NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY

1989 Steele Prizes page 831

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Calendar of AMS Meetings and Conferences

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

Abstracts of papers presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the *Notices* which contains the program of the meeting. 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
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	Louisville, Kentucky	October 11	December
	†	(96th Annual Meeting)			
	*	March 16–17, 1990	Manhattan, Kansas	December 12	February
		March 23–24, 1990	Fayetteville, Arkansas	December 12	February
	**	April 7–8, 1990	University Park, Pennsylvania	January 25	March
		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 903 for listing of special sessions.
** Please note a change in this date making it earlier than previously published.
† Preregistration/Housing deadline is November 17

Conferences

June/July 1990: AMS-Siam Summer Seminar on Vortex Dynamics and Vortex Methods, location to be announced.

Deadlines

	November Issue	December Issue	January Issue	February Issue
Classified Ads*	Oct 3, 1989	Oct 27, 1989	Nov 27, 1989	Jan 10, 1990
News Items	Oct 5, 1989	Nov 2, 1989	Nov 27, 1989	Jan 2, 1990
Meeting Announcements**	Sept 26, 1989	Oct 26, 1989	Nov 22, 1989	Dec 21, 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
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AMERICAN MATHEMATICAL SOCIETY

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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 the TEX typesetting system.

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Volunteer Activity

Many scientific and professional organizations are voicing concern over a changing attitude toward volunteer activity. Most evidence seems to be anecdotal. However, volunteer service in support of the scientific activity of the Society is too important to take these concerns lightly. We need to understand what changes are taking place and, if necessary, react to maintain member involvement in the scientific decision making of the Society.

There are two principal issues that seem to be new to volunteer activities at scientific and professional societies. The first issue is a difficulty in finding members willing to volunteer for service to the Society and the mathematics community. The second is that compensation is being sought to pay for administrative support and released time.

While not as big a problem at the AMS as at some other societies, these issues are of concern. What are the attitudes that have influenced these issues?

Sociological cycles parallel certain highs and lows of interest in scientific and professional organizations. However, Society membership is increasing and requests for Society involvement in various scientific and professional matters are similarly increasing. I do not perceive any decline of interest in what the Society could, or should, be doing to serve the mathematical community.

There has been a period of extreme pressure on the profession as employment opportunities for research mathematicians slowed down and tenure evaluations began to dominate the business of academic departments. Such evaluation processes often have little emphasis placed on service and almost no emphasis placed on service outside the immediate institution doing the evaluation. Proper recognition for mathematicians who contribute valuable service to the profession is a matter of great importance to the Society. At the present, it is very difficult for members to receive proper recognition and reward for taking time away from scholarly and personal activities to participate in Society activities. The Council of the Society took action during its August meeting to provide awards and citations in recognition of public and professional service. It is hoped that this action will lead to encouragement and recognition for such service. Details on these awards and citations will be reported in later *Notices*.

Universities, colleges, and corporations are also undergoing a change in policy toward volunteer activities of their employees. In the past, these institutions have provided released time, staff support, and other needs to enable the volunteer to better perform outside professional activities. These institutions now call upon the Society for compensation and reimbursement.

There is another issue that has been raised in this context. Namely, some question the amount of reliance on AMS staff, as opposed to membership support, for carrying out the work of the Society. I believe the effectiveness of our volunteer activity can be enriched through staff support. However, this support should be in parallel with service from Society members.

The importance of the volunteers who contribute their time and service for the scientific activities of the Society cannot be overestimated. We are fortunate in the AMS to have a very conscientious and supportive volunteer leadership. It will be this volunteer leadership, officers as well as committee members, that determines the success of the Society as we consider the many complex issues facing the mathematics community.

The Society needs this valuable contribution from the widest possible representation of its membership.

William H. Jaco
Executive Director

Letters to the Editor

Guidelines for Referees

The pamphlet "A manual for authors of mathematical papers" has been very helpful to the mathematical community. However I think a complementary manual for referees of mathematical papers is called for. Such a manual could accomplish at least two goals: (1) establish some general criteria for evaluating a mathematical paper; (2) give authors some idea of what a referee will expect to see in a research paper. If the society establishes a committee of respected mathematicians to prepare this manual, I think it would help to eliminate some of the capriciousness which seems to be increasing in the refereeing process. Also criteria for reviewers and editors could be included.

Gary F. Birkenmeier
The University of
Southwestern Louisiana
(Received June 12, 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.

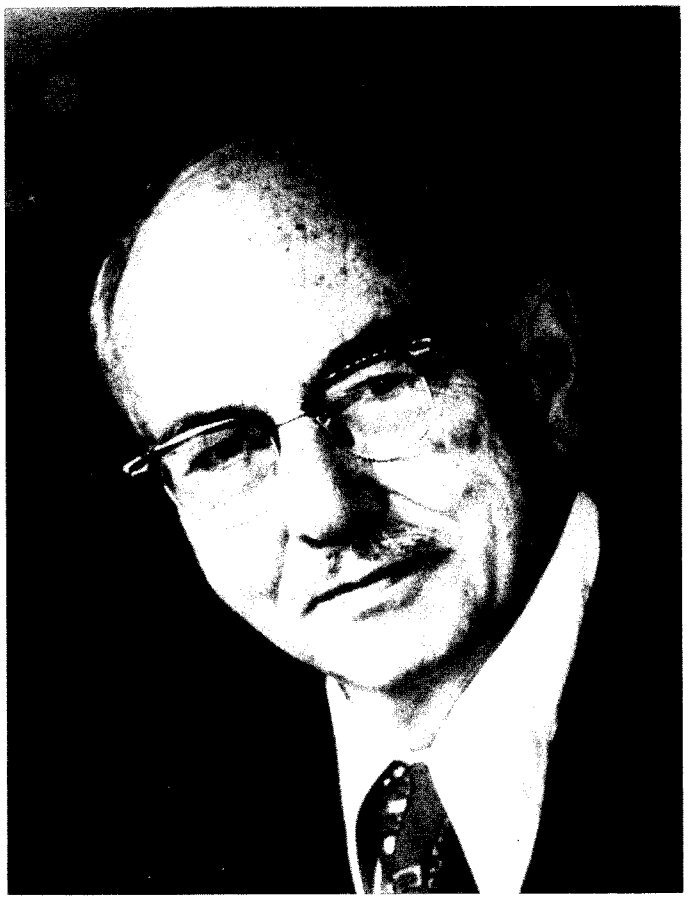
Edward James McShane
1904–1989

E. J. McShane was born in New Orleans and died 85 years later in Charlottesville, Virginia. He was a major contributor to several areas of mathematics, including the calculus of variations, integration theory, control theory, and stochastic calculus. He had a strong concern for the well-being of his fellow mathematicians and contributed to this in many ways. He was a deeply cultured man, with a flair for languages and a great variety of other interests. He was widely known for his warmth, generosity, and modesty, and for his fund of humorous and interesting anecdotes.

McShane was elected to the National Academy of Sciences in 1948. He served as President of the Mathematical Association of America in 1953 and 1954, and President of the American Mathematical Society in 1958 and 1959. Thus he was one of only four people who have, in the past fifty years, served both the AMS and the MAA as President. He later served from 1956 to 1968 as a member of the National Science Board. These periods of service, in addition to his service on numerous committees, illustrate the breadth and the depth of his concern for the mathematical community.

McShane's father was a medical doctor and his mother a former school teacher. He grew up in New Orleans, and throughout his life felt a strong attachment to that city. He graduated from Tulane University in 1925, receiving the Bachelor of Science and Bachelor of Engineering degrees simultaneously. He turned down an offer from General Electric and instead continued as a student instructor of mathematics at Tulane, receiving a Master of Science degree in 1927. He maintained an interest in the mathematics associated with engineering problems, but once remarked that he had never regretted his decision to become a mathematician rather than an engineer. He received a honorary doctorate from Tulane in 1949.

In the summer of 1927, McShane entered graduate school at the University of Chicago. During 1928-1929, it was necessary for financial reasons to interrupt his studies and teach at the University of Wichita. Nevertheless, he was able by 1930 to complete his doctoral dissertation and to receive his Ph.D. degree from Chicago under the supervision of G. A. Bliss and L. M. Graves. For the following two years he held a National Research Council Fellowship, spent at Princeton, Ohio State, Harvard and Chicago. This was a period during which the calculus of variations for multiple integrals was developing rapidly, including the problem of finding a minimal surface with given boundary (Plateau's problem). The "direct methods" explained in L. Tonelli's then new book *Fondamenta di Calcolo della Variazione* provided a key tool in these developments. McShane had earlier learned Italian in order to read opera libretti. He read Tonelli while yet a graduate student, and soon afterward reached the forefront of research on multiple integral problems.



In 1931 he married Virginia Haun, who survives him. Over the years the McShanes had an unusually warm, closely knit family life with their three children and later two sons-in-law, all trained in music as well as mathematics. (Later six grandchildren joined the group.) McShane himself was a devoted amateur cellist who found great pleasure in his family's musical activities. In his later years, he developed a strong interest in Chinese painting and calligraphy, and spent many happy hours in improving his technique.

Because of the Great Depression, openings in mathematics departments were virtually nonexistent in 1932. The McShanes spent 1932-1933 at Göttingen, during which time he translated into English the two volumes of Courant's *Differential and Integral Calculus*. They also saw at first hand some frightening aspects of the onset of Nazi power in Germany. After two years (1933-1935) on the faculty at Princeton, McShane joined the Department of Mathematics at the University of Virginia as a full professor in the fall of 1935. He remained there for the rest of his career, except for leaves of absence spent at other institutions.

In the late 1930s, McShane developed methods to provide existence theorems and necessary conditions for a very large class of single integral problems in the calculus of variations. He introduced the use of convex cones of variations, and observed that optimality of a trajectory implies the existence of a hyperplane separating a certain cone and ray from each other. This approach later provided the key to Pontryagin's principle in control theory during the 1950s, and to later developments in convex and nonsmooth analysis.

With the onset of World War II, McShane agreed to head a mathematics group at the Ballistics Research Laboratory in Aberdeen, Maryland. During this period (1942-1945) he wrote with J. L. Kelley and F. V. Reno a book on *Exterior Ballistics*, regarded as a definitive work on the subject. He was the AMS Colloquium Lecturer at the summer meeting of 1943.

McShane was deeply offended by the injustices suffered by some of his colleagues during the anti-communist hysteria that followed the war. In response to a question on the security form of the Aberdeen Proving Grounds, asking whether he had ever been involved with organizations that had at any time advocated the violent overthrow of the U.S. government, he replied affirmatively–that he was an employee of the State of Virginia. During the McCarthy era, the House Un-American Activities Committee "invited" him to express his views, but he was not subpoenaed. He did not cooperate with HUAC, but wrote a letter in which he stated his views and backed them up with quotations from various sources.

Over the years McShane achieved an extraordinarily deep understanding of integration processes as they arise in various guises. He wrote three books on integration, in addition to a number of research articles. His 1944 volume *Integration* provided a readable introduction to the Lebesgue theory at a time when few such books existed in English. He once remarked that any textbook was likely to be criticized by its readers for not supplying enough details, and by experts in its field for supplying too many details. He said that in writing the book on integration he had ignored the second possibility, since he was writing to instruct and not to impress. Many students benefited from the clarity of his exposition.

McShane's 1953 monograph on *Order Preserving Maps and Integration Processes* was an outgrowth of his search for a mathematically correct setting in which to treat divergent integrals in quantum physics. He was considerably bothered by what he considered pseudo-mathematical reasoning in the physics literature. After reading one such "pseudoproof" of a result for which a correct proof due to von Neumann was already available, McShane commented: "Anyone who can write such statements has forfeited all right to be scornful of the woman who could 'trace her ancestry to William the Conqueror with only two gaps'."

His interest in the mathematical foundations of quantum mechanics and quantum field theory continued for many years after World War II. Although his ambitious program in these areas did not reach fruition, the attempt profoundly influenced his subsequent work on integration processes and stochastic calculus. This is seen, for example, in his excellent 1963 survey article on *Integrals Designed for Special Purposes* and in his 1974 book on *Stochastic Calculus and Stochastic Models*, which is the definitive treatment of his approach to that subject.

In the 1960s and 1970s, when McShane's research interests turned toward developing a stochastic differential and integral calculus, the stochastic calculus of K. Ito was already in existence. It provided a convenient way to represent an important class of stochastic processes, called Markov diffusions, as the solutions to stochastic differential equations. For a stochastic differential equation in the sense of Ito, the random inputs are Brownian motion processes whose formal time derivatives are "white noises." However, at the time there was considerable confusion in the engineering literature about the correct interpretation if an idealized white noise is replaced either by a physical "wide band" noise or by a discrete process introduced for numerical approximation to the solution of the stochastic differential equation. This important issue was clarified by the work of McShane, Stratonovich, and Wong-Zakai.

In 1957, J. Kurzweil defined a modification of the Riemann integral that turned out to be more general than the Lebesgue integral. McShane's last book, *Unified Integration*, published in 1983, develops in a similar

vein a theory of integrals with applications to physics, differential equations, and probability.

During the 1950s and 1960s, McShane took a serious interest in efforts then under way to revitalize undergraduate mathematics in the United States. The MAA's Committee on the Undergraduate Program in Mathematics was established during his term as MAA President, and ever since then has been a leader in these endeavors. In 1964 he received the MAA's Annual Award for Distinguished Service to Mathematics.

Although AMS and MAA were the two organizations that benefited administratively from McShane's services as President, his research efforts were also of great interest to members of the Society for Industrial and Applied Mathematics. The September 1989 issue of SIAM's *Journal on Control and Optimization* is dedicated to McShane.

McShane's strong sense of fairness was exhibited in many ways. For instance, as an editorial board member he went out of his way to see that papers by young authors were refereed fairly and helpfully. He was extremely popular with the graduate students at the University of Virginia because of his clear lectures, his amusing anecdotes, and his willingness to think about their problems. During the 1940s and early 1950s, the university did not provide office space for graduate students, so McShane made his own office available as a common room where the graduate students could do their work and meet to discuss problems of common interest. His visits to the office were often accompanied by the introduction of a new mathematical problem or by his own contribution to a problem already under discussion. (One student, having made some progress on a problem but finding himself unable to solve it completely, intoned "Oh, for the brain of McShane!") Not only McShane himself, but his wife Virginia and the McShane children were extremely helpful and hospitable to the graduate students. They contributed greatly to fostering a sense of mathematical camaraderie at the University of Virginia.

A popular mathematical joke claims that mathematical talent passes from the father to the son-in-law. It is true that the McShanes' sons-in-law, H. N. Ward at the University of Virginia and R. B. Warfield at the University of Washington, are both research mathematicians. However, the McShanes' daughters, Jennifer Ward and Ginger Warfield, are also mathematicians, and Ginger is a member of the UW faculty. Some of the grandchildren have also exhibited exceptional mathematical talent.

Both mathematical research and the mathematics community have been enriched by McShane's contributions and his many years of dedicated service to our profession.

Wendell Fleming, Brown University
Victor Klee, University of Washington

1989 Steele Prizes Awarded at Summer Meeting in Boulder

Three Leroy P. Steele Prizes were awarded at the Society's ninety-second Summer Meeting in Boulder, Colorado.

The Steele Prizes are made possible by a bequest to the Society by Mr. Steele, a graduate of Harvard College, Class of 1923, in memory of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein.

Three Steele Prizes are awarded each Summer: one for expository mathematical writing, one for a research paper of fundamental and lasting importance, and one in recognition of cumulative influence extending over a career, including the education of doctoral students. The current award is $4,000 for each of these categories.

The recipients of the 1989 Steele Prizes are DANIEL GORENSTEIN for the expository award; ALBERTO CALDERÓN for research work of fundamental importance; and IRVING KAPLANSKY for the career award.

The Steele Prizes are awarded by the Council of the Society, acting through a selection committee whose members at the time of these selections were Frederick J. Almgren, Luis A. Caffarelli, Charles L. Fefferman, Jun-ichi Igusa, William S. Massey (Chairman), Frank A. Raymond, Neil J. A. Sloane, Louis Solomon, Richard P. Stanley, and Michael E. Taylor.

The text that follows contains the Committee's citations for each award, the recipients' responses to the award and a brief biographical sketch of each of the recipients. Professors Calderón and Kaplansky were unable to attend the Summer Meeting to receive the prize in person. They did, however, send written responses to the award.

Expository Writing

Daniel Gorenstein

Citation

The 1989 Steele Prize for Expository Writing is awarded to DANIEL GORENSTEIN for his book:

Finite Simple Groups, An Introduction to their Classification (1982);

and his two survey articles:

The Classification of Finite Simple Groups, and *Classifying the Finite Simple Groups*, Bulletin of the American Mathematical Society **1** (1979) pages 43-199, and **14** (1986) pages 1-98, respectively.

The classification of finite simple groups was the largest joint mathematical effort dedicated to the proof of a single theorem. The first hint that such a classification could be done was given by Brauer at the International Congress in Amsterdam in 1954. Brauer's idea was to study centralizers of involutions. Several deep theorems were proved in the late 50's and early 60's. Early in the 80's the program was finished, except for the formal writing of announced results and the checking of details.

What happened is extremely complicated. Hundreds of mathematicians got involved in the work, a vast enterprise was created, and over 10,000 journal pages appeared. During most of this period it was not at all clear where things were going or even whether success was possible. An uncharted universe full of too many unknown simple groups was an uncomfortable possibility to the classifiers. Twenty-one previously unknown sporadic groups were found in the period 1965-1980.

It would be almost impossible for our mathematical grandchildren to understand the achievements of the present generation on the classification problem without some guide through the tangle. This is what Gorenstein has given them in these three enthusiastic and well written surveys.

Gorenstein was a major figure in setting the direction of the classification program. He coordinated the activities in the program, functioning as the "coach" to a team, with optimism, perseverance, and technical power. His expository articles and books, especially the ones we list here, are beautiful accounts of this fantastic intellectual adventure. His presentation of theorems and definitions, as well as the flow of argument and the evolution of the ideas, is precise and generous and reaches out to

the reader. Again and again, he invites the reader to join in yet another episode, to share the excitement of a new idea and the frustration of coping with a deluge of difficulties. Along with the formalities, he tries to give a feeling for the way the ideas work. When appropriate, he is sketchy, yet does not talk down to the reader. These surveys are useful references for specialists and are also narratives for the general mathematical public. Considering the complexity of the subject, this is a great accomplishment.

Gorenstein proved some of the landmark results in the program. His numerous research papers are among the technically most difficult in the field. It is fortunate for mathematics that one who was able to contribute so much to the effort is also able to convey to us the excitement of the discovery and the ultimate coherence of the classification program.

Daniel Gorenstein

Biographical Sketch

Daniel Gorenstein was born on January 1, 1923, in Boston, Massachusetts. He received his Ph.D. from Harvard University in 1950.

Professor Gorenstein's first academic position was at Clark University, where he remained until 1964. He also served as visiting assistant professor at Cornell from 1958 to 1959. In 1964, he moved to Northeastern University. In 1968-1969, he was a member of the Institute for Advanced Study, and in 1969 he became a professor of mathematics at Rutgers University. He was chairman of the department there from 1975-1981, and in 1984, he was named the Jacqueline B. Lewis Professor of Mathematics. Since February, 1989, he has been Director of the new National Science Foundation Science Technology Center in Discrete Mathematics and Theoretical Computer Science, a consortium of Rutgers and Princeton Universities, AT&T Bell Laboratories, and Bell Communications Research. His main research interest is finite simple group theory.

Professor Gorenstein was a Guggenheim Fellow (1972-1973), as well as a Fulbright Research Scholar (1972-1973) and a Sherman Fairchild Distinguished Scholar at the California Institute of Technology (1978). He was elected to the National Academy of Sciences and to the American Academy of Arts and Sciences in 1987. He has been an Associate Editor of *Communications in Algebra* (1975-1983) and of *Annals of Mathematics* (1979-1984).

Professor Gorenstein presented Invited Addresses at the International Congress of Mathematicians in Nice, France (1970) and in Helsinki, Finland (1978), as well as an address at the British Mathematical Colloquium in Bangor, Wales in 1982. A member of the AMS for 45 years, Professor Gorenstein has been active in the mathematical activities of AMS-sponsored meetings. Among these are presentation of an Invited Address in New York in 1971 and organization of a special session on Classification of Finite Simple Groups in San Francisco in 1981. He also delivered the Colloquium Lectures in Anaheim in 1985.

Response

I am delighted and honored to have been awarded the Steele Prize for my writings on the classification of the finite simple groups. From the late 1950s until the early 1980s was a very exciting period in finite group theory. I had switched into the field from algebraic geometry, almost by accident in 1957, learning the basic material from Herstein while collaborating with him over the next few years. My first foray into simple group theory dated from the famous 1960-61 group theory year at the University of Chicago, during which Feit and Thompson settled the solvability of groups of odd order. It was there that I began a long collaboration with John Walter and met many of the then leaders in the field: Brauer, Suzuki, Graham Higman, and Ito. (It was only somewhat later that I met Philip Hall and Wielandt.) Alperin was spending the year in Chicago to write his thesis with Higman, while still a graduate student at Princeton.

Largely under the impetus of the odd order theorem, there was an awakening interest in finite group theory. Throughout the next decade and a half a long list of gifted young mathematicians, who were to play a prominent role in the classification proof, were attracted to the field. In the United States, Thompson had a string of outstanding graduate students: Sims, Goldschmidt, Lyons, Griess. Glauberman was a student of Bruck's at the beginning of the period and Aschbacher near the end. Ronald Solomon wrote his thesis with Feit, Seitz with Curtis, Stephen Smith (an American) with Higman at Oxford, O'Nan with me, and Shult was essentially self-taught.

But the attraction was not limited to the United States. Janko in Australia, Conway in England, and Fischer in Germany, each discovering three new sporadic groups, stimulated considerable additional interest, leading to an intensification of the search for further simple groups. Tits (entering the field somewhat earlier) had deepened our understanding of the Chevalley groups and their Steinberg-Suzuki-Ree variations, Bender in Germany was to prove the fundamental strongly embedded subgroup classification theorem, and Harada was beginning his career in Japan. At the end of the period, there were a number of others: Foote from Canada working with Thompson in Cambridge, England, Geoffrey Mason from England, coming to the United States, and writing his thesis with Fong, himself a former student of Brauer, and in Germany, Timmesfeld and Stellmacher, students of Fischer, and Stroth, a student of Huppert, but writing his thesis on a problem suggested by Held, who had himself been a student of Janko.

There were a great many other group theorists as well who made significant contributions to the classification proof. But it was Aschbacher's entry into the field in the early 1970s that irrevocably altered the simple group landscape. Quickly assuming a leadership role in a single-minded pursuit of the full classification theorem, he was to carry the entire "team" along with him over the following decade until the proof was completed.

I was fortunate indeed to have interacted in one way or another during this twenty-year period with most of the mathematicians I have mentioned.

Simultaneously with this burgeoning research effort, finite simple group theory was establishing a well-deserved reputation for inaccessibility because of the inordinate lengths of the papers pouring out. The 255 page proof of the odd order theorem, filling an entire issue of the Pacific Journal, had set the tone, but it was by far not the longest paper. Moreover, the techniques being developed, no matter how seemingly powerful for the problems at hand, appeared to have no applications outside of finite group theory. Although there was admiration within the mathematical community for the achievements, there was also a growing feeling that finite group theorists were off on the wrong track. No mathematical theorem could require the number of pages these fellows were taking! Surely they were missing some geometric interpretation of the simple groups that would lead to a substantially shorter classification proof.

The view from the inside was quite different: all the moves we were making seemed to be forced. It was not perversity on our part, but the intrinsic nature of the problem that seemed to be controlling the directions of our efforts and shaping the techniques being developed.

Thus in writing about the classification for the general mathematical audience, I had a dual motivation: on the one hand, to convey the nature of the solution as it was unfolding, both the methods involved and the striking results themselves, and, on the other, to attempt to convince the larger community that the internal inductive approach we were taking to the classification was, despite its resulting length, the only viable one for establishing the desired theorem. I hope I have achieved this second objective and I am indeed gratified that the summaries I provided of the classification proof have been held in high regard.

Fundamental Paper

Alberto Calderón

Citation

The 1989 Steele Prize for a Fundamental Paper is awarded to ALBERTO P. CALDERÓN for his paper:

Uniqueness in the Cauchy Problem for Partial Differential Equations, American Journal of Mathematics **80** (1958), pages 16-36.

