program Chair, WSC '89, IBM Research Division, T.J. Watson Research Center, Hawthorne, P.O. Box 704, Yorktown Heights, NY 10598, 914-789-7156.

*4–8. **Fifth Aerospace Computer Security Applications Conference**, Tucson, AZ.

INFORMATION: The MITRE Corporation, 7525 Colshire Drive, McLean, VA 22102.

10–16. **Asymptotic Methods for Computer-Intensive Procedures in Statistics**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

11–13. **Fourth SIAM Conference on Parallel Processing for Scientific Computing**, Chicago, IL. (Mar. 1989, p. 314)

17–23. **Theory and Numerical Methods for Initial-Boundary Value Problems**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

January 1990

1–6. **Zeitreihenanalyse**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

7–13. **Mathematische Optimierung**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

14–20. **Nonlinear Evolution Equations, Solitons and the Inverse Scattering Transform**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

*15–26. **Workshop on Composite Media and Homogenization Theory**, International Centre for Theoretical Physics, Trieste, Italy.

INFORMATION: ICTP, P.O. Box 586, 34100 Trieste, Italy.

17–20. **Joint Mathematics Meetings**, Louisville, KY. (Including the annual meetings of the AMS, AWM, MAA and NAM).

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

21–27. **Modelltheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

*22–26. **Workshop on Applications of Algebraic Topology to Geometry and Analysis**, Mathematical Sciences Research Institute, Berkeley, CA.

PROGRAM: This is the second of three workshops planned as part of MSRI's yearlong 1989-1990 program on algebraic topology and its applications.
ORGANIZING COMMITTEE: R. L. Cohen and J. D. S. Jones.
INFORMATION: I. Kaplansky, Director, MSRI, 1000 Centennial Drive, Berkeley, CA 94720.

28–February 3. **Regelungstheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

*29–February 16. **Second College on Variational Problems in Analysis**, International Centre for Theoretical Physics, Trieste, Italy.

INFORMATION: ICTP, P.O. Box 586, 34100 Trieste, Italy.

February 1990

4–10. **Funktiontheoretische Methoden Bei Partiellen Differential Und Integralgleichungen**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

4–10. **Nukleare Frechet-Räume**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

11–17. **Funktiontheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

18–24. **Mathematische Modelle in Der Biologie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

*20–22. **Association for Computing Machinery 1990 Computer Science Conference**, Washington, D.C.

CALL FOR PAPERS: Five copies of completed papers in a format suitable for review must be received by August 15, 1989. For further information, write to the address given below.
INFORMATION: B. Kyriakakis, Department of Computer Science, George Mason University, Fairfax, VA 22030, 703-323-2318.

*22–23. **Twenty-first SIGCSE Technical Symposium**, Washington, D.C.

CALL FOR PAPERS: Papers should be submitted by September 1, 1989. For further information about paper submission, contact G. Yaverbaum, c/o Felty and Company, 4211 Elemerton Avenue, Harrisburg, PA 17109, 215-787-8810.
INFORMATION: R. H. Austing, Department of Computer Science, University of Maryland, College Park, MD 20742, 301-454-2002.

25–March 3. **Eigenwertaufgaben In Natur Und Ingenieurwissensachaften Und Ihre Numerische Behandlung**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

March 1990

4–10. **Interval Methods for Numerical Computation**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

5–7. **SIAM Conference on Applied Probability in Science and Engineering**, New Orleans, LA. (Nov. 1988, p. 1389)

11–17. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

*14–19. **East European Category Seminar**, Predela, Bulgaria.

ORGANIZER: V. Topencharov.
PROGRAM: The program will include invited speakers, contributed papers, and problem sessions.
CALL FOR PAPERS: Abstracts are due by February 1, 1990.
INFORMATION: K. G. Peeva, Sofia 1000, POB 384, Institute of Applied Mathematics and Computer Science, VMEI "V.I. Lenin," Bulgaria.

16–17. **Central Section Meeting of the AMS**, Kansas State University, Manhattan, KS.

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

18–24. **Masstheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

18–24. **Third Centenary Celebration of the Mathematische Gesellschaft in Hamburg**, Bundesstraße, Hamburg. (Jan. 1989, p. 71)

*20–23. **Directions in Matrix Theory**, Auburn, AL.

SPONSORS: SIAM Activity Group on Linear Algebra; International Linear Algebra Society.
ORGANIZERS: F. Uhlig; T. Y. Tam; D. Carlson.
CONFERENCE THEME: This conference will trace past and present developments and outline future directions in linear algebra and its applications.
INVITED SPEAKERS: R. A. Brualdi; P. Fuhrmann; M. Marcus; H. Schneider; R. C. Thompson; P. van Dooren; T. Ando; J. Demmel; S. Friedland; C. Meyer; A. Ran; C. van Loan; I. Zaballa; A. Berman; J. Dongarra; T. Kailath; G. de Oliveira; G. Styan; N. K. Tsing; C. K. Li.
CALL FOR PAPERS: Deadline for conference abstracts is January 10, 1990.
INFORMATION: F. Uhlig or T.Y. Tam, Department of Mathematics-ACA, Auburn University, AL 36849-5307, 205-844-3641.

23–24. **Southeast Section Meeting of the AMS**, University of Arkansas, Fayetteville, AR.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 0240.

25–31. **Kontinuumsmechanik der Festen Körper**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

*26–April 6. **Workshop on Group Theory from a Geometrical Viewpoint**, International Centre for Theoretical Physics, Trieste, Italy.

INFORMATION: ICTP, P.O. Box 586, 34100 Trieste, Italy.

April 1990

*4–7. **Symposium on Distributions with Given Marginals (In Memory of Giuseppe Pompilj)**, Rome, Italy.

PURPOSE: This symposium will survey the state of research in the field and establish communication among interested people in different fields and countries.
SCIENTIFIC COMMITTEE: G. Dall'Aglio, University of Rome, Italy; S. Kotz, University of Maryland; J. Stepan, University of Prague, Czechoslovakia.
ORGANIZING COMMITTEE: G. Dall'Aglio, Chairman; S. Bertino; E. Bona; A. Rizzi; G. Salinetti; A. Cirenei.
INFORMATION: Dipartimento di Statistica, Piazzale Aldo Moro 5, I-00185 Rome, Italy. Telephone: 39-6-4958308.

21–22. **Northeast Section Meeting of the AMS**, Pennsylvania State University, University Park, PA.

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

May 1990

*7–June 1. **College on Recent Developments and Applications in Mathematics and Computer Science**, International Centre for Theoretical Physics, Trieste, Italy.

INFORMATION: ICTP, P.O. Box 586, 34100 Trieste, Italy.

21–25. **Eleventh United States National Congress of Applied Mechanics**, Tucson, AZ. (Nov. 1988, p. 1389)

23–25. **1990 International Symposium on Multiple-Valued Logic**, Charlotte, NC. (Apr. 1989, p. 496)

25–31. **Tenth International Conference on Pattern Recognition**, Resorts Hotel, Atlantic City, NJ. (Mar. 1988, p. 466)

June 1990

6–9. **Fifth Annual Conference of the European Consortium for Mathematics in Industry**, Lahti, Finland. (Apr. 1989, p. 496)

6–12. **1990 Barcelona Conference on Algebraic Topology**, Centre de Recerca Matematica, Barcelona, Spain. (Sept. 1988, p. 1060)

11–14. **Fourteenth Rolf Nevanlinna Colloquium**, University of Helsinki, Helsinki, Finland. (Apr. 1989, p. 496)

11–14. **World Organization of Systems and Cybernetics Eighth International Congress**, New York, NY. (Mar. 1989, p. 315)

*11–15. **Rigorous Results in Quantum Dynamics**, Liblice Castle, Czechoslovakia.

CONFERENCE TOPICS: Solvable models; waveguides; geometrical aspects of quantum dynamics.
INFORMATION: J. Dittrich, Theoretical Department, Institute of Nuclear Physics, 250 68 Řež, Czechoslovakia.

13–15. **Seventh Annual Quality and Productivity Research Conference**, Madison, WI. (Mar. 1989, p. 315)

18–20. **Joint WNAR-IMS Regional Meeting**, Montana State University, Bozeman, MT. (Mar. 1989, p. 315)

27–30. **Fourth International Congress on Algebraic Hyperstructures and Applications**, Xanthi, Greece. (Apr. 1989, p. 496)

July 1990

1–7. **Modulfunktionen In Mehreren Variablen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

1–18. **Twentieth Summer Session on Probability Theory**, Saint-Flour (Cantal), France. (Mar. 1989, p. 315)

8–14. **Variationsrechnung**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

*9–20. **Geometry and Topology of Four-Manifolds**, McMaster University, Hamilton, Ontario, Canada.

PROGRAM: This conference is designed to bring together experts in various aspects of this subject, such as differential geometry, algebraic surfaces, Yang-Mills theory, topology and analysis. There will be a limited number of talks, including several short courses.
INFORMATION: I. Hambleton, Department of Mathematics, McMaster University, Hamilton, Ontario, Canada L8S 4K1. Telephone: 416-525-9140, extension 4336.

15–21. **Stochastic Image Models and Algorithms**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

*15–23. **Colloquium in Honor of Roland Fraisse**, Centre International de Recontres Mathématiques, Luminy, France.

PRINCIPAL THEMES: Ordered sets; combinatorics; theory of relations, and mathematical logic.
INFORMATION: R. Bonnet, Department of Mathematics and Mechanics, Case Postale 322, Université Aix Marseille III, 13 397 Marseille Cedex 13, France.

16–20. **SIAM Annual Meeting**, Chicago, IL. (Nov. 1988, p. 1389)

22–28. **Konvexgeometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

29–August 4. **Mechanik Und Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

August 1990

5–11. **Mathematical Methods in Tomography**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

6–9. **1990 Joint Statistical Meetings**, Anaheim, CA. (Mar. 1988, p. 466)

8–11. **Joint Mathematics Meetings**, Ohio State University, Columbus, OH. (including the summer meetings of the AMS, AWM, MAA and PME) This is the 75th Anniversary of the MAA.

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

12–18. **Algebraische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

12–18. **Pre-Congress Topology Conference**, University of Hawaii, Honolulu, HI. (Feb. 1989, p. 183)

15–19. **International Conference on Knot Theory and Related Topics**, International House, Osaka, Japan. (Apr. 1989, p. 497)

19–25. **Mathematische Methoden Des VLSI-Entwurfs Und Des Distributed Computings**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

21–29. **The International Congress of Mathematicians 1990**, Kyoto, Japan. (Nov. 1988, p. 1389)

26–September 1. **Komplexe Analysis**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

28–30. **IMACS European Simulation Meeting on Problem Solving by Simulation**, Esztergom, Hungary. (Mar. 1989, p. 316)

*30–September 4. **International Conference on Potential Theory**, Nagoya, Japan.

INFORMATION: M. Kishi, Office of the Organizing Committee of International Conference on Potential Theory, Department of Mathematics, College of General Education, Nagoya University, Nagoya 464-01, Japan.

September 1990

***Neuronet-90: IMACS International Symposium on Neural Nets and Neural Computers**, Prague, Czechoslovakia.

INFORMATION: V. Hamata, General Computing Center, Czechoslovak Academy of Sciences, 182 07 Prague 8, P.O. Box 5, Czechoslovakia.

***IMACS Symposium on Modelling and Simulation of Electrical Machines**, ENSEM - Nancy, France.

INFORMATION: J. Robert, Institut Monteflore, B-28, Sart Tilman, B-4000 Liege, Belgium or R. LeDoeuff, ENSEM 2, Rue de la Citadelle, BP850-54100 Nancy, France.

2–8. **Topologie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

3–6. **Fourth Asian Logic Conference**, Tokyo, Japan. (Mar. 1989, p. 316)

3–7. **IMACS Symposium on Intelligent Models in Systems Simulation**, Brussels, Belgium. (Mar. 1989, p. 316)

9–15. **Surgery and L-Theory**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

*10–October 5. **School on Qualitative Aspects and Applications of Nonlinear Evolution Equations**, International Centre for Theoretical Physics, Trieste, Italy.

INFORMATION: ICTP, P.O. Box 586, 34100 Trieste, Italy.

16–22. **Risikotheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

23–29. **Random Graphs and Combinatorical Structures**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

30–October 6. **Diophantische Approximationen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

October 1990

7–13. **Arbeitsgemeinschaft Mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

14–20. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

21–27. **Mathematische Methoden In Der Robotik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

28–November 3. **Mathematical Economics**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

November 1990

2–3. **Central Section Meeting of the AMS**, University of North Texas, Denton, TX.

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

18–24. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25–December 1. **Stochastische Approximation Und Optimierungsprobleme In Der Statistik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

December 1990

2–8. **Multigrid Methods**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

3–7. **1990 Australasian Conference on Combinatorial Mathematics and Computing**, Palmerston North, New Zealand. (Feb. 1989, p. 183)

9–15. **Allgemeine Ungleichungen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

16–22. **Mathematische Logik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25–January 1. **Lineare Modelle Und Multivariate Statistische Verfahren**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

January 1991

16–19. **Joint Mathematics Meetings**, San Francisco, CA. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

July 1991

8–12. **Second International Conference on Industrial and Applied Mathematics**, Washington, DC. (Nov. 1988, p. 1389)

22–26. **Thirteenth IMACS World Congress on Computing and Applied Mathematics**, Trinity College, Dublin University, Dublin, Ireland. (Mar. 1989, p. 316)

August 1991

8–11. **Joint Mathematics Meetings**, University of Maine, Orono, ME. (including the summer meetings of the AMS, AWM, MAA, and PME)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

19–22. **1991 Joint Statistical Meetings**, Atlanta, GA. (Mar. 1988, p. 466)

January 1992

8–11. **Joint Mathematics Meetings**, Baltimore, MD. (including the annual meetings of the AMS, AWM, MAA and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

June 1992

29–July 1. **Joint Meeting with the London Mathematical Society**, Cambridge, England. (Mar. 1989, p. 316)

January 1993

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

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

January 1994

5–8. **Joint Mathematics Meetings**, Cincinnati, OH. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

New AMS Publications

REVIEWS IN FUNCTIONAL ANALYSIS, 1980–86

Introduction by William Johnson

These four volumes contain the almost 12,000 reviews appearing in *Mathematical Reviews* under primary or secondary subject classification 46, Functional Analysis, between 1980 and 1986. Many of the reviews presented here are of papers that study the structure of various classes of topological vector spaces; others are concerned with spaces of functions or distributions, Banach and other topological algebras, C*-algebras and other algebras of operators, categorical methods in functional analysis, and with the applications of functional analysis to other areas of mathematics (such as differential and integral equations) and to other disciplines (such as physics).

These review volumes make it possible to search large subject areas more quickly and to discern connections that can easily be overlooked in searches through individual *MR* issues. In addition, since the reviews of all papers that have a secondary classification in 46 are also included in these volumes, it is often possible to find related papers that might otherwise be missed. The unified index provides access to a large amount of material scattered over the 7 years of *MR* issues covered.

The chapters consist of reviews in the second-level *MR* classifications in the area 46, and sections within chapters consist of reviews in each of the third-level *MR* classification. Within each section, reviews are ordered by their *MR* number. Relevant cross-references are given with each review, and author and key indexes appear in the fourth volume.

1980 *Mathematics Subject Classification*: 46
ISBN 0-8218-0134-1, LC 89-6708
4 volumes, 2461 pages (softcover),
May 1989
Individual member $118, List price $196,
Institutional member $157, Reviewer $98
To order, please specify REVFUA/86N

Combination offer:
Reviews in Functional Analysis, 1980–86 (REVFUA/86) and **Reviews in Operator Theory, 1980–86 (REVOPE/86)**.
Special combined price. **Individual member $188**, List price $314, Institutional member $251, Reviewer $157
To order, please specify REVFAO/86N

REVIEWS IN OPERATOR THEORY, 1980–86

Introduction by Paul R. Halmos

Operator theory is the branch of mathematics that treats the objects of analysis (numerical valued functions and their limiting properties) by the methods of modern topology and algebra. While, roughly speaking, the area 46 deals primarily with the objects (i.e., topological vector spaces) associated with the category of topological linear algebra, the area 47 deals with the morphisms between these objects (i.e., the mappings–both linear and nonlinear–between these spaces). Although functional analysis and operator theory developed as identifiable fields in the early part of this century, they have seen tremendous growth in the past few decades and have found applications to diverse areas, both to purely mathematical areas and to other scientific disciplines. These volumes contain a wealth of information about linear operators, algebraic systems of linear operators, differential and integral operators, and nonlinear operators.

All the *Mathematical Reviews* entries having operator theory (*MR* classification number 47) as a primary or secondary classification between 1980 and 1986 appear in these volumes. They make it possible to search large subject areas more quickly and to discern connections that can easily be overlooked in searches through individual *MR* issues. The unified index provides access to a large amount of material scattered over the 7 years of *MR* issues covered.

The chapters consist of reviews in the second-level *MR* classifications in the area 47, and sections within chapters consist of reviews in each of the third-level *MR* classifications. Within each section, reviews are ordered by their *MR* number. Relevant cross-references are given with each review, and author and key indexes appear in the fourth volume.

1980 *Mathematics Subject Classification*: 47
ISBN 0-8218-0135-X, LC 89-6551
4 volumes, 2639 pages (softcover),
June 1989
Individual member $118, List price $196,
Institutional member $157, Reviewer $98
To order, please specify REVOPE/86N

Combination offer:
Reviews in Functional Analysis, 1980–86 (REVFUA/86) and **Reviews in Operator Theory, 1980–86 (REVOPE/86)**. Special combined price. **Individual member $188**, List price $314, Institutional member $251, Reviewer $157
To order, please specify REVFAO/86N

COMPUTATIONAL COMPLEXITY THEORY
Juris Hartmanis, Editor
(Proceedings of Symposia in Applied Mathematics, Volume 38)

Computational complexity theory is the study of the quantitative laws that govern computing. During the last 25 years, this field has grown into a rich mathematical theory. Currently one of the most active research areas in computer science, complexity theory is of considerable interest to mathematicians as well, since some of the key open problems in this field raise basic questions about the nature of mathematics. Many experts in complexity theory believe that, in coming decades, the strongest influence on the development of mathematics will come from the extended use of computing and from concepts and problems arising in computer science.

This volume contains the proceedings of the AMS Short Course on Computational Complexity Theory, held at the Joint Mathematics Meetings in Atlanta in January, 1988. The purpose of the short course was to provide an overview of complexity theory and to describe some of the current developments in the field. The papers presented here represent contributions by some of the top experts in this burgeoning area of research.

Contents

Juris Hartmanis, *Overview of computational complexity theory*
Stephen R. Mahaney, *The isomorphism conjecture and sparse sets*
Ronald V. Book, *Restricted relativizations of complexity classes*
Neil Immerman, *Descriptive and computational complexity*
Alan L. Selman, *Complexity issues in cryptography*
Shafi Goldwasser, *Interactive proof systems*

1980 *Mathematics Subject Classifications*: 68Q05, 68Q10, 68Q20, 68Q75, 94A60
ISBN 0-8218-0131-7, LC 89-6857
ISSN 0160-7634
140 pages, June 1989
Hardcover: **Individual member $20**, List price $33,
Institutional member $26
Softcover: **Individual member $17**, List price $28,
Institutional member $22
To order, please specify PSAPM/38N (hardcover), PSAPMS/38N (softcover)

J CONTRACTIVE MATRIX FUNCTIONS, REPRODUCING KERNEL HILBERT SPACES AND INTERPOLATION
Harry Dym
(CBMS Regional Conference Series, Number 71
Supported by the National Science Foundation)

This book evolved from a set of lectures presented under the auspices of the Conference Board of Mathematical Sciences at the Case Institute of Technology in September 1984. The original objective of the lectures was to present an introduction to the theory and applications of J inner matrices. However, in revising the lecture notes for publication, the author began to realize that the spaces $\mathcal{H}(U)$ and $\mathcal{H}(S)$ are ideal tools for treating a large class of matrix interpolation problems including ultimately two-sided tangential problems of both the Nevanlinna-Pick type and the Carathéodory-Fejér type, as well as mixtures of these. Consequently, the lecture notes were revised to bring $\mathcal{H}(U)$ and $\mathcal{H}(S)$ to center stage. This monograph is the fist systematic exposition of the use of these spaces for interpolation problems.

Contents

J inner functions

Reproducing kernel Hilbert spaces

Linear fractional transformations, matrix balls and more on admissibility

More on $\mathcal{H}(U)$ spaces

The Nevanlinna-Pick problem

Carathéodory-Fejér interpolation

Singular Pick matrices

The lossless inverse scattering problem

Nehari interpolation

A matrix interpolation problem

Maximum entropy

1980 *Mathematics Subject Classifications*: 30D50, 30E05, 46E20, 46E40; 47-02, 47A15
ISBN 0-8218-0722-6, LC 89-6802
ISSN 0160-7642
160 pages (softcover), June 1989
All individuals $13, List price $22
To order, please specify CBMS/71N

SINGULARITIES
Richard Randell, Editor
(Contemporary Mathematics, Volume 90)

This volume contains the proceedings of the Institute for Mathematics and its Applications Participating Institutions Conference on Singularities, held at the University of Iowa in July, 1986. The conference brought together an international group of researchers in algebraic and analytic singularity theory. This collection consists of research papers related to talks given at the conference.

The field of singularities takes techniques from and gives results to many areas of mathematics, including algebraic and differential geometry and topology, complex analysis, Lie algebras and reflection groups, and combinatorics. All these areas are represented here with an emphasis on local algebraic, analytic and tangential properties, deformation and topology of singularities, and arrangements of hyperplanes.

This volume will be of interest to current and prospective researchers in various aspects of singularity theory, as it provides an overview of the current state of singularity theory and details work in several subareas. Many of the articles provide a basis for further research, and a list of problems presented at the conference is included.

Contents

Marco Andreatta and Andrew Sommese, *Generically ample divisors on normal Gorenstein surfaces*
James Damon, *Topological equivalence for nonisolated singularities and global affine hypersurfaces*
Michael Falk, *The cohomology and fundamental group of a hyperplane complement*
T. Shizumi Fukui, *The modified analytic trivialization of a family of real analytic mappings*
Yih-Nan Gau, *On the topological types of quasi-ordinary surface germs*
H. Hauser and R. Randell, *Report on the problem session*
Shihoko Ishii, *Two dimensional singularities with bounded pluri-genera δ_m are Q-Gorenstein singularities*
Michel Jambu and Hiroaki Terao, *Arrangements of hyperplanes and broken circuits*
M. Kannowski, *Simply connected four-manifolds obtained from weighted homogeneous polynomials*
Toshitake Kohno, *Holonomy Lie algebras, logarithmic connections and the lower central series of fundamental groups*
Henry B. Laufer, *Tangent cones for deformations of two-dimensional quasi-homogeneous singularities*
Mutsuo Oka, *On the weak simultaneous resolution of a negligible truncation of the Newton boundary*
Peter Orlik, *Basic derivations for unitary reflection groups*
Hiroaki Terao and Yaichi Enta, *Basic derivations for G_{34}: Appendix to "Basic derivations for unitary reflection groups," by P. Orlik*
Donal B. O'Shea, *Spaces of limiting tangent spaces*
Ruud Pellikaan, *Series of isolated singularities*
Dirk Siersma, *Quasihomogeneous singularities with transversal type A_1*
Tohsuke Urabe, *Dynkin graphs and combinations of singularities on plane sextic curves*
Yi-Jung Xu and Stephen S.-T. Yau, *The inequality $\mu \geq 12p_g - 4$ for hypersurface weakly elliptic singularities*
Günter M. Ziegler, *Multiarrangements of hyperplanes and their freeness*

1980 *Mathematics Subject Classifications*: 14B05, 32B30; 32C40, 57R45
ISBN 0-8218-5096-2, LC 89-6662
ISSN 0271-4132
376 pages (softcover), June 1989
Individual member $25, List price $42,
Institutional member $34
To order, please specify CONM/90N

COMMUTATIVE HARMONIC ANALYSIS
David Colella, Editor
(Contemporary Mathematics, Volume 91)

An exciting array of both expository and research articles are contained in this volume, which represents the proceedings of a conference on commutative harmonic analysis, held in July, 1987 and sponsored by St. Lawrence University and GTE Corporation. The book brings together a host of articles by some of the top researchers in this field and provides an in-depth look at recent progress on many of the diverse areas of current research. Requiring a basic knowledge of Fourier analysis on commutative groups and a familiarity with Euclidean harmonic analysis, this book will be of interest to those beginning research in commutative harmonic analysis. In addition, those currently working in the field will find this book valuable for the broad overview it affords of this important research area.

Contents

Aharon Atzmon, *Spaces of entire functions with no proper translation invariant subspaces*
John J. Benedetto, *Gabor representations and wavelets*

Ron C. Blei, *Measurements of interdependencies of stochastic increments*
Yngve Domar, *Translation-invariant subspaces of weighted L^p*
S. W. Drury, *A survey of k-plane transforms*
Ron C. Blei and John J. F. Fournier, *Mixed-norm conditions and Lorentz norms*
Colin C. Graham, *Summary of some results on L^p-improving measures*
Håkan Hedenmalm, *On the f- and K-properties of certain function spaces*
Hans P. Heinig and Gordon J. Sinnamon, *Laplace representation of functions in mixed weighted Bergman spaces*
Shelby Kilmer, *Equivalence of Riesz products*
T. W. Körner, *Universal trigonometric series with rapidly decreasing coefficients*
W. Christopher Lang, *A hypergroup measure algebra that admits no analogue of the structure theorem of J. L. Taylor*
Colin C. Graham, Anthony To-Ming Lau, and Michael Leinert, *Continuity of translation and separable invariant subspaces of Banach spaces associated to locally compact groups*
Yong-Zhuo Chen and Ka-Sing Lau, *Harmonic analysis on functions with bounded means*
O. Carruth McGehee, *Gaussian sums and harmonic analysis on finite fields*
Jean-François Méla, *Quasi-invariant measures and Fourier properties*
L. Thomas Ramsey, *Stability of (deterministic) adaptive auto-regressive filters*
Sadahiro Saeki, *Some applications of Khintchin's inequalities*
Enji Sato, *Certain measures on locally compact abelian groups*
Richard Vrem, *Torsion and torsion-free hypergroups*
C. Robert Warner, *Weak S-sets and Helson sets*
Yitzhak Weit, *An asymptotic characterization of harmonic functions*
J. Michael Wilson, *Weighted inequalities for the square function*

1980 *Mathematics Subject Classifications*: 43-06, 42-06, 46-06, 47-06
ISBN 0-8218-5097-0
ISSN 0271-4132
320 pages (softcover), June 1989
Individual member $22, List price $36,
Institutional member $29
To order, please specify CONM/91N

CATEGORIES IN COMPUTER SCIENCE AND LOGIC

John W. Gray and Andre Scedrov, Editors

(Contemporary Mathematics, Volume 92)

Category theory has had important uses in logic since the invention of topos theory in the early 1960s, and logic has always been an important component of theoretical computer science. A new development has been the increase in direct interactions between category theory and computer science. In June, 1987, an AMS-IMS-SIAM Summer Research Conference on Categories in Computer Science and Logic was held at the University of Colorado in Boulder. The aim of the conference was to bring together researchers working on the interconnections between category theory and computer science or between computer science and logic. The conference emphasized the ways in which the general machinery developed in category theory could be applied to specific questions and be used for category-theoretic studies of concrete problems. This volume represents the proceedings of the conference. (Some of the participants' contributions have been published elsewhere.)