Calderón's paper marks a real watershed in the theory of singular integral operators, taking it beyond its traditional role in the study of elliptic equations. The specific application is to uniqueness in the Cauchy problem, a phenomenon which remains one of the most mysterious in linear PDE. In attacking this problem, Calderón set up an approach to energy estimates which has been of fundamental importance in dozens of subsequent investigations. Its specialization to hyperbolic equations alone has been very significant. It has also provided a model for general investigations, into such matters as local solvability. Truly this paper was a major progenitor of the modern theory of microlocal analysis.

Biographical Sketch

Alberto P. Calderón was born on September 14, 1920, in Mendoza, Argentina. A student of Alberto González Domínguez and Antoni Zygmund, Professor Calderón

received his Ph.D. from the University of Chicago in 1950.

Professor Calderón began his academic career as a visiting associate professor at Ohio State University (1950-1953). He was also a member of the Institute for Advanced Study (1955) and served as associate professor at the Massachusetts Institute of Technology (1955-1959). He then moved to the University of Chicago, where he served as professor of mathematics (1959-1968); Louis Block Professor (1968-1972); and chairman of the mathematics department (1970-1972). He returned to MIT, where he was professor of mathematics (1972-1975). From 1975 to 1985, he was University Professor of Mathematics at Chicago and is currently professor emeritus. Since 1975, he has simultaneously held a position as honorary professor at the University of Buenos Aires.

Alberto Calderón

Professor Calderón received the Bôcher Prize of the AMS in 1978 for a paper on the Cauchy integral on Lipschitz curves. In 1989, he was awarded the Wolf Prize in mathematics for his groundbreaking work on singular integral operators and their application to important problems in partial differential equations. He is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, and the French Academy of Sciences.

Professor Calderón gave an Invited Address at the International Congress of Mathematicians in Moscow (1966). In addition, he presented an AMS Invited Address in University Park in 1957 and delivered the AMS Colloquium Lectures on Singular Integrals in Ithaca in 1965. He serves as associate editor of the *Journal of Functional Analysis*, the *Journal of Differential Equations*, and *Advances in Mathematics*.

Professor Calderón has been a member of the AMS for 40 years. He was a Member-at-Large of the Council (1965-1967) and has served on numerous committees. These include the *Transactions* and *Memoirs* Editorial Committee (1959-1964); the Nominating Committee (1968-1969); the *Colloquium* Editorial Committee (1971-1976); and the Publications and Communications Committee (1971-1976).

Response

The Steele Prize bestows great honor on its recipients. I am most grateful for having been deemed worthy of joining their ranks.

I would like to make a few remarks—some of them perhaps of still current interest—on the paper "Uniqueness of the Cauchy Problem ..." for which I was awarded the Prize.

In trying to obtain the result in the paper, and after several fruitless attempts, I was finally led to the realization that every linear differential operator with sufficiently smooth coefficients can be represented as a composition of a singular integral operator and a fractional power of the Laplacian. These singular integral operators, which were slightly more general than the ones considered up to that time, form a nice algebra and can be manipulated with relative ease. This permitted me to obtain the necessary energy estimates and to prove the desired result.

It was immediately realized that the representation described above had a much wider scope of applications than just to the uniqueness of the Cauchy Problem, and other applications soon followed. Also the theory was greatly refined and extended in a certain direction through the introduction of the algebra of pseudo-differential operators by Kohn and Nirenberg. Linear differential operators with infinitely differentiable coefficients are included in this algebra, but more general ones are not, as can be seen immediately by observing that differential operators with non-infinitely differentiable coefficients cannot be composed freely. To deal with such operators it is necessary to return to the representation described above. It is possible to construct a scale of algebras of singular integral operators of various

degrees of refinement well suited to the treatment of differential operators with coefficients of various degrees of smoothness. The description of these algebras will appear in print in a not too distant future.

Finally I would like to mention two problems of interest that await solution.

The first one is to decide whether it is possible to further refine the theory of singular integral operators so as to bring within its scope the results of De Giorgi and Nash on the regularity of weak solutions of elliptic equations with merely bounded measurable coefficients. It has been known for a long time that this is possible in the case of two variables.

The second problem is to study the algebra generated by singular integral operators on Lipschitzian submanifolds of Euclidean space and find out whether this algebra posesses a structure similar to that of the algebra of singular integral operators in Euclidean space. If this were the case it would permit a systematic treatment of boundary value problems for elliptic equations in domains with Lipschitzian boundaries.

Career Award

Irving Kaplansky

Citation

The 1989 Steele Prize for cumulative influence is awarded to IRVING KAPLANSKY for his lasting impact on mathematics, particularly mathematics in America.

By his energetic example, his enthusiastic exposition and his overall generosity, he has made striking changes in mathematics and has inspired generations of younger mathematicians. His early works range over number theory, statistics, combinatorics, game theory, as well as his principal interest of commutative algebra. He completed the solution of Kurosch's problem on algebraic algebras of bounded degree, where Jacobson had made a decisive reduction, and considered numerous questions in the area of Banach algebras, always with the algebraic viewpoint. In particular, he brought the algebraist's instincts to bear on the problem of abstract characterization of von Neumann algebras.

Kaplansky has always been ready to lecture on something new, and the new lectures have usually turned into monographs or papers giving us his special insights. (His students will testify to less obvious enrichments.) The monographs on infinite abelian groups and on differential algebra are examples of such texts that have attracted many students to try their hands at these fields. In the early days of Lie algebras of prime characteristic he showed what ingenuity and patience could achieve regarding the structure of these troublesome systems.

As commutative algebra took on new life with the infusion of homological methods, he turned his interest once more in this direction, always trying to see past the formalism into "what was really going on." His remarkable success in doing so is witnessed by his publications from the late fifties onward and the influence they have had on other writers. Meanwhile he was continuing his diversified lecturing schedule, branching into infinite-dimensional Lie algebras and Lie superalgebras, among other topics.

Colleagues and students from the Chicago days report that one could always rely on his availability and on a challenging idea or question as a result of each conversation. His service to the University of Chicago and to the AMS has been characterized by the same unselfish spirit. The most recent evidence is offered by his superb leadership at MSRI.

His texts, at a range of levels, are numerous, even if one does not count second or later editions, or Chicago Lecture Notes. Though numerous, they are certainly not ponderous. He is a man of few words, writing with polished economy to get the important ideas across.

Biographical Sketch

Irving Kaplansky was born on March 22, 1917 in Toronto, Ontario. He received his Ph.D. from Harvard University in 1941. His main area of research interest is algebra but there was a substantial component in functional analysis (especially C*-algebras) during the 1950's. Work on Lie superalgebras that began in 1975 was inspired by mathematical physics.

Professor Kaplansky began his academic career as a Benjamin Peirce Instructor at Harvard University (1941-1944). He was a research mathematician in the Applied Mathematics Group of the National Defense Research Council at Columbia University (1944-1945). At the University of Chicago, he progressed from instructor to professor (1945-1969) and served as chairman of the mathematics department (1962-1967). From 1969 to 1984, he was the George Herbert Mead Distinguished Service Professor at Chicago. Since 1984, he has been the director of the Mathematical Sciences Research Institute in Berkeley.

Professor Kaplansky served as President of the AMS during 1985-1986. A member of the AMS for 48 years, he was also elected Member-at-large of the Council (1951-1953) and Vice President (1975). He has also served on numerous committees, including the *Bulletin* Editorial Committee (1945-1947; 1979-1985); the *Transactions* Editorial Committee (1947-1952); the Committee on Translations from Russian and other Slavic Languages (1949-1958); the *Proceedings* Editorial Committee (1957-1959); and the Nominating Committee (1977-1978). He

presented AMS Invited Addresses at Ann Arbor in 1948 and at Stanford in 1955.

A member of the National Academy of Sciences, Professor Kaplansky also served on the executive committee for the mathematics division of the National Research Council from 1959 to 1962. In 1989 he was elected to a four year term on the Council of the American Academy of Arts and Sciences.

He was on the Toronto team that won the first William Lowell Putnam competition and received the first Putnam scholarship at Harvard. In 1948-1949 he held a Guggenheim fellowship. He received two honorary degrees: Doctor of Mathematics (University of Waterloo, 1968) and Doctor of Science (Queen's University, 1968).

Irving Kaplansky

Response

The citation is flattering and I am very grateful. Indeed, it is too flattering.

If, during the nineteenth century, there had been a world wide Steele Prize for cumulative influence, most of the giants who come to mind would undoubtedly have been honored. Probably some others would have been honored who are only dimly remembered today. Time has a way of sorting these things out.

The citation kindly refers to my interest in a variety of subjects over the years. I hope I have helped to set a good example in that respect. There have, after all, been so many instances where the key idea needed to crack a problem in a certain field came from a totally different field. To give just one example: it is fortunate that the mathematicians working on Lie algebras of characteristic p and those working in Lie superalgebras were aware of Cartan's infinite pseudo-groups. I am going to take this opportunity to put in print some advice that I regularly give to students: spend some time every day learning something new that is disjoint from the problem on which you are currently working (remember that the disjointness may be temporary), and read the masters.

Another thing I wish to do is express my indebtedness to others. In the well worn phrase, mathematics is where it is today because we have all been standing on the shoulders of giants. I look back on the inspiration I derived from Richard Brauer at Toronto, from Saunders Mac Lane at Harvard, from colleagues and students at the University of Chicago, and during my visits to the Institute for Advanced Study.

The concluding reference in the citation to my directorship of MSRI is also much appreciated. Not counting conferences, more than a thousand mathematicians have been welcomed to MSRI in its first seven years. I hope that most of them enjoyed it and got a nontrivial shot of mathematical adrenalin. I am going to keep trying to make this happen.

Computers and Mathematics

Edited by Jon Barwise

Editorial notes

Can computers save our libraries?

The computer was once predicted to be the death of printing, and so of the library as we have come to know and love it. Information was going to be stored only electronically. Ironically, just the reverse has happened. The computer has made typesetting so much easier that papers and books are coming faster than ever. And with this explosion has come an explosion in the numbers of scientific journals, many of them at outrageous prices, especially the ones published by some of the private publishers, unaffiliated with any professional organization. Their strategy is basically to make enough off of library subscriptions to pay for the journal. But as a result, subscription prices are playing havoc with library budgets. Libraries can simply no longer afford to keep up with all the journals. What, if anything, can be done about it?

Every week or so I get a message from some reader of this column suggesting ways in which the information revolution brought about by the computer might help solve this problem. Suggestions have included replacing hardcopy journals with electronic journals or electronic bulletin boards, cheaper ways of publishing made possible by mathematical typesetting programs like TEX, and abstract services provided in email newsgroups.

I have tried, without success, to get someone to write a piece on this problem, one that would survey various possibilities, weighing the merits and costs of each. I also recently experimented with one suggestion by simply posting (on the newsgroups sci.logic and sci.philosophy.tech) a terse announcement of a draft of the article on program verification which appears later in this month's column. I restricted my announcement to the USA, for no particular reason. I was astonished to get over 300 requests for the article during the next week, requests which I was able to fill by simply sending the LATEX file by email. I quickly got many useful comments on the paper which I was able to take into account in the final version. I am anxious to repeat this experiment with a more technical paper, once I finish the one I am currently working on, to see if the response is similar.

This particular way of distributing information does not directly address the problems with our libraries. But it does indicate that the computer can provide alternative ways to "publish" technical work whereby results can be disseminated quickly and widely to interested parties without much cost or bother to anyone else.

The AMS is looking into various ways to use the computer to speed and ease the flow of information within the mathematical community. But, in the meantime, I suggest that readers of this column send me short suggestions, intended for publication. If I get enough of them, I will devote an issue of this column to them.

Send them to:

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This month's column

This month's column contains two reviews, one of DERIVE and the other of Calculus Calculator. I have also written a piece reporting on a current controversy about the use of mathematics in showing that computer systems are correct. In it, I summarize the controversy and try to assimilate it to the old question: how is applied mathematics possible?

Reviews of Mathematical Software

The Menu with the College Education

*Reviewed by Eric L. Grinberg**

In this article we will review **Derive**, *the mathematical assistant*, a menu driven symbolic manipulation program. **Derive** is the successor of muMATH, a very popular program introduced first for CP/M machines and the Apple II and later for the MS-DOS environment. The program runs on most IBM-PC compatible machines with the MS-DOS operating system version 2.1 or higher. It requires a minimum of 512 kilobytes of computer memory and one floppy disk drive. It supports a wide variety of display monitors. A special version is available for the NEC PC-9801. **Derive** is available for $200 from dealers and also from its source, Soft Warehouse Inc., 3615 Harding Avenue, Suite 505, Honolulu, Hawaii 96816 (Phone: (808)-734-5801); there are volume discounts for educational institutions. Unfortunately, muMATH is no longer available.

As a longtime muMATH enthusiast I was eager to find out how **Derive** was different. Thus I shall begin by discussing muMATH first. The program muMATH was released by the Soft Warehouse in 1979. It broke new ground: within the confines of a mere Apple II or CP/M machine it offered mathematical symbol manipulation, a capability until then reserved for far larger computer systems. Later muMATH was ported over to the IBM PC family of machines. The MS-DOS version of the program was clearly a direct translation of the Apple and CP/M versions. While retaining the very high level of ingenuity that made muMATH on these modest micros possible, the MS-DOS version did not take full advantage of the added power of the PC. Indeed, it was fairly typical of the first generation of PC software: it was very useful, offering capabilities never before available to a home user. It had a fairly primitive user interface including cryptic error control. It did not make full use of the machine resources. And it had (typewritten) documentation which was useful but which left some things to be desired. Soon a new generation of software appeared (about the time that Borland's *Sidekick* became available). This generation offered a far better user interface, including pop-up menus, context sensitive help, multiple (but nested) DOS shells, easy access to all memory and peripheral resources (especially graphics), extensive typeset documentation, and more (see for example Borland's numerical analysis package *Eureka*).

Derive represents a *partial* move of muMATH in the direction of this second generation of software. Below I shall first summarize some features of muMATH and then contrast them with **Derive**.

Although not as extensive in breadth as packages such as MACSYMA, muMATH did feature the differential and integral calculus, series, some transcendental functions, differential equations, vector analysis, and more. Sometimes it would get "stuck" doing a problem, but this could be circumvented. Its "expert knowledge" was open for the user to view. The algorithms and rules that muMATH used were included in the program disks in the form of a series of ASCII files which could be read using a text editor. The algorithms were written in muSIMP, a miniature LISP-like environment. The files were commented and included turnkey demonstrations of the new capabilities introduced by each routine. If muMATH got stuck on a problem (or if you just wanted to see how muMATH did a problem, say an integral from a calculus homework assignment) you could use the built-in debugger and single-step through the algorithm. If muMATH made a wrong decision at some step, you could add a rule which would direct muMATH to the right continuation.

Moreover, muMATH came with two sets of interactive lessons. The first set introduced the basic calculator-like features, e.g., entering a function symbolically and then differentiating it (to differentiate $tan^{-1}(1+x^2)$ type `DIF(ATAN(1+x^2),x);` . The second set of lessons, also interactive, exposed the programming features with which muMATH was written. These lessons enabled the user to write his own algorithms and enhancements to muMATH and, perhaps more importantly, taught some fundamental concepts of artificial intelligence. In some sense, this is what made muMATH so valuable: here was a complete miniature expert system with its inner workings explained. Without any outside background one could learn about, use, and modify an artificial intelligence

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environment, one of primary interest to mathematicians.

Of course, muMATH was (and, except for availability, still is) a valuable educational tool. Calculus students can use the program to check their work and even trace the solution to a problem step by step to see how it is done. Indeed, some schools now use muMATH in their calculus sequences. Also, muMATH is powerful enough to be useful in research endeavors. Many operations of higher mathematics can be represented as compositions of basic calculus and basic algebra operations. These expressions, while cumbersome and difficult to manipulate in the hands of humans, are often readily computable in muMATH. In particular, muMATH is especially good for generation of examples. The reviewer has used muMATH to compute intertwining numbers for integral operators on homogeneous spaces.

Still, these aspects of muMATH can be found elsewhere: by now there are many calculus books that offer accompanying tutorial floppy disks. Such tutorial programs provide many of the functions that muMATH has. Also, there are several mathematical symbolic manipulation programs available: MACSYMA, MATHEMATICA, MAPLE, and others. One can even get pocket calculators to perform some of these functions (see: *The chip with the college education* [2]). The larger of these programs "know" many more concepts of higher mathematics (e.g. curvature) and do not need to be taught so much. muMATH can be taught about curvature, but this entails some work on the part of the user, and it may require some other basic concepts that also have to be introduced. muMATH's role as a direct aid to elementary teaching and research computations does not make it stand above the rest. But the package, if reintroduced, *would* hold a unique position.

muMATH was fairly inexpensive, was available for small systems, and had an open architecture: the user could look inside its engine, see how it operates, and modify it if need be. The other programs mentioned are often black boxes. They cannot be viewed internally. Many require substantial memory and disk storage resources to run. Some are restricted to run only on top-of-the-line CPU chips such as the Intel 80386. muMATH runs nicely on inexpensive 8-bit machines using the Intel 8088. One could use muMATH and a low-cost laptop computer such as the Toshiba 1000 to perform complex symbolic calculations on the go.

Given that the Soft Warehouse did such a fine job implementing mathematical symbol manipulation on a small system it was hoped by many that they would follow up with the (far easier) task of adding a more versatile user interface that many of what I called second generation PC programs have. In the mid 1980s there were rumors about a "Son of muMATH". **Derive** is the long-awaited product. As will be detailed below, **Derive** fulfills some of these expectations. But we shall have to wait for future releases to fulfill the entire wish list.

Derive is entirely menu driven. The initial stage of the program loads a screen with menu options on the bottom. These include entry of new symbolic expressions, *build*ing new expressions out of old ones, performing calculus operations on expressions, factoring and expanding, solving equations, plotting (in two or three dimensions), simplifying, saving, loading and deleting expressions and files, managing windows, and setting various system parameters such as precision. Context sensitive help is also available. Many of the menu options lead to submenus. The area on the screen above the menu is used for displaying expressions, graphs, and other windows. I will now discuss the menu choices in detail.

Basic expressions are entered using the `author` command. This is essentially a line-oriented editor using mathematical notation similar to that of FORTRAN or BASIC. There are special mathematical characters available such as π which are invoked through the `alt` key. These basic expressions can be combined and mixed with basic operators and functions using the `highlight` and `build` commands. Overall, editing and moving around the menu screen tends to be a bit cumbersome and unintuitive. I find that I sometimes reach for the cursor arrows when I should be using the space bar or `tab` key. Still, **Derive** tries to be so flexible and gives so many simultaneous options that some compromise of the user interface might be necessary. Mouse support would certainly help, but many PC users do not have a mouse. A user who arranges his own hot keys using resident programs such as *Prokey* or *Superkey* and builds expressions using a resident editor such as *Sidekick* will probably increase his throughput. In any case, the shortcomings of the edit and motion functions are minor and do not seriously reduce the usefulness of the program.

Arithmetic is performed in user selectable precision. The available modes include `Exact`, `Approximate`, and `Mixed` . In `Exact` mode *rational* arithmetic is performed exactly (as long as there is sufficient memory available) and irrationals are stored symbolically; simplification of irrational expressions (especially those involving radicals) can be attempted but is not guaranteed to succeed. In `Mixed` mode rationals are still treated exactly but irrationals are replaced by rational

approximations. Finally, Approximate mode replaces irrationals by rational approximations and rounds fractions involving large integers to simpler fractions. These choices provide a good balance between economy of time, economy of memory, and protection from roundoff errors. The choices of notation are commensurate with (but independent of) the choices of precision. One thing that is missing is floating point coprocessor support (e.g. for the 80x87 family of chips). This could significantly speed up calculations in the Approximate and Mixed modes, and even in the Exact mode if cleverly implemented. On the other hand, **Derive** performs arithmetic quite well as it is.

Algebraic expressions may be entered using both the Latin alphabet and a limited number of Greek letters (those available in the extended ASCII character set supported by the PC environment). The user can attempt to simplify complex expressions using the multifarious command Simplify . This expression means different things in different contexts. Sometimes it means algebraic simplification and sometimes it could be called Go and do what I already told you to do! . For example, if you Simplify (x+1)(x-1)-(x+2)(x-2) you get 3. But if you Simplify DIF(f(x)), where f(x) is a predefined expression, then you get the derivative of f(x), presumably what you intended when you Authored DIF(f(x)) but forgot to select automatic simplification. To be fair, Simplify usually does its job well. For example, it quickly recognizes that ((2^0.5)^(2^0.5))^(2^0.5) is equal to 2, an identity that fooled an implementation of REDUCE which I once used on a mainframe.

Rational expressions in one or more variables can be expanded with user-selectable ordering of the variables. Fractional exponents can be handled using the Branch command. A particularly nice feature is the Factor command . Expressions may be factored relative to one or more variables. The factorization may be done at several different levels. The most basic (and fastest) level adds fractions (putting them under a common denominator) and factors out constants and least powers of variables. The next level, Square-free factoring extracts powers of sums (or products) of *different powers of sums*, but you have to select Rational factoring to handle $x^2 - 4$. Factorization over some algebraic field extensions of the rationals in the reals is available in *Radical factoring.* Finally, one can attempt Complex factoring, the highest level. I've used REDUCE on a mainframe to do symbolic factorization in the past. I remember cryptic error messages, memory overflow, and above all, large charges to my account balance. In contrast, **Derive**'s Factor is a pleasure to use, and I don't need to worry about how much the computation will cost. This is a nice reminder of how far we have come in single user software and hardware. It would have been nice to include a discussion of the algorithms used here (and in the rest of **Derive** for that matter). A modest extension of these would probably allow a mini number theory environment illustrating the concepts of field extensions.

Derive can handle variables with restricted domains (these may allow more simplification than a general domain would). It also accepts infinite values for variables. But the choices are limited. For instance, x can be declared Non-negative , but the condition $Re(z) \geq 1/2$ can only be specified indirectly.

The user can define constants and functions with multi-character names using both English and (some) Greek letters. Expressions may be turned into equations by simply inserting an = sign judiciously. Alternatively, an expression F can be treated as the equation $F = 0$ or $y = F$, where y is a user-selectable variable. **Derive** can be asked to solve a single (nonlinear) equation for a single variable, but it cannot handle simultaneous nonlinear equations. For simultaneous *linear* equations one can get around this by viewing a system as just one equation involving a vector variable and matrix notation; a new version of **Derive** allows vectors of equations as an alternative treatment of linear equations. The equation solver works rather nicely when there is a solution. For example, to solve $e^x = 5x$ to 20 digits of precision takes about two minutes on an Epson laptop (slightly slower than an IBM-AT); if *a priori* bounds are known the solution time can be reduced by restricting to a compact interval. Programs such as Borland's *Eureka* can do this much faster (with or without a numerical coprocessor), but not to arbitrary precision, and without the full availability of symbolic definitions. On the other hand, **Derive** can spend forever looking for a root and it is up to the user to decide when too much time has elapsed. This is one place where more information about the nature of the general algorithm, the state of the current calculation, and possible modifications would help. An expansion of the Solve command would be of great help in a numerical analysis class. The combined use of numerical and symbolic techniques (e.g. Newton's method combined with symbolic differentiation) has not been stressed sufficiently. **Derive** has the potential of providing a good environment for this.

A nice plus that **Derive** enjoys over muMATH is its plotting capability. It can handle most popular graphics displays in both text and graphics modes and a variety of colors (or alternatively in monochrome

mode). There are two types of plotting windows: two-dimensional and three-dimensional. If the user simply selects the `Plot` option, **Derive** decides which type of plot is appropriate by counting the number of variables in the expression to be plotted. Thus one cannot directly view the surface in $\mathbf{R}^3$ defined by $y = x^2$ (z arbitrary). Rather, one has to "fool" the program into using the 3D plot window by introducing a redundant z dependence (say $y = x^2 + z - z$). Another way to accomplish this uses the windowing capability (see below). Besides plotting curves and surfaces which are graphs **Derive** also boasts parametric and polar plots. It would also be nice to plot surfaces which are not graphs by simply specifying points on them (say, from a matrix). Virtual windows can be designated as `algebra`, `2D plot`, or `3D plot`. These can be split, stacked, and overlaid. In this way, several algebraic derivations and plots can be viewed simultaneously. The higher the screen resolution is, the more useful this feature is. Color also helps with viewing several drawings at once. The user is given a great deal of choice over the execution of the plot with well chosen defaults. Hidden line removal is available. During my first few tries at plotting I sometimes found the program unresponsive and preoccupied with operations that seem to have nothing to do with my plot. But after sufficiently many references to the manual (and the help screens, when I could get the plot command to stop so I could ask for help) I felt more in control of the plotting process. It would be helpful to have an optional pop-up window to the internal parameters of a plot process; this would relieve the feeling of frustration during those moments when the computer seems to "lock up". Still, the `Plot` command is useful, flexible, and easy to use in most instances (especially those that students are likely to encounter).