The papers published here relate to three different aspects of the conference. The first concerns topics relevant to all three fields, including, for example, Horn logic, lambda calculus, normal form reductions, algebraic theories, and categorical models for computability theory. In the area of logic, topics include semantical approaches to proof-theoretical questions, internal properties of specific objects in (pre-) topoi and their representations, and categorical sharpening of model-theoretic notions. Finally, in the area of computer science, the use of category theory in formalizing aspects of computer programming and program design is discussed.

Contents

Michael Barr, *Models of Horn theories*
Andreas Blass, *Geometric invariance of existential fixed-point logic*
J. R. B. Cockett, *On the decidability of objects in a locos*
V. C. V. de Paiva, *The Dialectica categories*
Peter J. Freyd, *Combinators*
Peter J. Freyd, *POLYNAT in PER*
Jean-Yves Girard, *Towards a geometry of interaction*
John W. Gray, *The category of sketches as a model for algebraic semantics*
J. Martin E. Hyland and Andrew M. Pitts, *The theory of constructions: Categorical semantics and topos-theoretic models*
Francois Lamarche, *A simple model of the theory of constructions*
J. Lambek, *Multicategories revisited*
Dana May Latch, *An application of minimal context-free intersection partitions to rewrite rule consistency checking*
F. William Lawvere, *Qualitative distinctions between some toposes of generalized graphs*
John C. Mitchell and Philip J. Scott, *Typed lambda models and cartesian closed categories*
Philip S. Mulry, *Some connections between models of computation*
Robert Pare, *Some applications of categorical model theory*
A. J. Power, *Coherence for bicategories with finite Bilimits* I

Leopoldo Román, *On partial Cartesian closed categories*
Andre Scedrov, *Normalization revisited*
R. A. G. Seely, *Linear logic, $*$-autonomous categories and cofree coalgebras*

1980 *Mathematics Subject Classifications*: 68F20, 18-06, 18099, 03B15
ISBN 0-8218-5100-4, LC 89-32893
ISSN 0271-4132
392 pages (softcover), June 1989
Individual member $25, List price $42,
Institutional member $34
To order, please specify CONM/92N

REPRESENTATION THEORY, GROUP RINGS, AND CODING THEORY
M. Isaacs, A. Lichtman, D. Passman, S. Sehgal, N. J. A. Sloane, and H. Zassenhaus, Editors

(Contemporary Mathematics, Volume 93)

This volume is dedicated to the memory of the Soviet mathematician S. D. Berman (1922-1987). Berman's work—for the most part in representation theory, group rings, and coding theory—is discussed here in a number of review articles. Among the topics covered are Berman's achievements in coding theory, including his pioneering work on abelian codes and his results on the theory of threshold functions. Also discussed are his contributions to the representation theory of groups over fields, his work on integral representations of groups, his accomplishments in infinite abelian group rings, and his fundamental results on units in integral group rings. In addition, there are 22 research articles written by an international group of researchers in areas of Berman's major interest.

Contents

B. N. Gartshtein and I. I. Grushko, *The S. D. Berman work on coding theory and on theory of threshold functions*
G. Karpilovsky, *Berman's contributions to group representations over fields*
A. I. Lichtman, *S. D. Berman's contribution to the theory of integral representations of finite groups*
Warren May, *The work of S. D. Berman on infinite abelian group rings*
Robert Sandling, *Berman's work on units in group rings*
Ja. G. Berkovic, *On p-subgroups of finite symmetric and alternating groups*
S. D. Berman and N. I. Vishnyakova, *Locally cyclic modules over a valuation ring*
K. Buzási, *On the modules over a real crossed group algebra*
K. Buzási and L. G. Kovács, *The minimal number of generators of wreath products of nilpotent groups*
Gerald Cliff and Alfred Weiss, *Torsion free space groups and permutation lattices for finite groups*
Everett C. Dade, *Clifford theory and induction from subgroups*
Vesselin Drensky, *The isomorphism problem for modular group algebras of groups with large centres*
Daniel R. Farkas and Peter A. Linell, *Zero divisors in group rings: something old, something new*
A. W. Hales and I. B. S. Passi, *The augmentation quotients of finite abelian p-groups*
B. Hartley, *Free groups in normal subgroups of unit groups and arithmetic groups*
Klaus Hoechsmann, *On the Bass-Milnor index of abelian p-groups*
G. L. Katsman and M. A. Tsafsman, *A remark on algebraic geometric codes*
E. Sh. Kerer, *On decomposition of a binomial in a skew polynomial ring*
L. Krop, *The associated graded algebra of a group algebra*
A. I. Lichtman, *On nilpotent and soluble subgroups of linear groups over fields of fractions of enveloping algebras and of group rings, I*
Martin Lorenz and D. S. Passman, *The structure of G_0 for certain polycyclic group algebras and related algebras*
Warren May, *The direct factor problem for modular abelian group algebras*
Todor Zh. Mollov, *On the isomorphism of the semi-simple group algebras of the primary abelian groups*
S. I. Ostrovskaya, *On the canonical irreducible representations of countable locally finite groups and infinite Frobenius group*
Jürgen Ritter and Sudarshan K. Sehgal, *Generators of subgroups of $U(\mathbb{Z}G)$*
E. M. Žmud, *Connectivity of the finite group and generalized characters*

1980 *Mathematics Subject Classifications*: 16, 20, 94
ISBN 0-8218-5098-9, LC 89-6942
ISSN 0271-4132
376 pages (softcover), June 1989
Individual member $29, List price $48,
Institutional member $38
To order, please specify CONM/93N

ITERATED NONLINEAR MAPS AND HILBERT'S PROJECTIVE METRIC, II
Roger D. Nussbaum

(Memoirs of the AMS, Number 401)

This book treats certain classes of nonlinear maps which take the interior of a cone in a Banach space into itself. Hilbert's projective metric and its variants play a prominent role in the analysis. The author also gives applications to problems from mathematical biology and to what are known as D-A-D

theorems. These applications provided part of the original motivation for this work.

Contents

Applications to some examples from mathematical biology

Eigenvectors for functions $f \in M_-$

D-A-D theorems

References

1980 *Mathematics Subject Classifications*: 47H07, 47H10, 47B55
ISBN 0-8218-2465-1, LC 89-6590
ISSN 0065-9266
118 pages (softcover), May 1989
Individual member $10, List price $17,
Institutional member $14
To order, please specify MEMO/401N

HYPERBOLIC PERIODIC SOLUTIONS, HETEROCLINIC CONNECTIONS AND TRANSVERSAL HOMOCLINIC POINTS IN AUTONOMOUS DIFFERENTIAL DELAY EQUATIONS

Hans-Otto Walther

(Memoirs of the AMS, Number 402)

In this work, the author studies autonomous delay equations which model feedback on the circle. He shows that, within this class, there exist equations with hyperbolic periodic orbits and transversal connections between them. The associated Poincaré maps have no continuous inverse; they constitute discrete (semi-) dynamical systems in an infinite-dimensional space with transversal homoclinic points. The author applies a result of Hale and Lin on symbolic dynamics, which extends the work of Šilnikov, in order to describe chaotic motion close to the transversal connections.

This book will provide readers with a detailed investigation of a chaotic system that cannot be reduced to the case of a diffeomorphism or an interval map. Requiring a basic knowledge of functional analysis, differential equations, calculus on Banach spaces, and dynamical systems, this book is aimed at mathematicians and graduate students interested in dynamical systems and functional differential equations.

Contents

Hyperbolic periodic solutions

On hyperbolic fixed points

Poincaré maps and solutions close to x_a

Heteroclinic connections between periodic orbits, homoclinic points of Poincaré maps, transversality

On chaotic behavior

1980 *Mathematics Subject Classifications*: 34K15, 58F13
ISBN 0-8218-2467-8, LC 89-6592
ISSN 0065-9266
104 pages (softcover), May 1989
Individual member $10, List price $16,
Institutional member $13
To order, please specify MEMO/402N

THE OSCILLATOR DUALITY CORRESPONDENCE FOR THE PAIR $O(2,2), SP(2,\mathbb{R})$

Tomasz Przebinda

(Memoirs of the AMS, Number 403)

This book is directed at mathematicians and physicists who wish to learn about and use the recent techniques of the representation theory of real reductive groups. Howe's theory of reductive dual pairs is a very recent approach to the theory of representations of classical groups. This book offers a complete description of the oscillator duality correspondence (the major object in Howe's study) for a simple pair of groups, $O(2,2)$ and $Sp(2,\mathbb{R})$. This pair is sufficiently complicated to require the full power of the Langlands-Vogan classification and the Knapp-Zuckerman unitarizability criteria. The author also includes a description of the unitary duals of these groups. The major new result of the work is that the oscillator duality correspondence maps the unitary representations of $O(2,2)$ to unitary representations of $Sp(2,\mathbb{R})$.

Contents

The oscillatory duality correspondence

A classification of irreducible representations

$R(O_{2,2} \cdot Sp(2,\mathbb{R}), \omega)$

Appendix A: The unitary dual of $Sp(2,\mathbb{R})$

Appendix B: The smooth Frobenius reciprocity theorem

Appendix C: The determinant representation of $O(p,q)$ and the oscillator duality correspondence

1980 *Mathematics Subject Classifications*: 22E45, 33A75
ISBN 0-8218-2464-3, LC 89-6540
ISSN 0065-9266
105 pages (softcover), May 1989
Individual member $10, List price $17,
Institutional member $14
To order, please specify MEMO/403N

FREYD'S MODELS FOR THE INDEPENDENCE OF THE AXIOM OF CHOICE

Andreas Blass and Andre Scedrov

(Memoirs of the AMS, Number 404)

The independence of the axiom of choice from the Zermelo-Fraenkel (ZF) axioms of set theory was established by Cohen in 1963 in one of the first applicatons of his technique of forcing. When Lawvere and Tierney introduced in 1970 elementary topoi, which are categories closely resembling the category of sets, they showed that forcing arguments can be translated into the language of topos theory to yield independence results for theories somewhat weaker than ZF. In 1980, Freyd gave a direct topos-theoretic proof of the independence of the axiom of choice from full ZF; his proof is not a translation of any previous forcing proof, and it was found by a direct topos-theoretic approach to the problem.

The purpose of the present work is to analyze the Freyd models by comparing them with the more familiar forcing models. It was already known, from other work of Freyd, that models like his are equivalent, in a certain sense, to some models obtainable by forcing. This book presents the details behind this result in a fairly general setting and exhibits, for each of Freyd's specific models, an explicit forcing construction of an equivalent model. Connections between these forcing models and those already considered by set theorists are presented.

To make this book accessible to set theorists as well as category theorists, the authors present extensive preliminary material from both fields, including information that is known to experts, but not easily available in the literature.

Contents

Permutation models

Forcing and Boolean-valued models

Topoi

Models represented by Boolean topoi

Freyd's models

Freyd's first example

Freyd's second example

1980 *Mathematics Subject Classifications*: 03E25, 03E35, 03E40, 03G30, 18B25, 18F20
ISBN 0-8218-2468-6, LC 89-6541
ISSN 0065-9266
144 pages (softcover), May 1989
Individual member $11, List price $19,
Institutional member $15
To order, please specify MEMO/404N

THE LINEARIZATION METHOD IN HYDRODYNAMICAL STABILITY THEORY

V. I. Yudovich

(Translations of Mathematical Monographs, Volume 74)

This book presents the theory of the linearization method as applied to the problem of steady-state and periodic motions of continuous media. The author proves infinite-dimensional analogues of Lyapunov's theorems on stability, instability, and conditional stability for a large class of continuous media. In addition, semigroup properties for the linearized Navier-Stokes equations in the case of an incompressible fluid are studied, and coercivity inequalities and completeness of a system of small oscillations are proved.

Contents

Estimates of solutions of the linearized Navier-Stokes equations
- Estimates of integral operators in L_p
- Some estimates of solutions of evolution equations
- Estimates of the "leading derivatives" of solutions of evolution equations
- Applications to parabolic equations and imbedding theorems
- The linearized Navier-Stokes equations
- An estimate of the resolvent of the linearized Navier-Stokes operator
- Estimates of the leading derivatives of a solution of the linearized steady-state Navier-Stokes equations

Stability of fluid motion
- Stability of the motion of infinite-dimensional systems
- Conditions for stability
- Conditions for instability. Conditional stability

Stability of periodic motions
- Formulation of the problem
- The problem with initial data
- A condition for asymptotic stability
- A condition for instability
- Conditional stability
- Stability of auto-oscillatory regimes
- Instability of cycles
- Damping of the leading derivatives

1980 *Mathematics Subject Classifications*: 76D05, 75E05; 35Q10, 35K22
ISBN 0-8218-4528-4, LC 89-315
ISSN 0065-9282
200 pages (hardcover), June 1989
Individual member $44, List price $74,
Institutional member $59
To order, please specify MMONO/74N

ORTHOGONAL SERIES
B. S. Kashin and A. A. Saakyan
(Translations of Mathematical Monographs, Volume 75)

The theory of general orthogonal series originated at the turn of the century as a natural generalization, based on Lebesgue integration, of the theory of trigonometric series. However, the most active developments have occurred in the past 25 years, when it has become clear that many propositions about properties of the trigonometric system remain valid for a broad class of orthonormal systems.

Focusing on the fundamental methods of the theory of orthogonal series, this book presents a study of general orthonormal systems as well as specific systems such as the Haar and Franklin systems, covering both classical and recent results. The authors prove a number of results that have appeared in the literature but have not been gathered together in a monograph, so this book will be of interest to specialists in the field. However, the book is primarily oriented toward beginners in this area, and many of the fundamental theorems are given full proofs. The required background includes a familiarity with functional analysis and with the basic theory of functions of a complex variable; some background material on the theory of functions and functional analysis is presented in the appendices.

Contents

Introductory concepts and some general results

Independent functions and their first applications

The Haar system

Some results on the trigonometric and Walsh systems

The Hilbert transform and some function spaces

The Faber–Schauder and Franklin systems

Orthogonalization and factorization theorems

Theorems on the convergence of general orthogonal series

General theorems on the divergence of orthogonal series

Some theorems on the representation of functions by orthogonal series

1980 *Mathematics Subject Classifications*: 42-02, 42C15, 42C20, 42C30, 30B50 30D55; 42A50, 42A55, 44A15, 42A61
ISBN 0-8218-4527-6, LC 89-333
ISSN 0065-9282
450 pages (hardcover), June 1989
Individual member $88, List price $146,
Institutional member $117
To order, please specify MMONO/75N

APPROXIMATION OF FUNCTIONS WITH BOUNDED MIXED DERIVATIVE
V. N. Temlyakov, Editor
(Proceedings of the Steklov Institute, Volume 178)

Intended for specialists in function theory and functional analysis, this book presents a systematic study of approximations of functions of several variables having a bounded mixed derivative or corresponding prelimit difference. The author establishes the orders of the widths of such classes and shows that, in questions involving approximation of functions in these classes, the sets of trigonometric polynomials with harmonics in "hyperbolic crosses" play the same role as the sets of trigonometric polynomials in the one-dimensional case. The Jackson-Nikol'skii inequalities are obtained for polynomials with harmonics in "hyperbolic crosses," and these inequalities are then used to prove certain imbedding theorems. The Bohr-Favard inequalities, which the authors establish for functions not having harmonics in hyperbolic crosses, allow the determination of the orders of the least upper bounds over certain classes of best approximations by trigonometric polynomials with harmonics in hyperbolic crosses.

Contents

The Bernstein and the Jackson-Nikol'skiĭ inequalities, and some imbedding theorems
- The Bernstein inequalities
- The Jackson-Nikol'skiĭ inequalities
- Relations between the best approximations in different metrics

Approximation of Functions in the classes $W^r_{q,\alpha}$ and H^r_q by Trigonometric Polynomials
- Definitions. A representation theorem for the class H^r_q
- Approximation of functions in the classes $W^r_{q,\alpha}$ and H^r_q in the L_p-metric for $1 < q \le p < \infty$
- Approximation of the functions $F_r(\mathbf{x}, \alpha)$ and the Bohr-Favard inequalities
- Approximation of functions in the classes $W^r_{q,\alpha}$ and H^r_q in the L_p-metric for $q = 1$, $1 \le q < \infty$ and for $1 \le q \le \infty$, $p = \infty$
- Approximation of functions in the classes $W^r_{q,\alpha}$ and H^r_q by linear methods

Widths of the Function Classes $W^r_{q,\alpha}$ and H^r_q in the Spaces L_p, $1 \le q \le p < \infty$

The widths of the classes $W^r_{q,\alpha}$

The widths of H^r_q

Some other extremal problems

Approximation of periodic functions of several variables by bilinear forms

Some generalizations of a theorem of Hardy and Littlewood

Best trigonometric approximations

Approximation of functions of the form $f(\mathbf{x} - \mathbf{y})$

Approximation of functions in the classes $W^r_{q,\alpha}$ and H^r_q

1980 *Mathematics Subject Classifications*: 26B99, 41A46, 41A50, 41A65, 42A10; 26B35, 41A17, 46E35
ISBN 0-8218-3126-7, LC 89-868537
ISSN 0081-5438
128 pages (hardcover), June 1989
Individual member $45, List price $75,
Institutional member $60
To order, please specify STEKLO/178N

EIGHT PAPERS TRANSLATED FROM THE RUSSIAN

V. A. Belonogov, Yu. A. Drakokhrust, R. F. Faĭziev, R. N. Ganikhodzhaev, S. S. Goncharov, G. Mints, E. M. Nikishin, A. N. Parshin, T. A. Sarymsakov, Yu. G. Zarkhin

(American Mathematical Society Translations, Series 2, Volume 143)

The papers in this volume range over a variety of topics, including modal logic, arithmetic algebraic geometry, orthogonal polynomials, stochastic matrices, and computing theory.

Contents

G. Mints, *Resolution calculi for modal logics*

R. F. Faĭziev, *Estimates in the mean in the additive divisor problem*

Yu. A. Drakokhrust., *On the complete obstruction to the Hasse principle*

Yu. G. Zarkhin and A. N. Parshin, *Finiteness problems in Diophantine geometry*

V. A. Belonogov, *D-blocks of characters of a finite group*

E. M. Nikishin, *On an estimate for orthogonal polynomials*

T. A. Sarymsakov and R. N. Ganikhodzhaev, *An ergodic principle for quadratic stochastic operators*

S. S. Goncharov, *Data models and languages for their description*

1980 *Mathematics Subject Classifications*: 03B45, 11D41, 11G10, 11G35, 11P99, 11R32, 14D10, 14H25, 14K15, 15A51, 20C15, 33A65, 47A35, 68Q65; and others
ISBN 0-8218-3124-0, LC 89-6770
ISSN 0065-9290
160 pages (hardcover), May 1989
Individual member $35, List price $58,
Institutional member $46
To order, please specify TRANS2/143N

SOCIÉTÉ MATHÉMATIQUE DE FRANCE, ASTÉRISQUE

The AMS distributes Astérisque only in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF, B.P. 126-05, 75226 Paris Cedex 05, France, or to OFFILIB, 48 rue Gay-Lussac, 75240 Paris Cedex 05, France. Individual members of either AMS or SMF are entitled to the member price. (ISSN 0303-1179)

ON THE GEOMETRY OF DIFFERENTIABLE MANIFOLDS, ROME, 23-27 JUIN 1986

(Astérisque, Number 163-164)

This volume is devoted to notes of courses given at Rome (23-27 June 1986) at the Dipartimento di Metodi e Modelli Matematici. The topics covered are: notion of width, isoperimetric inequalities in riemannian manifolds, division algebras associated to positiveley curved symmetric spaces and classification, almost symmetric spaces, invariants of the theory of knots, topology of 3-manifolds and an introduction to the program of research "Geometry Supercomputer Project" of the N.S.F. Each course is almost self contained: starting from a general approach to the subject, accessible to anyone who has basic knowledge of differential geometry and analysis, the authors arrive to new specialized problems. For this reason this volume can be very useful to young researchers.

1980 *Mathematics Subject Classification*: 00
ISSN 0303-1179
284 pages (softcover), 1988
Individual AMS or SMF member $23, List price $33
To order, please specify AST/163/64N

THE STORY OF THE HIGHER-DIMENSIONAL POINCARE CONJECTURE (WHAT ACTUALLY HAPPENED ON THE BEACHES OF RIO DE JANEIRO)
Stephen Smale

In this moving videotaped lecture, Smale presents a personal account of the events surrounding his famous proof of the Poincaré Conjecture for dimensions greater than 4. Beginning with a statement of the conjecture, he provides some interesting topological and geometric insight into some of the basic ideas of the proof. Without dwelling on technical details, Smale moves on to the personal and political events—such as his involvement in the Free Speech Movement, his subpoena by the House Un-American Activities Committee, and the withholding of his grant funds from the National Science Foundation—that form the main portion of the talk. He also describes some of the mathematical controversy resulting from his claim as originator of the proof of the conjecture. As he reads from original documents from the government and from science publications, the discrimination he endured and the support provided by his mathematical colleagues offer an intriguing glimpse into the way politics can influence science policy.

1980 *Mathematics Subject Classification*: 01
VHS format, approx. one hour,
May 1989
Price $59
To order, please specify VIDSMALE/2N

The following videotape is now available through the AMS.

INTRODUCING MATHEMATICA
A Science Television Production

This hour-long videotape features Mathematica creator Stephen Wolfram demonstrating his award-winning new software on a Macintosh IIx. Wolfram energetically leads the viewer through a variety of numerical calculations, algebraic calculations, and graphical renderings. He concludes with a discussion of programming in the language of Mathematica. Throughout the videotape, the computer screen is clearly displayed, showing the graphics in color and the commands in large, bold type for easy reading. The tape will serve as a brief survey of the capabilities of this revolutionary new mathematical software.

1980 *Mathematics Subject Classification*: 00
VHS format, approx. one hour, 1989
Price $49
To order, please specify VIDWOLFRAM/N

Use the order form in the back of this issue or call 800-556-7774 to use VISA or MasterCard.
Shipping and handling charges will be added.

AMS Reports and Communications

Recent Appointments

Committee members' terms of office on standing committees expire on December 31 of the year given in parentheses following their names, unless otherwise specified.

Carlos E. Kenig (1989), Haynes R. Miller (1990), Richard M. Schoen (1990), Barry Simon (1989), and Daniel Zelinsky (1991) have been appointed by President William Browder to the *Editorial Boards Committee*. Professor Zelinsky has also been appointed chairman.

Anatole Katok, George Mackey, and Smilka Zdrakovska have been appointed to the *Advisory Committee for the Russian-English Dictionary* by President William Browder. Other members of the committee Joseph Bernstein, Ralph P. Boas, chairman, James R. Bunch, Courtney S. Coleman, Joseph L. Doob, Bogdan Dudzik, Eugene Dynkin, Mark I. Freidlin, Paul R. Halmos, Edwin Hewitt, John R. Isbell, John McCarthy, Boris Mityagin, Eric John Fyfe Primrose, Boris Schein, Lawrence A. Shepp, and Ben Silver (ex officio).

Jean Taylor (1991) has been appointed by President William Browder to the *Program Committee for National Meetings*. Continuing members of the committee are James G. Arthur (1991), Robert M. Fossum (ex officio), Peter B. Gilkey (1990), George A. Hagedorn (1990), Hugh L. Montgomery (1989), chairman, and Peter Sarnak (1991).

Emanuel Parzen (IMS, 1991) has been appointed to the AMS-IMS-SIAM *Committee on Joint Summer Research Conferences in the Mathematical Sciences* by President Ram Gnanadesikan (IMS). Continuing members of the committee are William B. Arveson (AMS, 1989), John A. Burns (SIAM, 1990), Martin Golubitsky (SIAM, 1990), Daniel J. Kleitman (AMS, 1989), Anthony W. Knapp (AMS, 1992), Ingram Olkin (IMS, 1990), chairman, Mary Ellen Rudin (AMS, 1989), Stephen G. Simpson (AMS, 1990), and Gregg J. Zuckerman (AMS, 1992). Terms expire on June 30.

Martin Brown, William Fenton, Leon Harkleroad, Carol Russell, Elaine Salvo, Sandy Spears, Wiley Williams, and Jeffrey Allen Wright have been appointed by Presidents Lida Barrett (MAA) and William Browder (AMS) to the AMS-MAA *Arrangements Committee for the Louisville Meeting January 17–20, 1990*. Other members of the committee are Joseph A. Cima (ex officio), William H. Jaco (ex officio), John Oppelt, chairman, and Kenneth A. Ross (ex officio).

Reports of Past Meetings

The Council Meeting in Worcester

The Council met at 7:00 pm on 15 April 1989 in the Sturbridge Room of the Howard Johnson's Motor Lodge in Worcester, Massachusetts. Ex-President G. D. Mostow was in the chair.

The Council approved the minutes of the January 1989 Council and the minutes of business by mail. The first of these minutes by mail reports that William A. Veech was elected by the Council as Council representative to the Joint Policy Board for Mathematics (JPBM). The second reports that the Council elected Hugo Rossi to a four year term on its Executive Committee.

While sitting in Executive Session, the Council approved the request by Roger Howe, Chair of the *Bulletin* Editorial Committee, to appoint Joseph Bernstein, Harvard, and Robert Lazersfeld, UCLA, as Editors for Research Announcements to replace Spencer Bloch, whose term has expired. The Council also received the report of the Nominating Committee, which it approved in its entirety by making the following nominations for the Fall 1989 Election by the membership:

President-Elect
Michael Artin

Vice-President
(Two to be elected)
James Arthur
Phillip Griffiths
James Serrin
Dennis Sullivan

Associate Secretary
(Two to be elected)
Andy Roy Magid
Lance Small

Member-at-Large
(Five to be elected)
Joan Birman
Frank Clarke
Herb Clemens
Ed Floyd
Amassa Fauntleroy
Carl Pomerance
S. Yau

Trustee
(One to be elected)
Ramesh Gangolli
John Polking

In the event nominations by petition do not generate at least three more candidates, the Council will make additional nominations so as to bring the number of candidates for election to the position of Member at Large up to ten (10).

The Council approved changes in the qualifications for the AMS Centennial Fellowships. In the past the fellowships have been open to individuals five to ten years past the Ph.D. degree (or equivalent) but below the academic rank of professor. In the future the fellowship will be open to individuals seven to twelve years past the Ph.D. degree (or equivalent). The Council removed the rank restriction. The Council changed slightly the instructions to the Selection Committee so that they now read "The Selection Committee **will** give preference to applicants who have not had extensive postdoctoral fellowship support." The Council requested of the Trustees that the stipend be set at $36,000 for nine months of full-time research or the equivalent.

The *Bulletin* Editorial Committee received approval from the Council for publishing in the *Bulletin* a revised statement concerning standards for Research Announcements. The Council changed the names of the sectional Committees to Select Hour Speakers for sectional meetings to Section Program Committees. It approved the establishment of a new book series "Advances in Soviet Mathematics".

The Council discussed at length whether a review of two books on fractals written by Steven G. Krantz, which had been accepted for publication in the *Bulletin*, should be published in the *Bulletin* along with a response written by Benoit B. Mandelbrot. The Council reaffirmed the policy that responses not be published in the *Bulletin* by recommending that the *Notices* Editorial Committee publish this review and the response in the *Notices*.

Before adjourning at 11:55 p.m., the Council discussed, but did not act upon, other topics including cooperation with Pi Mu Epsilon, elections within the Society, stimulating mathematical education, rights of mathematicians in Chile, and sectional meetings.

Robert M. Fossum
Secretary
Urbana, Illinois

Miscellaneous

Personal Items

Benjamin Epstein, of the Israel Institute of Technology, has been elected a foreign correspondent member of the Class of Sciences of the Academia das Ciências de Lisboa.

Izrail Moiseevich Gel'fand, of the Steklov Mathematical Institute, was elected a guest member of the Japan Academy of Science, on February 13, 1989, and he received a Doctor of Science, honoris causa, from Kyoto University on March 27, 1989. This is the first time that Kyoto University has given an honorary degree.

Sang-Guen Han, of Ohio State University, has been appointed Assistant Professor of Mathematics at the Korea Institute of Technology, Daejon, Korea.

Arjan S. Mirchandaney, of Defiance College, Ohio, has been promoted to Professor of Mathematics at that institution.

Pablo M. Salzberg, of the University of the Sacred Heart, has been appointed Associate Professor of Mathematics at the University of Puerto Rico, Rio Piedras.

Deaths

Raj Chandra Bose, Professor Emeritus of Colorado State University, died on October 30, 1987, at the age of 86. He was a member of the Society for 37 years.

Howard Campaigne, of Portales, New Mexico, died on August 4, 1988, at the age of 78. He was a member of the Society for 51 years.

Edward H. Cutler, a member of the faculty of Lehigh University from 1930 until his retirement in 1968, died on March 15, 1989, at the age of 85. He was a member of the Society for more than 60 years.

Philip H. Krijgsman, of Oostwoud, the Netherlands, died on January 30, 1989, at the age of 88. He was a member of the Society for 32 years.

Paco Lagerstrom, of the California Institute of Technology, died on February 16, 1989, at the age of 75. He was a member of the Society for 45 years.

Edward A. Saibel, of Durham, North Carolina, died on April 9, 1989, at the age of 85. He was a member of the Society for 61 years.

Emory P. Starke, Professor Emeritus of Rutgers University, died on March 9, 1989, at the age of 93. He was a member of the Society for 64 years.

Visiting Mathematicians

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
Burns, Robert (Canada)	University of Queensland, Australia	Group Theory	4/89 - 6/90
Dennis, S.C.R. (Canada)	Université de Poitiers, France	Fluid Dynamics	4/89 - 9/89
Harris, Michael (U.S.A.)	Steklov Institute of Mathematics, U.S.S.R.	Number Theory	9/89 - 8/90
Hinkelmann, Klaus (U.S.A.)	University of New South Wales, Australia	Statistics	8/89 - 12/89
Hurley, James F. (U.S.A.)	University of the Philippines	Lie Algebras	6/89 - 7/89
Katz, Sheldon (U.S.A.)	Mathematics Institute at the University of Bayreuth, West Germany	Algebraic Geometry	8/89 - 12/89
Iwaniec, Tadeusz (U.S.A.)	Mittag-Leffler Institute, Sweden	Quasiconformal Mappings	1/90 - 5/90
Kra, Irwin (U.S.A.)	Hebrew University, Israel	Complex Analysis	11/89 - 2/90
Mohammed, Salah (U.S.A.)	University of Kaiserslautern, West Germany	Stochastic Differential Equations	6/89 - 8/89
Onneweer, Cornelis (U.S.A.)	National University of Singapore; Universidad Autonoma de Madrid, Spain	Harmonic Analysis	7/89 - 8/89 9/89 - 5/90
Protter, Philip (U.S.A.)	Université de Marseille, France	Probability	5/89 - 8/89
Shorack, Galen R. (U.S.A.)	Leiden University, The Netherlands; University of Rome, Italy	Statistics	8/89 - 12/89 1/90 - 8/90
Stephenson, W. Robert (U.S.A.)	University of Newcastle, England	Nonparametrics, Quality Control	9/89 - 5/90
Watkins, Mark E. (U.S.A.)	Technische Universität, Berlin, West Germany	Combinatorics	During 7/89

Visiting Foreign Mathematicians

Aas, Hans-Fredrik (Norway)	University of California, Santa Barbara	Post-Secondary Mathematics	9/89 - 6/90
Adali, Sarp (South Africa)	University of California, Santa Barbara	Optimal Control	6/89 - 8/89
Akgunduz, Nihat (Turkey)	George Washington University	Nonlinear and Postoptimal Stability Analysis	2/89 - 2/90
Amman, Herbert (Switzerland)	California Institute of Technology	Partial Differential Equations	1/90 - 3/90
Antoniadis, Anestis (France)	University of California, Irvine	Statistics	7/89 - 10/89
Arbel, Beno (Israel)	University of California, Santa Barbara	Strategies of Problem Solving	9/89 - 6/90

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Beauzamy, Bernard (France)	Kent State University	Polynomial Manipulations	9/89 - 10/89
Berruyer, Jacques (France)	University of California, Irvine	Functional Analysis	7/89 - 10/89
Bolfarine, Heleno (Brazil)	State University of New York at Binghamton	Sampling Theory	1/89 - 12/89
Bonato, Cezar (Brazil)	University of California, Irvine	Statistical Physics	7/89 - 6/90
Campanino, Massimo (Italy)	University of California, Irvine	Statistical Physics	10/89 - 12/89
Chen, Su-qing (China)	University of Western Ontario	Theoretical Physics	6/89 - 8/89
Cowley, Stephen (England)	California Institute of Technology	Theoretical Fluid Mechanics	1/90 - 7/90
Csorgo, Sandor (Hungary)	University of North Carolina, Chapel Hill	Statistics and Probability	8/89 - 6/90
Dranisnikov, Aleksander (U.S.S.R.)	Cornell University	Topology	9/89 - 6/90
Edwards, Christopher (England)	University of California, Irvine	Functional Analysis	3/90 - 8/90
Eljoseph, N. (Israel)	York University	Mathematics Education, History of Mathematics	9/89 - 6/90
Eremenko, A. E. (U.S.S.R.)	Purdue University	Complex Analysis	10/89 - 12/89
Friedman, Yaakov (Israel)	University of California, Irvine	Functional Analysis	7/89 - 8/89
Gohberg, I. (Israel)	University of Connecticut	Operator Theory	9/89 - 11/89
Goldie, Charles (England)	Cornell University	Probability	6/89 - 8/89
Gu, Bingchang (People's Republic of China)	George Washington University	Numerical Analysis, Applied Mathematics	3/87 - 1/90
Ha, Chung-Wei (China)	University of California, Santa Barbara	Nonlinear Analysis	9/89 - 6/90
Hirata, Koichi (Japan)	Northwestern University	Topology	9/89 - 8/90
Hyodo, Osamu (Japan)	Johns Hopkins University	Number Theory	9/89 - 5/90
Kamburowski, Jerzy (Poland)	North Carolina State University	Mathematics, Optimization, Flow Networks	1/89 - 6/90
Kato, Kazuya (Japan)	Johns Hopkins University	Algebraic K-theory	2/90 - 5/90
Kenshi, Ishiguro (Japan)	Purdue University	Algebraic Topology	8/89 - 5/90
Krengel, Ulrich (West Germany)	Georgia Institute of Technology	Ergodic Theory, Probability	8/89 - 3/90
Kroó, András (Hungary)	Old Dominion University	Approximation Theory	8/89 - 7/90
Kurokana, Nobushige (Japan)	Johns Hopkins University	Number Theory	3/90 - 6/90
Kuo, Tzee-Char (Australia)	University of Hawaii	Singularity Theory	9/89 - 1/90
Li, Gong-bao (China)	University of Connecticut	Partial Differential Equations	9/89 - 8/90
Li, Wenzhu (China)	University of Western Ontario	Theoretical Physics	5/89 - 7/89
Lin, Wen-Hsuing (Taiwan)	Northwestern University	Topology	12/89 - 8/90
Lui, J. P. (China)	University of Western Ontario	Theoretical Physics	10/89 - 12/89
Makagon, Andrzej (Poland)	Michigan State University	Stochastic Processes, Probability Theory	9/89 - 6/90
Marchesin, Dan (Brazil)	State University of New York at Stony Brook	Computational Fluid Dynamics	9/89 - 12/90
Marchetti, Domingos (Brazil)	University of California, Irvine	Statistical Physics	7/89 - 6/90
Mathieu, Yves (France)	University of California, Santa Barbara	Structure of 3-Manifolds	9/89 - 6/90
Mikami, Toshio (Japan)	Brown University	Dynamical Systems	9/89 - 5/90
Mimura, M. (Japan)	Memorial University of Newfoundland	Algebraic Topology	7/89
Miransky, V. A. (U.S.S.R.)	University of Western Ontario	Theoretical Physics	1/90 - 2/90

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Moeller, Manfred (West Germany)	Purdue University	Functional Analysis	8/89 - 5/90
Moszkowski, Paul H. (France)	Syracuse University	Combinatorics	9/88 - 5/90
Oates, Sarah (Great Britain)	Purdue University	Logic	8/89 - 5/91
Oda, Takayuki (Japan)	Johns Hopkins University	Number Theory	9/89 - 12/89
Olivieri, Enzo (Italy)	University of California, Irvine	Statistical Physics	9/89 - 12/89
Perez, Jose Fernando (Brazil)	University of California, Irvine	Statistical Physics	1/90 - 3/90
Pullin, Dale (Australia)	California Institute of Technology	Theoretical Fluid Mechanics	1/90 - 7/90
Qiu, Xiaojing (People's Republic of China)	George Washington University	Operations Research and Management Science	8/89 - 8/90
Russo, Alessandro (Italy)	Purdue University	Numerical Analysis	8/89 - 5/90
Ruttiman, Gottfried (Switzerland)	University of California, Irvine	Functional Analysis	3/90 - 8/90
Sa Barreto, Antonio (Brazil)	Purdue University	Partial Differential Equations	8/89 - 5/91
Saito, Shuji (Japan)	Johns Hopkins University	Algebraic K-theory	4/90 - 7/90
Saito, Takeshi (Japan)	Johns Hopkins University	Arithmetic Algebraic Geometry	9/89 - 5/90
Schaaf, Renate (West Germany)	University of Utah	Partial Differential Equations, Nonlinear Analysis, Mathematical Biology	9/89 - 6/90
Schlickewei, Hans Peter (West Germany)	University of Colorado, Boulder	Number Theory	8/89 - 12/89
Sherry, Thomas (Ireland)	University of Western Ontario	Theoretical Physics	7/89 - 8/89
Sitenko, Yu. A. (U.S.S.R.)	University of Western Ontario	Theoretical Physics	10/89 - 11/89
Stuart, Charles (Switzerland)	Cornell University	Nonlinear Analysis and Bifurcation Theory	8/89 - 12/89
Tadic, Marko (Yugoslavia)	University of Utah	Group Representations and Harmonic Analysis	9/89 - 6/90
Takenaka, Toshiharu (Japan)	Tulane University	Operator Theory	9/89 - 8/90
Tall, David (Great Britain)	Purdue University	Mathematics Education	1/90 - 5/90
Thukral, J. K. (India)	University of California, Santa Barbara	Operator Theory	9/89 - 6/90
Tresser, Charles P. (France)	University of Arizona	Dynamical Systems Theory	8/89 - 6/90
Tutek, Z. (Yugoslavia)	University of Saskatchewan	Numerical Analysis	7/89 - 6/90
Van Zwet, Willem (The Netherlands)	University of North Carolina, Chapel Hill	Statistics and Probability	1/90 - 6/90
Vazquez-Abad, Felicia (Mexico)	Brown University	Dynamical Systems	9/89 - 5/90
Vespri, Vincenzo (Italy)	Northwestern University	Partial Differential Equations	9/89 - 8/90
Wang, Gang (People's Republic of China)	Purdue University	Probability	8/89 - 5/90
Wang, Zhi-Qiang (People's Republic of China)	University of Utah	Sympletic Geometry, Nonlinear Analysis and Partial Differential Equations	9/89 - 6/90
Wendland, Wolfgang (West Germany)	University of Delaware	Partial Differential Equations	10/89 - 3/90
Willekens, Eric (Belgium)	Cornell University	Probability	7/89 - 8/89
Wu, Wen-Da (People's Republic of China)	Kent State University	Numerical Analysis, Symbolic Computation	7/89 - 8/89
Xie, Huimin (People's Republic of China)	Purdue University	Control Theory	8/89 - 5/90

Backlog of Mathematics Research Journals

Backlog. Information on the backlog of papers for research journals, primarily those published in North America, is reported to the Providence Office by those editorial boards which elect to participate. The figures are an estimate of the number of printed pages which have been accepted, but are in excess of the number required to maintain copy editing and printing schedules.

Observed Waiting Time. The quartiles give a measure of normal dispersion. They do not include extremes which may be misleading. Waiting times are measured in months from receipt of manuscript in final form to publication of the issue. When a paper is revised, the waiting time between an editor's receipt of the final revision and its publication may be much shorter than is the case otherwise, so these figures are low to that extent.

The observations are made from the latest issue published, before the deadline for this issue of *Notices*, from journals that have actually been received by a subscriber in the Providence, Rhode Island, area; in some cases this may be two months later than publication abroad. If the waiting time as defined above is not given in the journal, if no new issue has been received since the last survey, or if the latest issue is for some reason obviously not typical, no times are given in this report and such cases are marked NA (not available or not applicable).

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages 12/31/88	Backlog of Printed Pages 6/30/88	Editor's Estimated Time for Paper Submitted Currently to be Published (in Months)	Observed Waiting Time in Latest Published Issue (in Months) Q_1	M	Q_3
Acta Inform.	8	800	0	0	5	6	6	8
Aequationes Math.	6	640	0	0	9	11	13	18
Alg. Groups Geom.	4	600	0	0	7	6	6	8
Algorithmica	4	576	432	128	12	11	11	13
Amer. J. Math.	6	1200	0	800	12	16	18	21
Ann. of Math.	6	1250	600	500	10	10	12	15
Ann. Probab.	4	1600	250	0	15	11	12	14
Ann. Sci. École Norm. Sup.	4	650	0	0	11	8	9	10
Ann. Statist.	4	1800	180	300	9	10	10	13
Appl. Math. Letters	4	400	50	NA	1-4		NA	
Appl. Math. Optim.	6	672	185	192	10	11	12*	18
Arch. Hist. Exact Scis.	8	800	0	0	12	12	12	13
Arch. Math. Logic	3	200	0	NA	8	8	11	14
Arch. Rational Mech. Anal.	16	1600	0	0	10	8	11	14
Bull. Austral. Math. Soc.	6	1000	200	200	10	11	11	12
Canad. J. Math.	6	1152	0	400	8-10	8	9	13
Canad. Math. Bull.	4	256	288	300	20	15	20	21
Circuits Systems Signal Proc.	4	512	0	0	4	11	12	13
Comm. Algebra	12	2250	2220	2186	12	12	16	18
Comm. Math. Phys.	28	4928	0	0	7	7	9	10
Comm. Partial Diff. Equations	12	1610	0	NR	9	6	10	14
Comp. Math. Appl.	24	2400	1200	NA	6-8	10	11	20
Computing	8	720	180	NR	8	7	9	11
Constr. Approx.	4	448	112	112	9		NA	

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages 12/31/88	Backlog of Printed Pages 6/30/88	Editor's Estimated Time for Paper Submitted Currently to be Published (in Months)	Observed Waiting Time in Latest Published Issue (in Months) Q_1	M	Q_3
Discrete Comput. Geom.	6	600	370	370	15	7	10	20
Duke Math. J.	6	1500	150	400	9	9	11	13
Houston J. Math.	4	600	500	600	18		**	
Illinois J. Math.	4	704	858	835	24	20	24	24
IMA J. Appl. Math.	6	480	0	100	12	9	10	11
IMA J. Math. Appl. Med. Biol.	4	350	80	80	6		NA	
IMA J. Math. Control Inform.	4	350-400	NR	70	NR	9	9	12
IMA J. Numer. Anal.	4	550	0	0	18	8	11	16
Indiana Univ. Math. J.	4	NR	NR	NR	NR	11	12	14
Inst. Hautes Études Sci. Publ. Math.	2	400	0	NR	9-15		NA	
Internat. J. Math. Math. Sci.	4	832	125	232	6-8	11	15	21
Invent. Math.	12	2688	0	0	8	9	11	12
Israel J. Math.	12	1500	700	100	9	7	8	9
J. Algorithms	4	NR	NR	NR	NR	12	13*	15
J. Amer. Math. Soc.	4	1000	0	0	NA	6	8	12
J. Appl. Math. Simulation	4	350	100	100	4			
J. Assoc. Comput. Mach.	4	1000	250	100	6	8	9	13
J. Austral. Math. Soc. Ser. A	6	1100	600	800	18	19	22	24
J. Austral. Math. Soc. Ser. B	4	512	0	0	15	8	9	13
J. Classification	2	300	0	0	7		NA	
J. Comput. System Sci.	6	1000	800	300	18		NA	
J. Differential Geom.	6	1300	1200	1000	10	17	17	17
J. Integral Equations Appl.	4	700	0	0	12		NA	
J. Math. Biol.	6	720	0	100	7	7	8	9
J. Math. Phys.	12	3100	0	0	4	4	4*	4
J. Nigerian Math. Soc.	1	100	0	NR	12		NA	
J. Operator Theory	4	NR	NR	200	NR	13	13	17
J. Symbolic Logic	4	***	***	500	12		***	
Linear Algebra Appl.	15	4500	600	NR	10-12	7	8	10
Manuscripta Math.	12	1536	0	0	5	4	5	6
Math. Ann.	16	2816	0	0	15-17	9	10	14
Math. Comput. Modelling	18	1800	900	NA	6-8	9	11*	11
Math. Comp.	4	1500	50	0	12	11	12	16
Math. Control Signals Sys.	4	400	400	NA	24	17	18	21
Math. Oper. Res.	4	750	400	NR	20	17	18	21
Math. Programming Ser. A	3	330	166	190	15	12	12	13
Math. Social Sci.	6	600	90	180	10	7	9	9
Math. Systems Theory	4	256	0	0	4	5	7	15
Math. Z.	12	1824	0	0	11-12	11	12	15
Mem. Amer. Math. Soc.	6	2800	0	0	2	14	18	23
Michigan Math. J.	3	480	130	30	17	10	14	15
Monatsh. Math.	8	704	0	0	9	7	10	17
Numer. Funct. Anal. Optim.	12	1300	0	0	6	6	7	10
Numer. Math.	12	1488	0	0	5-6	6	7	12
Oper. Res.	6	1008	315	575	10	15	19	21
Pacific J. Math.	10	2000	NR	NR	12	12	12	14
Probab. Theor. Relat. Fields	12	1920	0	0	12	9	10	18
Proc. Amer. Math. Soc.	12	3000	0	100	8	12	13	15
Proc. London Math. Soc.	6	NR	NR	NR	NR	14	16	26
Quart. Appl. Math.	4	800	200	600	12	13	14	15

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages 12/31/88	Backlog of Printed Pages 6/30/88	Editor's Estimated Time for Paper Submitted Currently to be Published (in Months)	Observed Waiting Time in Latest Published Issue (in Months) Q_1	M	Q_3
Quart. J. Math. Oxford Ser. (2)	4	512	64	128	18	16	18	20
Results Math.	4	784	0	100	6	6	8	12
Rocky Mountain J. Math.**	4	1000	2000	1845	22		**	
Semigroup Forum	6	768	128	0	6	9	10	12
SIAM J. Appl. Math.	6	1850	556	654	NR	12	12	14
SIAM J. Comput.	6	1290	270	40	NR	10	10	11
SIAM J. Control Optim.	6	1500	215	232	NR	10	11	12
SIAM J. Discrete Math.	4	600	0	0	NR	6	7	8
SIAM J. Math. Anal.	6	1500	388	142	NR	8	9*	10
SIAM J. Matrix Anal. Appl.	4	600	30	0	NR	6	7*	9
SIAM J. Numer. Anal.	6	1500	639	525	NR	12	13*	13
SIAM J. Sci. Statist. Comput.	6	1200	400	86	NR	8	9*	9
SIAM Rev.	4	680	50	84	NR	11	15*	18
Topology Appl.	9	990	1100	825	13	16	16	17
Trans. Amer. Math. Soc.	12	5000	200	200	14	16	17	20

NR means no response received.
NA means not available or not applicable.
* From date accepted.
** This journal recently ended a moratorium on the acceptance of new papers; latest issue consists of pre-moratorium papers.
*** The publishers of this journal have authorized publication of extra pages as needed to reduce backlog to zero at the end of the 1989 volume.

AMS and LMS Agree to Copublish

The American Mathematical Society (AMS) and the London Mathematical Society (LMS) are pleased to announce a copublishing agreement for a book series devoted to the History of Mathematics.

Manuscripts for publication in this series will be selected by a six-person editorial committee consisting of three members appointed by each Society. AMS committee members are Peter L. Duren, University of Michigan, Richard A. Askey, University of Wisconsin, and Uta C. Merzbach; LMS committee members are Jeremy Gray, Open University, U. K., S. J. Patterson, University of Göttingen, West Germany, and C. Houzel, University of Paris.

The History of Mathematics series will present historical perspectives on individuals who have profoundly influenced the development of mathematics or have made great contributions to the mathematical community, or will trace the development of special areas of research.

Both Societies have been independently developing publications on this theme. The AMS launched its history series to commemorate the AMS Centennial in 1988. The appearance of the first volume, *A Century of Mathematics in America*, led to negotiations for collaboration. In addition to this cooperative publication venture, the AMS and LMS will sponsor a joint meeting in Cambridge, England, from June 29 to July 1, 1992.