There are many transcendental functions available for use, including those likely to come up in a calculus course. There are also financial and statistical functions. On the other hand, many special functions are missing (one example: Bessel functions). Of course, one could add these functions to the system by defining them in some way (power series, differential equations, etc.) But the newly defined functions will probably be "weaker" than the ones already included: it will take more time and memory to manipulate them just as it does in programming languages such as FORTRAN or BASIC. In contrast, languages such as FORTH allow the introduction of new functions that can be handled just as efficiently as the standard ones. Also, having more standard concepts already available in a package can make the package more useful. Thus, while one *could* add Bessel functions and much more to **Derive** on one's own, it might be better to directly *use* Bessel functions in an application with the assistance of **Derive**. Of course, adding more concepts would make **Derive** more memory intensive, and perhaps more expensive. It might also restrict it to larger machines (as has been the case with programs such as MACSYMA). A set of user selectable add-in modules would perhaps give the best compromise between extensive knowledge and modest machine and price requirements.

The `Calculus` commands handle most operations that a calculus student is likely to encounter. Besides standard integration and differentiation, these include *some* improper integrals, Cauchy principal values, and numerical integration. **Derive** has *some* knowledge of special integrals, but the user may be disappointed with his favorite tricky integral. Thus **Derive** can quickly evaluate $\int_{-\infty}^{+\infty} e^{-x^2}\,dx$ but not $\int_0^{\infty} \frac{dx}{1+x^n}$. It *does* succeed in evaluating $\int_0^{\infty} \frac{dx}{1+x^4}$ in a matter of seconds, but gives up on $\int_0^{\infty} \frac{dx}{1+x^5}$. Probably, it does not use complex contour integration techniques to evaluate definite integrals (a lot to ask for in a small system). But it should be possible to add such a package without too much effort.

The differentiation operation `DIF` cannot be combined with the `solve` feature to treat differential equations. Vector calculus-a standard feature of muMATH-was also missing from the review version of **Derive** but was added recently. Clearly, the former feature could be added without much effort.

Finite and infinite sums and products can be attempted. **Derive** uses the techniques of anti-differences and anti-quotients to solve these problems. Again, the user's favorite example may generate disappointment. Thus $\sum_0^{\infty} 2^{-n}$ can be evaluated while $\sum_{n=0}^{\infty} n^{-2}$ cannot be.

Finally, **Derive** offers a small vector and matrix manipulation package. This feature is most interesting when combined with the symbolic scalar operations (e.g. taking determinants of matrices of functions). The purely linear-algebraic features are quite limited and do not rival those of other packages such as MATLAB. For instance, one can take both positive and negative powers of a square matrix (and hence invert a nonsingular matrix), and one can evaluate the characteristic polynomial of a square matrix. But one cannot directly exponentiate such a matrix.

Derive comes with a set of files whose name ends in .MTH . These files are essentially turnkey demonstrations (with very limited error control) of

the basic features of the program. They make it easier for the user to get started and do something interesting soon after receiving the program. The user is offered options for saving various states of **Derive** for later restart and analysis. One option allows the storage of expressions in FORTRAN notation. This could later be used to code numerical routines in FORTRAN (or similar high level languages) based on results from **Derive**.

In summary, **Derive** provides a very useful and competent mathematical assistant, albeit an underemployed one. It incorporates some long awaited features to muMATH while taking away some old ones. It is natural to hope (expect ?) that the creators of **Derive** are hard at work on providing a full extension of muMATH. Combining the best of **Derive** and muMATH would give an environment useful both for students and researchers at a low cost. As it stands, **Derive** is a very smart symbolic calculator which is very useful for students and in some cases for researchers as well. I am happy to report that the staff at the Soft Warehouse has been very helpful and responsive to technical questions and bug reports. They are constantly adding new features. Who knows, they may even accept suggestions for future enhancements!

References

1. Herbert S. Wilf, *The disk with the college education*, American Math. Monthly (1982), 4–8.
2. Yves Nievergelt, *The chip with the college education*, American Math. Monthly (1987), 895–902.

Calculus Calculator (CC)

*Reviewed by Herbert L. Holden**

CC is a mathematical work sheet for an IBM PC with graphics capability. Memory requirements are 384k with CGA or Hercules graphics and 512k with EGA or VGA graphics. A special version is required for the AT&T 6300.

CC essentially emulates a calculator with the following added advantages.

1. Data is entered with a keyboard. I prefer this to the keys on a calculator which are often so small they can only be operated with the aid of dental tools.

2. All user input (such as the assignment of an arithmetic expression to a variable or a function definition) appears on the screen in a "user input window" as a log of user activity. A printed log can also be maintained.

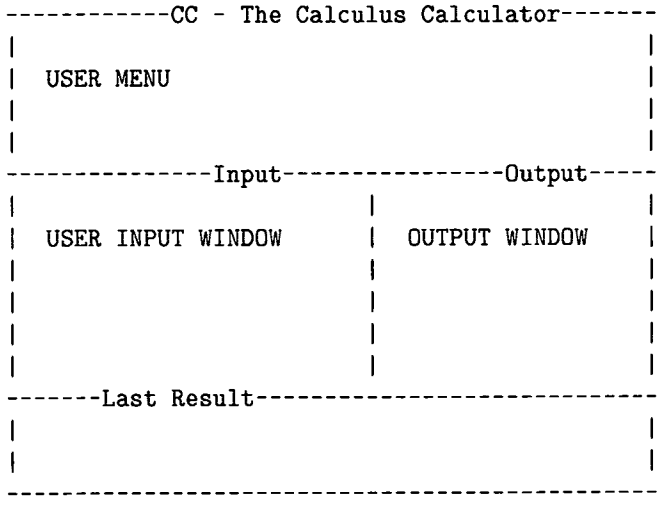
3. Information in the user input window can be edited on screen via cursor positioning. This makes it easy to modify and reimplement any previous input.

4. The current value of as many as 15 user defined variables can be displayed at one time.

5. Graphics have a resolution of 640 × 200 pixels.

6. Error messages are provided for syntax errors and a small help facility is available.

The basic format for the screen is:



The user may define as many as 100 variables and 100 functions. The names of user defined variables and functions are alphanumeric. They must begin with an alphabetic character, consist of at most 8 characters, and may not be a CC reserved word. For example, A, B, C are ok but I and D are not since they denote integrals and derivatives. The names of variables are not case sensitive.

Arithmetic expressions which are not assigned to a user variable are assigned to the variable ANS.

The user may define functions of one or two variables and the usual functions intrinsic to most programming languages are available.

The processing of a line of user input occurs when the cursor is on that line and the ENTER key is pressed.

The results of a sequence of user input are shown below.

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```
----------Input----------Output---------
|                      |                |
| 2+2                  | ANS  4.000000000 |
| A=3.2 //this is a comment | A    3.200000000 |
| B=a*ans              | B   12.800000000 |
| f(t)=1+t+t^2         | C    4.000000000 |
| C=f(2)-3             | E   25.000000000 |
| g(x,y)=x^2+y^2+sin(x*pi) |                |
| E=g(3,4)             |                |
|                      |                |
-------------------------------------------
```

To redefine C as $f(5) - 3$ simply move the cursor to the 2 in $C = f(2) - 3$, change the 2 to a 5 and press ENTER. The value of C will be updated in the output window.

Arithmetic expressions which result in undefined values return the value UNDEFINED rather than terminating the program.

It takes less than ten minutes to show someone familiar with the use of a PC the applications described so far. Students in many lower division mathematics courses (other than calculus) could take advantage of even these modest capabilities with reasonable confidence.

The contents of the input window and the status of all functions and variables may be saved to a disk file. This file may be retrieved at a later session appending the saved input window to the current input window and adding (or updating) variables and functions.

The expression $I(f, a, b)$ integrates the function f from a to b and the expression $D(f, a)$ evaluates the derivative of f at a. Sample user input might be: area $= I(f, 1.0, 2.5)$ or $m = D(f, 0.2)$.

A function may be defined as a derivative or an integral via constructs such as $h(x) = I(f, 0.0, x)$ or $df(x) = D(f, x)$.

In the current release (version 2.0) the differentiation is performed numerically instead of symbolically and the integration strives for full single precision accuracy which makes these operations very slow. These problems are to be corrected in version 3.0 which may be available this fall.

Plotting commands clear the screen and provide a separate graphics page. Each graphing command adds a graph to the graphics page and the command ERASE clears the graphics page. Graphics are available for user defined functions via the following constructs.

```
window(xmin,xmax,ymin,ymax)
            - Scales the plot region
graph(f)    - Point plot of the function f
              (600-800 x values)
lineg(f)    - Line graph of the function f
              (600-800 x values)
quickg(f)   - lineg(f) for every 20th x value
polarg(f,a,b,n)
            - Line graph of r=f(t) t=a to
              t=b with n points
paramg(f,g,a,b,n)
            - Line graph of (f(t),g(t)) t=a to
              t=b with n points
diffg(f,a)  - Line graph of f
              and the tangent line at a.
integ(f,a,b) - Line graph of f with shaded
               region from a to b
```

If a function is defined as an integral the graph may take longer than 30 minutes to complete because of the way integration is implemented. A predictor-corrector algorithm would be preferable in speed and would probably provide the accuracy needed for graphics.

The full width of the screen is used for graphics, which seems unnecessary in view of the fact that it is easy to rescale the window.

Other noteworthy functions are:

```
table(f,a,b,n)
  - Tabulates n values of f from a to b
solve(f,c)
  - Solve f(x)=0 near c using Brent's algorithm
```

A sequence of statements in the input window can be labelled as a block and executed as a block but no other programming is possible.

The software, manual, and related files come on one floppy disk. When the manual is printed it occupies about 60 pages. The manual is reasonably well-written and contains numerous examples and applications. It could benefit from an index and a list of reserved words.

Well, it certainly is a treat to use a software package that doesn't try to do everything. What this means to me is that I can learn to use the software in less than one hour and be proficient in less than five hours. There are so many applications on the market today that are so comprehensive that it takes a major commitment in time (100 hours) to become a proficient user.

CC is certainly not as comprehensive as packages like Point Five or Math CAD and lacks a video arcade

environment, but it is an effective and well-designed piece of software. Even a version of CC without graphics would be a desirable package.

CC is copyrighted by David Meredith and distributed by

Mathematics Application Group
Department of Mathematics
San Francisco State University
1600 Holloway Avenue
San Francisco, CA 94132

CC is shareware and the authors of the program suggest a $25 donation to the Applied Mathematics Fund at SFSU. Further information can be obtained by calling (415)338-2199.

Mathematical Proofs of Computer System Correctness

*Jon Barwise**

In the early years of the century, there was an exciting, if acrimonious, debate about the nature of mathematics and its relationship to the rest of the world. The debate took place in articles, published correspondence, and private letters. While it sometimes seemed to generate less light than heat, still, when the smoke cleared, the situation was brighter. The debate led to the careful formulation of various positions, e.g., formalism, Platonism, logicism, and intuitionism, which capture particular aspects of mathematical activity. Few modern mathematicians are terribly happy with any of these positions, but they do seem to have kept the wolf from the door, in that they allowed us to get on with mathematics.

Today a similar controversy about the nature of mathematics and its relation to the rest of the world is raging out of the sight of most mathematicians in the pages of *CACM*, the *Communications of the Association for Computing Machinery*. The debate is almost as exciting and at least as acrimonious. The purpose of this article is to draw the reader's attention to the controversy, and then contribute my two cents worth.

*I would like to acknowledge many conversations with John Etchemendy and Brian Smith over the years on the topic of modeling in mathematics and in computer science. I also need to acknowledge the role that Alan Bush has played in my thinking on the matters discussed in this essay. Talking to him, and watching him at work convinced me that there is something very important about program verification. I would also like to thank various readers of an earlier draft of this article for comments and suggestions.

Background of the Controversy

The present debate swirls around an article called "Program Verification: The Very Idea," [6] written by the philosopher James Fetzer. In this article, the author attacked a certain conception of program verification, and claimed to show that the proclaimed aims of program verification are, in principle, quite simply impossible.

Program verification, theory and practice, is a big business. Millions of dollars are spent on it annually. So rather predictably, there was a large, outraged response. Some of the letters accused Fetzer of misrepresentation, or of knowing nothing at all about program verification. Others accused the editor of publishing an "ill-informed, irresponsible, and dangerous article". On the other hand, some writers found merit in Fetzer's position. One even said that it did not go nearly far enough.* But to understand this debate, and what it has to do with mathematics, we need to back up a few years.

I assume that the reader has an intuitive grasp of notions like algorithm, program, (computing) machine, and implementation. In the way we are using these terms an algorithm $\mathcal{A}$ is an abstract computational process. A program P is a linguistic object that plays a causal role in a computation. In writing a program, one typically tries to implement some (implicit or explicit) algorithm. That is, one wants the program P, when run on a machine M, to carry out the algorithm $\mathcal{A}$. A proof of program correctness would prove that this is the case. (I reserve "computer system correctness" for a stronger notion, which I define towards the end of the article.) Program verification is the business of providing proofs of program correctness.

C. A. R. Hoare is one of the founders of the field of program verification. To see what is at issue, here is a famous quote from Hoare.

> Computer programming is an exact science, in that all the properties of a program and all the consequences of executing it can, in principle, be found out from the text of the program itself by means of purely deductive reasoning. [8]

* These letters can be found in the same issue of *CACM* as [2], [4] and [7].

Since the late 1960s, a great deal of effort has gone into developing program verification techniques.* In spite of two decades of work in the field, Fetzer claims that the premise on which it is based is false.

There was an earlier attack on program verification. In 1979, DeMillo, Lipton and Perlis [3] published a highly critical article. Their contention was that there was a crucial *social* difference between mathematical proofs and proofs of program correctness. In mathematics, proofs are subjected to public scrutiny. There is a social process at work which ends up accepting or rejecting a purported proof. No such process is at work in program verification, they claim. Program verifiers do not publish their purported proofs of correctness and subject them to the test of their peers. They can't. There are just too many programs, the programs are too long, the proofs of correctness too long and boring, and there are too few people interested in reading any such purported proofs. So, they argue, an all important social aspect of mathematical proofs is unavailable in the realm of program verification. The crucial social mechanism for winnowing proofs from faulty purported proofs is unavailable, so the aims of program verification are unsatisfiable.

The DeMillo, Lipton and Perlis article sparked quite a controversy in its own day, as can be imagined, but nothing like the controversy ignited by Fetzer's more recent article. In his article Fetzer did two things. First, he argued that DeMillo, Lipton, and Perlis were mistaken about the nature of proofs, that they conflated genuine formal proofs and "proof sketches". Genuine proofs have certain properties that proof sketches do not have. And with regard to the way mathematics is practiced, he would interpret DeMillo, Lipton and Perlis as saying that most "proofs" published in mathematics papers are simply proof sketches. The social process comes in, Fetzer claimed, in determining which proof sketches are indeed sketches of formal proofs. (We will return to this part of Fetzer's claim later.)

Fetzer's Argument

Fetzer's second aim, and the one which has drawn a firestorm of response, is to show that while DeMillo, Lipton and Perlis were wrong in their reasons, they were correct in their conclusion that program verification is impossible.

Fetzer's argument was summarized in a critical letter (one of the thoughtful reactions) by Bevier, Smith, and Young, roughly as follows:

1. The purpose of program verification is to provide a mathematical method for guaranteeing the performance of a program.

2. This is possible for algorithms, which cannot be executed by a machine, but not possible for programs, which can be executed by a machine.

3. There is little to be gained and much to be lost through fruitless efforts to guarantee the reliability of programs when no guarantees are to be had.

In responding, Fetzer calls their summary of his position perfectly reasonable, "so long as the first premise is intended as a reflection of the position that is – implicitly or explicitly – endorsed by the proponents of program verification."

All three points bear consideration, but we will start with the second. Can one conceivably give a mathematical proof that a given program P, when run on a machine M, will behave properly by being an embodiment of the algorithm $\mathcal{A}$? Or is it, in principle, impossible, as Fetzer claims?

Fetzer's argument for (2) (as he briefly summarized it in [7]) is that computers are

> complex causal systems whose behavior, in principle, can only be known with the uncertainty that attends empirical knowledge as opposed to the certainty that attends specific kinds of mathematical demonstrations. For when the domain of entities that is thereby described consists of purely abstract entities, conclusive absolute verifications are possible; but when the domain of entities that is thereby described consists of non-abstract physical entities ... only inconclusive relative verifications are possible.

Reaction to Fetzer's Argument

Many of the charges leveled against Fetzer's article are typical of encounters between practitioners of any field X and philosophers of X. The philosopher necessarily attempts to give an analysis of X as it presents itself to the informed outsider. The practitioner feels that the philosopher misses a (or the) main point of X. Out of frustration, he is all too often tempted to claim that one simply cannot understand X without doing

* This article will not assume any familiarity with such techniques. However, the reader interested in a simple introduction to them might consult Chapter 4 of [1] or Chapter 5 of [12]. For a more complete look at some of the theoretical issues behind program verification, see [5].

X. As mathematicians (let X be mathematics), we can all surely recognize the temptation. But such reactions do not really tell against the message carried by the philosopher; they simply try to cast doubt or ridicule on the messenger. I will ignore these sorts of reactions to Fetzer's article in what follows and try to get at the substance of the debate, as exemplified by some of the more thoughtful reactions to it.

The argument hinges on a perceived discontinuity between the world of mathematics, and the physical world. It is a gap that Bevier, Smith and Young [2] are at pains to diminish. They argue that if one gives a sufficiently fine-grained analysis of software and hardware, down to the level of logical circuitry, there is little to be made of the distinction. For example, they write ...

> whereas it is true that physical gates do not always behave as their mathematical counterparts ... the semantic gap is sufficiently small to render Fetzer's objections inconsequential. To deny any relation between, say, a physical AND gate and the corresponding Boolean function is to deny that there can be any useful mathematical model of reality. This is tantamount to asserting the impossibility of physical science. [2]

Bevier, Smith and Young also dispute point (1) (and (3), of course). They view program verification not as a branch of mathematics but as a physical science. The goal is not mathematical certainty, but "to make it possible to make highly accurate predictions about the behavior of programs running on computers."

In response to all the mail, the editor of *CACM* invited John Dobson and Brian Randell to try to put the situation into perspective. The result was [4]. Dobson and Randell find blame on both sides of the controversy. They find proponents of program verification guilty of overselling their trade. On the other hand, they accuse Fetzer of failing to observe the distinction between the reasons something *is* so, and the typically weaker reasons one has for *believing it to be* so. In particular, they accuse him of mistaking proofs of program correctness as "providing explanatory reasons for program correctness" whereas they should be taken as providing "merely evidential reasons" for program correctness. They say that "the hypothesis 'this program will execute correctly' is one that can never be proven, only falsified." They take the proof of a program's correctness to show only that certain kinds of errors are not possible.

It bears noting that none of these writers question Fetzer's claim that the aim of program verification is to say something about programs running on physical computers. Their defense is that program verification is a branch of science, not mathematics. So they seem to be backing away from the position staked out by Hoare that got program verification underway. And, in so doing, I think they give up something important too quickly.

Mathematics and the Physical World

At issue is one of the oldest puzzles in the philosophy of mathematics: *How is applied mathematics possible?* On the one hand is the observed fact that mathematics has great efficacy in science as well as in our day-to-day coping with the physical world. On the other hand, there is the seeming divide between the empirical facts of the physical world and the *a priori* nature of the deductive method. Or, from a realist perspective rather than a formalist, there seems to be a divide between the concrete physical objects that populate the physical world and the abstract objects about which we reason in mathematics.

It is this problem around which Fetzer and the more cogent defenders of program verification are warily circling. If there are no mathematical truths about physical objects, then clearly there is a sense in which program verification is impossible, since it would certainly follow that there cannot be a mathematical proof that a given program P, when run on a particular *physical* computer M, has any property whatsoever. On the other hand, applied mathematics is a fact of life. Why shouldn't program verification be a branch of applied mathematics? Whatever makes other forms of applied mathematics possible would surely make program verification possible as well. In what follows, I would like to sketch a picture of what I think is going on in general, and then apply it to three issues in computer correctness.

At the heart of the matter, I think, is the distinction between a given physical (or other) phenomenon and a mathematical model of that phenomenon. It is this distinction which is implicit in Dobson and Randell's "distinction between 'this is the way the world is' and 'this is a useful way of thinking of the world'." It is explicit in Bevier, Smith and Young's claim that Fetzer would have us "deny that there can be any useful mathematical model of reality."

Mathematics, both pure and applied, rests on our experience of the world and our ability to reason. Some of this experience is mathematical experience

with various sorts of abstract objects. But ultimately mathematics is grounded in our experience of the nonmathematical world. This claim is controversial, and it is not crucial to the point I want to make, but it does suggest an answer to the question before us. For if mathematics ultimately rests on our experience of the nonmathematical world, it would be odd indeed if mathematics were in principal unable to provide us with any truths about that world.

There are two ways to use mathematics to understand the world. One has become codified in the axiomatic method. We state explicitly various assumptions and then prove that various conclusions follow.* Euclidean geometry is a hackneyed example. There really are things like lines and triangles. Moreover, the axioms of plane geometry are true of them, or close to being true in normal circumstances. Axiomatic set theory is another example. There really are collections of things. Other examples are the axiomatic approaches to the natural or real numbers. In such cases we state as axioms some principles that seem true, or perhaps idealizations of true but messier facts, and prove consequences of the axioms. If our axioms are true, and if the purported proof is correct, then the conclusion must also be true. But what if our axioms are not exactly true? What if they are idealizations? Well, if the world is continuous enough, and if our axioms are close approximations to the facts, then our conclusions will also be close to the facts.

The second and more prevalent method for applying mathematics to the nonmathematical world is that of mathematical modeling. We use some previously established domain of abstract objects, say real numbers, functions, or sets, etc., about which we have an axiomatic theory, to build a model of the new phenomenon under study. For example, the Lebesgue integral is really a mathematical model of a real physical process for determining areas. And most of computer science uses set theory as a tool for modeling computers and other computational structures in the world.

With this form of applied mathematics, there is a somewhat different relationship between theorem and the world. For in this case theorems are really theorems about the domain of mathematical objects used to model the physical world. These truths *can* shed light on the physical world, though. To the extent that our mathematical model is faithful to the phenomenon being modeled, our theorems will correspond to facts about that phenomenon. So again we have at least the possibility of mathematics shedding light on things in the nonmathematical world, for example, determining physical areas or actual computational processes.

Both forms* of applied mathematics have a contingent element (what Fetzer calls "relativity") in their conclusions about the world. The axiomatic method says that our theorems are true *if* our axioms are. The modeling method says that our theorems model facts in the domain modeled *if* there is a close enough fit between the model and the domain modeled. The sad fact of the matter is that there is usually no way to prove – at least in the sense of mathematical proof – the antecedent of a conditional of either of these types.

Still, this does not doom the application of mathematics. After all, our axioms *are* often true, or close enough to the truth. And our mathematical models *are* often good representations of the phenomenon being modeled. Applying mathematics does not in general lend itself to absolute certainty, but it can carry deep and justified conviction. Or, as a philosopher might say, applied mathematics may not guarantee knowledge of facts about the physical world, but it can lead to the next best thing – justified true belief.

How can our conviction in applied mathematics be justified? In answering this, we need to distinguish between what it is that makes a mathematical model (say) fit the world, and what constitutes good evidence for believing that it does. For a model to be a good one there needs to be a mapping from the crucial features of the model to corresponding features of the physical world which is an isomorphism between the model and the modeled, at least in normal circumstances where the model is to be applied.

Sometimes we can have explanatory evidence that there is such a mapping. For example, we have something very close to a mathematical proof that the Lebesgue integral provides a good model of the intuitive notion of area, in normal circumstances. And when modeling something we have built and understand reasonably well, like a particular computer, we may be able to be reasonably certain of the fit between our model and the thing modeled. More typically, though, we only get empirical, experimental evidence that our model is a good one, through the

* This is a great oversimplification of the method, of course. What we really do is to try to systematize fairly self-evident truths about the domain, selecting some to serve as axioms, provided the others follow as consequences.

* Actually, these two forms of applied mathematics are just the ends of a continuum. Often there is some of each going on.

success we have in using it to predict facts in the domain modeled. If experience leads us to trust our model as being a good one, then we will be justified in trusting our theorems as corresponding with the facts of the world. If we are led astray, then we hope that the consequences are not serious, and we revise our model.

Many controversies and errors have arisen out of what one might call *the Fallacy of Identification*, the failure to distinguish between some mathematical model and the thing it is a model of. It is natural enough for the working mathematician to identify the two while he is trying to prove his results, for intuitions about the domain modeled guide us in finding theorems about the mathematical model. But when that final "*QED*" is put at the end of the proof, we must step back and remember that the identification is just that, an identification, not an identity. Fetzer is clear enough about the difference – at least in the case of computers. His antagonists are not so clear.

Fetzer's Argument, Revisited

There is a pervasive ambiguity within the program verification literature. Are the theorems about a mathematical model of computation? Or are they about the real thing? It is a bit hard to say, since the literature is far from clear about the distinction. Workers in program verification sometimes appear to fall prey to the Fallacy of Identification. If pushed to decide between the two, as Fetzer forces them to do, it seems that his antagonists want their work to be about the real thing, not just a model of it, as we noted earlier. They are more willing to give up the mathematical method than they are to give up their claim to be showing something about physically embodied computers. On the other hand, it seems that Hoare's program was meant to apply to mathematical models of computation, and only indirectly, via the model/modeled relation, to the real thing. This view is reinforced by Hoare's more recent principles (see [9]) that "computers are mathematical machines" and "computer programs are mathematical expressions." But whatever Hoare or others *want* to be doing, part of what they *are* doing is proving theorems about their models of computation.

Once things are disambiguated, there seems to be some agreement. Fetzer would agree that mathematical certainty can apply to the mathematical model. The program verification community agrees that mathematical certainty is not possible with regard to the particular physical computers running programs in real time. Where they seem to differ, then, is in how fatal they take the gap between the model and the domain modeled to be. Does the gap lead to Fetzer's pessimistic conclusion (3 above)?

In principle, at least, there is no more or less reason to doubt the applicability of a correct proof of a computer's correctness relative to a mathematical model than to doubt the applicability of any other theorem about some mathematical model of some real world phenomenon, provided we have similar weight of evidence for the appropriateness of the two models. So if there is an argument against the use of mathematical models in program verification, it must involve something problematic about computers, computer programs and computational activity.

The one candidate for a special problem suggested by Fetzer's article stems from the fact that computer programs play a causal role in computation, in that they actually engender the particular process that is carried out. There are two points to be made in response. First, there is the distinction between the program as abstract object, as "type," and the program as part of the physical world, as an instance of the type. It is the latter that plays a causal role. Fetzer is quite explicit in his determination to talk about the latter, but proofs of correctness are about the former. From a syntactic point of view, program instances are simple enough to have very reliable abstract models about which we can prove results. And we can also model the causal role these programs play in computers. At least it is no more problematic than any other form of causality in applied mathematics. In fact, it is rather less problematic, since we know quite well how this takes place, so we can model it quite faithfully. Indeed, as these things go, the models of programs and computers used in proving program correctness are in above average shape. We typically have quite good reasons for trusting them. So if we can come up with a genuine proof that a program is correct, it is typically a pretty reliable indication that the program will indeed compute the intended algorithm.

But this brings us back to a point made by DeMillo, Lipton and Perlis. Real programs are typically very long and complicated. What is the chance of getting a proof of correctness right, especially when there is so little outside interest in checking the proofs?

It seems to me that things are not as bad as they suggest. Admittedly, today's programs are often very long and the proofs can be pretty boring. But there are some telling points on the other side. (1) Program language methodology is advancing to allow programs to have structural features (modularity, typing, etc.)

to aid in their verification. (2) Programs written with eventual verification in mind can make the task simpler. (3) In my (nonempty but admittedly limited) experience, it is rare for such proofs to require great mathematical ingenuity. If they do, then there is something suspicious about the program. And (4), automated proof checking might help in weeding out faulty purported proofs from the real thing. But here a word of caution is in order.

Formal Proofs and Proofs

It seems to me that Fetzer and most of the computer science community, including those involved in automated proof checking, stumble over a landmine left by the retreating formalists. Namely, they fail to recognize the true role of formal languages and formal proofs in mathematics. Fetzer assumes that mathematical logic provides the test of a real proof, with what is usually written in journals being only proof sketches.

> ... a proof of a theorem T, say, occurs just in case theorem T can be shown to be the last member of a sequence of formulae where every member of that sequence is either given ... or else derived from preceding members of that sequence (by relying upon the members of a specified set of rules of inference.)

Here, at the risk of stepping on the toes of my fellow mathematical logicians, I must say that Fetzer, and many others, commit the Fallacy of Identification. That is, they identify a mathematical model of the domain of proofs with that domain itself.

The idea that reasoning could somehow be reduced to syntactic form in a formal, artificially constructed language, is a relatively recent idea in the history of mathematics. It arose from Hilbert's formalist program. There were proofs for thousands of years before logicians came along with the mathematizations of the notion. But these "formal proofs" are themselves certain kinds of mathematical objects: sequences of sentences in a formally specified artificial language, sequences satisfying certain syntactic constraints on their members. They certainly aren't what mathematicians since the time of the ancient Greeks were constructing, for one thing. For another, no particular system can claim to *be* the real notion of proof, since there are endless variations, as is evident from the fact that there are as many different deductive systems as there are textbooks in logic. They can't all be the real notion of proof. Rather, they provide somewhat different models of that notion. And, as Kreisel has observed ([**10**]) in making much the same point, 99% of all mathematicians don't know the rules of even one of these formal systems, but still manage to give correct proofs.

The distinction between formal proofs and real proofs raises the question as to the fit between our mathematical model and the real thing in a new setting. How confident can we be of this fit in this case?

We can be reasonably confident in most of the models, in one sense. We can be reasonably confident that the mathematical objects declared proofs do correspond, under the mapping between the model and the domain modeled, to real proofs, at least if we set aside matters of comprehensibility and elegance. But even here it is worth noting that it took many attempts to get the usual rules of formal logic straight, especially regarding quantifiers and the substitution of terms containing free variables. Many published versions of this model get things wrong, so that objects get counted as proofs (in the model) which do not at all correspond to a valid piece of reasoning.

On the other hand, I think it is clear that current formal models of proof are severely impoverished since there are many perfectly good proofs that are not modeled in any direct way by a formal proof in any current deductive system. For example, consider proofs where one establishes one of several cases and then observes that the others follow by symmetry considerations. This is a perfectly valid (and ubiquitous) form of mathematical reasoning, but I know of no system of formal deduction that admits of such a general rule. They can't, because it is not, in general, something one can determine from local, syntactic features of a proof. Which is just to say that the model of proof accepted by Fetzer (and his opponents) suffers from the very same objection as do models of computers. Which is not to say that it isn't useful. But still, it is a model, not the real thing. And it could be that the best proofs (in the sense of being most enlightening or easiest to understand) of a program's correctness will use methods, like symmetry considerations, that are not adequately modeled in the logician's notion of formal proof, and so which would not be deemed correct by some automated proof checker designed around the formalist's model.

Moreover, identifying proofs with formal proofs leads to what may be an even more serious mistake. Of course to write down a proof that a program P is correct for an algorithm $\mathcal{A}$, we need to have some description, representation, or "specification," of $\mathcal{A}$ itself. The formal model of proofs leads people to

suppose that the specification of the algorithm has been given in the artificial language over which the proof regime is defined, usually some descendant of the first-order predicate calculus. While writing things out in complete logical notation can sometimes result in added clarity, all too often it merely obscures things, which is why practicing mathematicians almost never use such a language. And, it is not uncommon for an error to enter the picture in the translation from the English description to the formal specification. Except for the hope of having proofs generated, partially generated, or checked by a computer, there seems to be no compelling reason to specify an algorithm in a formal language. Surely a better practice would be to initially describe the algorithm clearly and unambiguously in the language ordinarily used by mathematicians, an extension of English or some other human language.*