New Members of the AMS

ORDINARY MEMBERS

Nagwa MohSabry Abd El Mottaleb, Cairo, Egypt
Julia Abrahams, Arlington, VA
Jennifer H Agan, Chesapeake, VA
Clinton J Alverson, Georgia Tech
Jean-Philippe Anker, Princeton, NJ
Dominique Armal, Los Angeles, CA
Yurij A Baransky, New York, NY
Shlomo Edward Belaga, Univ Louis Pasteur, Strasbourg, France
Mark Robert Bell, Paramount, CA
Frank A Benford, Reno, NV
Maarten J Bergvelt, Univ of Georgia
James Boland, Clemson, SC
Barbara J Britton, Bemidji, MN
Bruce Brocka, Davenport, IA
Hayden H Burrus, Rochester, NY
Peter John Cadden, El Paso, TX
Jaroslaw Cel, Konskie, Poland
Buel E Chandler, Etters, PA
V V Chueshev, Kemerovo State Univ, USSR
Janis Cirulis, Latvian State Univ, USSR
Olga Costinescu, Iasi, Romania
James M Curry, Brisbane, CA
Joann C Delenick, New Haven, CT
Raymond L Dempsey Jr, Providence, RI
Gabriel Dimitriu, Univ Ali i Cuza, Iasi, Romania
Ed M Dougherty Jr, SAIC, Oak Ridge, TN
Roman Dwilewicz, Univ of Warsaw, Poland
Gerrit M Edris, San Francisco, CA
Kirsty J Eisenhart, Richmond, VA
Greg J Engl, Oakland, CA
Steven W Evans, Starkville, MS
Zarreen Hayat Farooqi, King Faisal Special Hosp, Riyadh, Saudi Arabia
Michael R Fehling, Mountain View, CA
Naomi Fisher, Univ of Illinois, Chicago
Sue H Fisher, Wakefield, RI
Brian J Fisk, Albuquerque, NM
Thomas Benton Fowler, Mitre, McLean, VA
Einar Fredriksson, IOS, Amsterdam, Netherlands
Luis Gallardo, Brest, France
Ashish Kumar Ganguli, Kanoi College, Dibrugarh, India
Edward H Ganley, Winchester, MA
Jeffrey J Gaynor, New York, NY
S I Gelfand, Moscow, USSR
Donald J Geman, Univ of Massachusetts, Amherst
Friedrich Gesztesy, Univ of Missouri-Columbia
Aurelian Gheondea, INCREST, Bucharest, Romania
Alexander V Gnedin, Acad of Science of the USSR, Moscow
Jacob D Goldstein, TASC, Reading, MA
Tracy Jo Goodson-Espy, Trevecca Nazarene College, Nashville, TN
Linda B Grant, Ayer, MA
Kyungsoon J Ha, Iowa City, IA
Larry Haist, Downsview, Ontario, Canada
Shaocen Han, Nanchong Teachers' College, People's Republic of China
Teodor Havarneanu, Iasi, Romania
Matthew J Hejna, Middletown, CT
Elizabeth H Hess, North Olmsted, OH
Cynthia M Hoesman, Ogdensburg, NY
Christian F J Högfors, Chalmers Univ of Tech, Goteborg, Sweden
I D Iliev, Sofia, Bulgaria
Ronni Rae Indovina, New Orleans, LA
Alexander J Izzo, Oakland, CA
Steven A Janowsky, Harvard Univ
Mirko Junge, Hamburg, Federal Republic of Germany
Winfried Just, Univ of Toronto, Canada
Mendel Kapilevich, Allston, MA
Martha Jane Kirker, Omaha, NE
Joseph Kowal, Pleasantville, NY
Michal Krynicki, Univ of Warsaw, Poland
Krzysztof S Kubacki, Simsbury, CT
I Kubiaczyk, Sroda, Poland
Sambhavi Lakshminarayanan, Univ of Texas at Dallas
Dale L Landis, C S Draper Lab, Cambridge, MA
Lawrence H T Le, Univ of Alberta, Canada
James J Levis, Springfield, IL
Hong Li, Little Rock, AR
Teck Cheong Lim, George Mason Univ, Fairfax, VA
Richard S Lively, SUNY at Buffalo
Sean D Lloyd, Woodacre, CA
Robert B Lockhart, U S Naval Acad
David Don Lorenzen, Portland, OR
Dennis L Lumpkin, Washington, DC
Samuel Magdal, Des Plaines, IL
Thomas G Masters, Seattle, WA
Mark V Matthews, Stanford Univ
James B McCaffrey, Bronxville, NY
Bill J Metaftsis, Volos, Greece
Ivailo M Mladenov, Bulgarian Acad of Science, Sofia
Stephen John Montgomery-Smith, Univ of Missouri-Columbia
Nabil Moussa, American Univ in Cairo, Egypt
Rusalin S Nikolaev, Higher Inst of Elct & Mech Eng, Varna, Bulgaria
Kaur Nirmaljeet, Punjab, India
Joseph D Novella, Pennsauken, NJ
Modeste Nzi, Univ Laval, Canada
Joseph P Oechsle, Malvern Prep School, Malvern, PA
Ronald S Ojakian, San Leandro, CA
Coert Olmsted, Univ of Alaska, Fairbanks
R N Ormotsadze, Tbilisi, USSR
Samuel T Osofsky, Cambridge, MA
Zoulikha Otmani, Univ of Annaba, Algeria
Roger E Owles, New London, CT
Pedro J Paul, Escuela Superior de Ingenieros, Seville, Spain
Bhadra Ragu Raghavan, Missouri City, TX
Lidia K Rejto, Univ of Wisconsin, Milwaukee
Christopher J Roesmer, Houston, TX
Crispin M Rope, Suffolk, England
Jean-Pierre Rosay, Univ of Wisconsin, Madison
Seth R Rosenthal, East Brunswick, NJ
Alexander V Rozenblyum, Grodno State Univ, USSR
David Karl Ruch, New Mexico State Univ
Barton L Salling, Woodside, NY
D C Simmons III, Denton, TX

Brian K Spohn, Sharon, PA
Thomas J Stone, Univ of Maryland
Zbigniew Szafraniec, Gdansk, Poland
Kornel Szlachanyi, Hungarian Acad of Science, Budapest
Domingo Alberto Tarzia, Univ de Rosario, Argentina
Michael Arijan Thelwall, Univ of Lancaster, England
Marshall M Thomas, Miami, FL
Robert S D Thomas, Vancouver, British Columbia, Canada
Tonko Tonkov, Sofia, Bulgaria
Daniel G Tormey, West Lafayette, IN
José Miguel Urbano, Coimbra, Portugal
Sue Van Hattum, Ann Arbor, MI
Luis Vega, Univ of Chicago
Roger D Warren, Madisonville Community College, KY
William S Watkins, Hanapepe, HI
Judith Rose Weaver, Key West, FL
Rodolfo Wehrhahn, Univ of Hamburg, Federal Republic of Germany
Lenard Weinstein, Palo Alto, CA
Tod L Westcott, San Francisco, CA
Nathaniel Whitaker, Amherst, MA
Ann L Winblad, San Francsico, CA
Jingbo Wu, Nankai Univ, Tianjin, People's Republic of China
Liang Sen Wu, East China Normal Univ, Shanghai, People's Republic of China
Ti Zuo Xuan, Beijing Normal Univ, People's Republic of China
Peiyuan Yan, Pennsylvania State Univ
Lu Yang, Academia Sinica, Chengdu, People's Republic of China
Mikhail Zaks, Inst of Mech of Cont Media, Perm, USSR
Fu Ji Zhang, Xinjiang, People's Republic of China
Jianping Zhu, SUNY at Stony Brook

RECIPROCITY MEMBERS

Allahabad Mathematical Society
Ranjit Kaur
Ghan Shyam Maheshwari
Australian Mathematical Society
Max A Lohe
Deutsche Mathematiker-Vereinigung e. V.
Manfred H Mőller
Claus Scheiderer
Gerhard J A Schneider
Wolfgang Wefelmeyer
Korean Mathematical Society
Kyu Hyuck Choi
Ki Shik Koo
Eun Hwi Lee
Young Whan Lee
London Mathematical Society
Hamza A S Abujabal
Andonakis Constantinos Kakas
R P Lewis
Mathematical Society of Japan
Mei Kobayashi
Yoshio Mimura
Kenji Ueno
Mathematical Society of the Republic of China
Song-Sun Lin
Société Mathématique de Belgique
Eric Cornelis
Société Mathématique de France
Phillipe LeChenadec
Helmut Meyer
Sociedad Colombiana de Matemáticas
Bernardo Recamán
Österreichische Mathematische Gesellschaft
Heinrich Reitberger

NOMINEE MEMBERS

Acadia University
Hume C L Smith
Adelphi University
Tariq Naeem Chaudary
David Phillips
V Murthy Tadepalli
Allegheny College
Corinne Renee Wallis
Amherst College
Andrew C Rosenburgh
Arizona State University
Zhong Bi
Russell Lloyd Carter
Robin A Cruz
Ken S Dailey
Haiyong Deng
Mahmoud M Fath El-Deni
Solomon M Francis
Omezzine Gouadria
Vikas Gupta
Steven J Gustafson
Suzette Mae Helgeson
Roy A Howard
Zhaofei Ji
Katalin Kolossa
Lisa A Langland
Jeayoung Lee
Mike O Lee
Edisanter Lo
Yu-Jen Lo
Congyun Lou
Rafael Marino
Jose Antonio Palacios
Jeong Yo Park
In-Soo Pyung
Joachim Rosenthal
James W Scholl
Hao Shen
Kaiming Wang
Ruoyu Wang
Mahn-Ling Woo
He-Yi Wu
Ki Ho Yang
An-Er Yu
Guoliang Zeng
Qi Zhao
Yan Zhao
Arkansas State University
Nancy Lee Crumpton
Richard E Farmer
John Michael Jackson
Donald Ray McWilliams
Tracie L Newsome
Robert L Perkins
Armstrong State College
Christina M Wohlert
Baylor University
Li Zhang
Beloit College
Vishram M Patwardhan
Bloomsburg University of Pennsylvania
Lee A Chasen
Boston University
Daniel Saunders Alexander
Solon Frederick Blundell
John F Brown
Mario Casella
Maureen Ann Dillon
Bradford R Findell
Joseph H Galia Jr
Mako E Harvta
Linda Kasten
Rozita Kheradvar
Sarah L Mabrouk
Farzan Nadim
Patricia M Odell
Andre E Robatino
Hector F Sanchez
Lionel C Slammert
Lisa Ann Smith
James Andrew Walsh
Bowling Green State University
Maria Lorna Bacarisa
Jeannine D Brown
Hongwei Du
Tony G Goedde
Sithy Aysha Hashim
Ashwini K Mathur
Broderick O Oluyede
Elsie S Valeroso
Wayne W Wu
Brandeis University
Susanta Basu
Stefano Brocco
Mo Cheng
Derrin S Gottlieb
Martina Knorr
Ngau Lam
Jiangang Luo
Alexander Magid
Joonsang Park
Seonghwa Park
Seungkyung Park
Susan Field Parker
Sangwook Ree
David L Ruhm

Ursula Weiss
Brigham Young University
Beverly Ann Cox
Rebecca Gale
James N Gartside
Jennifer Glines
Brent DeRay Hugh
Kate Nielsen
Matthew N Pierce
Millie Jean Westley
Ping Zhang
Brooklyn College, CUNY
Gene Alvarez
Lloyd B Miller
Brown University
Gregory Zvi Arone
Hongsheng Cai
Davide P Cervone
Yen-Mei J Chen
Seng Kiat Chua
Charles Delahunt
Chaujun Lee
Nancy L Lim
Ai-Min Liu
James J Sauerberg
Christopher W Towse
Stavros Theo Tsalidis
Bin None Wang
Bryn Mawr College
Regina B Cohen
Vikram Janakiraman
Julia Marie Malik
Bucknell University
Howard Smith
California Polytechnic State University
Mark Alley
Robin L Berman
Deborah A Bryant
Kara L Cretti
Will-Matthis Dunn III
Phillip Eckert
John W Fetcho
William B Horst
John E Masterson II
Michael B McNamara
Evan M Petersen
Michael F Pickett
Gregorio P Pineda
California State Polytechnic University
Terentie Bortis Jr
Edward David Burke
Heroe Soedjak
M Javad Sorouri
Robert B Vineyard
California State University, Fullerton
Sharon Beatrice Gee
California State University, Hayward
Babak Darab
David Faulkner
Michael S Fiske
Daniel Hsu
Don P Rose
Lawrence R Terbell
California State University, Long Beach
Nancy Esther Almeleh
Dana Dwight Clahane
Robert W Gordon
Hossein Shahmohamad
California State University, Los Angeles
Susan M Caldiero
Ayman A Hammad
Terence Y Nercessian
Lucila O Rios
Robert L Smazenka
Stephanie S M Wang
Paul D Wilson
California State University, Northridge
Lloyd G Berriman Jr
Robert J Birrell
James D Castro
Paulette R Cole
Lisa K Deutsch
David S Epstein
Leslie Lorraine Foster
James W Gilmore
Cheryl Ann Hertan
Kathleen M Island
Deogracias J Jaravata
Laurie P Kolpas
Prem B Lall
Shiu Ing Lee
Karen A McRitchi
Linda Louise Mulligan
Gary Iljin Park
Paul T Quick
Matthew G Robertson
Yokichi Tanaka
Hung Tran
Stephen G Valentine
California State University, Sacramento
Kirk A Wardlaw
California Institute of Technology
Andrew J Conley
John A Cortese
Paul R Dressel
Antonios D Melas
Vidyadhar Y Mudkavi
Ramin Naimi
Ann Tuan Nguyen
Petr Pich
Rachel E Shinn-Mendoza
Jude Thaddeus U Socrates
Jacobus Hendricus Van Lint Jr
Carleton University
Xinhong Ding
James R Hatton
Darlene N Heuff
Tom Hughes
Fred G Kuzniarz
Wing Tai Lau
Chih-Chi Lee
Dunxue Liu
Xing Qiao Liu
James M McQuillan
John M Thompson
Hao Yu
Mingyu Yu
Iain G deMille
Case Western Reserve University
Masoud Sabbaghan
Catholic University of America
Ehsanullah Ateegi
John Tennant Chludzinski
Alfredo Echeverri
Francis Mauro
Cheng-Pheng Tan
Central Michigan University
Tom L Gougeon
Central Missouri State University
Majid Saadatmanesh
Claremont Graduate School
Crystal L Gordan
Hamza Abidali Hamza
Sukumar Sinniah
Binghui Wu
Clarkson University
Brian D Bradie
Rakiba Rashid Chowdhury
Xia Huang
Moonja Kang
James M Keiser
Jane F Khondker
Guoqing Li
Wei Li
Alison G Read
Fengman Zhang
Cleveland State University
Paul E Dean
Richard A Rarick
College of Charleston
John Hume Lucas
College of Staten Island, CUNY
Joseph Newmark
Maurice L Richter
College of William & Mary
Marie D Burzynski
Laura L Lansing
Zesheng Yang
Liduo Yu
Colorado State University
Ibrahim Saleh Alkhanni
John M Arvidson
Ju-Hung Chen
Patrick Fitzgerald Coe
Oliver R Dale
Mark William Farmen
Daryl W Grunau
Mohammed A Hasan
Ross Parker Heikes
Layne R Hellickson
Jacqueline Sue Hoover
Joel E Iiams
Mark J Mason
Robert Russell Molina
Haytham Z Muhialdin
Glenn A Murray
Dongfeng Pan
Robert Andrew Powers
Annette L Prudente

Kimberly J Regnier
Christopher Shane Reid
Ahmad A Rhayyel
Mandyah G Sridhar
Susan L Stokes
Vicki R Turos

Columbia University
Harriet G Cone
Jason Stuart Hanson
Chi-Fong Lau
Gregory Michalopoulos
Panagiotis Papasoglu
Keith Aaron Pardue
Rivkee M Twersky
Qi Frank Xia

Columbus College
Seyedeh Alavioon
Richard Hays
David McKinney

Concordia University
Duc N Bir
Wah Keung Chan
Delija Geca
Atef Hanna Harb
Siu Yun Leung
Chinh Mai
Shashi Kant Mishra
Sanjay Mitter
William John D Osborne
Xiaoming Tangg
Pierre Vaillancourt

Cornell University
Brian C Hall
Thomas A Stiadle Jr

Dalhousie University
Edward Frank Card
Rajesh Gudta
Mark Thomson MacLean
Charlene Dawn Pawluck
Letlibe J Phahlamohlaka
M D Shafiqur Rahman
Yong Zhong

Dartmouth College
Joanna Ellis-Monaghan
Jonathan M Fisher
Philip D Tiu

DePaul University
Robert L Rarick
Marcy L Simon

Duke University
Danielle D Carr
Lijian Yang

East Carolina University
Tina A Anderson
Lisa L Biggers
Denise J Corbett
Virginia Wilson Johnson
Elizabeth C Legget
Christi Jo Lilley
Ellie Frances Lunsford
Robin A Rider
Kimberly Dawn Shinn

East Tennessee State University
Bill Larry Neal

Eastern Illinois University
Kenneth R Bronson
Allen J Bryant
Susan M Harris
Vincent Paul Lamie
Rich W Makino
Matthew M McKenzie
Tricia Lynne Setzke
Jacqueline K Sheehan
Dale Wayne Watkins
Mao-Zhi Zhu

Eastern Washington University
Salem N Al-Naemi
Jennifer Lee Bickerstaff
David K Goering
Joseph A Hayes
Vicki J Kijewski
Susanne K Lohr
Marc A Loizeaux
Tracy J Nehnevaj
Lisa Stafford Newberg
Hong T Tang

Eckerd College
James C Bishop
Sonya April Golden

Emory University
Basel Al-Nuseirat
Ashish Chowdhary
Sean F Ellermeyer
Harold E Findley
Raymond C Leung
Nancy MacInnes
Wm Ted Mahavier
Gary M Moland
Elsa J Newman
Yang Wang
Sylvia A Williamson

Florida Atlantic University
Jeffrey C Borowy
James Alan Fritz
Teresa P Hasenauer

Florida State University
Booker C Bense
Yihong Cai
Zhaolong Chao
Chi-Sing Chen
Jieru Chen
Ping Chen
Zhong Dong
Shangzuo Gao
Mark V Heiter
Shahryar Heydari
Robert E May
Enping Qian
Pedja Raspopovic
Kezhi Ruan
Daniel K Salstrand
Ruiya Song
Jay C Webb
Douglas J Wilberscheid
Jin Wu

George Mason University
Afsaneh Amiri
Linda Susan Kashishian
Matthew Paul Mohler
Hari S Pulapaka
Richard T VanMeter

George Washington University
Barbara A Leasher
Freydoon Rahbarnia

Georgia Institute of Technology
Daniel J Arrigo
James E Baugh
James Christopher Bond
Eric R Bussian
Richard J Coleman
John Mark Coney
Richard Brent Griffin
Timothy G Howard
Sharon Sheppard Hudson
Tim M Kelley
Wenming Kuai
Tuwaner Hudson Lamar
Donna C Miletto
Wesley Jackson Miller Jr
John Tilla Parish III
Christopher N Stainbrook
Michael Conrad Vorwerk
Bruce D Wallace

Gettysburg College
Carolyn M DeSilva

Goucher College
Vashti E McCollum

Grand Valley State University
Tammy Sue Alvesteffer
Timothy Frederick Englund
David J Hughes
Michael P Petersen

Hardin-Simmons University
Russell Erick Perkins

Harvard University
Shun-Jen Cheng
Jeffrey S Rosenthal
Andrew James Ward

Hunter College, CUNY
Robin S Kalder

Idaho State University
David Connors
Michael S Hunt
Catherine M Kunicki
Kathryn A Mueller
Curtis J Olson
Russell M Reimann
Rick A Simon
Elena Velásauez
Delelegne S Woldmedhin

Illinois Institute of Technology
Hasan Ahmad Almefleh
David J Anderson

Indiana University at Bloomington
David H Alyea
Mohammad A Asmar
Mahmound K Badra
Michael A Brilleslyper

Samuel N Camargo
James E Campbell
Min Chen
John Jeffrey Cutright
Honhyu Ding
Jeffrey A Duez
Harold E Ferguson
Mark A Gebert
John S Kauta
Won Mi Koh
Panagiotis Papadopoulos
Kimberly L Pearson
Kalyan Roy
Edward M L Sinor
Kang Xue
Yue Zou

Indiana University, Southeast
Therese A Jenkins
George Edward Rogers
Alana M Searl
Rhonda G Thomos

Indiana-Purdue University, Indianapolis
Pradeep N Alwis
Thisath Rajee Amarasinghe
Ek-Leng Chua
Rodney V Croos Dabrera
Marc Frantz
Cindy Jones
Yusheng Ma

Institute for Defense Analyses
James De Lucia
Jeffrey S Prisner

Iowa State University
Sunder B Athreya
Sinniah Balakrishnan
Shawn R Bina
Siamaur Bondari
Suzanne Chmiel
Rachel Dass
Bettie A DeGryse
Narendra Desirazu
Kaisheng Fan
Engih Haliloglu
John M Hansen
L Paul Hertzel
Chao-Pao Ho
Mike Hobart
Pamela A Johnson
Elizabeth C Joseph
Laura Kaye Kuehn
Rachel R Lamp
Sang-Moon Lee
Thiagarajah Maheswaran
Nicos A Philippou
Timothy R Ray
Kathy M Rogotzke
Jafar Saberi-Nadjafi
Xiaorong Shen
Eugene J Taylor
Lois Grace Thur
Rong Albert Wang
Charlotte A Wingert
Agacik Zafer

John Jay College Criminal Justice, CUNY
James Cosgrove Emerson

John Carroll University
Ben William Friedman
Paul A Gogniat
Deborah A Kramer
James Robert Merz
Bonnie V Racin

Johns Hopkins University, Baltimore
Roberto Nesbit Allen
Robert P Dobrow
ZuMing Feng
Mary Ann Hoppe
Takuji Kashiwabara
Masanori Morishita
Francoise Nelles

Kansas State University
Mufid A Abudiab
Minhaj Uddin Ahmed
Pranab Kumar Banerjee
Mary T Black
Samuel Eric Clement
Simin M-P Daryaee
Eissa Diab El-Habil
Xiao-Xiong Gan
Thomas D Hanson
A'alireza Ja'afari
Joseph M Kincaid
Yaping Liu
Patrick S Mitchell
Mitchell L Neilsen
Hassan Sayyar
Berad S W Schroeder
Jeffrey D Stevens
Mohsen Taghavi
Balaji R Tanjore
Roozbeh Vakil
Julie Lorraine Watson
Gummidigam Perumal Youvaraj
John T Zerger

Kean College of New Jersey
John E Butcher

Kent State University, Kent
John K Alexopoulos
Laura Slomkowski Collard
Yaser K Doleh
Alan R Egolf
Keith R Fuller
Davood Haghighi
Chao-Jen Hsu
Darci L Kracht
Miguel LaCruz
Daniel M Lewis
Meiyu Eleanor Lin
Ibrahim J Masri
Lemma Mulatu
Theresa S Polanski
Srinivasavaradhan Rajagopalan
Mohamed Omar Rayes
Yong Ho Shin
Vilmar Trevisan
Sanjiva Weerawarana

Lake Forest College
Robert A Lindenbusch
Karen M Masella
David J Wittry

Laurentian University
Barry G Adams

Lehigh University
Lisa B Besso
Maureen T Carroll
Huifen Chi
Joey-Margaret Christner
Elias A Dabeet
Dhawal Kulkarni
Raphaelina Shiut Lyn Loke
Camille Althea Lisa McKayle
Kenneth G Monks
Douglas C Phillippy
Rafael M Richards
Salvatore T Rizzo Jr
Kimberly Jan Rose
Jian-Hua Wang
Hasan Abdulraheem Yousef

Louisiana State University, Baton Rouge
Fariborz Asadian
Karen Dommert Aucoin
Barry W Cantin
Mark A Curole
Jill A Dumesnil
Jerry G Eldridge
Sam S Kharoba
Jungsoon K Lee
Wendy M Lieuw-A-Len
J D Moss Jr
Thomas Carrere Palfrey
Sandra Reuben

Louisiana Tech University
Ali Rafic Dergham
Mahmoud Sami Nashawi
Mohammadreza Pourjavad
Khalil Rassy

Loyola University of Chicago
John P Dohm
Shannon M Signer
John Guy del Greco

Macalester College
James E Colliander
David J Scamehorn

Maharishi International University
Mabel M Scaroni

Mankato State University
Gayle M E Brekke
Jerry C Burkhart
Kai-Chung Randy Cheng
David J Hendricksen
Jill D Hultman
Kathrine E Johnson
Joyce Lee-Chu Lu

Marquette University
K S Ajan
Peter Scott Crandall
Xiangjun Liu
Susan F Pustejovsky
Stephen P Zambo III

Massachusetts Institute of Technology
Matthew Ando
Eric K Babson
Jonathan Beck
Harry A Chomsky
Richard Gustat Ehrenborg
Leonid Friedlander
Wayne Dean Goddard
Kenneth A Graves
Daniel Grieser
Ian H Grojnowski
Farshid Hajir
Milja-Riitta Hakosalo
William C Jockusch
Richard R Kerswell
Michael Kierszenbaum
Sherry Elizabeth Marcos
Sherry E Marcus
Leonard J Schulman
Esteban Gregorio Tabak
Erlan E Wheeler II
McGill University
Andonowati
Julie Berube
Roger Bielawski
David Alan Clark
Harold Kenney Colomay
Djordje Cubric
Chantal David
Matthew Egan
Hongde Hu
Wengun Mao
Stephen John Hamilton New
Lakshmi Nilakantan
K Peter Russell
Margaret R Sloan
Predrag Tanovic
Marchand Van Rooyen
Ming Wei
Jian-Jun Xu
McMaster University
Cindy R Boulanger
John Andrew Toth
Deidre A Wilson
Philip Matthew Wylie
Memorial University of Newfoundland
Jorge L Gonzalez
Afework Solomon
Memphis State University
Guantao Chen
Younhee Ko
Robert L McDaris
Jungsheng Wang
Michigan State University
Khalid M Amin
Said Bahi
Kathleen R DeAngelis
Brian T Egleston
Fuad J Foty
Joon Hyuk Kang
Rajesh Lal
John R Osowski
Richung Shaw
Peter Lynn Smith
Jeffrey L Van Domelen
Todd V Vredevoogd
Zhaohui Xu
Kouacou Yao
Michigan Tech University
William J Forrest
Daniel K Hayden
Thomas Methner
Melinda S Plank
Takayuki Yamauchi
Hao Zhang
Montana State University
Michael Barber
Margaret H Cunningham
Douglas K Daenzer
John G Evans
Dan Feng
Gary A Hellenga
Michael D Sanford
Thomas M Tanner
Harold Stanley Taylor
Kevin Wayne Trutna
Christopher Francis Wend
Mount St Vincent University
Shahriar H Hooshangi
Murray State University
Jeffery L Brownfield
Joseph D Mahoney
James Randall Post
Jamie L Summerville
Muskingum College
Joseph M Allen
New Mexico State University, Las Cruces
Rajan Alex
Alireza Arasteh
Andrew S Canham
Hui-Ping Chao
Salem I El-Gawi
Stephen D Merrin
Margaret M Poston
Eduardo Quinonez-Rico
Maria M Rascual-Dunlap
Fadi A Salem
Christopher E Stuart
Renwei Yan
New York University, Courant Institute
Christoper Apelian
Hartosh Singh BAl
Isabella Birindelli
Thomas Connor Bishop
Steven A Buchwalter
Jaime Estrada-Betancourt
Luiz Renato Fontes
Pedro Silva Girao
Kenneth R Gittelson
Carl A Harverl
Tong Li
Patrick Po-Yen Lin
Tyng-Luh Liu
Shenglin Lu
Ajay K Marathe
Christos G Michaelides
Daniel D Nadler
Clara Garza Padilla
Pablo Padilla
Katarzyna Pietruska-Paluba
Raul Quiroga
Rodolfo Riverol
Hans Schmitt
Philippe Seeman
Anjana Kenny Shah
Scot Shinderman
Mark A Taylor
William H Weinstein
Brian T R Welton
Yanni Zeng
Zhifeng Zhang
Giovanni B Zoli
North Carolina State University
Barbara Ann Bailey
Margaret K Bes
Laura A Britt
David L Chinkes
Susan Y Dresser
Gregor A Hoghe
Susan Ruth House
Elizabeth Sherrod Jones
David W Justice
George Warren Marshbourne
David M Mathews
Mary Beth McDaniel
Ray A Monteiro
Lakshmi Mukundan
Geoffrey A Neal
Himank Bhusan Subedi
Marwan Tarabichi
Robert W Vallin
Darren M Welch
Chyuan-huei Yang
Yadong Yang
North Dakota State University, Fargo
Mathew E Alufohai
David R Burns
Steven Michael Lehmann
Chad H Scott
North Georgia College
Neva L Coley
Emily Judith Griggs
Dorothy L Lewis
Northeastern Illinois University
Hassen Bensmida
John Joseph Bien
Susan C Bittorf
Jean P Cassidy
Robert D Duncan
Marianne E Minnis
Duyen Thuy Pham
Northeastern University
Yiannis C Bassiakos
Duane Chen
Susan J Diesel
Miloud Haik
Monir Hossain
Ernst Hyacinthe
Richard K Jordan