Programs and Computer Systems

As should be clear by now, I disagree with Fetzer's highly pessimistic conclusion (3 above). I think that program verification *is* an effective way of getting more reliable programs. However, there is another problem, if we turn from the question of program verification to the larger question of computer system correctness.

Computer systems are not just physical objects that compute abstract algorithms. They are also embedded in the physical world and they interact with users. They are intended to generate real world activity. The starting assumption of the program verification task is that we are given a mathematical algorithm $\mathcal{A}$, or perhaps some description of it, to implement. But, from the point of view of correctness of the entire system, this begs at least half the question. The larger question of computer system correctness is not whether the machine implements $\mathcal{A}$, but whether the machine carries out the intended real world task. Thus, to solve the larger problem, our mathematical models need to include not just a reliable model of the computer, but also a reliable model of the environment in which it is to be placed, including the user (Smith [11]).

Typically, this additional modeling is implicit in the design of the algorithm. But if we are going to divide things up in this way, then a full proof of computer system correctness need consist of not just a proof of program correctness, relative to a reliable model of the computer, but also of a proof of algorithm correctness, relative to a model of the environment in which the system is to be placed. Who really gives a damn that the program correctly computes the algorithm $\mathcal{A}$ if $\mathcal{A}$ is not the one needed in the real computer system.

The question of algorithm correctness is seldom addressed. Partly this stems from the fact that builders of computer systems, like others, find it all too easy to fall into the Fallacy of Identification, forgetting that there can be a gulf between their implicit model and the world. Partly it is because there are fewer known tools at hand to study algorithm correctness. But even if it is addressed, how about the question of the fit between the model and the domain modeled?

Here things are not so rosy. Many "bugs" in programs that make it into general use are not program errors at all. Rather, they result from a failure to anticipate some situations in which the program is required to operate, and some uses the users put it to. These are mismatches between the model of the computer's environment and the computer's actual operating environment.

Modeling the environment and the user is typically *far* more complex than modeling a computer. For example, it often involves many aspects of human psychology, to mention just one nightmare. A good model of the user may need to model her beliefs about the program and how it operates, her likely desires, and her physical abilities. (For example, can she use a mouse quickly and accurately?) Next to modeling this sort of stuff adequately, modeling the computer, or the solar system, is a piece of cake.

In the sort of applications of program verification that really worry Fetzer (like air traffic control or SDI) these problems arise with a vengeance. The unexpected situation is an ever present danger, as is the unusual user. Such cases, being unanticipated by the model builder, often do not fit with the model. There are many documented cases of such mismatches ([11]). And if these mismatches take place in a critical computer system we may well not be able to go back and redesign the model. For we may not be around.

In sum, I think Fetzer is correct when he points to the theoretical limitations of program verification. But they're just the limitations implicit in any applied mathematics. Program verification, a branch of applied mathematics, is currently an extremely useful tool for improving the performance of programs, and so of real world computers. On the other hand, proofs of computer system correctness are of value only to the extent that we can rely on the underlying models of

* Another motivation for writing a "formal" specification at some stage might be as a step toward writing the desired program.

the computer and its environment. Hopefully articles critical of computer system correctness methodology, techniques, and standards will not be drowned out, but will help to generate an improved understanding among professionals and the public of what such proofs show and what they do not show about the correctness of physical computers operating in the the real world. For only with such an understanding can those outside the computer science community intelligently assess the relative advantages and dangers of a given proposed use of computer systems.

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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.

This column is written during the dog days of summer when the Nation's Capital is suffering under the worst tropical climate in memory. The weatherman says it's all due to the Omega effect, which is just describing the curious bend in the jet stream that keeps all the moisture from the Gulf of Mexico bottled up along the Eastern seaboard.

Other things seem to have gotten stuck here too: Congressional preoccupation with ethics issues continues; the Supreme Court went home for the Summer after two highly controversial decisions, and with more surprises expected in the Fall. The House of Representatives, after relentlessly lambasting the former Secretary of Defense, Caspar Weinberger, for not controlling a run-away budget, suddenly changed its mind when Secretary Dick Chaney proposed actually cutting two weapons systems and trimming the defense budget by some $30 billion over the next five years.

The National Science Foundation's budget continues to be the responsibility of Congressional appropriations subcommittees that have to balance NSF requests with those of NASA, the Departments of Veterans Affairs and of Housing and Urban Development. The politics of the situations are awesome and requests are rarely judged on their merits alone.

The physicists prevailed in the House and got a $200 million promise to get the Superconducting Supercollider construction started. But no new money, mind you, just a clip here and there from the high energy physics budget in DOE. So far, the SSC is an internal family affair for the physicists, who will probably have to sacrifice some of their magnetic fusion budget. But that situation can change very quickly to the disadvantage of the other sciences.

The crunch will come when all the science budgets in NASA, NSF, and DOE bump against the ceilings set by the budget committees. As this is written, the Senate has not taken up any of the appropriations bills yet, but by the time they emerge from the Senate, they will most likely be different from the House versions. And that means more negotiations and horse trading involving very powerful political forces whose identity is not even known at this time.

On the positive side, however, we should remember that the year began with some very strong statements by our "education" President and the largest number of Congressional Hearings devoted to science, education, and university infrastructure support in many years. We have a science adviser to the President after a long wait who, by his experience in Washington, can be expected to be a powerful spokesman in science policy matters both within the White House and in the Administration's dealings with Congress. Maybe he arrived too late to influence much of the fiscal year 1990 budget debate, but he should be counted on in future years.

The Federal Coordinating Council for Science, Engineering and Technology (FCCSET, commonly referred to as "FIXIT") published its long-awaited report on the future of high-speed computing and electronic broadband networks. Many of their recommendations were anticipated by a 1987 panel chaired by Harold Ravecé, Duncan Lawrie, and Alvin Despain. Their report was sponsored by NSF and DOE, and published by SIAM under the title "A National Computing Initiative".

By the time you read this, Congress should be back from the Labor Day recess. We can expect a busy calendar this Fall for the Congress and the executive branch agencies that will be defending their 1991 budget proposals against OMB—we hope with full cooperation of the President's Science Adviser. But there could still be a surprise in relation to the 1990 budget if the Gramm-Rudman-Hollings targets are not being met.

News and Announcements

Sergeĭ L'vovĭch Sobolev 1908-1989

Sergeĭ L'vovĭch Sobolev, the eminent Soviet mathematician whose work had a substantial influence on the development of twentieth century mathematics, died on January 3, 1989 in Leningrad, at the age of 81. Sobolev made fundamental contributions to the theory of partial differential equations, functional analysis, function theory, mathematical physics, and computational mathematics.

Sobolev was born in St. Petersburg (now Leningrad) on October 6, 1908. He mastered the high school material on his own, and entered Leningrad University in 1925. Clearly a mathematical prodigy, Sobolev was elected Corresponding Member of the Soviet Academy of Sciences at the age of 25 and elected Academician at 31.

From 1930 to 1931, Sobolev served as docent at the Leningrad Electrotechnic Institute, and in 1932, he moved to the Leningrad branch of the Steklov Institute. He took a position at the Moscow branch of the Steklov Institute in 1934 and became director of the Institute in 1941. He also taught at Moscow University for more than 20 years. From 1952 to 1957, he headed the first department of computational mathematics in the Soviet Union.

Among Sobolev's most important mathematical accomplishments was his creation, together with V. I. Smirnov, of the now classical method of solving the wave equation describing oscillation in an elastic medium. The study of Sobolev function spaces, which he introduced in the 1930s, immediately became a whole area of functional analysis. Sobolev's notion of generalized function (distribution) turned out to be especially important; with further development by Laurent Schwartz and I. M. Gel'fand, it became one of the central notions of mathematics. His contributions to computational mathematics are apparent in his influential monograph, *Introduction to the Theory of Cubature Formulas.*

In 1957, Sobolev moved to Novosibirsk and became one of the organizers of the Siberian Branch of the Soviet Academy of Sciences. He was also a professor at Novosibirsk University from 1960 to 1978.

Sobolev was elected to the French Academy of Sciences, the Academia Nazionale dei Lincei, and many other scientific societies. He also served as chairman of the National Committee of Soviet Mathematics.

Ribet and Bahri Receive Fermat Prize

Abbas Bahri and Kenneth A. Ribet have received the Fermat Prize for Research in Mathematics, awarded by Université Paul Sabatier and Matra-Espace. The two will share the prize of 100,000 FF.

Bahri was cited for "the introduction of new methods in the calculus of variations". He made great strides in this area with his development of the method of critical points at infinity. Born in Tunisia, Bahri was educated in France and received his doctorate from the Université de Paris VI in 1981. He is currently professor of mathematics at Rutgers University.

The citation for Ribet commended his "contribution to number theory and to Fermat's Last Theorem". In his work in arithmetic algebraic geometry, Ribet has recently focused on modular forms and the Taniyama-Weil Conjecture. He received his doctorate from Harvard University in 1973 and is currently professor of mathematics at the University of California at Berkeley.

The Fermat Prize rewards the research of mathematicians working in areas influenced by the contributions of Pierre de Fermat: principles of variational theory, the foundations of calculus of probabilities and of analytic geometry, and number theory. This list of areas is not restrictive, however; the spirit of the prize is to reward the research results that are accessible to the greatest number of mathematicians.

Ribet and Bahri are the first recipients of the prize, which will be awarded every other year in Toulouse. There is also a Junior Fermat Prize, which was not awarded this year. Further information, such as the rules of the contest and application deadlines, is available from Prix Fermat de Recherche en Mathématiques, J. B. Hiriart-Urruty, Professeur des Mathématiques, Université Paul

Sabatier, 118 route de Narbonne, 31062 Toulouse Cédex, France.

NSF Awards Visiting Professorships

As an important part of the National Science Foundation's initiative to enhance the participation of women in U.S. science and engineering research, the Visiting Professorships for Women program has awarded grants totalling $2.36 million to 27 women scientists. In addition, the host institutions have contributed nearly $500,000 to these awards.

The program enables women scientists and engineers from industry, government, and academic institutions to serve as visiting professors. The visiting professors will perform research, and will be involved in lecturing, counseling, and other activities to encourage students, particularly other women, to pursue careers in science and engineering.

The 27 award winners were selected on the basis of a review process that focused on the merit of the research, and on a proposed plan for lecturing and serving as counselor and mentor to women entering research careers. VPW awardees are highly regarded researchers and teachers, and have made outstanding contributions to their disciplines.

Seven of the Visiting Professorships were awarded to mathematical scientists. These recipients, their institutional affiliation, and the institutions they propose to visit are:

INGRID DAUBECHIES, AT&T Bell Laboratories (NJ), University of Michigan; URSULA HAMENSTADT, California Institute of Technology, University of Pennsylvania; JENNY HARRISON, University of California, Berkeley, Yale University; JOAN P. HUTCHINSON, Smith College, University of Washington; LINDA KEEN, CUNY H. L. Lehman College, Princeton University; JOYCE R. MCLAUGHLIN, Rensselaer Polytechnical Institute, University of California, Berkeley; MEI-CHI SHAW, University of Notre Dame, University of Wisconsin, Madison.

Minority Scholars Awarded Fellowships

The National Research Council has announced the names of 102 minority scholars who have received fellowships in two programs sponsored by the Ford Foundation, the Predoctoral and Dissertation Fellowships for Minorities program and the Postdoctoral Fellowships for Minorities program.

Only one award was made in the mathematical sciences. It went to Jaime L. Hernandez-Santiago, who will receive a postdoctoral fellowship for research in applied mathematics at the School of Medicine at Louisiana State University.

The fellowships provide funds for research costs, stipends, and tuition to help increase the presence of underrepresented minorities on the nation's college and university faculties.

Plans for the 1990 fellowship competitions are now under way. Further information and application materials are available from the Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418. Deadlines will begin around the middle of November 1989 for the 1990 competition for the predoctoral and dissertation fellowships, and around the end of 1989 for the postdoctoral fellowships.

New Calculus Grants Announced

The National Science Foundation (NSF) has announced awards in its calculus curriculum development program. The program was begun in 1988 in response to concern from the mathematical sciences community about the declining quality of the calculus course. The purpose of the NSF program is to provide leadership to stimulate the development of high quality undergraduate calculus curricula.

The NSF received a total of 74 proposals and made 17 new awards. In fiscal year 1989, $1.86 million will be spent on the new grants, with the remainder of the $2.3 million program budget going to five continuing grants. Several of the new grants resulted from one-year planning grants awarded in the first year of the competition.

Listed below are the names of the projects, the principal investigators and their institutions, the sizes and durations of the grants, and short descriptions. (The dollar amounts given represent the entire grant to be disbursed over the specified time periods, not the amount to be granted during 1989.) The project descriptions were supplied by NSF staff.

Curriculum Development Project: Calculus
David O. Lomen, David Lovelock, University of Arizona
One year, $104,806

Materials are being developed that complement the calculus courses. Integrated supplements are being developed that feature labs, projects, problems, and software packages. In the labs, students perform guided "experiments." Projects involve the student discovering and conjecturing results related to calculus. Problems are challenging, realistic questions that might require modern technology to solve. The software packages will supply the appropriate materials for MS-DOS and Macintosh machines.

Calculus and Computers: Toward a Curriculum for the 1990's
Marcia Linn,
University of California at Berkeley
One year, $42,898

This award was used to fund a conference held at U.C. Berkeley this past August. Faculty from a broad spectrum of institutions, including two-year colleges, learned about and exchanged ideas on how to use Mathematica in teaching calculus. The

invited speakers and the PIs have been using Mathematica and other integrated symbol manipulation and graphics systems in their calculus courses and described exciting possibilities for their use.

Rapid Dissemination of New Calculus Projects
Thomas W. Tucker,
Mathematical Association of America
One year, $41,540

Detailed descriptions (syllabi, assignments, laboratories, exams, sample text material, preliminary assessment) of eight to ten new calculus projects are being prepared for publication. Project summaries of approximately 50 additional projects are included.

Calculus and Mathematica
J. Jerry Uhl, Horacio Porta,
University of Illinois,
Urbana-Champaign
One year, $25,000

Using live Mathematica notebooks, this pilot project is developing a non-traditional, entirely new course. Emphasis is placed upon individual student use of the Mathematica program for instruction, computation, and symbolic manipulation within the Mathematica notebooks. The goal is to motivate the students to better understand the foundations and enable them to execute calculations far beyond those expected of students in the traditional course.

Calculus Redux
Judith H. Morrel,
Butler University
One year, $27,000

Students are finding more excitement and making better progress in calculus because of a revised curriculum that emphasizes problem solving, building intuition, and improving written mathematical expression. A data base is being created consisting of non-routine, open-ended, multi-step problems and discussion modules emphasizing concepts, experimentation, and widely varying applications.

A Revitalization of an Engineering/Physical Science Calculus
Elgin H. Johnston,
Iowa State University
Science & Technology
Four years, $210,889

A four year program is under way to revitalize the calculus course taken by science, engineering, and mathematics students. The revised curriculum stresses the modelling and problem solving aspects of calculus and teaches students to use commercially available symbolic and numerical software to handle the technical aspects of the subject.

Calculus with Computing: A National Model Course
Keith D. Stroyanm,
University of Iowa
One year, $65,000

A curriculum is being developed to present calculus as the language of science. The project treats beginning calculus as a laboratory course with modern computers and scientific software as the laboratory equipment. This development is built on a long history of successful use of computers in a calculus laboratory and will make use of new software so that students have a serious start on their education in scientific computation.

Core Calculus Consortium: A Nationwide Project
Andrew M. Gleason,
Deborah Hughes-Hallet,
Harvard University
Five years, $1,973,762

A national consortium of institutions is developing an innovative core calculus curriculum that is practical and attractive to a multitude of institutions. Led by Harvard University, the consortium consists of the University of Arizona, Colgate University, Haverford-Bryn Mawr Colleges, the University of Southern Mississippi, Stanford University, Suffolk Community College, and Chelmsford High School. The refocus of calculus will use the "Rule of Three" whereby topics are explored graphically, numerically, and analytically.

Calculus Reform in Liberal Arts College
A. Wayne Roberts,
Macalester College
Three years, $567,263

A calculus curriculum is being developed that stresses understanding rather than techniques, contains realistic applications, and promotes the ability to write coherent arguments. Twenty-six liberal arts colleges in the Midwest are participating in the development of five Resource Collections containing fundamental materials that can be used for curriculum development in calculus at any institution. These collections are to be published as five separate volumes.

Utilization of Technology in Non-traditional Calculus
Wanda Dixon,
Meridian Junior College
One year, $25,000

The calculus curriculum is being revised to place more emphasis on learning the concepts, solving realistic problems, and improving estimation skills. Materials are being developed to utilize the HP-28S hand-held calculator.

Calculus: Restructuring and Integration with Computing
Richard H. Crowell,
Dartmouth College
One year, $289,171

This project integrates personal computers into the calculus course. A substantial body of new courseware is being created that will enable the students to use a personal computer as a regular part of their homework to explore, analyze, or verify the central concepts of the calculus. Students are expected to write some of their own software and/or to modify existing software as an integral part of the course. Substantial restructuring of course materials will incorporate the advantages the computer affords. The ultimate goal is to produce a new computer-based calculus text.

Collaborative Learning in Calculus
Patricia R. Wilkinson,
CUNY Borough Manhattan CC
Two years, $50,000

This collaborative learning project is providing students, especially those from minority groups, a better chance to achieve success in calculus. These students are working in informal study groups with the assistance of specially trained tutors.

Calculus in the Liberal Arts Curriculum/Multidisciplinary Resources for College Calculus
Ronald W. Jorgensen,
Nazareth College of Rochester
Two years, $78,232

A calculus curriculum is being developed using the computer algebra system MAPLE in conjunction with writing assignments. The courses will be organized in diagnostic learning units and will require students to keep a journal, to be evaluated regularly by the instructor. This system of ongoing feedback between student and teacher will enhance self-evaluation on the part of the student.

The Computer Revolution in Calculus: Innovative Approaches to Concepts and Applications
William E. Boyce,
Rensselaer Polytechnic Institute
One year, $55,000

A new calculus course is being designed that exploits the power of a computer as an integral part of teaching and learning. The course takes advantage of a computer's capacity to perform numerical computation, produce sophisticated graphics, and carry out extensive symbolic manipulations. Students will be provided with powerful and versatile problem-solving tools and simultaneously gain a deeper understanding of the underlying mathematical concepts.

Project CALC: Calculus as a Laboratory Course
Lawrence C. Moore, David Smith,
Duke University
Four years, $585,756

Students are benefiting from a completely restructured calculus curriculum at Duke University and the North Carolina School of Science and Mathematics. The new curriculum features an integrated computer laboratory for exploration and development of intuition and emphasizes writing to promote student comprehension and expression. The course materials are being developed jointly by members of the faculties of the two schools.

Calculators in the Calculus Curriculum
Thomas Dick,
Oregon State University
Four years, $264,106

This joint effort involves universities, two- and four-year colleges, high schools, and high technology industry to develop and implement a new calculus curriculum which makes integral use of symbolic/graphical calculators. Text materials appropriate for the equivalent of three semesters of calculus are being produced and class-tested in a variety of instructional settings. Workshops will provide continuing instructional support for teachers using the curriculum materials and symbolic/graphical calculator.

The Calculus Companion: A Computational Environment for Exploring Mathematics
Edmund A. Lamagna,
Diane L. Johnson,
University of Rhode Island
Three years, $161,535

The calculus curriculum is being revised to provide students with more complex, real world problems, to help them develop the skills involved in performing multi-step reasoning, and to help them learn to express mathematical ideas precisely and coherently. A unique computational environment is being developed in which students use the computer as both a tutoring device and a computational aid. The system, called the Calculus Companion, consists of a user-friendly interface to the computer algebra system MAPLE, and numerical computation and graphical display routines.

The deadline for proposals for next year's competition is **February 2, 1990**. Although the program will be substantially the same next year, the NSF has decided to fund a few pilot projects in differential equations and linear algebra for the first two years of calculus. The program announcement and more information are available from John S. Bradley, Program Director, Calculus Curriculum Development, USEME, Room 639, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-7051; electronic mail jbradley@note.nsf.gov (Internet) or jbradley@nsf (Bitnet).

Call for Nominations for Waterman Award

The National Science Foundation (NSF) has called for nominations for the 15th annual Alan T. Waterman Award. The award is intended to give recognition to an outstanding young researcher in any field of science, mathematics, or engineering and to encourage further high-quality research.

The recipient receives up to $500,000 for up to three years of research or advanced study in the mathematical, physical, medical, biological, engineering, social, or other sciences at the institution of the recipient's choice.

Candidates must be U.S. citizens or permanent residents and must be 35 years of age or younger, or not more than five years beyond the Ph.D. by December 31 of the year in which the nomination is made. Candidates should have sufficient personal accomplishments, outstanding capability, and exceptional promise for significant future achievement. In addition, candidates' research should exhibit quality, innovation, and potential for discovery.

The mathematical scientists who have received previous Waterman

Awards are Charles Fefferman (1976) and William P. Thurston (1979), both of Princeton University; Harvey Friedman of Ohio State University (1984); and Edward Witten of the Institute for Advanced Study (1986).

The deadline for nominations is **December 31, 1989**. Nominations for the award may be submitted by individuals, professional societies, industrial companies, and by other appropriate organizations within the scientific and educational communities. A special form is necessary for submitting nominations. The forms and further information may be obtained from Lois J. Hamaty, Executive Secretary for the Alan T. Waterman Award Committee, National Science Foundation, 1800 G Street, NW, Room 545, Washington, DC 20550; telephone 202-357-7512.

The award will be made in May, 1990. The Waterman Award was established by Congress in 1975 to mark the 25th anniversary of the NSF and to honor Waterman, the first director of the Foundation.

Staff at the NSF's Math Division

Listed below are the Program Directors for the coming academic year in the Division of Mathematical Sciences (DMS) at the National Science Foundation.

Classical Analysis
202-357-3455
John V. Ryff

Modern Analysis
202-357-3697
Ira Herbst

Geometric Analysis
202-357-3451
Russell B. Walker

Topology and Foundations
202-357-3457
Ralph M. Krause

Algebra and Number Theory
202-357-3695
Ann K. Boyle
Jonathan D. Lubin

Applied Mathematics
202-357-3686
Alfonso Castro
Fred Howes

Computational Mathematics
202-357-3691
Alvin Thaler (Acting)

Statistics and Probability
202-357-3693
Mary Ellen Bock
Peter W. Arzberger

Special Projects
202-357-3453
Deborah F. Lockhart
Alvin Thaler

The administrative staff includes:

Division Director
Judith S. Sunley
202-357-9669

Deputy Division Director
Bernard R. McDonald
202-357-9669

Administrative Officer
Tyczer Henson
202-357-3683

The permanent staff consists of Boyle, Krause, McDonald, Ryff, and Sunley. The incoming rotators are Herbst, University of Virginia; Castro, University of North Texas; and Howes, University of California at Davis. Thaler, on the permanent staff of the Foundation, is returning to the DMS after a stint in the NSF's Directorate for Computer and Information Science and Engineering.

The community expresses its thanks for a job well done to outgoing rotators William L. Paschke, University of Kansas; Peter W. Bates, Brigham Young University; Bart S. Ng, Indiana University-Purdue University at Indianapolis; Raymond C. Y. Chin, Lawrence Livermore Laboratories; and Elbert A. Walker, New Mexico State University.

All of the DMS staff can be reached via electronic mail. To form an individual's address, take the first initial and last name, and append @note.nsf.gov for Internet, or @nsf for Bitnet. For example, to contact John Ryff through Internet, use the address jryff@note.nsf.gov.

Staff at DoD Agencies

Five agencies of the Department of Defense fund research in the mathematical sciences: the Air Force Office of Scientific Research (AFOSR), the Army Research Office (ARO), the Defense Advanced Research Projects Agency (DARPA), the National Security Agency (NSA), and the Office of Naval Research (ONR). Recently there have been a number of staff changes in the mathematics programs at the defense agencies. In order to facilitate contact with these agencies, the names, addresses, and telephone numbers of the staffs are provided below.