John Kanellopoulos
Jeanne A LeSuer
John J Lindhe
Hong Lu
Dara Moazzami
Jack M Nedelman
Rajashree Ram Mohan
Krishnan Prakash Santhana
Kimberley M Smith
Muhammad Jamil Suaydun
Edward M Sullivan
Tao Sun
Junjie Tang
Mary Walkins
Lei Wang
Xiaochun Zhang

Northern Arizona University
Melanie Lynn Bell
Litsa Penny Howington
Elpitha T Howington-Kraus
Cynthia M Piez-Walton
Kim Marie Sonier

Northern Illinois University
Clayton S Ames
Jonathan O Kun Ikoba
Susan T Janes
Jacqueline A Pconka
Karen C Reckamp
Brian D Spears
On-Ki A Tung

Northwest Missouri State University
T Jean Chapman
Cheryl Stark Hibbard
Charles E Sanders

Northwestern University
Nina S Bohrod
Jenny E Dorrington
Christopher J Flannery
John F Gately
Joseph E Gottman
Steven M Hetzler
Deepa Krishnamurti
Mohamed Ishak Riffi
Jody M Sorensen

Oberlin College
Greg J Bloy
Scott T Hofmeister

Occidental College
Behnam Sadeghi

Ohio State University, Columbus
Ming Cheng
Kiran Babu Chilakamarri
Robert L Craighead Jr
Amy Jane Edwards
Ellen Gethner
Steven J Giust
Scott Steven Gray
Inger Johanne Haaland
Stephen Paul Hess
Intae Jeon
Yang Jiang
Brian D Jones
Haewon Joung
Mahmood Karbasi-Amel
Robert A Killam
Fredrick T Klevenow
Douglas A Lapp
Ali Lari-Lavassani
Paul G Larick
Euiwoo Lee
Yoonweon Lee
Degang Ma
Emery Major
D Manivannan
William Donald McGregor
Prabhav G Morje
Gary Stephen Nonnemacher
Eric Olson Olson
John David Palmer
Edward Thomas Reischman
Liming Ren
Stanley E Ross
Youyu Shao
Shu-Leung Tang
Agnes Tuska
Hon-kit Wai
Lee Scott Wayland
Ivan Weisz
Kuo-Chi Wu
Mingzhi Xu
Zhongde Yan
Yuping Yang
Xiaoya Zha
Lianmin Zhou
Rong Zong

Ohio University
David J Adams
Abdullah H Al-Huzali
Haitham M Alkhatib
Zhixiong Cai
Myung Hyun Cho
Senfong Chuang
Basil W Coutant
Donald E Davis
Ananda D Gunawardena
Jorge A Gutierrez
Jeannette L Kline
Sonja Kotlica
Sharon R Landon
Mark E Long
Diane M Mack
Edward Miller
Ahmad I Murab
G M Abul Quasem
Crystal M Ratliff
Mohammad Ali Saleh
Sharon A Smith
Roxane R Threm
Daxin Wu
Yusof Bin Yaacob
Janet Eunsook Yi
William Young Jr

Ohio Wesleyan University
Rohit Verma

Oklahoma State University, Stillwater
John David Abbott
Steven G Barnett
Rachid Belhachemi
Steven R Capehart
Robert N Crosswhite
Tonya J Duffield
Lee Jay Elder
Karen Lynn Floyd
Valerie Ann Fridley
Keith L Hall
James Kent Harrelson
C A Hocker
Julia D B Jones
Dwight D Martin
Rhetta J Mooney
Rupert Ferd Nowlin
Kelly J Pendergraft
Bill Jay Seitter
Ganapathy Subramanian Sundaram
David A Sutherland Jr
Cheung Wong
Barbara De Las Mercedes Zamora
Thomas E Zerger
Ying Zhuang

Oregon State University
Elizabeth A Altstadt
Gudrun M Bodvarsson
Stuart F Boersma
Sirilath J DeSilva
Kathryn Ann Dukes
Donald L Hickethier
Daesik Hwang
Kathy M Ivey
Duan Jin
Marilyn M Koshlap
Robert M LaFollette
Suravate Lekhyananda
Roger Mark Ludlow
Young Kou Park
Martin S Perlot
Scott L Peterson
Gowri Ramanathan
Chris Lee Schwartz
Tuen Tuen
Brian C Vogt
Alison Warr
Andrew Howard Warren
Troy D Warwick

Pennsylvania State University, University Park
Daniel W Abbey
Christopher C Byrne
Ai-Shya Chao
Davod Carl Falvo
Ningning Han
Catherine Ann Hess
Wu-Hsien Hsieh
William Jahng
Alouf Jirari
Janusz Konieczny
Scott A Krutsch
Yong Lin

Paul John Moses
Tom Michael Mudi
Bagisa Mukherjee
Garth Payne
Jinshui Qin
Jose Tristan Fua Reyes
Chen-Chen Shih
Todd Andrew Simpson
Richard P Spindler
Kelly John Suman
Wei-Yi Wang
Charles A Williams
Jian-An Wu
Kaiyu Zhang
Jun Zhong
Jun Zhu

Polytechnic University
Mokhtar Dahou
John F Detko
Maurice C Figueres
James Porter Hill
Woonkam W Ip
John E Knight
Elizabeth R McNew
Barry B Mittag
James Ponnley
Siu Kei Pun
Frank Ragland
James E Roberts
In-Kong Whang

Portland State University
Steven Hongjin Cho
Mark L Elliot
Raymond D Finch
William D Hammack
Dina P Lodhia
Anne Karen Regan
Kenneth A Skach
Zhiqing Zhou

Princeton University
Ayelet Lindenstrauss
Luis Manuel Navas
Alberto Parmeggiani
Ravi K Ramakrishna

Purdue University
Dai-Gyoung Kim
Ieng Tak Leong
Tsanchi Li
Dong-Ho Tsai

Queen's University
Youshi Chen
N Natalie Heisler
Jie Huang
William D Irish
Wojciech Jaworski
Selena Ken
Eugene S Y Li
Ian James McKay
Leopold L Perriott
Janice M Pogue
Halip Saifi
Sumantri Slamet
Surjadi Slamet
Xiao Fan Zhang

Queens College, CUNY
Julie L Bernstein
Loucas Chrysafi
Hal M Weinstein

Reed College
Eric M Freden

Rensselaer Polytechnic Institute
Omer L Ari
Kevin P Bongiovanni
Brian T Borchers
Jennifer R Buckman
Hakki Cakal
Robert John Cederberg
Zhao-Yang Cheng
Rebecca A Clark
Lou Ann Colby
Douglas K Cooper
Alan C Cramer
Eileen M Curry
Brian S Delidow
Carol Jean Driggs
Tim Gallagher
Jeffrey A Graham
Elizabeth J Granger
David M Hipfel
Atilla A Hosekioglu
Michael Joseph Jaye
Andre G Kalocsai
Elaine V Korngold
Michael Steven Linnington
Todd McComb
Katherine M McGrath
M Cecilia C Mercado
Scott D Mirer
Kelley B Mohrmann
Nanjangud C Narendra
David S Ng
Aaron Paul Roudabush
Philip J Schlatter
David Anthony Schmidt
Iman W Schurman
John J Tabak
Daniel C Testa
Arthur J Ticknor
Barbara A Wagner
Yun Jenny Wang
Xiao-Lei Charley Wu

Rockefeller University
Jose-Maria R Prats

Rockford College
Nancy C Casten
Sherrie Ann Krowczyk
Diane R Schuett
Douglas Ray Winder

Rutgers University, New Brunswick
Douglas E Bonar
Leonardo Cangelmi
Guoyi Ding
Randall S Fairman
Meiling Gao
Robert Hochberg
Elizabeth Graf Jurisish
Peter Mark Kayll
Yaxian Lin
Wensheng Liu
George C Mukalel
Augusta B Rainsford
Hasna Riahi
Atul N Roy
Guillaume Donat Sanje Mpacko
Renée B Schwarzschild
James Dimitri Sharp
Guoqing Tang
Tze-Ming To
Kendall H Willets
Chuanfu Xie
Jianing Zhang

Rutgers University, Newark
Jacob Strum

SUNY at Buffalo
Mohd O Alsani
Gustavo Arenas-Wiedfeldt
Todd M Baker
Edward M Dumanis
Wei-zheng Gao
Xiaobin Gao
Kimberly E Javor
Susan K Kim
Jingquan Li
Xiaosong Liu
Ping-Yuan Lu
David J Rose
Michael John Roy

SUNY at Stony Brook
Ivan Castro De Almeida
Pablo Ares
Gregorio Pacelli Bessa
Enrique Javier Elizondo
Kevin Jon Fried
Jonathan A Grib
Adam Harris
Rubén A Hidalgo
Xinhui Jiang
Victoria Anne Kelly
Jongsu Kim
Linus K H Kramer
Mayer Amitai Landau
Mei-Man Lee
Liangqing Li
Ailyna Lubbers
Richard E Mirman
Ann-Marie Murhaime
Gabriel P Paternain
Alfredo Poirier
Grace C Roberts
R Clinton Sprague
Janet C Woodland
Qiuping Xu

SUNY, College at Brockport
Stephen A Ecklund
Laura Marie Gross
Mark S Harris
Mary Colleen Knappen
Daya N Manatunga
Karen J McGill

Deborah J Morley
Thomas J Pawlaczyk

SUNY, College at Geneseo
Amy C Salvati
Shilpa Talwar

SUNY, College at Potsdam
Ronald D Bousquet
Christina A McCormick
David K Paul
Daniel A Voce

Santa Clara University
Stephen M Debacker
Thomas E Goetze
Christina Puff Hall
Sarah A Johnson

Seton Hall University
Donna J Idler
Susan Emily McLoughlin

Simon Fraser University
S Ekambaram
Jing Huang
Yuhe Ren
Ranasinghege T Samaratunga
Joseph Yu

Skidmore College
Kingsley G Babcock
Ronald J Epstein
Kurt Gardiner
Michael J Stampalia

South Dakota State University
Janel K Fiksdal
Michael F Hanna
Deborah L Leiferman
Brajendra Nath Panda
James K Wiggs
Betty M Yih

Southeast Missouri State University
Jeffrey B Bard
Cheryl Jarrell McAllister

Southern Illinois University, Carbondale
Robert S Gregory
Bassam Ahmad Issa

Southwest Missouri State University
Helen I Draschil
Peter H Egler
Hidehiro Kanai
Richard Kapalko

Southwest Texas State University
Paul Smith Ache III
Melanie L Andrews
Steven S Cunningham
Paul F Foutz
Javier Garza
Deborah Markl Herod
Stephen Logan Herod
Hyo K Kim
Robert G Main
Bobby Ross Phillips Jr
Cynthia L Schneider
Kristin W Stoley
Jacqueline S Stolle

Springer-Verlag New York
Jolanda L von Hagen

St John's University
David Lawrence Abrusci
Diane Agud
William Joseph Amplo
Keesoo Nam

St Louis University
Daniel John Borzynski
Thomas B Fox
Gail S Hallemann
Eric L Novak
Geraldine Z Prange
Aaron Keith Trautwein

St Olaf College
Aric A Hagberg
James S Larson
Andrew S Leahy

Stanford University
Claire Chiu-Mieng Chan
Yng-Ing Lee
Christakis A Pallikaros

Stetson University
James Richard Soltys

Stockton State College
Anthony F Breitzman
Nancy J Lord

Suffolk University
Jack P Hajj

Syracuse University
Richard B Evans
Amir Foroudi
Xin Ke
Michael John Mertsock
Jung Hwan Song
Vandana Srivastava
Timothy J Strohm

Temple University
Tong T Banh
John G Edenhofner Jr
Bo Gao
Ming Gu
Rosemarie A Iorio
Jean-Claude Joseph Jacob
Aeyoung Jang
Jonathan C Knappenberger
Xue Sen Lin
John Edward Majewicz
Craig R Orr
Sheldon D Parnes
Italo Simonelli
Shari L Stumpo
Venkata Rajan Subramaniam
Karen G Sullivan
Xiaodong Tan
Karen E Taylor
Michelle Theoret
Jinsong Wang
Wenrui Wang
Elida R Wylie
Frank F Yu
Yue Zhang

Texas A & M University
Laura Garcia Brill
Dat Duc Bui
Chih-Hsuan Chen
Philip E Doren
Florence M Fillion
C Yvette Fisk
Craig A Hatcher
Shu-Fen Hsu
Lucyna Kabza
Derrick A Lue
Lingyun Ma
Daoud S Mashat
Tonya Stephanie Pasztor
Nancy J Simpson
Christopher B Standish
I Leon Turner
Lien N Vuong
Roy F Wenger
Janice L Wittrock
Fan Yu

Texas Christian University
Laura A Ferguson

Texas Tech University
R Ariyaratna
Terri L Calton
Rosana C Carpio
Honmin Chen
Haskiz Cinemre
Mary Kathleen Coleman
Erhan Coskun
Chian-Chian M Du
Bi-Wun Fan
Jianqiu He
Allan Dean Herbert
Charles C L Huang
Boon K Kua
Jonathan Todd Lee
Seung H Lee
Jin Liu
Chi-Kit Lo
Diane E Martin
Manuel Martinez
Marcia B Murray
Stuart S Nielson
Brian Patrick O'Dwyer
Erik S Packard
Bijan Pashaie
Agaytha Hope Reed
Christopher A Reed
Andreas H Soemadi
David Ramon Tucker
Garry W Tucker
Jiang-Ming Wu
Mehmet Yumak
Xiaozhu Zheng

Trenton State College
David E Boliver Jr
Yvonne A Kemp
Peter Robert Peterson
Martha L Rimathe
Derald E Wentzien

Trinity College
Gerard R Guillemette
Paul D Owen

Tufts University
Theo M Montgomery
Tulane University
Julien L Doucet
Rachelle F Folse
Michael Reiner Huth
Gwenette T Kebodeaux
Jane E Kranshan
Thomas Mabece
Sergio Macias
Gerald Vandergrift
United States Naval Academy
John M O'Brien
Mary Jo Salerno
University Nac Autonoma de Mexico
Ernesto Vallejo
University de Costa Rica
Carlos Azofeifa-Zamora
Hugo Barrantes
Alan Dixon
Francisco Quesada
Ali Sheik
University de Montreal
Benoit M LaRose
Denis Lavigne
Denis Lemire
Paul D Matthews
Josee Pronovost
Kali Spathoni Stefatos
Martin Trudeau
University of Alabama-Birmingham
Anwar Abed Ayaad
Marawan Baker El-khazendar
Sheila Larue Huckaby
Abed Rabou M Isleem
Christopher H J Pladdy
University of Alabama-Huntsville
M Leigh Baggette
William R Belcher
E Judith Cantey
Genevieve S Crook
Martin D Frankford
Jangtai Lin
Gregory Naidenko
Arjuna I Ranasinghe
Michael R Stroud
Andrew Thomas Wilson
University of Alberta
Allen Kun Chien
Sulin Di
Dechang Jiang
Jean-Paul Pascal
Yanning Peng
James F Semple
Qin Xu
Yaozhu Yu
Hongliu Zheng
University of Arkansas at Fayetteville
J Todd Allen
Stephen J Bowling
James M Cox Jr
Achamyeleh Gebremariam
Mary K Hanson
William W Hardy
Judy K Hawkins
James R Henderson
Philip James Jennings
Thomas G Limperis
Deborah Jo Lyda
Susan E McLaughlin
Abbas Meigooni
Pamela J Mills
Sunil S Moghe
Guy Nelson
David L Roberts
Kumiko H Smith
Pamela K Smith
Diane M Stowe
James F Tarvin
Tracy R Thompson
Ronald G Tolleson
Gordon B Weir
Kyung Y Yoo
Paula G Young
Shu Zhang
Suisheng Zhu
University of Bridgeport
Thomas P Campoli
University of British Columbia
Aaron B Boxer
Xiaoming Cai
Gwangcai Fang
Monica F Hess
Stephen D Hnidei
Djun Maximilian Kim
Alex Y C Ma
Hongsheng Qin
Sivaguru Sornalingam Ravindran
David T Robinson
Wulin Suo
Roger Tribe
Wenzheng Xie
Hamid Reza Zohouri Zangenah
Huiheng Zheng
Bo Zhou
Jianming Zhou
Weiping Zhu
University of California, Irvine
Cheryl Ann Arthur
Ronald P Barry
William C Burns
Rachel Bernadette Cohen
Patricia L Dugan
Alexandra L Hanlon
Tony Ho
D A Jones
Alan S McRae
Joseph R Mingrane
Sy Poormand
Brian Craig Pringle
Philippe Relouzat
Edward Michael Root
Ian E W Schindler
University of California, Los Angeles
Robin Tami Bodnar
Eric S Brussel
Wilson J Castrellon
Marlene Diane Demerjian
Larry Joseph Green
Shirin Joy Handjani
Jacob Iliadis
Thomas David Keisler
Hongjun Li
Timothy J Murphy
Kevin D Oden
Aaron N Simon
Paul A Speciale
Theodore L D Szeto
Osamu Tokiwa
Hung-Ju Wu
Huashi Xia
Li-Ping Yang
University of California, San Diego
Joseph A Alfano
Michele E Alspaugh
Jeffrey P Angel
Raymond Anthony Beaulieu
Desiree A Beck
Nantel Bergeron
Ronald W Breitenbach
Stephen H Brindle
Nancy J Celniker
Robert R Curtis
Nagamani Dharanipragada
Ricardo Damon Fierro
Theresa Marie Gallo
Robert L Goild
Karen L Gordan
Ezra Quintin Halleck
John Michael Harby
Alain Jeanneret
Colleen Laurel Kelly
Michael Kramer
Jules Pierre Leichter
Lawrence Michael McGlynn
Melissa Mellissinos
Mihoko Minami
Patricia Noguera Miranda
Steven Christopher Poulos
Arun Ram
Eitan Joseph Reiner
David Hill Robinson
Joseph R Shinnerl
Walter Keith Silbert
Raymond Louis Stinson
Andrew T Taylor
Cynthia E Trimble
Elinor Laura Velasquez
Frederick John Weening
Dean M Yasuda
Carlos Merino dela Lama
University of California, Santa Barbara
Patrick Joseph Belliotti
Naveen S Bisht
William BonDurant
Yeh-Chan Chen
Samuel E Fairchild
Michael J Grady
Paul Stanley Keller

Steven Slova Krigman
Jim Kruidenier
Alan Eliot Lash
Kristin Ann Petersen
Vien H Pham
Jennifer C Schultens
Robert Albin Schwennicke
Benjamin F Shang
George S Vaughan
Franklin D H Vaugn
Hung N Vuong

University of California, Santa Cruz
Mathew H Koebbe
Susan L Tappero
Gnanalakshmi Vanniasegaram

University of Chicago
Eun-Sung A Cho
Steven Dworkin
Shun-Ichi Kimura
Michael B Korey
Masahiro Kumabe
Alan J Roche
Frank Sottile
Sarah J Witherspoon

University of Cincinnati
Kuzman Adzievski
Lijia Guo
Doris Hinestroza
Peter G Kaup
Khaldoun M Khashanah
Xiangyang Liu
Pat A Martin
Susann M Mathews
Carlos Enrique Mejia
Qiuyue Meng
Peng Qu
Albain Helison Rarivoson
Ruiguang Song
Margarita M Toro
Craig M Wasielewski
Lisa R Wittensoldner

University of Colorado, Boulder
Boudjema Achab
Fathi M Allan
Ronald C Antweiler
Joyce L Armstrong
John P Coleman
Bruce Alan Fast
Brian G Kauffman
Mark A Limber
Faan Tone Liu
John M McArthur
Karla J Oty
Donna T Sueper
John Andrew Verzani

University of Connecticut, Storrs
Nkechi M Agwu
Ellora Ameen
Ronald E Champeau
Maoli Chang
Fang Feng
Yanling Feng

University of Dallas
Edward P Wilson

University of Dayton
Maro M Azzi
Antoine C Chemaly
Youssef N Raffoul
James R Spencer

University of Delaware
John P Buckley
Majid Masso
Zengniang Tong
Qi Zhang

University of Florida
Laura Coburn Bruce
John Carol Burkett
Carlos E Canas
Salai T Dhavakodi
Vanita Singh Hensel
Shihai Li
Philip Andrew Pina
Maria Brenda Roa Rayco
Hrvoje Sikic
Antonis Valaristos
Ronald Albert Wiener
Rosemary Farrar Williams

University of Georgia
David C Chang
Ralph R Craig
Ree Guan
Hong Ki Kim

University of Hawaii
Liann Siyil Ching
Robert A Knight
Wane M Sugikawa

University of Houston-University Park
Christopher Atsumi Asano
John Brian Burghduff
Craig A Carthel
Lizhao Chang
Stuart Emroy Chase
Sanjay Datta
William K Earl
Ahmad Festok
Mary H Jennings
Wenyao Jia
Qing Le
Yu Li
Andrew Joseph Lienhard
Kenneth Alan McAdams
Dominique Adeni Monteiro
David John Olsen
Tim Sever
Kanagasabapathy Umasuthan
Chuanguo Wang
Kevin W Wright

University of Illinois at Chicago
Douglas E Burke
Netiva Caftori
Gauri Chakravorty
Fudong Chen
Siu-Leung Chung
Ajay Gupta
Andrew Isaacs
C S Lee
Chi-Wah Leung
Yaxin Li
Chengjie Luo
Gaston N Mbateng
Fan C Meng
Jesse R Nemoyer
Evanthia Papadopoulou
Sharon K Robbert
Niandong Shi
Tamas I Solymosi
Feng Sun
Norman E Watkins
Anqing Xi
Huihuang Xu
Eva Zabric
Yi Zheng

University of Illinois at Urbana-Champaign
Daniel W Azzi
Kendra Z Azzi
Bradley R Carlile
Hasan Gül
Kara J Kelley
Mark E Leonard
Toni Moushmof
Mary Lynn Reed
Kang Tan
Vonn A Walter
Huiju Wang
Carol S Wessel

University of Iowa
Jerry Dean Allison Jr
Prapasri Asawakun
Stuart Chase Barnum
Mirna R Bravo
William A Brenneman
Tekamul Buber
John Robert Bunn
Jerome E Carter
Ximena C Catepillan
Hsiao-Ying Chang
Da-Qing Chen
Zhongwen Chen
Ausking Fong-Ching Cheng
Mei-Hsiu Chi
Dug Hwan Choi
Wai Pong Chun
Minyoung Chung
Olga Ivette Cordero-Brana
Mark Allen Craiglow
Rini Das
Edward F Dillon
Robert Dennis Dittmar
Philippos P Drousiotis
Furrukh Fahim
Raul Francisco Figueroa
Qing-Qing Fu
Abdol Reza Hamedi
Kenneth J Hammell
Yue-Chan P Ho
R Michael Howe
Mao-Sung Hsu

Zhibao Hu
Weifeng Huang
Zhen Huang
Pi-Fang Hung
Youngmok Jeon
Jun Ji
Ping Jiang
Weilin Jiang
Shuw-hwey Juang
Hong-Chul Kim
Jong Sung Kim
Sang-Hee Kim
Steven J Larsen
Eun Ho Moon Lee
Ming-Gong Lee
Eric Y Leung
Rebecca L Lewin
Kwun-Shen Lin
Mingchun Lin
Ying-Hsiung Lin
Chi-Mei Luh
Emmanuel Maou
Laura B Mastrangelo
John R Mattheis
Robert G McDougall
Juan Conejeros Melin
Christopher Joseph Mortika
Mika Teresa Moteki
Kenneth Byron Mullen
Vesna Musicki-Kovacevic
Muhammad Asif Naseer
Patricia Neri
Daniel J O'Loughlin
Todd D Oberg
Olakunle Adisa Ogunlana
Asuman Hatice Oktac
Patricio O Olivares
Bahram Omidfar
Jea-Nam Park
Chaoxin Qin
Xiu-Chi Quan
Nigel Kent Ray
Nancy Lynne Rhodes
Maria Eugenia Rios
Ravi Ahmad Salim
Shery Dabagh Shadlu
Karen F Smith
Rick L Spellerberg
Michael T Suelzer
Safdar Raza Syed
Beng Chong Teo
Hassime Traore
Chi-Tui Tsai
Silvia Rosa Valdes-Leon
Viswanath Venkatesh
Shian-Wei Wang
Yong Wang
Ana M Wills
Randall Gordon Wills
Li Na Xu
Zhuan Xu
Jau-Bin Yang
Yajun Yang
Jeng Yen
Xiaoxian Yu
Chun Zhang
Jian Qiang Zhang
Wenyao Zhang
Jinshi Zhou
Luis Saul Zurlo

University of Kansas
Nancy B Campbell
Mary Rachel Combrink
Beth A Edmonds
Gregory Gaspari
Mi-Aeng Lee
Jeffrey W Townsend