AFOSR, Directorate of Mathematical Sciences
AFOSR/NM
Building 410
Bolling AFB
Washington, DC 20332
Charles J. Holland, Director,
202-767-5025

Mathematical Optimization
Finite Mathematics
Neal D. Glassman
202-767-5026

Applied Analysis
Mathematics of Physical, Chemical, and Biological Systems
Arje Nachman
202-767-4939

Artificial Intelligence
Computer Science
Abraham Waksman
202-767-5028

Mathematics of Signal Processing and Communication
Statistics and Probability
Eytan Barouch
202-767-4940

Mathematics of Computation
Arje Nachman (acting)
202-767-4939

Mathematics of Dynamics and Control
James Crowley (acting)
202-767-5025

ARO, Mathematical Sciences Division
P.O. Box 12211
Research Triangle Park, NC 27709
Jagdish Chandra, Director
919-549-0641
(all program managers may be contacted at this number)

Applied Analysis and Physical Mathematics
Julian Wu

Numerical Methods and Scientific Computation
Kenneth D. Clark

Probability and Statistics
Gerald Andersen

Systems, Control, Modeling, and AI
Jagdish Chandra

Special Projects (Centers of Excellence)
Jagdish Chandra

Conferences, Symposia, and Workshops
Francis Dressel

Kenneth D. Clark joined the staff of ARO in June from his previous position at Bell Northern Research. He replaced Arthur Wouk, who retired this year.

DARPA, Applied and Computational Mathematics Program
1400 Wilson Boulevard
Arlington, VA 22209
Louis Auslander, Program Manager,
202-694-3145

NSA, Mathematical Sciences Program
Attn: RMA
Ft. George G. Meade, MD 20755-6000
Marvin Wunderlich, Director,
301-859-6438

ONR, Mathematics Division
Code 1111
800 North Quincy Street
Arlington, VA 22217
Neil Gerr, Director,
202-696-4321

Signal Analysis
Neil Gerr
202-696-4321

Operations Research
Julia Abrahams (acting)
202-696-4320

Probability and Statistics
Julia Abrahams
202-696-4320

Discrete Mathematics
Marc Lipman
202-696-4310

Numerical Analysis
Richard Lau
202-696-4316

Applied Analysis
John Lavery
202-696-4314

There have been several changes in the mathematics program at ONR. Neil Gerr, who had been serving as acting director, is now the director. Two positions that had been vacant for several months have now been filled. The new program managers are John Lavery, from the NASA-Lewis Research Center, and Marc Lipman, from IUPU at Fort Wayne. Gerr says he is continuing to recruit for the position of program manager for Operations Research. Those interested in more information about the position can contact him at the address and phone number given above.

In addition, two programs that were established at ONR two years ago—Boundary Value and Inverse Problems, and Calculus of Variations—have been combined into the Applied Analysis program.

Mathematical Reviews Hits One Million

Tuesday, July 25, 1989, was a big day at the office of Mathematical Reviews (MR). On that day, at 11:45 a.m., the one-millionth item was stamped. (Every item that MR treats is given a unique acquisition number, called its "control number", which is stamped on the item and used to track the item as it proceeds through the MR system–from receipt to published review. On July 25 the control number reached 1 000 000.)

MR was founded in 1940 by the American Mathematical Society, with Professor Otto Neugebauer (who had previously founded Zentralblatt für Mathematik) as its editor. Hence it has taken just slightly less than 50 years for MR to reach this milestone.

Robert G. Bartle, the present Executive Editor of MR, had the honor of stamping the first 7-digit number on a paper to the cheers of the MR staff which had assembled to watch this once-in-a-lifetime event. The staff then broke for a celebration in the lunchroom of the MR building, which once housed a brewery. The record shows that the one-millionth paper is: "An extension of Kazhdan-Lusztig theory", by Vinay V. Deodhar of Indiana University. This article appeared in a conference proceedings entitled "Invariant theory", published in Contemporary Mathematics, vol. 88 (1989), 579-583.

The fact that one million items have been stamped does NOT mean that MR has reviewed one million items–yet. For one thing, the stamping takes place at the front end of the production line, before the review has been written. There are two other reasons that one million control numbers does not mean one million reviews:

(i) it may be decided at a later stage that a stamped item is in fact outside the scope of MR;
(ii) some stamped items are included in the MR data base and listed in MR indexes, but are not reviewed (e.g., long abstracts, or other items that appear to be preliminary reports of a forthcoming paper).

By the end of 1989, MR will have published a total of approximately 920,000 reviews; it will not be until 1991 that the one-millionth review is published.

The growth of the size of MR reflects the growth in mathematical publication during the last fifty years. The first volume of MR, in 1940, contained 2,120 reviews in 400

pages. In 1950 there were 5,241 reviews in 873 pages. In 1960 there were 7,824 reviews in 1,600 pages, but the next year there were 13,382 reviews in 2,548 pages. In 1989 there will be about 48,800 reviews in approximately 10,000 pages (including indexes).

The most memorable (and probably the most significant) figure is that in each decade, MR has published approximately twice as many reviews as it did in the preceding decade. If the present rate of growth continues, it is estimated that just about January 1, 2000, MR will stamp the number 2 000 000.

New Associate Executive Director for AMS

Donovan H. Van Osdol has joined the AMS staff in Providence as an Associate Executive Director of the Society. Formerly Professor of Mathematics and Chairman of the Mathematics Department at the University of New Hampshire, he began his new position on July 24, 1989.

Van Osdol received his Ph.D. in mathematics, with a minor in operations research, from the University of Illinois in 1969. He served as assistant professor at Wilkes College before moving to UNH in 1970. His main areas of mathematical research are category theory and homological algebra.

Since 1988, Van Osdol has been a co-principal investigator for a planning grant for calculus curriculum development from the National Science Foundation. In addition, he has served since 1984 as a consultant for the Institute for Quality and Productivity at UNH.

Among the many responsibilities of Van Osdol's new position, the two most visible to the mathematical community are serving as Managing Editor of *Notices* and overseeing AMS membership services.

News from the Mathematical Sciences Institute

Cornell University

Hamiltonian Systems Series

This fall, the Mathematical Sciences Institute (MSI), will offer a special series on Hamiltonian Systems. Under the overall direction of Jerrold E. Marsden, Berkeley and Cornell, three workshops at Cornell and an affiliated one at the Centre de Recherche Mathématique in Montréal will explore new advances in understanding systems that govern the motion of mechanical systems in engineering, physics, and chemistry. Recent advances have occurred in the areas of computer simulation and theory, and the MSI workshops will focus on both areas, with special attention to topics such as the Block Diagonalization Technique, a new technique in stability theory; chaotic dynamics in engineering and chemical systems; symbolic manipulators and symplectic integrators for the computer simulation of mechanical systems; and Berry's Phase. Many other related topics will be addressed. (See this section in the July/August issue of *Notices* for a complete list of topics and workshop organizers.)

This series on Hamiltonian Systems will provide an excellent opportunity to further develop existing theory and computer simulation of mechanical systems. "Lots of things are poised for discovery," says Marsden, and a large contingent of the field's leading researchers will be at Cornell University for varying periods of time over the course of the semester, creating the best possible environment for advances. Those expected to spend significant time at Cornell include: C. Scovel, Los Alamos National Laboratory; M. Field, Australia; R. Grossman, University of Illinois; P. S. Krishnaprasad, University of Maryland; R. Ratiu, University of California, Santa Cruz; J. Simo, Stanford; C. Stuart, École Polytechnique; and S. R. Wiggins, California Institute of Technology. Eighteen additional short term visitors will be at Cornell for a month or less. These include: S. Antman, University of Maryland, A. Bloch, Ohio State; D. David, CNLS Los Alamos; S. Ge, MSRI; J. Harnad, École Polytechnique; D. Holm, Los Alamos National Laboratory; D. Lewis, Stanford; J. H. Lu, University of California at Berkeley; R. S. Mackay, University of Warwick; F. Magri, Universita di Milano; Y. G. Oh, MSRI; G. Patrick, University of California, Berkeley; T. Posbergh, Stanford; G. Raugel, École Polytechnique; J. Scheurle, Universitat Hamburg, W. Shadwick, University of Waterloo; V. Rom-Kedar, University of Chicago; M. Tratnick, CNLS Los Alamos.

The semester-long series will provide an opportunity to fully explore emerging interdisciplinary connections. New theoretical areas draw from both mathematics and engineering; for example, the mathematical tools used to study chaotic dynamics bridge mathematics, engineering, and chemistry. Techniques borrowed from the study of chaotic particle trajectories in fluid mechanics are being used to study chemical reaction rates. The application of the concepts of chaotic trajectories in Hamiltonian Systems to chemical reaction rates has been developed in the last 18 months by, among others, G. S. Ezra and P. Holmes, Cornell, and S. R. Wiggins, California Institute of Technology. Other new applications of Hamiltonian Systems concepts have also become evident. For example, ideas about the dynamics of coupled rigid bodies are transferrable to polarization laser dynamics and Berry's phase has applications in magnetic resonance imaging.

To attend any MSI workshop, contact the Institute at Cornell University, 2012 Caldwell Hall, Ithaca, NY 14853-2602, 607-255-8005. To attend the affiliated conference in Montréal on Hamiltonian Systems,

Transformation Groups, and Spectral Transform Methods, contact: J. Harnad, École Polytechnique, CP 6079, Succursale A, Montréal, Québec, H3C 3A7, Canada, 514-343-7487, or the conference sectary at 514-343-2197.

Postdoctoral Applications Sought

Applications for 1990-1991 post doctoral positions are currently being invited. The deadline is December 15, 1989. Awards will be made by January 31, 1990. For details see the advertisement in the July/August *Notices* of the AMS or contact MSI at Cornell University.

News from the Institute for Mathematics and Its Applications

University of Minnesota

The Institute for Mathematics and its Applications (IMA) program for 1989-1990 is "Dynamical Systems and Their Applications". The program will begin September 5 with an opening workshop that will feature introductory lectures by Rutherford Aris, Shui-Nee Chow, Paul Fife, Martin Golubitsky, John Mallet-Paret, Kenneth R. Meyer, Richard Moeckel, Grisha Sivashinsky, and Forman A. Williams. The topics of concentration for the period September to December are Chemical Reactions and Combustion Dynamics. The organizers include Rutherford Aris, Donald Aronson, Paul Fife, Amable Linan, Harry Swinney, and Forman Williams. There will be a workshop on "Pattern and Dynamics in Reactive Media" during October 16–20, 1989 and a workshop on "Dynamical Issues in Combustion Theory" during November 13-17, 1989.

The winter program will concentrate on Hamiltonian Dynamics and Mathematical Physics; L. Kadanoff, R. McGehee, K. Meyer, J. Moser, C. Robinson, and E. Zehnder will be the organizers.

During March–April, 1990 there will be a concentration on Mathematical Physiology and Differential-Delay Equations. A series of lectures in Neural Networks and Developmental Biology is planned.

During April–June, 1990 the concentration will be on Fluid Flow and Convection Dynamics. Turbulence in Fluid Flows, Nonlinear Phenomena in Atmospheric and Oceanic Sciences and Chaotic Processes in Geological Sciences will be among the topics to be studied.

DMS Advisory Committee Meeting in November

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) will hold its semi-annual Advisory Committee meeting on November 6-7, 1989, at NSF headquarters in Washington, DC. The committee, which consists of mathematical scientists from academia, laboratories, and industry, advises the DMS on setting priorities and formulating plans.

The last committee meeting included discussions of several crucial funding priority issues, such as the new geometry initiative, small travel grants, and educational activities (see "Setting Scientific Priorities," *Notices*, May/June 1989, page 540).

The meeting will be open to the public. Suggestions for topics of discussion should be made to Judith Sunley, DMS Director, 202-357-9669; Internet, jsunley@note.nsf.gov; Bitnet, jsunley@nsf. Those wishing to attend the meeting should contact Trudy Sensibaugh at the same telephone number, or via Internet, tsensibaugh@note.nsf.gov or Bitnet, tsensibaugh@nsf. The address is National Science Foundation, Division of Mathematical Sciences, Room 339, 1800 G Street NW, Washington, DC 20550.

MS 2000 Plans Curriculum Conference

The National Research Council project Mathematical Sciences in the Year 2000 (MS 2000) will sponsor a one-day conference focusing on the service role for mathematics and statistics. The conference, entitled "Mathematical Sciences: Servant to Other Disciplines", is part of the MS 2000 curriculum review and as such, will be an opportunity to gather information concerning service courses taught by mathematical sciences departments at the undergraduate and graduate level. The perspective will be from the client's viewpoint, since the invited participants will represent a broad range of disciplines that rely on mathematics and statistics course offerings to support their curricula and educate their students. Beyond the factual information about what is currently being offered, the speakers will address the mathematical needs of their curricula and whether mathematical sciences departments are fulfilling the need.

The conference will be held on Friday, October 13, 9am to 4:30 p.m., at the University of Maryland, College Park Campus. There will be 8 to 10 disciplines represented, including the areas of physics, chemistry, biology, engineering, computer science, management, the social sciences, the arts and the humanities. The conference will be structured in a congressional hearing format, with the participants making 10 to 15 minute statements to the MS 2000 Committee, followed by a 20 to 25 minute question and answer period between the presenter and the committee. The audience will have an opportunity to participate in the question and answer period to the extent that time permits.

A substantial proportion of the teaching in the mathematical sciences is in this service capacity, and people both inside and outside the mathematical sciences are troubled by the effectiveness of the instruction. This

conference should be a convenient means for the audience and the participants to gain some insight into the difficulties.

Information about the conference program, directions for the University of Maryland campus, and overnight accommodations have been sent to mathematical sciences departments. Individuals interested in attending the conference are asked to contact the department office for details. This information can also be requested from the MS 2000 Office, NAS 301, National Research Council, 2101 Constitution Avenue N.W., Washington, DC 20418, or by email jav@athena.umd.edu. A registration fee of $30 is being charged to offset the cost of lunch, refreshments and the conference proceedings. The deadline for registration is **October 4, 1989**.

Mathematical Contest in Modeling

Eight student teams from across the country have received awards for their outstanding solutions to the Mathematical Contest in Modeling (MCM), which gives teams of students the opportunity to challenge their skills in solving real-world problems. The winning papers were chosen from among 211 entries.

Participation in the contest has grown rapidly since it was first instituted in 1985. The number of entries has increased more than 40% in the last two years.

Each three-student team had a weekend to produce an in-depth analysis of one of two modeling problems. The contest gives the teams a choice of two problems, one "continuous" and one "discrete." This year, the continuous problem, chosen by 93 teams, was based on a paper written by two biologists in 1981. They had classified, by antenna and wing length, two species of small insects called midges. One species had six midges, the other had nine. When plotted as points on a graph of antenna versus wing length, the midges formed two clusters whose convex hulls did not overlap. Three additional midges fell between the clusters, and the problem was to decide to which species each of these three belonged. Teams generally used a statistics approach, but one of the winning teams applied neural nets.

The discrete problem, chosen by 118 teams, asked for a scheme for assigning aircaft to a runway queue. Relevant factors were the number of passengers on board, connections, and time schedules. (A pre-contest sampling of airlines revealed that they use a first in, first out scheme. One regional airline was experimenting with a different scheme.) The students' solutions ranged from assignment-type linear programming approaches to solutions based entirely on statistics.

The judges chose as winners three of 17 midge papers designated as Meritorious. The schools, together with their MCM advisers, are: California Polytechnic State University, T. D. O'Neil; California Institute of Technology, D. B. Wales; and Washington University, H. Mukai.

Also chosen as winners were five of the 22 Meritorious solutions to the airport problem. The schools and MCM advisers are: Drake University, A. F. Kleiner; Harvey Mudd College, R. L. Borrelli; North Carolina School of Science and Mathematics, D. Teague; Ohio State University, T. G. Ralley; and the University of Dayton, R. C. Steinlage. The North Carolina School of Science and Mathematics, a high school in Durham, was also a winner last year, when it was the first precollegiate team to place in the MCM.

The MCM is sponsored and administered by the Consortium for Mathematics and its Applications, a Massachusetts-based organization that publishes a wide variety of innovative curricular materials. The Society of Industrial and Applied Mathematics (SIAM) and the Operations Research Society of America (ORSA) also provide financial support for the MCM. In addition, SIAM and ORSA chose one winning team from each problem category and paid the expenses for the team members to attend the societies' meetings. ORSA chose CalPoly and Harvey Mudd, and SIAM selected CalTech and Harvey Mudd.

Ben Fusaro of Salisbury State University is the founder and director of the MCM. The next MCM will be held in February, 1990. Those interested in further information can contact Fusaro at Department of Mathematics, Salisbury State University, Salisbury, MD 21801.

American Team Places Fifth in Olympiad

A team of six American high school students placed fifth in the 30th International Mathematical Olympiad, held July 13–24 in Braunschweig, West Germany, with one team member receiving a perfect score.

The American team scored 207 out of a possible 252 and led the participating western countries in a competition dominated by eastern nations. Ahead of the Americans were teams from China (237), Romania (223), the U.S.S.R. (217), and East Germany (216). There were only 3 western countries among the top 13 teams, with West Germany placing 8th and France 13th. Fifty countries sent a total of 291 students to the competition.

The judges also awarded individual first, second, and third prizes to deserving team members. Jordan Ellenberg of Potomac, MD received a gold medal for a perfect score of 42, one of only 10 perfect scores. Four American team members received silver medals: Samuel Kutin of Old Westbury, NY (32), Andrew Kresch of Havertown, PA (37), Jeffrey Vanderkam of Raleigh, NC (35), and Samuel Vandervelde of Amherst, VA (32). David Carlton of Oberlin, OH received a bronze medal (24). Twenty gold, 55 silver, and 72 bronze medals were awarded.

The Olympiad teams competed by working on solutions to six challenging mathematical problems in two, 4 1/2-hour sessions. One problem from the exam asked the competitors to prove that it is possible to arrange the numbers $1, 2, 3, \ldots, 1989$ into 117 lists of 17 numbers each, in such a way that every list has the same sum.

The U.S. Olympiad activities are sponsored by eight national organizations in the mathematical sciences, including the Mathematical Association of America and the AMS. Financial support is provided by IBM, the Army Research Office, the Office of Naval Research, Hewlett-Packard, and the Matilda R. Wilson Fund.

AAAS Science Education Directory 1989

The *AAAS Science Education Directory 1989*, a resource for anyone who is involved in science, mathematics, or technology education, is now available. The *Directory* lists key persons in the nation who are responsible for science, mathematics, and technology education. It contains addresses and telephone numbers of principal executives, directors, administrators, and policy-makers who are leaders in associations, scientific academies, museums, educational research centers, educational laboratories, and state and federal government agencies. The *Directory* also provides information about the major science and mathematics education activities of these organizations. Some 1700 individuals, programs, and organizations are included.

The 1989 edition has been revised and expanded. A new section has been added that lists more than thirty national educational organizations with interests in science, mathematics and technology education. The "Resources" section includes many new listings of programs and activities for students and teachers. This section contains a variety of information that should be useful to teachers, university educators, community organizations, and others who work on specific programs to strengthen science, mathematics and technology education. In addition to the state supervisors of mathematics and science, the 1989 edition includes the names and addresses of the specialists in social studies. Key Congressional committees responsible for science education funding and their members, reflecting the latest changes in the new administration, are listed too.

A detailed table of contents and four indices help readers quickly locate information.

For a free copy of the 180-page *AAAS Science Education Directory 1989*, write to Barbara Walthall, American Association for the Advancement of Science, Office of Science and Technology Education, 1333 H Street, N.W., Room 1139, Washington, DC 20005.

Electronic Submission of Abstracts

In the May/June 1989 issue of *Notices*, the Society announced the availability of a new service for submitting abstracts in electronic mail using the plain TEX and $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX computer typesetting systems. This service has now been expanded to include the LATEX system as well.

Many members have requested that the AMS allow for electronic submission of abstracts for talks given at Society meetings. Before this service was available, speakers were required to send to the AMS Providence office paper copies of their abstracts, which are then used for camera copy to produce the publication *Abstracts*. This service will prove a great convenience to the many who use the TEX system and software packages, and will make the production of *Abstracts* faster and more efficient.

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.

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, $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX, or LATEX package.

AMS Council Agenda and Minutes Subscriptions

The Agenda and Minutes of the AMS Council, the governing body of the Society, are now available through subscription. One may receive only the Agenda, or the Agenda and subsequent Minutes of Council meetings. The latter includes the open minutes of the Executive Committee and Board of Trustees (ECBT).

The Council meets three times per year. A typical Council Agenda, together with attachments, runs about 80 pages, with the Council Minutes somewhat shorter. The Minutes of

the ECBT, which meets twice yearly, usually comprise over 100 pages, including attachments.

These subscriptions are available only to AMS individual and institutional members and will begin in 1990. Individual and institutional members will have received information about these subscriptions in their dues notices, or they may contact the Customer Services Department, AMS, P.O. Box 6248, Providence, RI 02940.

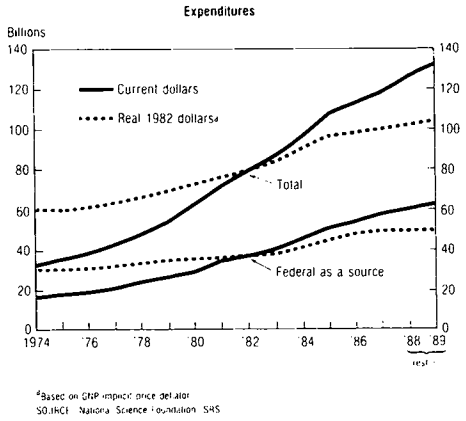
Slow Rate of R&D Growth for 1989

The nation's expenditures for research and development (R&D) are expected this year to grow only by 1% in inflation-adjusted dollars—the lowest rate since 1975, according to estimates by the National Science Foundation (NSF). The lackluster showing is attributable both to a downturn in R&D funding by industry and to tightening federal budgetary constraints as a result of the federal deficit.

Overall, the nation is expected to spend $132 billion on R&D in 1989, about 5% more than the amount estimated for 1988 (not including R&D spending by U.S. industry). Between 1977 and 1982, real R&D expenditures increased fairly steadily at an average rate of 4.5% per year. This rate jumped to 6.9% per year between 1982 and 1986, the most rapid growth in any 3-year period since the 1960s. In both 1986 and 1987, however, this rate of growth dipped to 2% per year and is estimated at 3% for 1988.

Much of the gain in the nation's support for R&D during the 1980s is attributable to large increases in federal defense spending. The federal government, which has consistently supplied approximately one-half of the nation's total R&D expenditures, will put an estimated 66% of its 1989 R&D dollars toward defense activities. In 1980, such defense-related spending accounted for one-half of federal R&D funding. While increases in defense expenditures are responsible for fully 90% of the estimated growth in federal R&D support since 1980, most of this growth took place in the first half of the decade.

In 1989, the nation is expected to spend $19 billion on basic research, $27 billion on applied research, and $86 billion on development. These totals represent real increases from 1988 of 3%, 1%, and 1%, respectively. Since 1985, the rate of growth in basic research funding has annually exceeded that in both applied research and development.



Over the past decade, however, spending on development has been considerably higher than on research. Much of the growth in development is a result of the major increases in federal support for defense R&D, which is about 90% development. Even with the recent gains in federal support for civilian R&D, which has a relatively higher research component, defense-related R&D continues to receive the majority of federal R&D funds, by a two-to-one margin.

Slow growth in R&D is also seen in U.S. companies. According to NSF estimates, U.S. firms are expected to spend more than $61 billion for R&D in 1989, a 2% constant-dollar increase over 1988 levels. R&D spending increases varied widely among the industries. For example, the chemical industry projected a 10% increase in R&D spending in 1989, compared to no growth at all in the motor vehicles industry.

The data presented in this article come from a variety of NSF surveys. A more detailed analytical report covering these data was published in the spring by the Science Resource Studies Division of the NSF.

Erratum

In the list of recent recipients of the National Science Foundation's Presidential Young Investigator Awards (*Notices*, May/June 1989, page 569), the name of one of the awardees, Bruce Donald, was inadvertently omitted. Donald is a theoretical computer scientist at the Mathematical Sciences Institute at Cornell University. His research involves the use of algorithms in robotics.

Funding Information for the Mathematical Sciences

Travel Grants for ICM-90, Kyoto

The American Mathematical Society has applied to several funding agencies for funds to permit partial travel support for U.S. mathematicians attending the 1990 International Congress of Mathematicians in Kyoto. In anticipation of the availability of funds, the Society is preparing to administer the selection process.

Mathematicians who wish to apply for travel support can find an application form at the back of this issue. Note that the deadline for completing and returning the application form to Providence is **November 1, 1989**. Applications will be evaluated by a panel of mathematical scientists under the terms of a proposal submitted to the National Science Foundation by the Society. Recent recipients of doctoral degrees, as well as women and members of minority groups, are encouraged to apply.

If a mathematician accepts a grant for partial support of the travel to Kyoto, these travel funds may not be supplemented by any other NSF funds. It is the current intention of NSF's Division of Mathematical Sciences to provide *no additional funds* on its other regular research grants for travel to ICM in 1990. However, an individual mathematician who does not receive a travel grant may use grant funds, subject to the usual restrictions and prior approval requirements.

The first announcement of the 1990 International Congress of Mathematicians appears in this issue of the *Notices*.

NSF Solicits Proposals for Geometry Institutes

The National Science Foundation (NSF) has announced an experimental activity to involve mathematicians and scientists of all ages in research and education involving new geometric concepts. The Division of Mathematical Sciences and the Directorate for Science and Engineering Education invite proposals for the establishment of Regional Geometry Institutes (RGIs), where research mathematicians will congregate to learn new geometric tools and to interact with mathematics educators and students.

Plans call for between one and three awards during the first year of this experimental activity. Should it prove successful, additional awards may be made in future years.

In the RGIs, a critical mass of research geometers, geometry educators and teachers, and students may gather for activities within a framework that promotes individual intellectual growth while encouraging interaction between these groups.

Each RGI should incorporate both an Advanced Research Component and a Creative Education Component and should effectively integrate the research and education objectives of both. The research components are aimed primarily at university and college faculty and graduate students interested in acquiring new geometric tools for use in their own research specialty. The education component may involve geometry education researchers, undergraduate and secondary faculty, undergraduates, and/or secondary students.

The RGIs will be based at academic institutions, either at a single host campus or a regional collection of campuses. So as to promote the establishment of extended interaction among participants, it is desirable that RGIs be maintained for two or more years. However, it is likely that the majority of the activity will take place during the summers.

A prospective host institution will select as the focus of the research component a particularly active area of mathematics that significantly incorporates geometric ideas. Lead research figures, known to be strong expositors, will deliver plenary lectures on various aspects of the specialty, designed specifically to be understandable to the audience at hand.

The education component should stress geometric concepts not usually emphasized in the standard geometry curriculum. The component will focus on activities which will improve students' and faculty members' geometric and visual thinking and may be primarily concerned with precollege and/or college level geometry.

The deadline for proposals will likely be **October 1, 1989** or **November 1, 1989**. Further information and a program solicitation are available from Russell B. Walker,

Program Director, Geometric Analysis Program, Division of Mathematical Sciences, Room 339, National Science Foundation, 1800 G. Street, NW, Washington, D.C. 20550; telephone 202-357-3451; electronic mail rwalker@note.nsf.gov (Internet).

Visiting Professorships for Women

The Visiting Professorships for Women program at the National Science Foundation (NSF) is designed to provide opportunities for women in science and engineering to advance their careers while enhancing their visibility in these professions. The program is open to women employed in industry, government, or academia.

The program allows a woman scientist or engineer to pursue advanced research at an academic institution. In addition to her research responsibilities, the visiting professor undertakes lecturing, counseling, and other activities to increase the visibility of women in the host institution and to provide encouragement for other women to pursue careers in science and engineering.

Applicants must hold a doctoral degree (or have equivalent experience) in a field normally supported by the NSF and must have independent research experience. The instruction and other activities may be directed to the undergraduate or graduate levels, or to the community at large. Proposals will be evaluated on the plans for such activities, as well as the scientific merit of the proposed research. The usual award will be for 12 months for a full- or part-time professorship, but awards for one academic semester or for 24 months will be considered.

Last year, out of a total of 25 awards made in all disciplines supported by the NSF, two went to women in the mathematical sciences.

The deadline for applications is **November 15, 1989**. For further information about guidelines and eligibility, contact Margrete Klein, Program Director, Visiting Professorships for Women, National Science Foundation, 1800 G Street, N.W., Washington, DC 20550; telephone 202-357-7734.

NSF-AWM Travel Grants for Women

The National Science Foundation (NSF) is sponsoring a program of travel grants for women mathematicians, administered through the Association for Women in Mathematics (AWM). In providing support for women to attend research conferences in their fields, these grants are intended not only to advance women's research activities, but also to increase awareness that women are actively involved in mathematical research.

The travel grants will suport travel and subsistence to a meeting or conference in the applicant's field of specialization. There is a maximum of $1000 for domestic travel and $2000 for foreign travel. To be eligible, an applicant must be a woman holding a doctorate in a field of research supported by the NSF's Division of Mathematical Sciences (or have equivalent experience). A woman may not be awarded more than one grant in any two-year period and should not have available other sources of funding (except partial institutional support).

There will be four award periods in the coming year, with applications due **November 1, 1989**, **February 1, 1990**, **May 1, 1990**, and **August 1, 1990**. An application should include a description of current research and how the proposed travel would benefit the research, a curriculum vita, and a budget. These materials should be sent to the Association for Women in Mathematics, Box 178, Wellesley College, Wellesley, MA 02181.

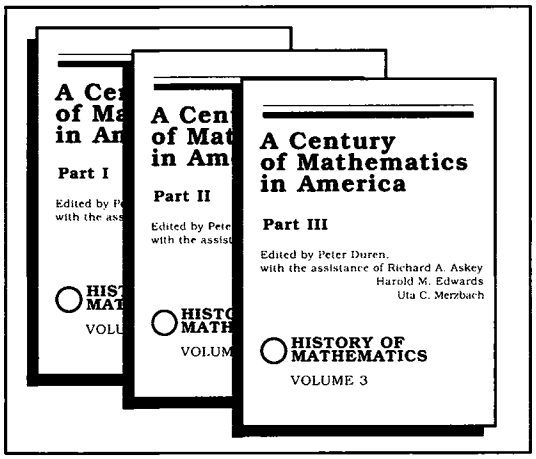
Postdoctoral Fellowships in Japan

In an effort to strengthen ties between U.S. and Japanese researchers in science and engineering, the National Science Foundation (NSF) established last year a "Japan Initiative." The initiative includes a number of programs designed to increase the number of American researchers who can operate with ease in Japan's research community and follow developments in the Japanese research literature.

As part of the program, the NSF has established two postdoctoral fellowship programs. The first, sponsored by the Japan Society for the Promotion of Science, will award 25 fellowships to conduct research in Japanese university laboratories or at other institutions affiliated with the Japanese Ministry of Education, Sciences, and Culture. The 12-month research visits are open to U.S. citizens or nationals not more than 35 years of age. The program provides airfare for the awardee, a monthly stipend, a modest housing allowance, medical insurance, and a language-training allowance.

Through the second program, sponsored by the Japanese Science and Technology Agency, approximately 35 young American researchers will have the opportunity to collaborate with Japanese colleagues at nonacademic research facilities in Japan. The awards may be held for 6-24 months and provide a monthly stipend, travel, housing, medical insurance, and research-related expenses. The Japanese Union for Science and Engineering will provide language training for the participants at Tsukuba Science City. To be eligible, applicants must be no more than 35 years of age.

The deadline for both programs is **November 1**. For more information, contact: Japan Initiative, Room 1208, Division of International Programs, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-9558.



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Acknowledgement of Contributions

The officers and the staff of the Society acknowledge with gratitude gifts and contributions received during the past year. Contributing members of the Society paid dues of $132 or more. In addition to contributions to the AMS Centennial Research Fellowship Fund, there were a number of unrestricted general contributions. Some of the contributors have asked to remain anonymous. All of these gifts provide important support for the Society's programs. Also listed this year are AMS members who contributed, thru the Society, to the International Mathematical Union's Special Development Fund for travel grants to young mathematicians from developing countries. The names listed below include those whose contributions were received during the year ending March 31, 1989.

CONTRIBUTING MEMBERS

Adams, Elliott T.
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●Becker, Ronald I.
Becker, Thomas
Beckman, Frank S.
Beckmann, William H.
*Beckner, William
Bédard, Robert
Bedford, Eric D.
Beebe, Alfred S.
Beechler, Barbara J.
Beekman, John A.
●Beekmann, Wolfgang
Beem, John Kelly
Beesley, E. Maurice
●Beeson, Michael J.
Behnke, K.
Beig, Robert
●Beineke, Lowell W.
●Bekken, Otto Borger
Bélair, Luc
Belak, Diane M.
Belfi, Victor A.
Bell, Allen D.
Bell, Howard E.
Bell, James M.
Bell, Murray Gordon
*Bell, Stoughton
Bellamy, David P.
Belley, J. M.
*Bellin, Gianluigi
Bellissard, Jean V.
Bellomo, Nicola
●Bellout, Hamid
Belpaire, Gerald
Bemelmans, Josef
Benardete, Diego
Ben-Artzi, Matania
Bence, James Kenyard
*Bencsath, Katalin A.
Bendat, Julius S.
Benedetto, John J.
Benes, Vaclav E.
Benham, James W.
Ben-Israel, Adi
Benitez, Carlos
Benkart, Georgia M.
Bennett, Andrew G.
Bennett, Fredricka T.
Bennett, Larry F.
●Bennhold, Cornelius
Benson, Dave
Benson, David Bernard
Benson, Donald C.
Benson, F. Chal
Benson, Steven R.
Benyamini, Yoav
Berbee, Henry C. P.
Berenbom, Joshua
Berend, Daniel
●Berens, Hubert
Berenstein, Carlos A.
Berestycki, Henri
Berg, Christian
Berg, Gene A.
Berg, Gunnar
*Berge, John Orrin
Berger, Alan E.
Berger, Marcel
Berger, Marsha J.
Berger, Neil E.
Berger, Robert W.
Berger, Ruth I.
●Berger, Thomas R.
Berglund, John F.
Bergman, George M.
●Bergmann, Arthur
Bergmann, Peter G.
Bergstrand, Deborah J.
Bergstrom, Roy C.
Bergum, Gerald E.
Bergweiler, Walter
Berin, Alec
Beringer, Alfred
Berkovitz, Leonard D.
Berkowitz, Harry W.
Berlekamp, Elwyn R.
Berman, David R.
Berman, J. Michael
Berman, Stephen
Bermond, J-C
Bermúdez, Alfredo
Bernardi, Salvatore D.
●Berndt, Bruce C.
Bernfeld, Stephen R.
Berni, Betty
Bernis, Francisco
Berresford, Geoffrey C.
Berstein, Israel
Berterman, John E.
Bertin, Emile M.
Bertolini, Giovanni
Berton, John A.
●Berzsenyi, George
Beschler, Edwin F.
Bessenrodt, Christine
Betancourt, Carlos M.
Betsch, Gerhard
Betz, Ebon E.
●Beyl, F. Rudolf
Beylkin, Gregory
Bezdek, Andras
●Bezuidenhout, Carol E.
Bhaskaran, M.
Bhatnagar, R. K.
Bhattacharya, Rabi N.
Bialek, Paul R.
Bialostocki, Arie
Bianco, Anthony J.
Bianco, Lucio
*Bickel, Marilyn S.
Bierstedt, Klaus D.
Bierstone, Edward
Biles, Charles M.
Billera, Louis J.
Billigheimer, Claude E.
Billik, Martin
Bilodeau, Gerald G.
Bindschadler, David E.
Bing, Kurt
Bingham, Michael S.
Binkley, Dean H.
Bircher, John J.
Biriuk, George
●Birkenmeier, Gary F.
Birman, Joan S.
*Birnir, Bjorn
Biroli, Marco
Bishop, Alan A.
Bishop, Christopher J.
Bishop, Richard L.
Bisson, Terrence Paul

Bisztriczky, Tibor
Bjorklund, Peter B.
●Björner, Anders
Black, David L.
Blackall, Clair J.
Blackmore, Denis L.
Blackwood, Philip D.
Blad, Michael C.
Blair, William D.
Blais, J. A. R.
Blakemore, Carroll F.
Blanch, Gertrude
Blanche, Ernest E.
Blanchet-Sadri, Francine
Blankinship, William A.
Blatter, Christian
Blatter, Jorg
Blattner, Robert J.
Bledsoe, Woodrow W.
●Blei, Ron C.
*Bleick, Willard E.
Bleiler, Steven A.
Blij, Frederik Van Der
*Blizard, Wayne D.
Bloch, Ethan D.
Bloch, William L.
Blomstrom, Carol A.
●Blondel, Corinne
Bloom, David S.
Bloom, Frederick
●Bloom, Thomas
●Bloom, Walter R.
*Blows, T. R.
Bluher, Grigory
Blum, Dorothee Jane
Blum, Ilya Eugene
Blum, Joseph
*Blum, Lenore
Blumenthal, Robert A.
Blyth Rentzsch, Barbara J.
Boardman, John M.
Boas, Ralph P.
Bobisud, Larry E.
Bobonis, Augusto
Bodnar, Istvan
Bodnarescu, M. V.
Bodvarsson, Gunnar
●Boe, Brian D.
Boffi, Giandomenico
Bogart, Kenneth P.
Bohnke, G. C.
Boisvert, Robert E.
Boivin, Andre
Boivin, Daniel E.
Bojanic, Ranko
Bojars, Juris A.
Boley, David B.
Bolker, Ethan D.
Bolley, Don S.
Bollinger, Robert A.
Bollman, D. A.
●Boman, Jan
Bond, David B.
●BonDurant, Bill
Bonet, Jose
Bonin, Joseph E.
Bonner, Richard F.
Boo, Per-Anders
Booker, Andrew J.
Booker, T. Hoy
*de Boor, Carl
Boos, William
Boothby, William M.
Borchers, Hans-Jurgen
Borel, Armand
*Borelli, Mario
Börgers, Christoph
Borrelli, Robert L.
Borucki, Leonard John
Borwein, David
Bosch, Carlos Giral
Bosch, William W.
Bose, N. K.
Bossavit, A.
Boswell, Rupert D., Jr.
Botelho, Fernanda
Bott, Raoul H.
●Bottazzini, Umberto
Bottema, Murk J.
Bouchet, Andre
Boules, Adel N.
Boulet, Genevieve
Boultbee, Nan
Bourgeois, Brian A.
●Bourgeois, Sister Denise
Bourgin, Richard D.
Bourland, David
Bousfield, Aldridge K.
*Bousquet, Michel
Boutin, Pierre
Bouwsma, Ward D.
Bovier, Anton
Bower, Julia W.
Bowers, Philip Lee
Bowie, Harold E.
Boyack, Stephen W.
Boyce, Elsa K.
Boyce, William E.
Boyd, John P.
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Boyle, Ann K.
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Boyle, Mike
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Braam, Peter J.
Brachman, Malcolm K.
Brackx, Freddy F.
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Bradley, John S.
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*Brady, Wray G.
Bragg, Arthur E.
●Brahana, Thomas R.
Brakke, Kenneth A.
●Bralver, Peter Jeffrey
Bramble, James H.
Bramsen, John D.
Brandal, Willy
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Branner, Bodil
Branton, Michael G.
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Brattström, Gudrun B.
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Braun, Willard J.
Bravo, Raul
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Brechner, Beverly L.
Breckenridge, John C.
Breen, Lawrence S.
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Breidbart, Seth I.
Brender, Melvin
Brennan, Joseph P.
Brenner, Philip
Brent, Richard P.
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Bresson, Maurice J.
Bressoud, David M.
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Brewer, Linda K.
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Brierley, William L.
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Brinkmann, Hans-Berndt
Britton, John L.
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●Broline, Duane M.
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Bromley, Darwin P.
Brommundt, Eberhard W.
Brons, Hans
Brons, Kenneth A.
Brons, Morten
Brooks, Burrow P.
Brooks, Robert
*Brosamler, Gunnar A.
Brosowski, Bruno H.
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Browder, William
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*Brown, Arthur A.
Brown, Arthur B.
Brown, Edgar H., Jr.
Brown, Gayle M.
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Brown, Gerald D.
Brown, Gerald L.
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Brown, Patrick J.
Brown, Richard L.
Brown, Robert Dillon
Brown, Robert E.
●Brown, Robert Freeman
Brown, Robert Gregory
*Brown, Scott W.
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Browne, H. Nelson, Jr.
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Brualdi, Richard A.
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Brucks, Karen M.
Bruckstein, Alfred M.
Brueggemann, Wolfgang
Bruen, Aiden A.
Bruggeman, Roelof W.
Brumer, Armand
*Brumfiel, Gregory W.
Bruner, Robert R.
Brunet, Richard M.
*Brunner, Hermann
Bruns, Winfried
●Brunson, Barry W.
Brunswick, Natascha A.
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Bryant, John G.
Bryant, Robert L.
Bryce, Gerald M.
Brydges, David C.
Brylawski, Thomas H.
Brylinski, Jean-Luc
Brylinski, Ranee Kathryn
Bryn, Milo F.
*Brzenk, Ronald M.
Brzezinski, Juliusz
Bshouty, Daoud
Bube, Kenneth P.
Buccino, Alphonse
Buchanan, Thomas
*Buck, Marshall W.
●Bucki, Andrzej J.
Buckley, Joseph T.
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Bucy, Richard S.
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Budnik, Paul, Jr.
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Buehler, Royce E.
Buekenhout, F.
Buhler, Joe P.
Buianouckas, Francis R.
Bula, Witold
*Bulger, Leonard L.
Bulirsch, Roland Zdenek
Bullen, Peter
Bullivant, David P.
Bulman-Fleming, Sydney D.
Bump, Daniel Willis
Bungart, Lutz
Bunge, Marta C.
●Buntinas, Martin G.
Buoncristiani, John F.
Burchard, Hermann G.
Burckel, Robert B.
Burgess, C. Edmund
Burgess, Richard Dennis
Burgess, Walter D.
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Burkill, John C.
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Burns, Anne M.
Burns, Daniel M., Jr.
Burns, Keith H.
Burr, Stefan A.
Burris, Stanley N.
Burstall, Francis E.
Burton, Leonard P.
Busemann, Herbert
●Busenberg, Stavros N.
Buser, Peter J.
Businger, Walter A.
Buss, Samuel R.
Butchart, John H.
Butcher, John C.
Butcher, Ralph Stevens
Butler, John B., Jr.
Butler, Lynne M.
Butnariu, Dan
Buttke, Thomas F.
Butts, Thomas R.
●Buys, Mutiara
Buzano, Ernesto
Byerly, Robert E.
Byrd, Kenneth A.
Byrne, Catriona M.
Byrne, Charles L.
Byrnes, Christopher I.
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Byrnes, Raymond Albert, Jr.
Cable, Charles A.
Caccianotti, Luciano
●Cacioppo, Robert Joseph
Cadogan, Charles C.
de Caen, D.
Caflisch, Russel
Cagnac, Francis
Cain, Bryan E.
*Cain, George L., Jr.
Caines, Peter E.
Cairoli, R.
Calabi, Eugenio
Calderbank, Robert
Calderer, M. Carme
Caldwell, Gordon R.
Caldwell, Roderick P. C.
Caldwell, William V.
Callahan, James J.
Callegari, Andrew J.
Calvert, Bruce D.
Calvert, James E.
Calvis, David T.
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Camarena, Vicente
Cameron, Douglas E.
Cameron, Edward A.
●Camillo, Victor P.
Camina, A. R.
Campanino, Massimo
Campbell, Harold E. A.
Campbell, L. Andrew
*Campbell, Neville Ray
Campbell, Paul J.
●Campbell, R. B.
Campillo, Antonio
Campiti, Michele
Campos, L. M. B. C.
●Candiotti, Alan
Candy, Gregory T.
●Canfield, E. Rodney
Cannon, James W.
Cannon, John R.
Cantoni, Vittorio
Cantor, Robert M.
Cantrell, James C.
Cap, Clemens Heinrich
●Capasso, Vincenzo
Capozzi, Alberto
Cappell, Sylvain E.
Capuzzo Dolcetta, Italo
Caranti, A. E.
Carbery, Anthony
*Cardenas, Humberto T.
Cardona, Ivan
Caricato, Gaetano
Carini, Luisa
Carleson, Lennart A. E.
Carlson, Bengt G.
●Carlson, David H.
Carlson, James A.
Carlson, James W.
Carlson, John R.
Carlson, John W.
Carlson, Jon F.
Carlson, Kermit H.
Carlson, Robert C.
Carlsson, Renate
Carmichael, Richard D.
do Carmo, Manfredo P.
Carr, Donna M.
Carroll, Edward M.

Carroll, Michael P.
•Carroll, Timothy B.
Carruth, James H.
Carson, Andrew B.
•Carstens, Allan M.
Cartan, Henri
Carter, David W.
Carter, James E.
Carter, Thomas J.
Cartier, Pierre
Carton-Lebrun, C.
•Caruso, J. L.
*Carver, George E.
Casazza, Peter G.
Case, Bettye Anne
Casey, Robert Francis
Casey, Stephen D.
Casian, Luis Guillermo
Casler, Burtis G.
•Cassels, J. W. S.
Cassidy, Phyllis J.
Cassity, C. Ronald
Castagnoli, Erio A.
•Castelfranco, Ann M.
Castillo-Chavez, Carlos
Castore, Glen M.
Catanese, Fabrizio M. E.
Catanzano, Sheri
Cateforis, Vasily C.
Cater, Frank S.
*Cato, Benjamin R., Jr.
Cattabriga, L.
Causey, William M.
Cauvi, Roberto Jose
Cavender, James A.
Caveny, Deanna Marie
Cawley, Robert
Cazzaniga, Franco
Cebollero, Blanca S.
Cecil, Thomas E.
•Cegrell, Urban
•Cehelsky, Priscilla
Cerda, Joan
Cerruti, Umberto
Certain, Melinda W.
deCesare, Kenneth M.
Cesari, Lamberto
Chabert, J. L.
Chacon, Paul R.
Chae, Dongho
Chaffee, James W.
*Chaiken, Seth D.
Chakerian, Gulbank D.
Chakravarty, Subinoy
Chalmers, Bruce L.
Chalmers, Graham D.
Chambers, Daniel Warren
Champagne, Carol Z.
Chan, Jack-Kang
Chan, Jean B.
Chan, Tony F.
•Chandarana, Sharad
Chandler, Michael Paul
Chang, Bomshik
Chang, Chao P.
Chang, Chienming A.
Chang, Chin-Huei
Chang, Der-Chen Edward
Chang, Eugene J.
Chang, Gerard J.
*Chang, I-Chen
Chang, I-Lok
Chang, Kun Soo
Chang, Ping-Tung
Chang, Shao-Chien
Chang, Sun-Yung Alice
Chang, Yu
Chanillo, Sagun
Chantala, Diane Kim
Chao, J. A.
Chaperon, Marc
Chapin, Steven Arthur
•Charalambous, Michael Georgiou
Charles, Josette
Charney, Ruth M.
Chatterji, Srishti D.
Chauvin, Andre
Chee, Pak Soong
Cheeger, Jeff
Cheifetz, Steven Todd
Chein, Orin N.
Chen, Concordia C.
Chen, Daniel K. C.
Chen, Dayue
*Chen, Etang
*Chen, Kwan-Wei
Chen, Li-Chen
Chen, Louis H. Y.
Chen, Peili
Chen, Shuxing
Chen, W. W. L.
Chen, Wanxi
Chen, Wenxiong
Chen, Y. W.
Chen, Yongzhuo
•Chen, Zhibo
Cheney, E. W.
Cheng, Benny N.
Cheng, Cheng
Cheng, Jih-Hsin
Cheng, Kuo-Shung
Cheng, Raymond S.
Cheon, Seok-Hyeon
Cherniavsky, John C.
Chernoff, Herman
Chernoff, Paul R.
Cherny, Julius
Cheung, B. K. S.
Cheung, Chi-Keung
Cheung, Maria L.
Cheung, Wing-Sum
Chiarenza, Filippo
Chicks, Charles H.
Chicone, Carmen C.
Chidambaraswamy, Jayanthi
*Chihara, Theodore S.
Chikwendu, Sunday C.
Childs, Lindsay N.
Chillag, David
Chillak, Edward W.
•Chillingworth, David R. J.
Chinburg, Ted C.
Ching, Wai-Sin
Chinn, William G.
Chiswell, Ian M.
Cho, Choong Yun
Cho, Min-Hyung
Choe, Geon Ho
Choe, Young Han
Choi, Kwok-Pui
Choi, Un Haing
Choi, Yun Sung
Choksi, Jal R.
Chong, Chi Tat
Choquet, Gustave
*Choudhary, Yogendra K.
•Choudhury, Bejoy K.
Chouteau, Charles C.
Chover, Joshua
*Chow, Pak S.
Chrestenson, Hubert E.
Christensen, Chris
Christy, Joe
•Chu, Chinku
*Chu, Tienchen
Chuang, Pi-Chun
•Chuaqui, Rolando B.
*Church, Alonzo
Church, Philip T.
Churchill, Edmund
Churchill, Richard C.
Ciarlet, Philippe G.
•Cifuentes, Patricio
*Cima, Joseph A.
Cincotta, Dominick Anthony
Cinlar, Erhan
Cipriani, Fabio
Cirina, Marco
Civin, Paul
*Clapp, Robert E.
Clapsadle, Raymond A.
Clare, Loren Paul
Clark, Bradd Evans
Clark, Cathy Ann
Clark, Charles L.
Clark, Curtis
Clark, Katherine A.
Clark, Kenneth D.
Clark, Robert A.
•Clark, W. Edwin
•Clarke, Francis
Clarke, Graham Thomas
Clarkson, Helen E.
Clarkson, Peter A.
Clary, Stuart
Claus, Elly
•Clausing, Achim
Cleaver, Charles E.
Clee, William A.
Clemens, Charles Herbert
Clements, George F.
Clifford, Alfred H.
Clifford, Jane E.
Clifton, Larry M.
Cline, Edward T.
Clivio, Andrea Giovanni
Clover, William J., Jr.
*Coar, David R.
•Cobham, Alan
Cochran, Douglas
Cochran, James A.
Cochran, Tim D.
Cochrane, Todd E.
Cockburn, Julio Bernardo
Cockburn, Sally Patricia
Coddington, Earl A.
Coen, Salvatore
Coffey, John
Coffman, Robert L.
Cogburn, Robert F.
Cogdell, James Wesley
Cohen, Arjeh M.
Cohen, Daniel I. A.
Cohen, Frederick R.
Cohen, Henry B.
Cohen, Leon W.
Cohen, Marshall M.
Cohen, Martin J.
Cohen, Michael P.
Cohen, Moses E.
Cohen, Ralph L.
Cohen, Teresa
Cohn, Donald L.
Cohn, George I.
Cohn, Harvey
Cohn, Leslie
Cohn, Richard M.
Cohn, Stephen Edward
Cohn, William S.
Colbourn, Charles Joseph
Colby, Robert R.
*Cole, Brian J.
Cole, Charles A.
Cole, Herman D.
•Cole, Nancy
Cole, Paul Dana
Cole, Randal H.
Coleman, A. John
Coleman, Courtney S.
Coleman, Robert
Coleman, Thomas F.
Coleman, William
Collet, Pierre
•Colley, Susan Jane
Collier, Jarrell D.
Collier, William G., Jr.
Collins, Dennis G.
Collins, Ken
Colonius, Fritz
Colonna, Flavia
Colquitt, Landon A.
Colson, Henry D.
Comellas, Francesc
Comenetz, Daniel
*Comerford, Leo P., Jr.
Comez, Dogan
Comfort, Edwin H.
•Comfort, W. Wistar
Conlon, Joseph G.
Conlon, Lawrence W.
Conlon, Samuel B.
Conn, Jack Frederick
Connelly, Robert
Connolly, Mary V.
•Connor, Frank F.
Connor, Jeffery S.
Connors, Edward A.
Conrad, Bruce P.
Conrad, Joseph F.
Constantin, Peter S.
Constantinescu, Corneliu
•Conway, John B.
•Cook, Edith A.
Cook, Joseph M.
*Cook, Larry T.
Cooke, Roger Lee
Cooley, Clifford R.
Coolsaet, Arnold A.
Coonen, Jerome T.
Cooper, E. D.
Cooper, Hilda L.
Cooper, Jeffery M.
Cooper, Mark A.
Cootz, Thomas A.
Copeland, Arthur H., Jr.
Copeland, Terry S.
•Copper, Mark L.
Coppotelli, Fred
Coram, Donald S.
•Coray, Daniel
Corazza, Paul J.
Corbett, John V.
Cordero, Luis A.
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Corduneanu, Constantin
Corlette, Kevin David
Cornell, Gary
Cornette, James L.
•Correa, Nelson L.
Corrigan, Thomas Carney
Corson, Jon M.
Cortzen, Barbara
•Corwin, Stephen P.
Cosner, George C.
Costa, David G.
Costenoble, Steven R.
•Cote, Louis J.
*Cotsaftis, Michel
Cotter, Christopher S.
Cotton, Robert M.
Couch, W. Eugene
Coulter, Malcolm A.
Countryman, William Mark
Coury, Nicholas J.
*Couty, R.
Covington, Thomas E.
•Cowen, Carl C., Jr.
Cowan, Jack D.
*Cowan, Richard E.
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Cowles, John R.
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•Cox, Lawrence H.
Cox, Raymond H.
*Cox, S. H., Jr.
•Cox, Samuel H.
Cox, Stephen E.
Coxeter, H. S. MacDonald
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Cranston, Michael Craig
Crapo, Henry H.
Crauder, Bruce C.
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Creese, Thomas M.
Criscenti, Jacqueline P.
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Crone, Lawrence J.
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•Crow, Edwin L.
*Crowe, John A.
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Culbertson, James T.
Cummings, James
Cunkle, Charles H.
*Cunningham, A. B.
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Cunningham, Richard J.
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•Currie, Melvin R.

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*Cushman, John H.
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Cutrer, M. Wayne
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Dadok, Jiri
●Daepp, Ulrich
Dahl, Erlend
Dahlin, Rolf B.
*Dai, Taen-Yu
Dalang, Robert C.
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●Davidson, Kenneth R.
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Davis, Chandler
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Davis, James F.
Davis, James H.
●Davis, Linda M.
Davis, Martin D.
*Davis, Paul W.
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Davitt, Harold H.
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●Dawson, John W., Jr.
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●Day, Martin V.
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De La Penha, Guilherme M.
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De La Sen, Manuel
●De Luca, Aldo
De Marr, Ralph E.
De Meersman, Roger
De Snoo, Hendrik S. V.
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*De Vries, Hendrik
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Dechéne, Lucy I.
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Deeter, Charles R.
DeFacio, Brian
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●Dehesa, Jesus Sanchez
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Dekker, Jacob C. E.
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Delaney, Matthew S.
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Delchamps, David F.
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*Delges, H. Wolfgang
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DellaPietra, Vincent J.
●DeLong, R. Peter
Delporte, Jean
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*Demko, Stephen
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Dencker, Nils
●Dennin, Joseph B.
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*Deo, Sadashiv G.
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Derr, Leroy J.
Deruaz, Marcel A. F.
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Desoer, Charles A.
Desolneux-Moulis, Nicole
Desquith, Eticnne
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●Detofoli, Rino
DeTurck, Dennis
Deuber, Walter Alfred
Deumens, Erik
●Deutsch, Daniel H.
Deutz, Andre H.
Devaney, Robert L.
Deveney, James K.
●Devlin, Keith J.
Dewallens, Jean H.
●Dewilde, Philippe
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Dibner, Steve
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Dilcher, Karl H.
●Dillon, Meighan Irene
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●Dinitz, Jeffrey Howard
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Dodson, Christopher T. J.
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Doerfler, Willibald
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Doherty, Patricia Ann
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Domino, Laurence E.
Domokos, Gabor
●Donald, Matthew James
Donaly, James P.
●Doner, John E.
Donoho, David Leigh
Donovan, Peter
Doob, Joseph L.
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Dooley, Thomas J.
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Doran, Robert S.
●D'Orazio, Silvano
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Dorfmeister, Josef F.
Dorlas, Tony C.
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Dougherty, Robert P.
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●Doust, Ian R.
Dovermann, Karl Heinz
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*Doyle, John C.
Doyle, Jon
●Doyle, Peter G.
Drager, Lance D.
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Draper, Richard N.
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Dray, Tevian
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Dreben, Burton S.
Dressel, Francis G.
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Driver, Bruce K.
●Droms, Carl G.
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Dubson, Alberto S.
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Dunham, Douglas J.
Dunion, Thomas J.
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*Earle, Clifford J., Jr.
*Eaton, Timothy R.
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*Edmundson, H. P.
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*Eiss, Joseph J.
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•Elson, Constance McMillan
•Elton, John H.
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*Epstein, Henry
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Eschenbach, Dieter
Escobales, Richard H., Jr.
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Eskin, Gregory
Eslinger, Robert C.
*Espino-Santana, Victor M.
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•Esteban, Maria J.
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Etheridge, William L.
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Evans, Trevor
Evens, Leonard
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Ewy, Daniel J.
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Ezeilo, James O. C.
Fabec, Raymond C.
Fabes, Eugene B.
Fabrega, Enfedaque Albert
Fabrykowski, Jacek W.
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Faierman, Melvin
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Falkner, Neil F.
Fall, Thomas C.
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Famoye, Kiya Felix
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Faran, James J.
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Farmer, Thomas A.
Farmer, William Michael
Farnsteiner, Rolf
Farrell, Roger H.
Fass, Arnold L.
Fathi, Albert
Faucett, William M.
Faulkner, Frank D.
Faurre, Pierre L.
Federbush, Paul
Feehan, Paul Matthew Niall
•Feeman, George F.
•Feeman, Timothy G.
Feferman, Solomon
Fegan, H. D.
Fegreus, John F.
Feigenbaum, Joan
Feighn, Mark E.
Fein, Burton I.
Feingold, Alex J.
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Feinsilver, Philip
Feit, Paul
Feit, Walter
•Feldman, Alexander
Feldman, Arnold D.
Feldman, Chester
Feldman, David Victor
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Feldman, Jacob
•Feldman, Marcus B.
Feldman, Norman
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Felland, Michael E.
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Fellman, Johan
Fellows, Michael Ralph
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Fenley, Sergio Roberto
Fenske, Christian
Fenstad, Jens E.
*Ferguson, David R.
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*Fernandez-Rodriguez, Maria L.
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Ferreira, Andrew P.
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Field, Michael J.
Fife, James H.
Figueiredo, Ana Maria
Fillmore, Jay P.
Finch, David V.
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Finch, Steven Richard
*Fine, Benjamin
Fingerman, Joel
Finkelstein, Leib
Finkelstein, Louis D.
Finlayson, Henry C.
Finol, Carlos E.
•Finston, David R.