University of Louisville
Glenna E Major
Jerry L Yeager

University of Lowell
Ting-Yu Kao
Karen Marie Provencher
Norma Jean Slattery

University of Maryland, Baltimore County
M Abbad
Nettie J Barrick
Ming Chen
Joseph H Clements III
Heather A Danahy
Shidong Li
Anindita Niyogi
Nabendu Pal
Wen-Jong Shyong

University of Maryland, College Park
Sy-Mien Chen
Michael P Chernesky
Fernando Garibay
Marianne Guerin
Xian-Zhong Guo
Chinsan Lee
Sangyeol Lee
Donald E K Martin
Mark B Phillips
Boyd B Roberts
Elizabeth W Rutman
Patrick J Sime
Filia Vonta

University of Massachusetts, Amherst
Daniel J P Carter
Klara Finkele
Josephine Sears Rodriquez
Nicholas J Schmitt

University of Miami
Steven F Browdy
Higinio V Fernandez
Anne L Siegman
Javier J Solis-Diaz
Xiaobo Wang
Wanming Zeng

University of Michigan
Raul Miguel Aguilar
Mark Bollman
Augusto César Cárdenas
Shou-Te Chang
Stephen Coffman
Raimundo A Comas
Jay M Coskey
Robin Joseph Cunningham
Dale S Darrow
Jeff Diller
Brian Scott DuBuis
Paul A Fabel
Timothy M Feldkamp
Walden Freedman
Annette S Fubois
Michael J Glanzberg
Donna J Glassbrenner
Say Song Goh
Erik P Guentner
Istok Hozo
Yung-Sheng Hsiao
Thomas A Kaeding
Su-Jen Kan
Mordechai Katzman
Nancy A Keithly
Andrew C Martin
Stephen A Meigs
Leila Miller
Myoungho Moon
Max Neumann-Coto
Monika Nitsche
Joseph J Palen
Yeon Sook Park
Tricia A Perkins
Srdjan Petrović
Matthias Pfau
James E Pierce
Curtis L Powell
Margaret A Readdy
Lisa Madeleine Reno
Susan E Rice
John H Rickert
David Anthony Santos
Samuel E Schillace
Ingrid U Scholz
Colin M Sheppard
Alexey Shevoroshkin
Haw-Yaw Shy
Karen E Smith
Doug Sweeney
Daniel E Talayco
Douglas Mark Van Wieren
Wafa Wei
Mar I Whinston
Cynthia A Wick
Gretchen Wright
Cynthia J Wyels
Robert Lawrence Yest

University of Minnesota, Minneapolis
Elena Claudia Achával
Stephanie Brod
Rosa L Cabanela
James A D'Ambrosia
Tannaz Daver
Manuel Adrian Del Pino
Sophia A Demoulini
Michael S Dennis
Eugenio H Durand

Michael Abel Ekhaus
Michael S Ellman
Jonathan A Entner
Julian Frederic Fleron
Sudhasree Gadam
Xiaolin Ge
Xianghong Gong
Changfeng Gui
Jong-Sheng Guo
Yung-Jen Lin Guo
Aaron L Hagen
Haile K Haile

University of Missouri, St Louis
Frank T Manganaro

University of Montana
Richard S Kitchen
William G Stoner Jr
Jill A Tilton
Judy M Troutivine

University of North Carolina at Chapel Hill
James R Bennett
Shu-Hui Chang
Colin Day
Louise Aubrey Humphries
Kim-Fai Hung
Lars J Kjeseth
Haijing Ma
Jennifer M McNulty
Taehoon Park
Jeffrey T Sheats
Michael F Tuchman

University of North Carolina at Greensboro
Lisa J Carnell
Susan M Himes
Amy C Russell

University of New Mexico
Mansour Fahimi
Scott J Irwin
Andrew P Price
John Edward Snyder Jr

University of North Dakota, Grand Forks
Cheryl L Halcrow
David B Sullivan

University of North Texas
Ismail A Ali
Celeste A Carter
Jorge Cossio
Charles B Dawson
Michael D Green
Jeffery Dale Griffin
Mehran Hassanpour
James W Hipp Jr
Gregory B King
Lee Clayton May
Gerard Peter Naughton
Rita Marie O'Brien
Ossama A Obeid
Charlotte K Simmons
Donald W Spear
William D Stark
Debora Tejada

University of Notre Dame
GianMario Besana
Nancy De Souza Cardim
Ambar Kumar Chowdhury
Jan Spalinski
Kaining Wang

University of Oregon
Michael E Boardman
Christof G Braun
David L Collett
Richard C Gayle
Lorna Brooke Hanes
Jeff C Lutgen
Thomas M McKenzie
Christopher Sean O'Connor
Sheng L Wu

University of Ottawa
Nelly Faycal
Kilani Ghoudi
Aliasghar Jodayree
Kun Qian
Qingxin Zhu

University of Pennsylvania
Jeff Abrahamson
Mark S Alber
Sammy K Daghir
Stacy E Finkelstein

University of Pittsburgh, Pittsburgh
Frank M Canonico
Michael A Farabaugh
Sharon R Frazier
Ping Hu
David M Kaziska
Youmin Lu
Joel S Moreland
David Christopher O'Neal
Victoria S Radel
Carol Santel
Joseph M Santmyer
Jennifer L Smith
Adefemi J Sunmond
Chu-Huei Tsai
Xiaopu Yan
Hefei Yang

University of Regina
Yodit Y S Seifu
Hong M Wang
Shaoming Wang

University of Rhode Island
Elizabeth A Gambuto
Spiridon A Kuruklis
Prasant Mohapatra
Erin F Murray
Michael R Petrarca
Ieda W Rodrigues
Edward J Soares
Yi Xu

University of Rochester
Frederick J Ford
Margaret L Morrow
Seonhee Yoon Sonn

University of San Francisco
Jerrold R Goodwin

University of Saskatchewan
Liang Chen
Amarjit Singh Dhillon
Kwan Sang Fung
Keqin Liu
Gordon Eric Sarty
Jiawu Sun
Guy R Thomas
H Murat Tuncali
Jian Wang
Xikui Wang
Yong Wang
Chim Chwee Wong
Keyi Wu
Yiqiang Zhao

University of South Carolina
James T Allis
Yousef A A Bdeir
Mahmoud A Breigheith
Hsingjung Chen
Colin Richard Day
Baiqiao Dzing
Koffi Baana Fadimba
Nathan L Hall
David L Harvey
Xiaohua Hu
George Kyriazis
Kuo-Ming Li
Yi-Jen Liao
Der-Fen Liu
Jacklyn R Pitts
Roger E Rosenthal
Paul D Sisson
Hsing-Win Christine Sun
George Vairaktarakis
Somasundaram Velummylum

University of Southern Colorado
Catherine May Bonan

University of Southern Mississippi
Ann H Adkins
Duncan Y Amegbletor
Grace Adams Carman
Jerry W Clemons
Deborah E Crovetto
Joyce S Deer
Leigh Ann Myers
James T Rayner
Alicia C Shows
Cabrina LaSha Sutton
Elizabeth Dawn Temple

University of Southwestern Louisiana
Hamed E Abulkheir
Ching-Hui Chang
Shannon S Cobb
Nasser El-Kassar
Dorene J Fox
Tai-Wai Fung
Chen-huan Jan
Enoch Lee
Jyh-jiuan Lin
Diana J Major
Kit Keung Nip
Jennifer Marie Prejean

John M Sanders
Sanphetch Thong-Iam
Benedict Man Lam Wong
University of Tennessee, Chattanooga
Sherri Lynn Barnes
Gina Conner Hyden
University of Tennessee, Knoxville
Azmy Sima'an Ackleh
Douglas Joseph Baney
Richard Frederick Barrett
Mary Grace Cameron
Tomasz Dubejko
Tracy Renee Duvall
Marek A Galecki
Theodoros Katsaounis
Raymond M Lazarus
An Lu
Son N Luong
Joyce Shealy Nicholas
Michael Plexousakis
Mohamad Majed Sidani
Cornelius Stallman
Jennifer Noble Tuggle
James Robert Williams
John Wise
Katherine Ann York
University of Texas at Arlington
Ali A Ansari
J C Coleson
Sung Nam Ha
Ronald Duane Johnson
Peggy Louise Lawless
Mohsen Mahmoudi
Arthur Frederick Migala
Narayanaskiamy Nagarajan
Bryant Morgan Wyatt
University of Texas at Austin
Ailsa Glenyss E Ammons
Michael A Atchison
Carl E Baribault
Gary D Berg
Antonie Boeruoel
Stephen W Buffum
Fouad Chaatit
Debao Chen
E-Hon James Chen
John Douglas Cook
James Anthony Epperson
Terry S Fuller
Kenneth J Galli
Allison Anne Gangoso
Jeffrey G Glosup
Chain Goodman-Strauss
Kathleen K Grandin
Brooke Lanae Hagood
Eerik Thomas Harms
Edward J Harris
Jeffrey J Holt
Zhimin Huang
Elizabeth E Kamman
Eric Krieckhaus
Stanley G Kuricek
Puay Leng Lee
Herbert D Liang
Zartaj Taha Majeed
James Wade McDonald
Valdir Antonio Menegatto
Chris L Morin
Irina Mukherjee
Lindsay Arthur Packer
Robert M Patton
Stephanie Lynn Phillips
Christopher G Pinner
Johan Rade
Shenghui Ren
Cindy L Scaff
Robert Philip Schafer
Matthew B Shostak
Michael C Sullivan
Endang Sumartinah
Eddy H Tan
Stephanie M Tyler
Barbara J Wahl
Steven L Wilson
Xian Qun Zeng
Changning Zhang
Dagan Zhang
Liu Zhuxing
University of Texas at El Paso
Armando Barranon-Cedillo
Victor Manuel Carrillo
Li Ding
Guozhong He
Dejian Lai
Yan Liu
Daniel Vallejo
Jorge Rosalro Viramontes
Yuanyin Wu
Jian He Zhou
University of Toledo
John William Kasipye
Madhumath Soundararajan
Dongjun Wang
Zi-Yi Wang
University of Toronto
Dietrich Burbulla
John J Chew
Kenneth G Clarke
David J D Earn
Shane R J Forbes
Jianmin Gao
Piotr Boleslaw Koszmider
Bohdan Ihor Kurpita
Joyce Kwan
Václav Linek
Iwan Pranoto
Randall M Pyke
Peter Rodney
Tam Siu Hing
Catherine Stanley
Anders G Svensson
John Vrolyk
University of Utah
Mike C Lee
Charles N May
University of Victoria
Kunikyo Tang
University of Virginia
Paula M Andersen
David K Blackwell
Peter F Blanchard
John D Driggers
Maud J Eno
Lyn H Geisler III
Jonathan P Hexter
Daniel L King
Christopher S Marron
Steve Morics
Teresa M Neeman
Terri L Perkins
M Kate Smith
P L Wilger
University of Washington
Perry N Adkison
Andy Spero Demetre
Hao A Nguyen
Jiseong Park
Lizabeth V Rachele
Daniel J Schapiro
John W Swisshelm
Joseph F Wilcox
University of Waterloo
Marc A Chamberland
Mo Chen
Jose Andres Correa
Alex T Kachura
Frank W Letniowski
William J Martin
Sheena M McRae
Minghua Qu
University of Wisconsin, Madison
Rahul Bhaskar
Bo-lian Liu
Robert C Mattson
Hocine Mekias
Randy J Pruim
William Brian Repko
Mary Anne Schlieper
Lee E Schumacher
Kevin H Strobel
Stephen D Szlydlik
Susan E Wagner
Zaifei Ye
Bingyu Zhang
University of Wisconsin, Milwaukee
Athula I Abeyratne
Steven M Condie
Matthias Kanta
Michael A Karls
Julie A Letellier
Glen E Lobo
Eric G Qian
Rohini R Rajput
B David Redman Jr
Joel S Schmitter
Sivanesan Sivalingam
Long Wang

University of Wisconsin, Parkside
Bhanumati N Rao
University of Wyoming
John Keough Alsup
Jean M Arbogast
James Lee Duncan
Athula Gunawardena
Borre B Johnsen
Rajeev S Kuruganti
Chao Li
XingJing Li
Peng Lu
James D Marcum
Richard A Mitchell
George J Montopoli
Mark J Oliver
Ramjith Ananda Samandra
Shannon L Schumann
Jian Shen
Stanley S Smith
John E Spitler
Hong Wang
University of the District of Columbia
Bevra B Krattenmaker
Utah State University
Charles Ning Chen
LoRee Y Crandall
Sandra L M DeSouza
Jim Frankenfield
Jana Kaye Huber James
Sang-Gu Lee
Yoon-Mee Lee
Guangyu Liu
Yi Qian
Eric R Rowley
Dusty E Sabo
Gary Shea
Darren Duane Wick
Yuhua Xu
Shumin Ye
Kevin Yokoyama
Yan-Kun Zhou
Virginia Polytechnic Institute and State University
Dennis R Adams
Andrew N Blackwood
Martin T Capone
Virginia K Chapman
Chun Wo Cheung
Harold W Ellingsen Jr
Robin C Endelman
Amy M Ferguson
Yuzhen Ge
Marek P Grabowski
Marianne C Graveline
Scott E Inch
Makoto Ishigaki
Kathy A Kauffman
Annegret C Liebers
William Calvin Linderman
Saburo Matsumoto
Milosz R Michalski
Philip W Miller
Young W Park
Stacy L Pickral
Tapan Rai
Joseph L Rodriguez
Lamberto Rondoni
Tad E Womack
Russi G Yordanov
Xiaohong Zhang
Vanderbilt University
Thomas P Bass Jr
Scott T Burleson
James Buford Hart
Todd M Haynes
Peter Jipsen
Thomas J Klein
Bradford Franklin Lyon
Lisa R Markus
David K Menser
Lori Michelle Parker
Jonathan E Ramey
C Cary Timar
William D Towle
Gengqiang Zhou
Villanova University
Paul M Delpo
Paul J Laumakis
Ramon A Martinez
John E Santomas
Loretta Fitzgerald Tokoly
Virginia Commonwealth University
Thomas A Pavlish
Wake Forest University
Jill T Branoff
Tammy Ann Campbell
Robert L Carscadden
Joseph Nicholas DeMaio
Mark Charles Ginn
Karen A Henderson
Ann K Hughes
Eva Y McKinney
Carol J Moore
Rebecca L Moore
Ramona Renee Ranalli
Manju M Seal
Terri M Stump
Ruisheng Xiao
Washington & Lee University
Anne K Aitken
Terence Adam Wynne
Washington State University
Kourosh Amirsehi
Brent A Banister
Christi L Bohmbach
Zhiya Cai
Sun-Ring Chime
Lyle Eric Cochran
Cathleen Marie Craviotto
Margaret A Gamon
Jian Guo
Philip E Gustafson
Jeffrey B Haag
David Dennis Hudson
Koonchan Kim
Ed Korntved
Danny T M Lau
Michele S Ortega
Jeffrey S Palmer
Raquel Ruiz de Eguino
Felix Simpasa
Rebekah N Stengle
Frank P Tailoka
Diana L Wells
Limin Zhang
Washington University
Chi Gu
Ruijia Liao
Carlo Morpurgo
Krzysztof Nowak
Maciek Paluszynski
Wayne State University
Ibtesam M Al-Naggar
Dilip Kumar Bayen
Imad Ahmad Dakka
Xianghu Jia
Mi Kyung Joo
Young Kwon Kim
Carol S Lambert
Qijin Liu
Bing Fei Lu
Karen M Meldrum
Faris A Odish
Vanine M Peters
Gregory I Schtulberg
Rohana Talagalage
Debbie E Wrotslavsky
Wesleyan University
Damon L Ellingston
Kristin I Hubner
Wayne S Marge
Andrew T Moliator
Agnes T Paras
Sophia M Raczkowski
Donald B Sawabini
Colathur Raja Vijayan
Dejan Zivkovic
West Virginia University
Tate Roy Bennett
Paul D Blankenship
Anne McKnight Brown
Yit Q Chew
Stephanie E Crawford
Robert E Creese
Charles B Davis
Michael N Ferencak
Yifei Hu
Jianming She
Western Illinois University
James A Dowell Jr
Pankaj Kumar
Sandra K Taylor
Hong Xian
Kyi Zin
Western Michigan University
Elzbieta Bozena Jarett
Juiqiang Lise

Western Washington University
Robert H Dillon
Karen A Linton
Greg Richard Schwartz
John Day Solomon
Westminster College
Mary K Joyce
Wichita State University
Yeshewawoin Aregaye
P D Crawley
Donna J Gorton
Meer M Hossain
Muhammad Kamal Hussain
Troy L Kinast
Habib Parvin-Nejad
Mukul S Patel
Gholam Reza Sarhangi
Dale Song
Leonardo Traverzo
Nikolaos Tsikalakis
Renjin Tu
William Paterson College
Eswar G Phadia
Xavier University
Don A Bohn
Yale University
Fusun Akman
John L Bohn
William A Cherry
Jim Huang
Asriel U Levin
Paul R Mac Manus
Lucas A Monzon
E Theodore L Omtzigt
Felipe Miguel Pait
Elon Rimon
Stuart D Smolen
Michael A Tanoff
Niall D Whelan
Hong Yan
Tze-Lung Yim
Yeshiva University
Jonathan Hecht
Aviva Hirshaut-Lubin
Manuel H Jacobowitz
Philip T Reiss
Deborah Adele Solomon
Ariella L Taragin
York University
Carlo Lisi
Zhengbin Wang
Ziqiang Wu
Youngstown State University
Jaw-Wu Liou
Frank J Palocyi Jr
Raghuram K Srinivasa

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 1989 RATE IS $42.50 per inch on a single column (one-inch minimum), calculated from the top of the type; $18 for each additional 1/2 inch or fraction thereof. No discounts for multiple ads or the same ad in consecutive issues. For an additional $10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Advertisements in other sections of the classified pages will be set according to the advertisement insertion. Headlines will be centered in boldface at no extra charge. Classified rates are calculated from top of type in headline to bottom of type in body copy, including lines and spaces within. Any fractional text will be charged at the next 1/2 inch rate. Ads will appear in the language in which they are submitted.

Prepayment is required of individuals but not of institutions. There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified advertising.

DEADLINES are listed on the inside front cover or may be obtained from the AMS Advertising Department.

U. S. LAWS PROHIBIT discrimination in employment on the basis of color, age, sex, race, religion or national origin. "Positions Available" advertisements from institutions outside the U. S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U. S. laws. Details and specific wording may be found following 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 800-556-7774 and speak to Paula Montella for further information.

SEND AD AND CHECK TO: Advertising Department, Attn: Paula Montella, AMS, P.O. Box 6248, Providence, Rhode Island 02940. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02904. Individuals are requested to pay in advance, institutions are not required to do so. AMS FAX 401-331-3842.

POSITIONS AVAILABLE

NORTHERN MICHIGAN UNIVERSITY DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

The Mathematics and Computer Science Department invites applications for both temporary and tenure-track positions at the rank of Assistant Professor. All specialties welcome–mathematics, mathematics education, statistics, and computer science.

Northern is primarily an undergraduate institution and a commitment to teaching is an essential requirement for the positions. Scholarship and professional activity are both encouraged and supported.

Applicants should send a resume, transcripts, and three letters of recommendation to Dr. Terrance Seethoff, Head; Department of Mathematics and Computer Science; Northern Michigan University; Marquette, MI 49855-5340.

Northern Michigan University is an equal opportunity, affirmative action employer.

COMMUNITY COLLEGE OF PHILADELPHIA

The Mathematics Dept. invites applications for an anticipated tenure track position beginning Fall Semester 1989. Candidates must have at least a Master's Degree in Mathematics, a commitment to quality teaching both remedial and college level students, and a serious interest in curriculum development. Preferred areas of specialization are ODE and Dynamical Systems. #1

The department is actively engaged in developing new mathematics courses. It has recently received grants from NSF and CASET. Outstanding benefits. Send curriculum vitae and 3 letters of recommendation to: W. Clee, Head, Dept. of Mathematics, COMMUNITY COLLEGE OF PHILADELPHIA, 1700 Spring Garden St., Philadelphia, PA 19130. Women and minorities are encouraged to apply. CCP is an affirmative action/equal opportunity employer.

UNIVERSITY OF OKLAHOMA CHAIRPERSON DEPARTMENT OF MATHEMATICS

Nominations and applications are invited for the position of Chairperson in the Department of Mathematics effective Fall, 1989. Candidates must possess an earned doctorate, a substantial record of research achievement, a commitment to excellence in teaching, and leadership and administrative abilities appropriate to a growing department that is dedicated to a balanced program of quality research and teaching. The Mathematics Department has over thirty faculty members, most of whom are actively involved in research, and offers programs for the bachelors, masters, and Ph.D. degrees. There is also an extensive program of scientific activity supplemented by a substantial endowment for discretionary funds. Candidates should send a cover letter, vita, selected reprints, and arrange to have four letters of reference (including at least one concerning administrative abilities) sent to: Dr. Kevin Grasse, Chair Search Committee, Department of Mathematics, 601 Elm-Phsc 423, Norman, Oklahoma 73019. Phone 405-325-2903.

Closing dates for applications are March 15, 1989, and every two weeks thereafter until either the position is filled or the final closing date of June 1, 1989. The University of Oklahoma is an Affirmative Action/Equal Opportunity Employer.

LINCOLN LAND COMMUNITY COLLEGE

Math Instructor–tenure track. To teach in a comprehensive community college math program which includes developmental, technical, transfer courses through D.E. and computer related courses. Master's required. Preference given to those with previous college teaching experience and ability to teach programming languages. $18,649–$42,502 on a 2-semester salary. Begins August 17, 1989. Contact Director of Personnel, Lincoln Land Community College, Shepherd Road, Springfield, Illinois 62794-9256. EOE/AA-Minorities are encouraged to apply.

POSITIONS AVAILABLE

RESEARCH ASSOCIATE IN NUMERICAL ANALYSIS

Applications are being invited for a position as **Research Associate** with the CERSIM and the Department of Mathematics and Statistics, commencing on or before September 1, 1989. The position is expected to be funded for a three-year term and may lead to a tenure-track appointment with the Department.
Duties involve:
- research on numerical simulation of polymeric flow;
- supervision of graduate students.
Applicants must have:
- a Ph.D. in Mathematics, or equivalent, in the area of numerical solution of partial differential equations by the finite elements method.
- a demonstrated interest for team work in a multidisciplinary research environment.

To be considered for a tenure-track position in the Department, the successful candidate should hold a Ph.D. degree in the Mathematical Sciences and have competence in teaching in the French language.

Candidates with Ph.D. degrees in other areas than Mathematics will be considered for the Research Associate position only.

In accordance with Canadian immigration requirements, preference will be given to Canadian citizens and landed immigrants.

Please send all material to:

Robert Côté
Département de mathématiques
et de statistique
Faculté des sciences et de génie
Université Laval, Québec
G1K 7P4

The closing date for applications is May 30, 1989.

POSTE D'ATTACHE DE RECHERCHE EN MATHEMATIQUES NUMERIQUES

Le Centre de recherche en sciences et en ingénierie des molécules (CERSIM) et le Département de mathématiques et de statistique sollicitent des candidatures pour un poste d'attaché de recherche pour une durée possible de 3 ans débutant au plus tard le ler septembre 1989. Ce poste d'attaché de recherche pourra être intégré au Département de mathématiques et de statistique.
La personne retenue:
- ferra de la recherche portant sur la simulation numérique des écoulements de polymères et ce, dans le cadre d'une action structurante;
- contribuera à la direction d'étudiant(e)s des 2ème et 3ème cycles.
La personne intéressée doit:
- détenir un doctorat en mathématiques ou un diplôme jugé équivalent avec spécialisation en résolution numérique des équations aux dérivées partielles par la méthode des éléments finis;
- manifester de l'intérêt pour la recherche multidisciplimaire et le travail d'équipe.

Dans la perspective d'une intégration au Département de mathématiques et de statistique, les qualités d'enseignant de la personne intéressée et ses capacités à s'exprimer en français seront prises en considération.

On recevra aussi les candidatures de personnes possédant un doctorat dans une discipline autre que les mathématiques. Ces personnes ne seraient pas cependant intégrables au département de mathématiques et de statistique.

Conformément aux exigences relatives à l'immigration au Canada, cet avis de concours s'adresse en premier lieu aux citoyen(ne)s canadien(ne)s et aux résident(e)s permanent(e)s du Canada.

Le curriculum vitae doit parvenir avant le 30 mai 1989 à l'adresse suivante:

Robert Côté
Département de mathématiques
et de statistique
Faculté des sciences et de génie
Université Laval, Québec
G1K 7P4

HONG KONG BAPTIST COLLEGE

HONG KONG BAPTIST COLLEGE, A Government-funded, Degree-granting Institution of Higher Education, invites applications for the post of **Principal Lecturer in Mathematics (PR03)**. Applicants should possess a Ph.D. with extensive research and teaching experience in several areas of applied mathematics. Familiarity with computer usage in sciences and other disciplines is desired. The successful candidate is expected to provide leadership and be actively involved in teaching subjects in applied mathematics, supervising student projects, conducting research in one or more applied areas, and co-operation with other departments on matters relating to mathematical sciences. Salary range HK$316,800 to HK$393,240 p.a. by 5 increments (approx. US$40,615 to US$50,415 p.a.). Overseas appointees may be offered an initial 2 year contract with 25% gratuity payable at the end of contract. Appointment may be renewable on contract or on Superannuable Terms. Other benefits include housing assistance, medical/dental benefits, education allowance for children, passage and vacation leave. Applications with complete curriculum vitae and names and addresses of two referees should reach the Personnel Office, Hong Kong Baptist College, 224 Waterloo Road, Kowloon, Hong Kong by May 31, 1989.

UNIV. OF N.C. AT CHAPEL HILL
Dept. of Mathematics
Chapel Hill, NC 27599

Applications are invited for a senior level tenured appointment in the general area of applied and computational mathematics, effective Fall 1989. Rank and salary depend on qualifications. A Ph.D. and demonstrated excellence in research and teaching are required. Applications will be accepted until the position is filled. Contact Jon Tolle, Mathematics Department, Box 3250 Phillips Hall, UNC at Chapel Hill, Chapel Hill, NC 27599. EO/AA Employer. Women and minorities are encouraged to identify themselves voluntarily.

POSITIONS AVAILABLE

UNIVERSITY OF MINNESOTA, DULUTH
Department of Mathematics and Statistics

Nontenure positions for 9/1/89-5/31/90. Teach 12-14 hours per week of Math and/or Statistics. Some limited service to the department. An active research program is encouraged. Annual reappointment based on performance and need. Demonstrated evidence of effective teaching and communication skills appropriate to a faculty position is required. Required: Master's in Math, Statistics, Computer Science, or related area. Desired: Doctorate in Math, Statistics, or Computer Science; 1 year of college teaching. Competitive salary. Send resume, 3 letters of recommendation, transcript (if degree in progress or completed in past 5 years) to D. E. Anderson by 8/11/89; some decisions as early as 6/9/89. THE UNIVERSITY OF MINNESOTA IS AN EQUAL OPPORTUNITY EDUCATOR AND EMPLOYER AND SPECIFICALLY INVITES AND ENCOURAGES APPLICATIONS FROM WOMEN AND MINORITIES.

CYPRESS COLLEGE

Two full time, tenure track mathematics teaching positions are open at Cypress College, a community college in southern California, effective Fall, 1989. A Masters Degree or higher is required. Previous teaching experience and a working knowledge of at least one computer language are desirable. Send letter of application, transcripts, resume, and three letters of reference to Personnel Office, NOCCCD, 1000 N. Lemon, Fullerton, CA 92694. Deadline: June 7, 1989. EOE/AA.

PUBLICATIONS

MATH SCI PRESS, 53 Jordan Rd., Brookline, MA 02146, 617-738-0307, TOPICS IN PHYSICAL GEOMETRY, by R. Hermann, $80. In Preparation: DIFFERENTIAL FORMS IN LAGRANGIAN AND QUANTUM FIELD THEORIES.

SITUATIONS WANTED

Mathematician or Math Instructor. Age 32. U.S. citizen; security clearance attained. Specialty: Combinatorics. Experience: Several months tutoring minority students, three years classroom teaching, three years service in communications security. References and resume provided upon request. Phone: (816)763-6790 or respond to: Applicant Code 333, Advertising Department, AMS, P.O. Box 6248, Providence, RI 02940.

Doctorate in Applied Mathematics seeking assistant professorship, one publication in Computer and Mathematics, 5 years teaching assistant experience, won a teaching award, available now, resume upon request phone: (412) 361-5338 or respond to: Applicant code 506, Advertising Department, AMS, P.O. Box 6248, Providence, RI 02940.

RESEARCH MATHEMATICIAN. Ph.D. of Sci. 1971. Specialty: optimization, applied math., mechanics of airplane, rocket flight. 41 articles, 3 books, 13 inventions (9, 1, 13 for the 5 last years). 19 years exp. in indust. research & teaching in USSR. Employment authorized by INS. Ref. & res. upon request. Will relocate. Available immed. A. Bolonkin, 1001 Ave H, Apt. 9-C, Brooklyn, NY 11230.

MATHEMATICS PH.D. 1973. TEACHING AND RESEARCH (ACTIVE). 20 years experience in Teaching. 16 years experience in research, including more than a year at Bonn Universität. Fluent in British, Spanish. Basic knowledge German, Japanese. Elementary knowledge Latin, Greek. Also knows philosophy, several religions and sports. Respond to: Applicant Code 521, Advertising Department, AMS, P.O. Box 6248, Providence, RI 02940.

BOOKS WANTED

BOOKS WANTED

LET WISC-WARE MARKET your mathematics software. We duplicate and distribute to colleges & universities; you collect the royalty. Your DOS-based Windows program may cover any area of math, statistics, or other fields for instruction or research. Call or write for information on how to submit your program to Wisc-Ware, Academic Computing Center, University of Wisconsin-Madison, 1210 W. Dayton, Madison, WI, 53706 (800)543-3201.

Addison-

MATHS 89

Advanced Book Program

New and Recent Titles

An Introduction to Chaotic Dynamical Systems, 2nd Edition

Robert L. Devaney, Boston University

The second edition of this best-selling text includes new material on the orbit diagram for maps of the interval and the Mandelbrot set, as well as striking color photos illustrating both Julia and Mandelbrot sets. It introduces many of the basic concepts of modern dynamical systems theory and leads to the point of current research in several areas. A comprehensive exploration into the mathematics of chaos.

0-201-13046-7/HB/320 pp/1989/$41.95

A Comprehensive Introduction to Linear Algebra

Joel Broida, Broida Development Corp.
S. Gill Williamson, Univ. of Calif., San Diego

Includes a large amount of background material necessary for a more advanced understanding of linear algebra, as well as an introduction to several more advanced topics, including tensors, exterior algebras, and Hilbert spaces. Appropriate for upper division undergraduates and beginning graduate students in mathematics, applied mathematics and related fields.

0-201-50065-5/HB/752 pp/1989/$45.25

Tubes

Alfred Gray, University of Maryland

Provides a proof of Weyl's formula for the volume of a tube about a submanifold of Euclidean space and describes some generalizations. This book makes this important formula available to researchers and advanced graduate students in mathematics, statistics, physics and related areas. The book is unique in that the auxilliary concepts necessary for understanding the formula are thoroughly explained. A new and better approach than provided by most geometry books.

0-201-15676-8/HB/320 pp/1989/$43.25

A Concrete Approach to Mathematical Modelling

Michael Mesterton-Gibbons, Florida State Univ.

A substantial text that introduces a broad selection of mathematical models within a coherent framework and encourages readers to be critical and resourceful in applying and developing them. The book emphasizes both the usefulness and limitations of mathematical models. Many examples and exercises are included throughout the book, and a solutions manual is available.

0-201-12910-8/HB/630 pp/1989/$48.50

Mathematica™: A System for Doing Mathematics by Computer

Stephen Wolfram, Wolfram Research Inc.

This is the definitive book on *Mathematica*, written by the main architect of the system. The book starts with an introduction to *Mathematica*, then leads the reader through the whole range of *Mathematica's* capabilities, ending with a reference guide to the system. The book will be valuable not only to *Mathematica* users, but also to those with a more general interest in computers, mathematics, and their relationship.

0-201-19334-5/HB/450 pp/1988/$44.25
0-201-19330-2/PB/450 pp/1988/$29.95

Semio Physics: A Sketch

René Thom, Institut des Hautes Etudes Scientifiques

A philosophical synthesis originating from scientific practice, this book provides a new treatment of classical problems of philosophy, using an interdisciplinary approach to describe the original roots of scientific explanation. According to the author, "...the intellegibility of the world demands a certain metaphysical approach (as opposed to the current positivist interpretation which would reduce science to a pure nomology governed by practical efficacy)."

0-201-50060-4/HB/256 pp/1989/$45.25

Tools for Mathematicians

HANDBOOK OF DIFFERENTIAL EQUATIONS

Daniel Zwillinger

This handbook is a compilation of the most important and widely applicable methods for solving and approximating ordinary, partial, and stochastic differential equations. For every class of differential equations, there are general introductory remarks, exact analytical solution techniques, and numerical techniques.

For each technique:

- the types of equations the method applies to is given
- the procedure for carrying out the method is described
- one or more examples are worked out in detail
- special warnings and cases are indicated
- extensive references are given.

This in-depth book will be a valuable reference for engineers and scientists who need to solve differential equations. Students who wish an overview of solution techniques will also find this easy-to-use handbook useful.

December 1988, 696 pages, $49.95
ISBN: 0-12-784390-6

LARGE DEVIATIONS

Jean-Dominique Deuschel and Daniel W. Stroock

A Volume in the PURE AND APPLIED MATHEMATICS Series

This book provides a survey of the modern mathematical theory of large deviations. Starting from two classical examples, Cramer's Theorem concerning independent R-random variables and Schilder's Theorem for rescaled Wiener measures, the authors develop general principles. These include Varadhan's version of the Laplace asymptotic method and an introduction to the connection between large deviations and convex analysis. Returning to large deviations from the strong law, with variables taking values in Banach spaces or the space of probability measures on a Polish space, the authors include Sanov's theorem for the empirical distribution of independent random variables. Written for a non-specialist audience, the book can be used as the basis for a graduate course on the subject and will bring the reader up to the current level of research.

May 1989, 322 pages, $34.95
ISBN: 0-12-213150-9

ADVANCED TOPICS IN THE THEORY OF DYNAMICAL SYSTEMS

edited by
G. Fusco, M. Iannelli, and L. Salvadori

A Volume in the NOTES AND REPORTS IN MATHEMATICS IN SCIENCE AND ENGINEERING Series

This work covers new research on a wide range of topics in the theory of dynamical systems, including both theoretical aspects and problems arising from applications. A number of articles are devoted to finite dimensional systems, with special emphasis on the analysis of existence of periodic solutions to Hamiltonian systems. Others deal with infinite dimensional systems and are concerned with recently developed methods in the general approach to existence and qualitative analysis problems in the general theory as well as with the study of particular systems arising in the natural sciences.

March 1989, 280 pages, $29.95
ISBN: 0-12-269990-4

NUMERICAL METHODS FOR INITIAL VALUE PROBLEMS IN ORDINARY DIFFERENTIAL EQUATIONS

Simeon Ola Fatunla

This monograph is a complete treatment of systems of ordinary differential equations, with emphasis placed on the numerical treatment of special equations—stiff, stiff oscillatory, and singular initial value problems, which are often characterized by large Lipschitz constants and which have received considerable attention over the past 15 years. Existing robust codes for these categories of problems are highlighted. This monograph provides an invaluable reference tool for students and researchers in mathematics, computer science, and engineering.

1988, 312 pages, $44.50
ISBN: 0-12-249930-1

THE NUMERICAL SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Granville Sewell

This text offers an introduction to the use of finite difference and finite element methods for solving ordinary and partial differential equations. It can be used as a textbook for graduate or advanced undergraduate courses on the numerical solution of partial differential equations, but it may also be used as a reference handbook by the researcher interested in solving differential equations. While the methods presented are given a theoretical foundation, and error bounds are derived in most cases, the computational aspect is stressed, and many of the methods are illustrated with FORTRAN programs.

1988, 284 pages, $39.95
ISBN: 0-12-637475-9

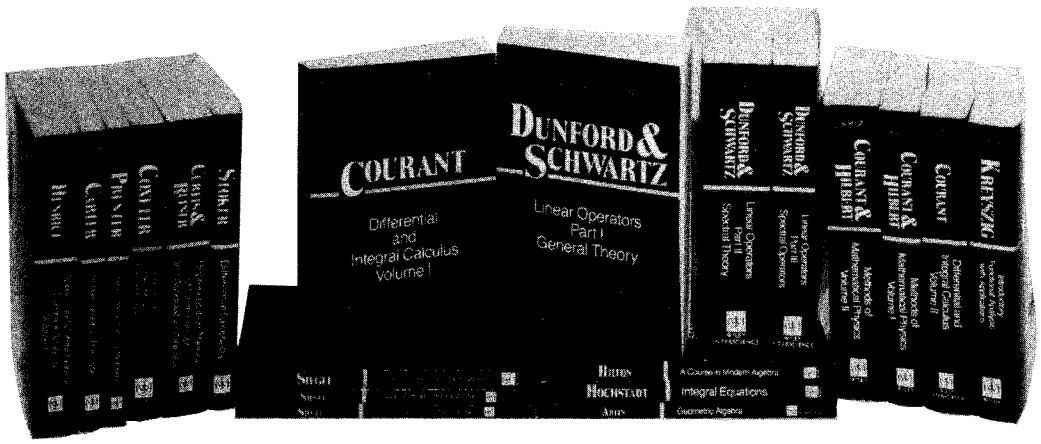
ACADEMIC PRESS
Harcourt Brace Jovanovich, Publishers
Book Marketing Department #31059, 1250 Sixth Avenue, San Diego, CA 92101

CALL TOLL FREE 1-800-321-5068

WILEY MATHEMATICS from THEORY to PRACTICE

The Wiley Classics Library

The ***Wiley Classics Library*** consists of selected books originally published by Wiley-Interscience that have become recognized classics in their respective fields. With these new unabridged and inexpensive editions, Wiley hopes to extend the life of these works by making them available to future generations of mathematicians and scientists.



Richard Courant & D. Hilbert
Methods of Mathematical Physics, Volume I
1-50447-5 $29.95

Methods of Mathematical Physics, Volume II
1-50439-4 $29.95

P. Hilton & Y.C. Wu
A Course in Modern Algebra
1-50405-X $24.95

D.J. Stoker
Differential Geometry
1-50403-3 $26.95

Peter Henrici
Applied and Computational Complex Analysis, Vol. I – Power-Series-Integration - Conformal Mapping-Location of Zeros
1-60841-6 $29.95

R.W. Carter
Finite Groups of Lie Type
1-50683-4 $29.95

Richard Courant
Differential and Integral Calculus, Volume I
1-60842-4 $29.95

Differential and Integral Calculus, Volume II
1-60840-8 $29.95

Erwin Kreyszig
Introductory Funtional Analysis With Applications
1-50459-9 $29.95

C W. Curtis & I. Reiner
Representation Theory of Finite Groups and Associative Algebras
1-60845-9 $29.95

Nelson Dunford & Jacob T. Schwartz
Linear Operators, Part I General Theory
1-60848-3 $29.95

Linear Operators, Part II, Spectral Theory -- Self Adjoint Operators in Hilbert Space
1-60847-5 $29.95

Linear Operators, Part III Spectral Operators
1-60846-7 $29.95

P. M. Prenter
Splines and Variational Methods
1-50402-5 $24.95

Harold M. Coxeter
Introduction to Geometry Second Edition
1-50458-0 $29.95

C.L. Siegel
Topics in Complex Function Theory, Vol. I – Elliptic Functions and Uniformization Theory
1-60844-0 $29.95

Topics in Complex Function Theory, Vol. II -- Automorphic & Abelian Integrals
1-60843-2 $29.95

Topics in Complex Function Theory, Vol. III – Abelian Functions and Modular Functions of Several Variables
1-50401-7 $24.95

H. Hochstadt
Integral Equations
1-50404-1 $24.95

Emil Artin
Geometric Algebra
1-60839-4 $29.95

Also Available

NONNEGATIVE MATRICES IN DYNAMIC SYSTEMS
A. Berman, Technion, Israel; M. Neumann, Univ. of Connecticut & R.J. Stern, Concordia University, Quebec, Canada
1-62074-2 225pp June 1989 $39.95

ELEMENTS OF COMPUTER ALGEBRA WITH APPLICATIONS
A.G. Akritas, University of Kansas
1-61163-8 448pp March 1989 $44.95

SIMULATED AND ANNEALING BOLTZMANN MACHINES:
A Stochastic Approach to Combinatorial Optimizations and Neural Computing
E. Aarts & J. Korst, both of Philips Research Labs, Eindhoven
1-92146-7 272pp Feb. 1989 $49.95

THE AVERAGED MODULI OF SMOOTHNESS
With Applications in Numerical Methods and Approximation
B. Sendov & V. Popov, both of the Bulgarian Academy of Sciences
1-91952-7 181pp March 1989 $57.95

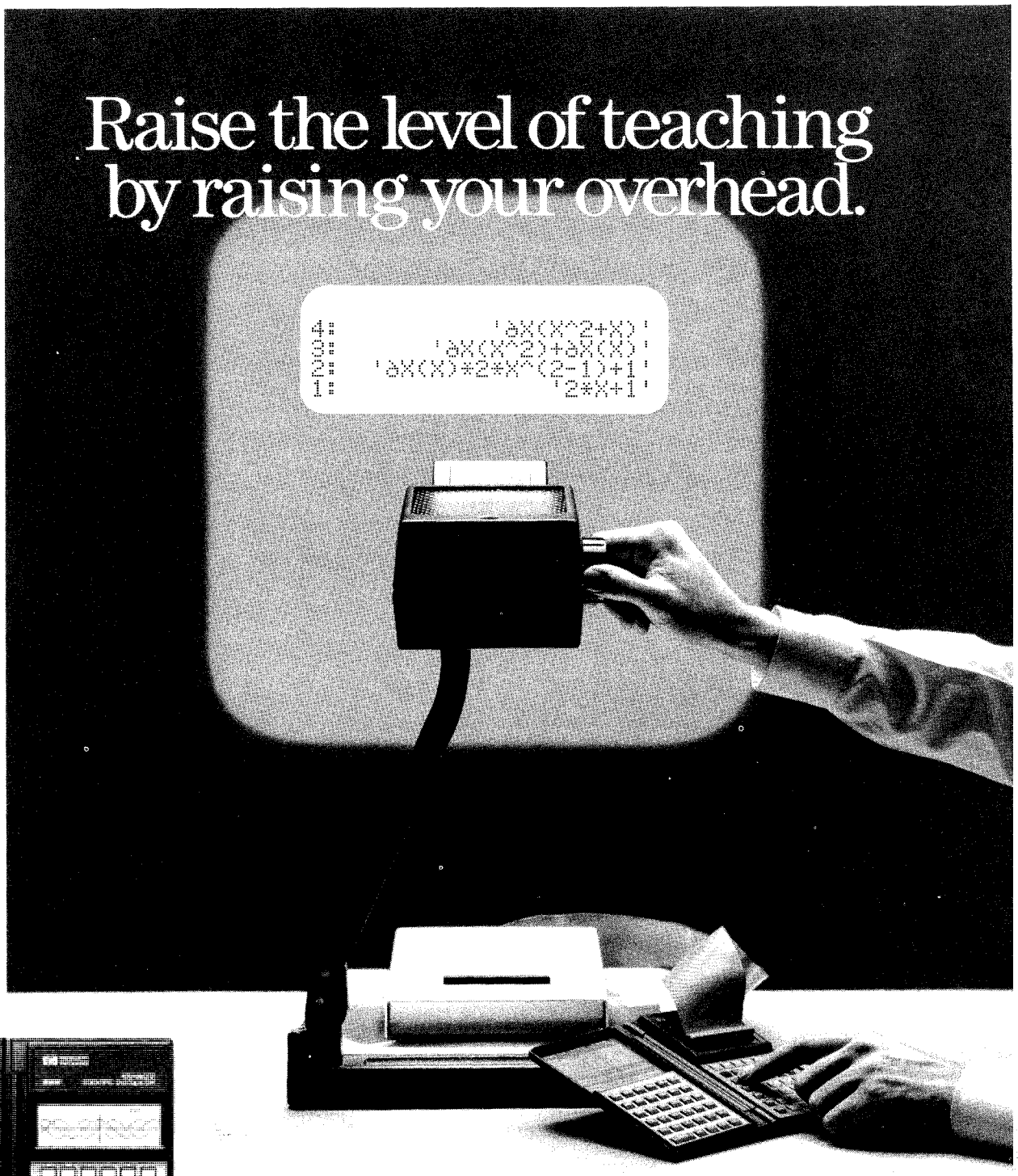
ALTERNATE REALITIES
Mathematical Models of Nature and Man
J. Casti, Technical University of Vienna, Austria
1-61842-X 500pp Jan. 1989 $34.95

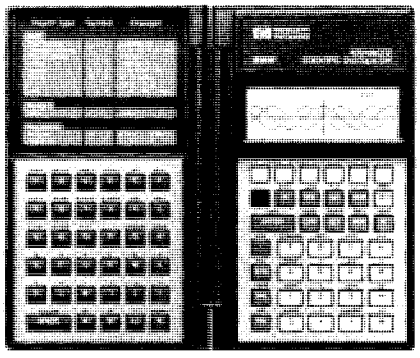
WILEY

To order, write: WILEY-INTERSCIENCE
605 Third Avenue, NY, NY 10158
Attn: Sharon Nelson, 5th Floor

To order by phone: Call TOLL-FREE **1-800-526-5368**
In New Jersey, call collect: (201) 342-6707
Prices subject to change without notice & higher in Canada *Order#: 0-0112*

Raise the level of teaching by raising your overhead.





Now there's a better way to teach algebra and calculus in the classroom. In fact, two ways.

First, introduce your students to the HP-28S. It's the only calculator that offers symbolic algebra and calculus.

Then, introduce yourself to the overhead display for the HP-28S. It allows you to project your calculations on an HP-28S for everyone in the classroom to see.

A scholastic offer for you.

If your department or students purchase a total of 30 HP-28S calculators, we'll give you a classroom overhead display for the HP-28S absolutely free. (A $500 retail value.)

Plus, your very own HP-28S calculator free. (A $235 retail value.)

To learn more, and get free curriculum materials, call (503) 757-2004 between 8am and 3pm, PT. Offer ends October 31, 1989.

There is a better way.

HEWLETT PACKARD

Calculator Support, Hewlett-Packard, 1000 NE Circle Blvd., Corvallis, OR 97330

Help Save Selim G. Krein

Our eminent Soviet colleague Selim G. Krein is gravely ill. He needs open-heart surgery (a cardiac bypass operation). In the Soviet Union the success rate for this operation is poor. In the USA it is routine, but the cost may run as high as $50,000.

Send your contributions payable to:

Selim G. Krein Fund
Key Bank N.A.
1196 Western Avenue
Albany, New York 12203

Fund Coordinator:
Boris Korenblum
Department of Mathematics and Statistics
State University of New York at Albany
Albany, New York 12222

Special Memorial Fund

Professor Qi-Ming Wang of the Institute of Mathematics, Academia Sinica, Beijing, was killed in an automobile accident on April 7, 1989 while visiting Harvard University. Professor Wang had just arrived in the United States where he planned to spend several months before returning to China where, most likely, he would have become the Director of the Mathematical Institute. A fund in memory of Professor Wang will be donated to the Institute of Mathematics, Academia Sinica.

Persons who wish to donate to this fund may send a check payable to "American Mathematical Society Wang Fund" to

American Mathematical Society Wang Fund
Annex Station
P. O. Box 1571
Providence, RI 02901-1571

ANNOUNCING...

MathSci™ on CD-ROM

Now you can access *Mathematical Reviews* (*MR*) and *Current Mathematical Publications* (*CMP*) on CD-ROM (Compact Disc–Read Only Memory). The CD, called MathSci Disc, combines the searching features of online MathSci with the browsing ease of printed *MR*. For a fixed annual fee, MathSci Disc can be used at leisure without access charges or telephone connections.

Semi-Annual Issue

MathSci Disc is produced by SilverPlatter® and is issued semi-annually. The first MathSci Disc became available in January 1989 and contains all the reviews and abstracts from *MR* 1985 through 1988 and over 68,000 entries from *CMP*. The July disc will have all the information on the January disc plus the January-June updates. Access to current information between successive CD issues is available online from MathSci, which is updated monthly on DIALOG, BRS, and ESA.

Easy-to-Operate

MathSci Disc is available for the IBM PC and will be available for the Macintosh. SilverPlatter's user-friendly CD software with help screens and menus makes MathSci Disc easy to use. Words and phrases in the text of the reviews and abstracts are searchable with an adjacency operator. Records can be downloaded from the CD to the hard disk for editing or for processing with TEX software into typeset form with mathematics.

Fixed Cost

The MathSci Disc annual lease fee includes the January and the July issues of MathSci Disc, the SilverPlatter search software for the IBM or the Macintosh, the SilverPlatter search manual with a MathSci Disc chapter, and a toll-free help line.

The 1989 MathSci Disc is available at a low annual lease fee, equal to that of the printed *MR*:

Nonmembers: List price - $3,510*
additional leases - $2,106*

AMS members & *MR* subscribers:
AMS Members: $2,808*
MR subscribers: $2,106*
AMS members with an *MR* or first MathSci Disc subscription: $1,685*

Individuals at institutions subscribing to MathSci Disc can order a copy for personal use at a 90% discount: $351*. (*Plus shipping & handling for addresses outside the U.S. and Canada.)

For more information on MathSci Disc or to receive a copy of the lease agreement, please contact Taissa Kusma, Database Services Manager, American Mathematical Society, P. O. Box 6248, Providence, RI 02940 or call (800) 556-7774 in the continental U.S. or (401) 272-9500. Internet: TTK@MATH.AMS.COM; Telex: 797192; FAX: 401-331-3842.

AMERICAN MATHEMATICAL SOCIETY

Application for Membership 1989

Date ..... 19.....

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. Your name will be added to our mailing lists upon our receipt of your completed application, and payment for member dues.

Subscriptions to the Notices *and the* Bulletin *(New Series) are included as part of your membership.*

.....
Family Name *First* *Middle*

Please indicate below the way your name should appear in the Combined Membership List.

.....
Family Name *First* *Middle or Initial*

Place of Birth .....
City *State* *Zip/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 five from the list at right*)

....

Address for all mail

.....

.....

.....

.....
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 1571, Annex Station, Providence, RI 02901-9930

To use VISA or MasterCard, fill in information requested and mail to American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

For Foreign Bank Transfers: The name and address of the AMS bank is Rhode Island Hospital Trust National Bank, Account #000-753-111, One Hospital Trust Plaza, Providence, RI 02903, U.S.A.

VISA ○ *MasterCard* ○ ....
Account number *Expiration date*

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 of the 1980 Mathematics Subject Classification below. Select no more than five category numbers and fill in the numbers where indicated on the left. 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.

00 General
01 History and biography
03 Mathematical 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 and optimal control; optimization
51 Geometry
52 Convex sets and related geometric topics
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 mechanics
82 Statistical physics, structure of matter
83 Relativity
85 Astronomy and astrophysics
86 Geophysics
90 Economics, operations research, programming, games
92 Biology and 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 $38,000, the dues are $66; for those whose annual professional income is $38,000 or more, the dues are $88.*

*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 $38,000 or less, the dues are $56 and for those whose annual professional income is above $38,000, the dues are $75.*

*For a **joint family membership,** one pays ordinary dues, based on his or her income, and 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 $132.*

*For either **students** or **unemployed individuals,** dues are $22, and annual verification is required.*

*The annual dues for **reciprocity members** who reside outside the U.S. and Canada are $44. 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 ($66 or $88).*

*The annual dues for **external members,** those who reside in developing countries which do not have any mathematical society, are $47.*

*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 either unemployed or student members.*

1989 Dues Schedule

For any category of membership where no dues prices are given, the higher one is to be paid by persons whose annual professional income is $30,000 or more.

Ordinary member ..... ○$66 ○ $88

CMS Cooperative rate ..... ○ $56 ○ $75

Joint family member (full rate) ..... ○ $66 ○ $88

Joint family member (reduced rate) ..... ○ $46 ○ $68

Contributing member (minimum $132) ..... ○

Student member (please verify)[1] ..... ○ $22

Unemployed member (please verify)[2] ..... ○ $22

Reciprocity member (please verify)[3] ..... ○ $44 ○ $66 ○ $88

External member ..... ○ $47

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.*

Reciprocating Societies

- ○ Allahabad Mathematical Society
- ○ Asociación Matemática Española
- ○ Australian Mathematical Society
- ○ Berliner Mathematische Gessellschaft e.V.
- ○ Calcutta Mathematical Society
- ○ Dansk Matematisk Forening
- ○ Deutsche Mathematiker-Vereinigung e.V.
- ○ Edinburgh Mathematical Society
- ○ Gesellschaft für Angewandte Mathematik und Mechanik
- ○ Glasgow Mathematical Association
- ○ Indian Mathematical Society
- ○ Iranian Mathematical Society
- ○ Irish Mathematical Society
- ○ Islenzka Staerdfraedafelagid
- ○ Israel Mathematical Union
- ○ 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
- ○ New Zealand Mathematical Society
- ○ Nigerian Mathematical Society
- ○ Norsk Matematisk Forening
- ○ Österreichische Mathematische Gesellschaft
- ○ Polskie Towarzystwo Matematyczne
- ○ Punjab Mathematical Society
- ○ Real Sociedad Matemática Española
- ○ 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
- ○ Société de Mathématiques Appliquées et Industrielles
- ○ Société Mathématique de Belgique
- ○ Société Mathématique de France
- ○ Société Mathématique Suisse
- ○ Southeast Asian Mathematical Society
- ○ Suomen Matemaattinen Yhdistys
- ○ Svenska Matematikersamfundet
- ○ Union Mathemática Argentina
- ○ Unione Matematica Italiana
- ○ Vijnana Parishad of India
- ○ Wiskundig Genootschap

.....

Signature

Order Form

For VISA or MasterCard orders, send to:
American Mathematical Society
P.O. Box 6248
Providence, Rhode Island 02940
(800) 556-7774

For orders with remittances, send to:
American Mathematical Society
P.O. Box 1571, Annex Station
Providence, Rhode Island 02901-1571
(401) 272-9500

Ordered by: _____

Mail to (if different): _____

QTY	CODE	AUTHOR and TITLE	PRICE
			$
		Shipping and Handling ☐ Surface ☐ Air	
		Total due (**All orders must be prepaid in U.S. funds**)	$

Charge by phone in the continental U.S.
800-556-7774

☐ Check or Money Order ☐ VISA ☐ MasterCard

Card Number

Card Expiration Date _____ Signature _____

Shipping and Handling

	First Book	Each Additional	Maximum
Surface	$2	$1	$ 25
Air	$5	$3	$100

NOTI

Prices are subject to change without notice.

Books are sent via surface mail (UPS to U.S. addresses and printed matter elsewhere) unless air delivery is requested. The shipping and handling charges for book orders are shown in the table. **Journal back numbers**, *Mathematical Reviews* indexes and review volumes are sent via surface mail to any destination unless air delivery is requested. Postage for surface mail is paid by the AMS. Air delivery rates, which will be quoted upon request, must be paid by the purchaser. **Software**: Nonindividual customers need not prepay provided a Purchase Order number is given with the order. Software/books are sent via UPS to U.S. addresses, first class mail to Canada, and air delivery elsewhere. Add shipping and handling for Software/Books: $8 per order in the U.S. and Canada; $35 per order air delivery outside the U.S. and Canada.

Customers in these areas should request price information from and direct their orders to the following distributors:
Europe/Middle East/Africa: Clarke Assoc.-Europe Ltd., 13a Small Street, Bristol BS1 1DE, England. Tel. 01-0272-268864, Telex 445591 CALORB G; exclusive distributor of AMS books.
Japan: Maruzen Co. Ltd., P.O. Box 5050, Tokyo International 100-31, Japan. Tel. Tokyo 272-7211, Telex J26516
India: Allied Publishers Pvt. Ltd., 15, J. N. Herdia Marg., Ballard Estate, Bombay 400038, India

Staple here

Fold here

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 554B PROVIDENCE, RI

POSTAGE WILL BE PAID BY ADDRESSEE

Member Services Department
AMERICAN MATHEMATICAL SOCIETY
P. O. Box 6248
Providence, RI 02940

Fold here

Fasten PAYMENT securely

Change of Address

Members of the Society who move or who change positions are urged to notify the Providence Office as soon as possible.

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

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

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

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

Name: _____ Customer code: _____

Change effective as of: _____

Old mailing address: _____

NEW mailing address: _____

New position: _____

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

New employer: _____

Location of employer: _____

City State/Province Country Zip Code

Telephone number(s): _____

Electronic address(es): _____

Recent honors and awards: _____

Personal items for publication in *Notices*: _____

Mail completed form to:

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

Staple here

Fold here

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 554B PROVIDENCE, RI

POSTAGE WILL BE PAID BY ADDRESSEE

Member Services Department
AMERICAN MATHEMATICAL SOCIETY
P. O. Box 6248
Providence, RI 02940

Fold here

Fasten PAYMENT securely

MAA Minicourse Preregistration Form, Boulder, Colorado

August 7–10, 1989

NOTE: This is not an AMS Short Course Form. Please use the Boulder, Colorado Pregistration/Housing Form to preregister for the AMS Short Course.

To preregister for MAA Minicourse(s), please complete THIS form and return it with your payment to:

Susan Wilderson
Mathematical Association of America
1529 Eighteenth Street, N.W.
Washington, DC 20036
Telephone: 202-387-5200

_____ Telephone: _____

(Please print) Surname First Middle

_____

Street address City State Zip

- Deadline for MAA Minicourse preregistration: June 1, 1989 (After this date, potential participants are encouraged to call the MAA headquarters at 800-331-1622.)
- Deadline for cancellation in order to receive a 50% refund: July 31, 1989
- Each participant must fill out a separate Minicourse Preregistration form.
- Enrollment is limited to two Minicourses, subject to availability.
- Please complete the following and send both form and payment to Susan Wilderson at the above address:

  I would like to attend ☐ 1 Minicourse ☐ 2 Minicourses

  Please enroll me in MAA Minicourse(s): #_____ and #_____

  In order of preference, my alternatives are: #_____ and #_____

- PAYMENT

  Check enclosed: $ _____

  Credit card type: ☐ MasterCard ☐ Visa

  Credit card # _____ Expiration date: _____

  _____ _____

  Your Employing Institution Signature (as it appears on credit card)

Minicourse Number and Name	Organized by	Fee
1. The use of personal computers in an introductory linear algebra course	Homer Bechtell	$30
2. Combinatorics via functional equations	Donald R. Snow	$30
3. Chaotic dynamical system	Robert L. Devaney	$30
4. Faculty-managed programs that produce minority mathematics majors	Uri Treisman & Ray Shiflett	$30
5. Starting, funding and sustaining mathematics laboratories	Stavros N. Busenberg	$30
6. Group theory through art	Thomas Brylawski	$30
7. HP-28S short course for nearly inexperienced users	Jerold Mathews	$30
8. Applications of the HP-28S for experienced users	Thomas W. Tucker	$30
9. A seminar on women in mathematics	Miriam P. Cooney	$30

☐ I plan on preregistering for the Boulder, Colorado meetings **ONLY** in order to attend the MAA Minicourse(s) indicated above. It is my understanding that, should the course(s) of my choice be filled, full refund of the Boulder meetings preregistration fee will be made.

Summer List of Applicants

Instructions for Applicant Form on facing page

The form. Forms submitted by job applicants who attend the August meetings in Boulder will be posted. The first impression a prospective employer has of an applicant may be based on the appearance of this form.

The forms should be carefully typed using a fresh black ribbon. The best results are obtained with a carbon-coated polyethylene film ribbon, but satisfactory results may be obtained using a ribbon made of nylon or other woven fabric if suitable care is exercised. It is important that the keys be clean and make a sharp, clear impression. Use a correcting typewriter or correction tape or fluid if necessary. Submit the original typed version only. Hand lettered forms are acceptable if prepared carefully.

The summary strip. Information provided here will be used to prepare a printed list of applicants for distribution to employers. Please supply all information requested, and **confine your characters to the boxes provided**. Use the codes below. Circled letters identify corresponding items on the form and the strip.

Address forms to the Mathematics Meetings Housing Bureau, P. O. Box 6887, Providence, RI 02940. The deadline for receipt is **June 1, 1989**.

(A) Specialties

AL = Algebra	AN = Analysis
BI = Biomathematics	BS = Biostatistics
CB = Combinatorics	CM = Communication
CN = Control	CS = Computer Science
CT = Circuits	DE = Differential Equations
EC = Economics	ED = Mathematical Education
FA = Functional Analysis	FI = Financial Mathematics
FL = Fluid Mechanics	GE = Geometry
HM = History of Math	LO = Logic
MB = Mathematical Biology	ME = Mechanics
MO = Modelling	MP = Mathematical Physics
MS = Management Science	NA = Numerical Analysis
NT = Number Theory	OR = Operations Research
PR = Probability	SA = Systems Analysis
ST = Statistics	TO = Topology

(B) Career Objectives

AR = Academic Research	AT = Academic Teaching
NR = Nonacademic R&D	NC = Nonacad. Consulting
NS = Nonacademic Supervision	

(H) (I) Duties

T = Teaching	U = Undergraduate
G = Graduate	R = Research
C = Consulting	A = Administration
S = Supervision	IND = Industry
GOV = Government	DP = Data Processing

Location

E = East		S = South
C = Central		M = Mountain
W = West	O = Outside U.S.	I = Indifferent

(L) U.S. Citizenship Status

C = U.S. Citizen	P = Permanent Resident
T = Temporary Resident	N = Non-U.S. Citizen

Summer List of Applicants

Mathematical Sciences Employment Register

August 1989 Boulder, Colorado

(Please type. See instructions on facing page.)

APPLICANT: Name_____

Mailing address (include zip code) _____

_____

Ⓐ Specialties_____

Ⓑ Career objectives and accomplishments

ACADEMIC: ☐ Research, ☐ Teaching

NON-ACADEMIC: ☐ Research and Development, ☐ Consulting, ☐ Supervision

Near-term career goals_____

_____

Significant achievements or projects, including role_____

_____

Honors and offices_____

Other (e.g., paper to be presented at THIS meeting)_____

_____

Selected titles of papers, reports, books, patents_____

_____

Ⓒ Degree Year Institution

____ ____ _____

____ ____ _____

____ ____ _____

Ⓓ No. of abstracts, internal reports____

Ⓔ No. of papers accepted____

Ⓕ No. of books and patents____

EMPLOYMENT HISTORY:

	Present	Previous	Previous
Ⓖ Employer			
Position			
Ⓗ Duties			
Years	____ to ____	____ to ____	____ to ____

DESIRED POSITION:_____

Ⓘ Duties_____

Ⓙ Available mo.____ /yr.____ Location_____ Salary____

Ⓚ References (Name and Institution)

_____

_____

_____

Ⓛ Citizenship: (check one) ☐ U.S. Citizen ☐ Non-U.S. Citizen, Permanent Resident

☐ Non-U.S. Citizen, Temporary Resident

Ⓜ **I plan to attend the Summer Meeting** yes ☐ no ☐

SUMMARY STRIP

Family Name, First Name, Mailing Address,

Address (cont'd.), Address (cont'd.), State & Zip Code, Ⓐ Specialties,

Ⓑ Career objectives, Ⓒ Highest Degree, Ⓒ Yr., Ⓒ Institution, Ⓓ, Ⓔ, Ⓕ, Ⓖ Most recent employer,

Ⓗ Present duties, Ⓘ Desired duties, Ⓙ Available mo./yr., Ⓛ

MathDoc ™

Your Best Access to Inaccessible Items in the Mathematical Literature

What is MathDoc?

MathDoc is the document delivery service offered by the AMS, designed for users of *CMP*, *MR*, and MathSci who wish to obtain copies of original articles.

MathDoc is particularly useful for obtaining "inaccessible" items that cannot easily be obtained through interlibrary loan. For example, you might want one of these:

Acta Sci. Natur. Univ. Sunyatseni (1986), No. 1, pages 90-93
Many Chinese journals are available only in a very small number of U.S. libraries.

Methods and Algorithms in Numerical Analysis (1984), Moskov. Gos. Univ., pages 154-162
Russian collections are often printed in limited quantities and **MathDoc** may be the only U.S. source.

Sûrikaisekikenkyûsho Kôkyûroku (1986), No. 581, pages 85-100
This Japanese journal is available only through a limited number of sources in the U.S.

600,000+ Item Access

MathDoc has access to over 600,000 items at present in mathematics and related subjects, including 70,000 articles from Soviet journals.

95% Success Rate in Two Working Days

And **MathDoc** has over a 95% success rate in quickly locating and supplying the articles in journals, collections, and conference proceedings listed in *CMP*, *MR*, and MathSci...usually within two working days.

Although **MathDoc** cannot ordinarily supply an entire book, it often can give you information about the book's availability through other sources.

How to Use MathDoc

This labor-intensive service is a very low-cost method of locating documents. The AMS makes **MathDoc** available essentially at cost as a service to the mathematical community.

The current price for each item is
$12 for the first ten pages copied
$2 for each succeeding ten pages or less
copyright royalties * (if applicable)
plus postage.

An invoice is sent with the requested item. There is a 5% discount for VISA and MasterCard prepayments. Documents are mailed first class within North America and airmail elsewhere.

*MathDoc complies with copyright laws and adds copyright royalties, when applicable. MathDoc is affiliated with the Copyright Clearance Center (CCC), Salem, MA.

Ordering Information

For further information or to place an order through **MathDoc**, write to

MathDoc Document Delivery
Mathematical Reviews
416 Fourth Street
P. O. Box 8604
Ann Arbor, MI 48107-8604 USA

OR telephone (313) 996-5268 and ask for **MathDoc.**
OR send your order via FAX (313) 996-2916
OR send electronic mail (Internet) to MATHDOC@SEED.AMS.COM
All electronic mail will be acknowledged.
OR order through the DIALOG DIALORDER or the BRS systems.

Preregistration/Housing Form, Boulder, Colorado

August 7–10, 1989

Must Be Received in Providence No Later Than June 1, 1989

Please complete this form and return it with your payment to
Mathematics Meetings Housing Bureau
P.O. Box 6887, Providence, Rhode Island 02940 – Telephone: (401) 272-9500, Ext. 290-Telex: 797192

DEADLINES:

Preregistration/Dormitory Reservations	June 1, 1989
Housing Changes/Cancellations	July 17, 1989
Preregistration Changes	July 31, 1989
50% Refund on Preregistration	July 31, 1989 (no refunds after this date)
90% Refund on Residence Hall Package	July 17, 1989 (no refunds after this date)
50% Refund on Banquets/Tour/Hoe Down	July 14, 1989 (no refunds after this date)

	REGISTRATION FEES Preregistration by mail by June 1, 1989	At Meeting
JOINT MATHEMATICS MEETINGS		
Member of AMS, CMS, MAA, PME	$ 63	$ 82
Nonmember	98	127
* Student, Unemployed, or Emeritus	18	23
AMS SHORT COURSE		
Member/Nonmember	40	50
* Student or Unemployed	15	20

(N.B.: A separate form appears in this issue for preregistration for MAA Minicourses)

* 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 who is not a student; it is not intended to include persons who have voluntarily resigned from their latest position. The emeritus status refers to any person who has been a member of the AMS or MAA for twenty years or more and is retired on account of age or on account of long term disability from his or her latest position.

PREREGISTRATION SECTION: Please check the function(s) for which you are preregistering:

Joint Meetings ☐ AMS Short Course (August 6–7) ☐ (A separate form for MAA Minicourses appears in this issue)

1) _____ Telephone: _____
(Please print) Surname First Middle

2) _____
(Mailing address)

3) Badge information: a) Nickname (optional): _____ b) Affiliation _____ c) City&State _____

4) I am a student at _____ City&State _____ 5) Emeritus member ☐ Unemployed ☐

6) Accompanied by spouse _____ Number of children _____ (Enumerate only if accompanying to meeting)
(name)

7) Member of AMS ☐ CMS ☐ MAA ☐ PME ☐ Nonmember ☐ (Member discount applies only to members of AMS, CMS, MAA, and PME) Member of other organizations: AWM ☐ NAM ☐ **MR Classification #** _____

8) Joint Meetings fee $ _____ 9) **AMS** Short Course fee $ _____ 10) Dormitory payment $ _____

11) _____ MAA 25-Year Banquet ticket(s) @ $21 each = $ _____ 12) _____ PME Banquet ticket(s) @ $9 each = $ _____

13) _____ Rocky Mtn. Nat'l. Park Tour tkt(s) @ $12 each = $ _____ 14) _____ Western Hoe Down Adult tkt(s) @ $19 each = $ _____
_____ Western Hoe Down Vegetarian tkt(s) @ $16 each = $ _____ _____ Western Hoe Down Child (5–12 yrs.) tkt(s) @ $9 each = $ _____
I will bring _____ children under 5 years of age to the Western Hoe Down.

15) TOTAL AMOUNT ENCLOSED FOR 8 through 14 $_____ NOTE: May be paid by check payable to AMS (Canadian checks must be marked "U.S. Funds") or VISA or MasterCard credit cards.

Credit card type: _____; Card number: _____ ; Expiration date: _____
If this is your credit card, please print your name as it appears on the credit card on the line below as well as sign your name.
If this is not your credit card, please print card holder's name as it appears on the credit card on the line below, and have the card holder sign:

_____
(Printed name) (Signature)

Please complete the Housing Section on the reverse if you will require dormitory accommodations.

If housing is not needed, please indicate arrival/departure dates in Travel Section on the reverse.

For office use only:

Codes: Options: Hotel: Dorm: Room type:

Dates: Hotel Deposit Room/Board Pmt Total Amt. Paid:

Special Remarks:

$ _____ room/board paid; $ _____ room/board due

HOUSING SECTION:

☐ PLEASE CHECK HERE IF YOU WILL **NOT** BE STAYING IN ANY HOTEL, MOTEL, OR DORMITORY

☐ PLEASE CHECK HERE IF YOU WILL BE STAYING IN ONE OF THE HOTELS/MOTELS LISTED IN THE TEXT

UNIVERSITY HOUSING

NOTE: Full prepayment for room and board is required. Please make checks payable to AMS. Canadian checks must be marked "In U.S. Funds"; VISA and MasterCard credit cards will also be accepted. Acknowledgements of your residence hall reservations will be sent to address indicated on reverse. **The University's Kittredge Commons Office will assign ALL rooms. Purchase of meal tickets is mandatory, and the price is included in the rates below.**

Please circle applicable rates listed below for each day and enter totals in column at far right. Rates listed below are PER PERSON.

	Adults	Children 6-13 yrs. in bed	Children 6-13 yrs. in rollaway	Children under 6 yrs.*	**Enter total rate per day**
8/4 (no meals)	$29.00 single $19.00 double	$14.00 single $9.00 double	$3.00	$3.00	
8/5	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
8/6	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
8/7	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
8/8	$34.00 single $23.00 double	$18.00 single $12.00 double	$6.00	$3.00	
8/9	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
8/10	$41.00 single $31.00 double	$23.00 single $18.00 double	$12.00	$3.00	
Total for Residence Hall Package = (Please insert this amount in #10 on the reverse.)					$

*There will be a $3.00 rollaway or crib charge for all children under 6 years of age. Meals are free. Smoking and nonsmoking rooms are available upon request.

Please list other room occupants; indicating ages of children.

FULL NAME ARRIVAL DATE DEPARTURE DATE

_____

_____

☐ I am **not** going to the Western Hoe Down, but plan to eat dinner on campus on Tuesday, August 8. I will purchase a ticket at the Meetings Registration Desk for this meal.

TRAVEL SECTION: (Arrival/Departure dates are mandatory.)

I plan to arrive by on _____ (date) am/pm and depart on _____ (date) am/pm

☐ I plan to drive to the meeting. ☐ I will need a parking sticker for the University of Colorado campus.

Turn to Springer-Verlag For the Latest Information in Mathematics

Second Edition!

Mathematical Methods of Classical Mechanics

by **V.I. Arnold,** University of Moscow, USSR
translated from the Russian by **K. Vogtmann** and **A. Weinstein**
This new edition contains three new appendices:

- Poisson structures
- Elliptic coordinates and integrable systems
- Singularities of ray systems

In addition, numerous corrections have been incorporated into the text.

As in the first volume, this edition constructs the mathematical apparatus of classical mechanics from the very beginning and examines all the basic problems in dynamics, including the theory of oscillations, the theory of rigid body motion, and the Hamiltonian formalism. The author's modern approach, based on the theory of the geometry of manifolds, distinguishes the book from traditional textbooks. Emphasis throughout is on geometrical considerations: for example, phase spaces and flows, vector fields, and Lie groups.

Mathematical Methods of Classical Mechanics includes a detailed discussion of qualitative methods of the theory of dynamical systems and of asymptotic methods like perturbation techniques, averaging, and adiabatic invariance.

1989/544 pp., 269 illus./Hardcover $49.80
ISBN 0-387-96890-3
Graduate Texts in Mathematics, Volume 60 *(Second edition)*

Learning Discrete Mathematics With ISETL

by **N. Baxter,** Dickinson College; **E. Dubinsky,** Purdue University; and **G. Levin,** Clarkson University, USA
Written for use in a course on learning mathematics through the use of ISETL (Interactive SET Language), this text aims to motivate and challenge students. The student's initial introduction to the language comes through terminal sessions. A copy of what appears on the screen is provided in the text and the student is asked to reproduce that screen on his or her terminal. Students should learn to write code, think about what they have written and predict its results, and run their programs to check their predictions. Many explanations are provided and preview sections, at the beginning of each chapter, guide readers through the text.

Students and researchers in mathematics, computer science and engineering will find this book useful.

1989/416 pp., 43 illus./Hardcover $45.00
ISBN 0-387-96898-9

Mathematical Introduction to Linear Programming and Game Theory

by **L. Brickman,** SUNY Albany, NY, USA
Mathematical elegance is a constant theme in this treatment of linear programming and matrix games. Condensed tableaux, minimal in size and notation, are employed for the simplex algorithm. In the context of these tableaux, the beautiful termination theorem of R.G. Bland is proven more simply than heretofore, and the important duality theorem becomes almost obvious. Examples and extensive discussions throughout the book provide insight into definitions, theorems, and applications. There is considerable informal discussion on how best to play matrix games.

The book is designed for a one-semester undergraduate course. Readers will need a degree of mathematical sophistication and general tools such as sets, functions, and summation notation. No single college course is a prerequisite, but most students will do better with some prior college mathematics. This thorough introduction to linear programming and game theory will impart a deep understanding of the material and also increase the student's mathematical maturity.

1989/app. 152 pp./92 illus./Hardcover $34.00
ISBN 0-387-96931-4
Undergraduate Texts in Mathematics

Selected Papers II, III, and IV

by **S.-S. Chern,** MSRI and the University of California, Berkeley, CA, USA and Nankai Institute of Mathematics, Tianjin, China
Together with **Volume I, Selecta,** these volumes contain most of Chern's mathematical papers. They give a picture of his mathematical education, from his mathematical beginnings in China, to the world centers, and from local differential geometry, to the modern developments of global differential geometry and applications to physics.

These volumes make Chern's papers, which previously appeared only in obscure journals and monographs, now easily accessible.

Volume II: **1989/444 pp., 2 illus./Hardcover $45.00**
ISBN 0-397-96816-4
Volume III: **1989/504 pp., 2 illus./Hardcover $49.00**
ISBN 0-387-96817-2
Volume IV: **1989/463 pp., 2 illus./Hardcover $45.00**
ISBN 0-387-96820-2

Lectures on the Geometry of Numbers

by **C.L. Siegel**
rewritten by **K. Chandrasekharan,** ETH Zurich, Switzerland
with the assistance of **R. Suter**
Based on Carl Ludwig Siegel's lecture on the "Geometry of Numbers" at New York University during 1945-46. The freshness of his approach still lingers, and his presentation has its attractions for aspiring young mathematicians.

Chandrasekharan, with the assistance of Suter, has rewritten the text, but has maintained Siegel's style – in keeping his uncanny skill and perspecuity in argument, with an occasional flash of wit.

1989/app. 176 pp., 35 illus./Hardcover $45.00
ISBN 0-387-50629-2

Ramanujan's Notebooks

Part II
by **B.C. Berndt,** University of Illinois, Urbana, IL, USA
This is the second of four volumes devoted to the editing of Ramanujan's notebooks. It examines Chapters 10-15 in Ramanujan's second notebook. References are provided in the literature where proofs may be found for those results that are known; where results are not known, attempts are made to uncover proofs.

The final results are fascinating, yet, for the most part, Ramanujan's methods remain a mystery. Readers will strive to discover Ramanujan's thoughts and further develop his beautiful ideas.

1989/359 pp./Hardcover $79.80/ISBN 0-387-96794-X

Also available:
Ramanujan's Notebooks: Part I
Contains an account of Chapters 1-9 in the second notebook as well as a description of Ramanujan's quarterly reports.
1985/Hardcover $65.00/ISBN 0-387-96110-0

Ordering Information:
Call Toll-Free: 1-800-SPRINGER. In NJ, call (201) 348-4033.
Or send FAX: (201) 348-4505.
For mail orders, send payment plus $2.50 for postage to:
Springer-Verlag New York, Inc., Attn: S. Klamkin – Dept. S242, 175 Fifth Avenue, New York, NY 10010. We accept Visa, MasterCard and American Express charges (please include exp. date and signature), as well as personal checks and money orders.

Springer-Verlag New York Berlin Heidelberg Vienna London Paris Tokyo Hong Kong