Firey, William
Fischer, Arthur E.
*Fischer, Carl H.
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Fischer, Ismor
Fishback, William T.
Fisher, Matthew P.
Fisher, Stephen D.
Fishman, Louis
Fisk, Steve
Fitzgerald, Eugenia E.
Fitz-Gerald, Gary F.
Fitzgibbon, William E.
Fitzpatrick, Ben G.
Fitzpatrick, Ben, Jr.
Fitzsimmons, Patrick J.
*Fixman, Uri
•Fjelstad, Paul T.
•Flagg, Bob
Flaherty, Francis J.
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•Flath, Dan
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Flensted-Jensen, Mogens
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Flosser, H. O.
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Flynn, David E.
Flynn, Lawrence E.
Flynn, Robert
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•Fokas, Athanassios S.
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Fong, Kirby W.
•Fong, Paul
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Fontenot, Robert A.
Foran, James
Forbes, Stephen H.
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•Ford, Charles Edwin
Ford, David
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Ford, David James
*Ford, Ralph M.
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Forster, Klaus-Jurgen
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Fournelle, Thomas A.
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Fowler, Frederick C.
Fox, Jeffrey Stephen
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*Foxby, Hans-Bjorn
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Fragoso, Marcelo D.
Fraleigh, J. B.
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Francel, Margaret Ann
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*Franco, Salvatore S.
•Francoise, J. P.
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•Fredricks, Gregory A.
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Freedman, Allen R.
•Freedman, Marvin I.
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Freeland, Mark S.
Freeman, Edmund E.
Freeman, Robert S.
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*Freije, Margaret Napolitano
*Freiman, Gregory A.
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*French, Donald A.
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Fridman, Buma L.
*Fridy, John A.
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•Friedberg, Solomon
Friedberg, Stephen H.
*Friedland, Shmuel
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Frohardt, Daniel E.
Frohlich, Jurg M.
Frohliger, John A.
Frohman, Charles D.
•Früchtenicht, Wiebke
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Fuchs, Peter Rudolf
Fuchs, Wolfgang H.
Fuchssteiner, Benno
Fuglede, Bent
•Fuhrken, E. Gebhard
Fuji-Hara, Ryoh
•Fujimagari, Tetsuo
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Fuller, Leonard E.
Fuller, Luther B.
Fuller, Robert Arthur
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Fuqua, Jeffry B.
●Fürer, Martin
Furutani, Kenro
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Gabay, Jacques
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Gacs, Peter
Gadella, Manuel
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●Gage, Michael E.
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Gambaudo, Jean-Marc
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Ganser, Carl C.
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Gantos, Richard L.
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Garcia, Mariano, Jr.
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Garcia-Loygorri, Cristobal
●Gard, Thomas C.
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Gartland, Eugene C., Jr.
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Gasper, George, Jr.
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●Gau, Yihnan David
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Gautschi, Walter
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●Geller, Susan C.
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Gerisch, Wolfgang
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●Ghosh, Parimal K.
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●Greller, Larry David
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●Gross, Kenneth I.
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Gutknecht, Martin H.
Guy, Richard K.
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•Guzman, Fernando
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•Hamill, William A.
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Hamilton, Phillip M.
*Hamlett, Troy R.
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Hanes, Kit
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Hoover, Thomas B.
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Ito, Hiroshi
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Kim, Hong Jong
•Kim, Hyuk
Kim, Ihn Sue
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Kim, JeongSook Lee
Kim, Jong-Chul
•Kim, Kyung Hwa
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Lee, Dó-Won
●Lee, Hung-Mou
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Lee, Kotik K.
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Lee, Shyling
●Lee, Tzong-Yow
Lee, Wen-Chien
Lee, Will Y.
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Levine, Harold I.
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●Levy, Lawrence S.
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●Luk, Hing-Sun
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Post, Karel A.
Pothen, Alex
Potter, Amy M.
Potter, Walter M.
Potts, Donald H.
Poulin, Bernard
Poulsen, Ebbe T.
Pourciau, Bruce Hunter
Pour-El, Marian B.
Pouzet, Maurice
Powell, C. Spencer
*Powell, Russell E.
Power, Stephen Charles
Powers, Morris Walton
Powers, Robert T.
●Powers, Victoria Ann
Powls, Keith W.
Pradines, Jean
●Praeger, Cheryl E.
Prakash, Deepak
Prakash, Jagdish
Pratt, Vaughan R.
Preiss, Mitchell Paul
Preissendorfer, Manfred W.
Preston, Gordon B.
Presutti, Errico
*Prevots, Claude
Price, Charles M.
Price, G. Baley
Price, John F.
Price, Justin J.
Price, Roderick A.
Price, Thomas E., Jr.
Price, Thomas M.
●Priestley, Hilary A.
●Prill, David D.
Primc, Mirko
Primer, Jeremy D.
Prince, Geoffrey Eamonn
Prindle, John C.
Proctor, C. Wayne
●Proctor, Robert A.
Promel, Hans Jurgen
●Propes, J. C.
Protas, David S.
Protopopescu, V.
Protter, Murray H.
Protter, Philip E.
●Proulx, Viera Krňanová
Provencher, Normand
Pruitt, William E.
Pruss, Jan
Prussner, Laird Drew
Przytycki, Jozef H.
Pucci, Patrizia
Puerta, Fernando
Puigbo, Jaume Vila
●Puppe, Dieter
Pursell, Lyle E.
Putnam, Alfred L.
*Puttaswamy, T. K.
Pym, John S.
Quan, Loi T.
*Quigley, Frank D.
Quinn, Declan P. F.
Quinn, Frank S., III
Quinn, Grace S.
Quinn, Joseph E.
Quinn, Michael Paul
Quint, Richard A.
Quintana, Ricardo B., Jr.
●Quinto, Eric Todd
Quiring, Donald K.
Rabau, Patrick F.
Rabier, Patrick J.
Rabinovitch, Peter
Rabinowitz, Paul H.
Radjabalipour, Mehdi
Radkowski, Alfred F.
Radulescu, Nicholas Andrew
Radzikowski, Marek J.
Radzikowski, Pawel
*Rager, John E.
Raggio, Guido A.
●Rahman, Mizanur
Raisbeck, James G.
●Rajca, John F.
Rajnak, Stanley L.
Rakesh
Rall, Louis B.
Ralph, William J.
Ralston, James V.
Ram, Ram Bachan
*Ramachandran, Doraiswamy
Ramaley, James F.
*Ramalho, Margarita
Ramanujan, Melapalayam S.
Ramaroson, Francois
Ramirez, Arturo Flores
Ramm, Alexander G.
Ramsay, Bruce E.
Ramsay, Keith A.
Ran, Andre C. M.
●Randall, A. Duane
Randol, Burton S.
Raney, George N.
●Rangaswamy, K. M.
Range, R. Michael
●Rankin, R. A.
Rankin, Samuel Murray
Rankin, Stuart A.
Rao, Ranga R.
*Rao, Veldanda V.
●Raphael, Louise A.
Rapp, P. E.
Rascle, Michel
Rassias, Themistocles Michael
*Rathbun, Ethel
Ratiu, Tudor Stefan
Ratliff, Louis J., Jr.
Ratner, David A.
Rätz, Jürg J.
Rausen, John
Raussen, Martin
Rave, Werner J.
Ravenel, Douglas C.
Rawnsley, John H.
Rawsthorne, Daniel A.
Rayburn, Marlon C.
Read, Dwight
●Read, Thomas T.
Reade, Maxwell O.
Reardon, Philip C.
●Rebarber, Richard L.
Reber, Douglas C.
*Rechard, Ottis W.
Reddy, William L.
Redfield, Robert H.
Redheffer, Raymond M.
Redlin, Lothar H.
Redmond, Don
Redner, Richard A.
Reed, David L.
Reed, Robert E.
Reedy, Christopher L.
Rees, Elmer
Rees, Mina S.
Rees, P. K.
Reese, Matthias F.
Reese, Matthias F., III
Reese, Richard H.
Reese, Sylvester
Reetz, Dieter A.
Reeves-Hicks, Ernestine
*Regan, Francis
Rehmann, Ulf
●Reich, Daniel
Reichaw, Meir
●Reichel, Lothar
Reid, James D.
Reid, K. Brooks
Reid, Les
●Reid, Talmage James
Reid, William H.
Reilly, Ivan L.
Reilly, Norman Raymond
Reineck, James F.
Reiner, Irma M.
Reinhardt, Elsi A.
Reinhardt, William N.
Reisel, Robert B.
Reissner, Eric
Reitwiesner, George W.
Rejto, Peter A.
Rembis, Frederick C.
Rempel, Richard S.
Remus, Dieter
Renardy, Michael
●Renault, Jean N.
●Renegar, James M.
Renner, Lex E.
Renno, James G., Jr.
Renshaw, James H.
●Repka, Joe
Resch, Richard I.
Restrepo, Guillermo
*Retherford, James R.
Retnam, P. Xavier Raja
Revesz, Michael Bela

Reyes, Edgar N.
Reyes, Francisco G.
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Reynolds, Donald F.
Reynolds, Robert J.
Reynolds, William F.
●Reznick, Bruce A.
Rhai, Tong-Shieng
Rhee, Choon Jai
Rhodes, Frank
Rhodes, Patricia V.
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Riazi-Kermani, Mohammad
Ribes, Luis
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Ricci, Fulvio
Ricci, Michael G.
Ricci, Stephen J.
Rice, Henry G.
Rice, John William
●Rich, Andrew
Richard, B. K.
*Richards, Donald St P.
Richards, Franklin B.
Richards, John F.
Richards, Pamela C.
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●Richardson, Roger W., Jr.
Richert, Hans-Egon
Richert, Norman J.
Richmond, Glayvera
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Richter, Guenther E.
Richter, Horst P.
Richter, Linda Jean C.
Richter, Michael M.
Richter, Stefan
Richtmyer, Robert D.
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Rickey, V. Frederick
Rickman, B.
Riddle, Malcolm Lee
*Ridolfo, Anthony S.
Rieffel, Marc A.
Rieger, Georg J.
Riemen, William P.
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Riesel, Hans I.
Rigdon, Robert D.
●Riihentaus, Leo Juhani
●Rijnks, H.
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*Riley, Geoffrey William
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Ringeisen, Richard D.
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Ringseth, Paul F.
●Rinne, Dan C.
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Rishel, Thomas W.
Risnes, Martin
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Ritter, David L.
*Rivet, Roger
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●Roberts, Anne Drinkwater
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Roberts, Dorothy K.
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Roberts, Joel L.
Roberts, Joseph B.
Roberts, Lawrence Gordon
●Roberts, Leslie G.
Roberts, Mark
Roberts, Richard C.
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●Robertson, James B.
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Robinson, Donald W.
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Robinson, G. de B.
Robinson, Geoffrey Raymond
●Robinson, Helen Drummond
●Robinson, Karl H.
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Rodriguez, Mauro Efrain C.
●Rodríguez, Rubí E.
Rodriguez, Sanjurjo Jose
Rodriguez-Exposito, Jose
●Rodriguez-Anger, Rita V.
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Roels, Jacques Albert
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Rogowski, Paul B.
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Rohrlich, David E.
Roitman, Judith
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Roos, Bernard W.
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●Rose, Harvey E.
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Roselle, David P.
Roseman, Joseph J.
Rosen, Lon M.
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Rosen, Ned Ira
Rosen, William G.
Rosenbaum, Robert A.
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Rosenberg, Ivo G.
Rosenberg, Milton
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Rosenblatt, Joseph Max
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Rosenfeld, Gerald
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Rosenfeld, Ronald L.
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Rosenstein, George M., Jr.
Rosenthal, Arthur J.
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Rosenthal, Eric S.
Rosenthal, Erik J.
Rosenthal, Haskell P.
●Rosenthal, Kimmo I.
Rosenthal, Peter
Rosenthal, Steven M.
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Ross, David A.
Ross, J. Andrew
Ross, Kenneth A.
Ross, Paul
Rossa, Robert F.
Rossi, Guido A.
Rossi, Hugo
Rossler, Otto E.
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van Rossum-Wijsmuller, Marijke
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Rothberger, Fritz
Rothman, Neal J.
Rothschild, Bruce L.
Rothschild, Linda Preiss
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Rotthaus, Christel
Rouche, Nicolas
Roush, Fred
Rousseau, Cecil C.
Rousseau, Christiane
*Roussou, Athina
Rouys, Robert L.
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●Rovnyak, Virginia G.
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●Rowen, Louis Halle
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Royer, James Samuel
Royster, Wimberly C.
Ruben, Flores Espinoza
Ruberman, Daniel
Rubin, Jean E.
Rubin, Karl
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Rubinstein, Joachim H.
Rubinstein, Robert
Rudin, Bernard D.
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Rudnick, Karl
Rudolph, Daniel Jay
Rudolph, Lee N.
Ruelle, David P.
Ruess, W.
Ruh, Ernst A.
Ruijsenaars, Simon Norbert
Ruiz, Alberto
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Rulla, James L.
Rumbos, Adolfo J.
Rumely, Robert S.
Rumsey, Howard C., Jr.
Runck, Paul Otto
Rupp, Russell D.
●Ruscheweyh, Stephan
Rush, David Eugene
●Rushanan, Joseph J.
Ruskai, M. Beth
Russell, David Martin
●Russell, Dennis C.
Russell, Gary L.
Russo, Dominick A.
Russo, Paula A.
Rutland, Leon W., Jr.
Rutledge, Dorothy S.
Rutschman, David H.
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Ruttimann, Gottfried T.
Ruymgaart, Peter A.
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Ryan, Frank B.
Ryan, Kevin M.
Ryan, Michael D.
Ryan, Patrick J.
Ryan, Peter M.
Rychlik, M.
Rydeen, Clarence F.
Ryeburn, David
Rykken, Charles John
Sabbagh, Gabriel
Sabharwal, Ranjit S.
Saccoman, John J.
Sachs, Jeffrey R.
Sachs, Robert L.
Sacks, Paul E.
Sacksteder, Richard C.
●Sadosky, Cora S.
Sadun, Lorenzo A.
Saeki, Sadahiro
Saff, Edward B.
Sagan, Bruce E.
●Sagong, Seok
Sah, Chih-Han
Sahab, Salem M.
Sahoo, Prasanna
Saigusa, Youichi
Saito, Kazuyuki
Saito, Kichi-Suke
Saito, Shiroshi
Saitō, Yoshimi
Saitoh, Saburou
Sakai, Fumio
Sakai, Katsuro
Sakai, Makoto
Sakuma, Motoyoshi
Salamanca-Riba, Susana Alicia
Salamin, Eugene
●Salamon, Dietmar A.
Saleem, Mohammad
Salehi, Ebrahim
Salisbury, Thomas S.
Salkind, William
Sallee, G. Thomas
●Sallee, John F.
Salles, Maurice
Saltiel, Leon
Saltman, David J.
Salvadori, Anna
Salzberg, Pablo M.
Samelson, Christopher L.
Samelson, Hans
Sampson, Gary
●Sampson, Gilbert L.
Samuel, Pierre
Sanchez-Vazquez, Gonzalo
●Sand, Mark P.
Sanders, B. L.
Sanders, Georgia E.
Sanders, Jan A.
Sanders, Marc D.
Sanders, Robert W.
Sanderson, Brian J.
Sanderson, Donald E.
Sanderson, John M.
Sandomierski, Frank L.
Sands, Jonathan Winslow
Sangren, Ward C.
Sangwine-Yager, Jane Rosamund
Sant, Lino
Santalo, L. A.
●Santana, Victor Espino
Santos Filho, Jose Ruidival S. D.
Sanz-Serna, J. M.
Sanz-Sole, Marta
Saphar, Pierre David
Sarason, Donald E.
Sarason, Leonard
Sarian, Edward
Sario, Leo
Sarrat, Charles F.
Sasaki, Takeshi
Sastri, Chelluri C. A.
Satake, Ichiro
Sathaye, Avinash
Sato, Hiroki
Sato, Ken-iti
Sato, Shizuka
Sattinger, David H.
Sauder, Dean L.
Saut, Jean Claude
Savariraj, G. A.
Sawada, Hideki
Sawyer, Eric T.
Sawyer, Stanley A.
Saxton, Ralph Arthur
Sayeki, Hidemitsu
Scalzo, Richard C.
Scanlon, Jane Cronin
Scaramuzzi, Roberto
Scarborough, Steve Douglas
Scarpellini, Bruno J.
Scarpi, Giambattista
Scarsini, Marco
Schaal, Werner G. H.
Schacher, Murray M.
Schachermayer, W.

Schaefer, Paul T.
Schaeffer, John M.
Schaettler, Heinz M.
*Schafer, Alice T.
*Schafer, Richard D.
Schäffer, Juan Jorge
*Schaffer, Steven
Schafke, R.
Schapiro, Philip J.
Schaps, Malka Elisheva
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Scharlemann, Martin G.
Schattschneider, Doris W.
Schatz, James R.
Schatzman, James Carl
Schatzman, Michelle
Schauer, Richard L.
Schaumberger, Norman
Schay, Geza
●Schechtman, Gideon
●Schecter, Stephen
Scheffer, Carel L.
Scheffer, Vladimir
Scheier, M. A.
Scheim, David E.
Scheinberg, Stephen
Scheinerman, Edward R.
Schell, Emil D.
*Scherkoske, Kenneth D.
●Scheurle, Jurgen K.
Schibell, Stephen T.
Schiffer, Max M.
Schiller, Ilya
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Schiller, John J.
Schilling, R. J.
Schillo, Paul J.
Schirmeier, Horst
Schleifer, Louis M.
Schlesinger, Ernest C.
Schlessinger
●Schlichenmaier, Martin
Schlick, Tamar
Schlingmann, Dirk
Schlipf, John S.
Schmeelk, John F.
Schmerl, James H.
Schmets, Jean F.
Schmetterer, Leopold K.
Schmickler-Hirzebruch, Ulrike
Schmid, Josef
Schmid, Jurg
*Schmid, Rudolf
Schmid, Wilfried
*Schmidt, Dieter S.
Schmidt, Henry J., Jr.
Schmidt, Kenneth C.
Schmidt, Klaus D.
Schmidt, Ralph O.
Schmidt, Roland
Schmidt, Wolfgang M.
Schmitt, Klaus
Schnabel, Dan
Schneebeli, H. R.
Schneider, Dennis M.
Schneider, Hans
Schneider, Victor P.
Schnitzer, Franz J.
Schnyder, Walter A.
Schochet, Claude L.
●Schochet, Steven H.
Schoenberg, Isaac J.
Schoenenberger-Deuel, Johanna
Schoenfeld, Lowell
●Schoenwaelder, Ulrich F.
Scholl, Anthony J.
Scholz, E.
Schon, Rolf
●Schonbek, Maria Elena
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Schori, Richard M.
●Schottenloher, R. Martin
●Schrauf, Geza H.
Schreiber, Bert M.
Schreiner, Erik A.
Schremmer, Françoise
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Schroeck, Franklin E., Jr.
Schroeder, Carolyn L.
●Schryer, Norman L.
Schubert, Cedric F.
Schubert, David C., Jr.
●Schue, John
Schueller, George W.
Schuett, Werner
Schultz, Phillip
Schulz, Friedmar J.
●Schulze-Pillot, R.
Schumacher, Carol S.
Schumacher, Georg B.
Schumacher, Scott
Schumaker, John A.
Schumaker, Larry Lee
Schumitzky, Alan
Schunck, Brian G.
Schupp, Paul E.
Schurrer, Augusta L.
Schuster, Seymour
●Schutt, Ingo
Schwalbe, Daniel A.
*Schwartz, Charles Freund
Schwartz, Jacob T.
Schwartz, Laurent
*Schwartz, Lionel
Schwarz, Binyamin
Schwarz, Gerald W.
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Schweiger, Fritz
Schweitzer, Eric
Schweizer, Berthold
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Scoppola, Carlo M.
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Scott, Leonard L., Jr.
Scott, Paul James
Scott, Peter
Scott, Ridgway
Scott, Warner Henry Harvey, III
Scott-Thomas, John F.
Scourfield, Eira J.
Scoville, Richard
Scriba, Christoph J.
●Scroggs, James E.
Scull, Sidney C.
Seal, Charles Edwin
Searl, James E.
Sears, Michael
Secunda, Jeanne
Sedory, Stephen A.
Sedwick, Jackson L.
See, Richard
Seebach, J. Arthur
Seebeck, Charles L., III
Seeley, Robert T.
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Segert, Jan
●Sehgal, Sudarshan K.
Sehgal, Surinder
*Sehgal, Virindra M.
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*Seid, Howard A.
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●Seidel, J. J.
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Seifter, Norbert
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●Seiler, Wolfgang K.
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●Selby, Michael J. P.
Seldin, Jonathan P.
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Selman, Alan L.
Selmer, Ernst S.
●Seltzer, Stanley E.
●Semadeni, Zbigniew W.
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Semmes, Stephen William
Sempi, Carlo E.
Sen, R. N.
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Senge, George
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Seppala-Holtzman, David
●Sepulveda, Eric
Serapioni, Raul
Serbyn, William D.
Serfling, Robert J.
Serizawa, Shozo
Serre, Jean-Pierre
*Serrell, Robert
Servatius, Brigitte
Servedio, Frank J.
Sethian, James A.
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Sever, Michael
Sexauer, Norman E.
Sexton, Harlan B.
Seydel, Robert E., Jr.
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Shapiro, George S.
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Shapley, L. S.
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Sharpe, Michael J.
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Shaw, Guy B.
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Shearer, James W.
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●Sheingorn, Mark
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Sherlock, Philip Thomas
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●Shifrin, Theodore
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*Silbert, Gary Allen
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•Smith, Hal L.
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West, Donald C.
West, James E.
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Western, D. W.
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Westphal-Schmidt, U.
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*Wetzel, Marion D.
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Wildenhain, Kenneth R.
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Wilkens, David L.
Wilker, John B.
Wilkins, David A.
Wilkinson, Steven V.
*Wilkinson, Stuart A.
Williams, Alice T.
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Williams, Dana P.
Williams, David A.
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Williams, Gregory P.
Williams, Hugh M.
●Williams, John K.
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*Williams, Lynn R.
*Williams, Mark
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Williamson, Frank, Jr.
Williamson, Jack
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Wills, Jorg M.
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*Woltermann, Michael L.
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Wong, Philip Pit-Wang
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Wong, Yung-Chow
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Wood, John W.
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Woods, Dale
Woods, R. Grant
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Wright, David G.
Wright, David J.
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Wright, Marcus W.
Wright, Mary H.
Wright, Otis C.
Wright, Thomas Perrin, Jr.
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Wyss, Walter
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Xenos, Philippos John
Xia, Daoxing
Xu, Geng
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Yaku, Takeo
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Yang, Jeong Sheng
●Yang, Kichoon
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Yang, Wei-Shih
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Yanowitch, Michael
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Yasue, Kunio
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Yates, George R., Jr.
Yau, Shing-Tung
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Yhap, Ernesto Franklin
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Yocom, Kenneth L.
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Yoneda, Kaoru
Yoneguchi, Hajimu
Yood, Bertram
Yorke, James A.
Yoshida, Norihiro
Yoshino, Genji
*Yoshino, Takashi
Yoshizawa, Taro
●Younce, Matthew B.
●Young, Anne L.
Young, Barry H.
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Young, Donald F.
Young, Eutiquio C.
Young, Lael M.
*Young, MacDonald Burritt
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Yovanovich, M. Michael
Ypma, Tjalling J.
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Yung, Tin-Gun
Zaballa, Ion
Zachariah, Thomas M.
Zacks, Shelemyahu
Zadeh, Lotfi A.
Zafrullah, Muhammad
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Zajac, Edward E.
Zalik, R. A.
Zama, Nobuo
Zambrini, Jean-Claude
*Zame, Alan
Zamfirescu, Christina M.
●Zamfirescu, Tudor
Zanolin, Fabio
●Zaslavsky, Alan M.
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*Zaslove, Barry L.
Zedek, Mishael
Zeheb, Ezra
Zehnder, Eduard J.
Zelinsky, David S.
Zelle, Joseph
●Zeller, Mike
Zemmer, Joseph L., Jr.
Zero, Jose Rodolfo
Zhang, Jian
●Zhang, Jiaxiang John
Zhang, Ning
*Zhang, Xianke
Zhao, Zhi-Yong
Zharn, P. Joseph
●Zhou, Zhiming
●Zhu, Jianchao
Zia, Lee L.
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Ziegler, John Alan
●Ziegler, Lynn
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Ziemer, William P.
Zierau, Roger Craig
Zierler, Neal
Ziller, Wolfgang
Zilmer, Delbert E.
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Zitron, Norman R.
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Zlatev, Zahari
Zo, Felipe J.
Zoch, Richmond T.
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Zorn, M. A.
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Zorzitto, Frank A.
Zouyousefain, Mohammad S.
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Zucker, Steven M.
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Meetings and Conferences of the AMS

FUTURE MEETINGS

Coming Events

The First Announcement of the 1990 International Congress of Mathematicians to be held in Kyoto, Japan, August 21-29 appears at the end of this section. Interested parties should read this information and then complete and mail the form which appears at the back of this issue in order to receive the Second Announcement, which will contain details on the scientific program, preregistration and accommodations. Elsewhere in this issue is an article regarding the possibility of travel grants to mathematicians wishing to attend the Congress, should funds become available.

Louisville Meetings

Louisville, Kentucky, a city perhaps best known for the Kentucky Derby, is the site for the upcoming Joint Mathematics Meetings, to be held January 17-20, 1990. This unique city offers much more than horse races and mint juleps: as the gateway to America's westward expansion, a focal point for innovative research in medical technology, and a bastion of southern charm, Louisville is a rich blend of the past, present, and future.

This remarkable city will provide a pleasant backdrop for the rich mathematical program at the Joint Meetings. AMS activities begin with the Short Course on *Mathematical Questions in Robotics*, organized by ROGER BROCKETT. This Short Course will explore the mathematics of robot kinematics and dynamics, with a focus on both the physical and computational structures. The speakers, in addition to Brockett, will be JOHN B. BAILLIEUL, BRUCE R. DONALD, MADHUSUDAN RAGHAVAN, and SHANKAR SASTRY.

The tradition of excellence in expository lectures will continue with the AMS-MAA Joint Invited Address series, featuring BARRY SIMON (speaking on eigenvalue perturbation theory), CHARLES W. CURTIS (on representation theory of finite groups), and JON BARWISE (on nonwellfounded sets). GEORGE B. DANTZIG, holding the honor of Gibbs Lecturer, will speak on *The world of pure math which goes by other names.* The prestigious Colloquium lectures will be presented by SHLOMO STERNBERG.

The MAA program will include LEONARD GILLMAN's Retiring Presidential Address, which will be on innovative teaching methods with attention to minorities. Other MAA Invited Addresses are by JANOS D. ACZEL speaking on work on the second part of Hilbert's Fifth Problem, MICHAEL BARNSLEY speaking on fractal geometry and its applications, THOMAS KAILATH speaking on displacement structure of matrices and some applications, JUDITH D. SALLY speaking on a topic to be announced later, and PETER WINKLER speaking on the (sometimes) strange behavior of large random things. This talk is about 0, 1-limit laws in probability theory and the interesting situations in which they do not hold.

The deadline for abstracts of papers submitted for consideration for AMS contributed paper sessions is **October 11, 1989**. The deadline for submission of papers for consideration for presentation at an AMS special session is **September 20, 1989**, three weeks earlier than the deadline for contributed papers. Information on MAA contributed paper sessions can be found elsewhere in this issue.

So, Louisville will be the place for mathematics this January! Mark your calendars now, and be sure not to miss the November 17 deadline for preregistration and housing. A full announcement for the Louisville meeting, including the Preregistration/Housing Form, will appear in the next issue of *Notices*.

Hoboken, New Jersey
Stevens Institute of Technology
October 21 – 22

Second Announcement

The eight-hundred-and-fifty-first meeting of the American Mathematical Society will be held at Stevens Institute of Technology in Hoboken, New Jersey on Saturday, October 21, and Sunday, October 22, 1989.

Invited Addresses

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

RUSSEL CAFLISCH, Courant Institute of Mathematical Sciences and the University of California, Los Angeles, *Mathematical analysis of vortex sheets*, 1:30 p.m. Sunday.

BRUCE KITCHENS, IBM Thomas J. Watson Research Center, Yorktown Heights, *Symbolic dynamics*, 11:00 a.m. Sunday.

FANG HUA LIN, Institute for Advanced Study and University of Chicago, *Level sets of solutions of elliptic and parabolic equations*, 11:00 a.m. Saturday.

SHELDON E. NEWHOUSE, University of North Carolina, Chapel Hill, *The dynamics of two-dimensional diffeomorphisms*, 1:30 p.m. Saturday.

Special Sessions

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

Geometry related to computer vision, PRABIR BHATTACHARYA, University of Nebraska, Lincoln, and ROBERT A. MELTER, Long Island University.

Algebraic semantics, STEPHEN L. BLOOM, Stevens Institute of Technology.

Mathematical fluid dynamics, RUSSEL CAFLISCH.

Low-dimensional topology, MARK E. FEIGHN, LEE D. MOSHER, AND ULRICH OERTEL, Rutgers University, Newark.

Smooth dynamical systems, BRUCE P. KITCHENS AND SHELDON E. NEWHOUSE.

Finite groups, RICHARD N. LYONS AND RICHARD O'NAN, Rutgers University, New Brunswick.

Computational algebra, CHARLES C. SIMS, Rutgers University, New Brunswick.

Algebraic geometry, p-adic aspects, MARVIN D. TRETKOFF, Stevens Institute of Technology.

Contributed Papers

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

Registration

The meeting registration desk will be located in the lobby of the Stevens Center and will be open from 8:00 a.m. to 5:00 p.m. on Saturday, October 21, and from 8:00 a.m. to 12:00 noon on Sunday, October 22.

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

Social Event

A special reception and dinner will be held Saturday evening, October 21, in the S. W. Williams Library. The event will include cocktails and a buffet dinner appropriate to the harvest season. Participants can make reservations by sending a check for $25 per person to Denise Ryan, Department of Mathematics, Stevens Institute of Technology, Hoboken, NJ 07030. Reservations should be made by the first week in October. Participants having any questions regarding the dinner should call Ms. Ryan at 201-420-5448.

Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Boulder meeting announcement on page 457 of the April 1989 issue of *Notices*.

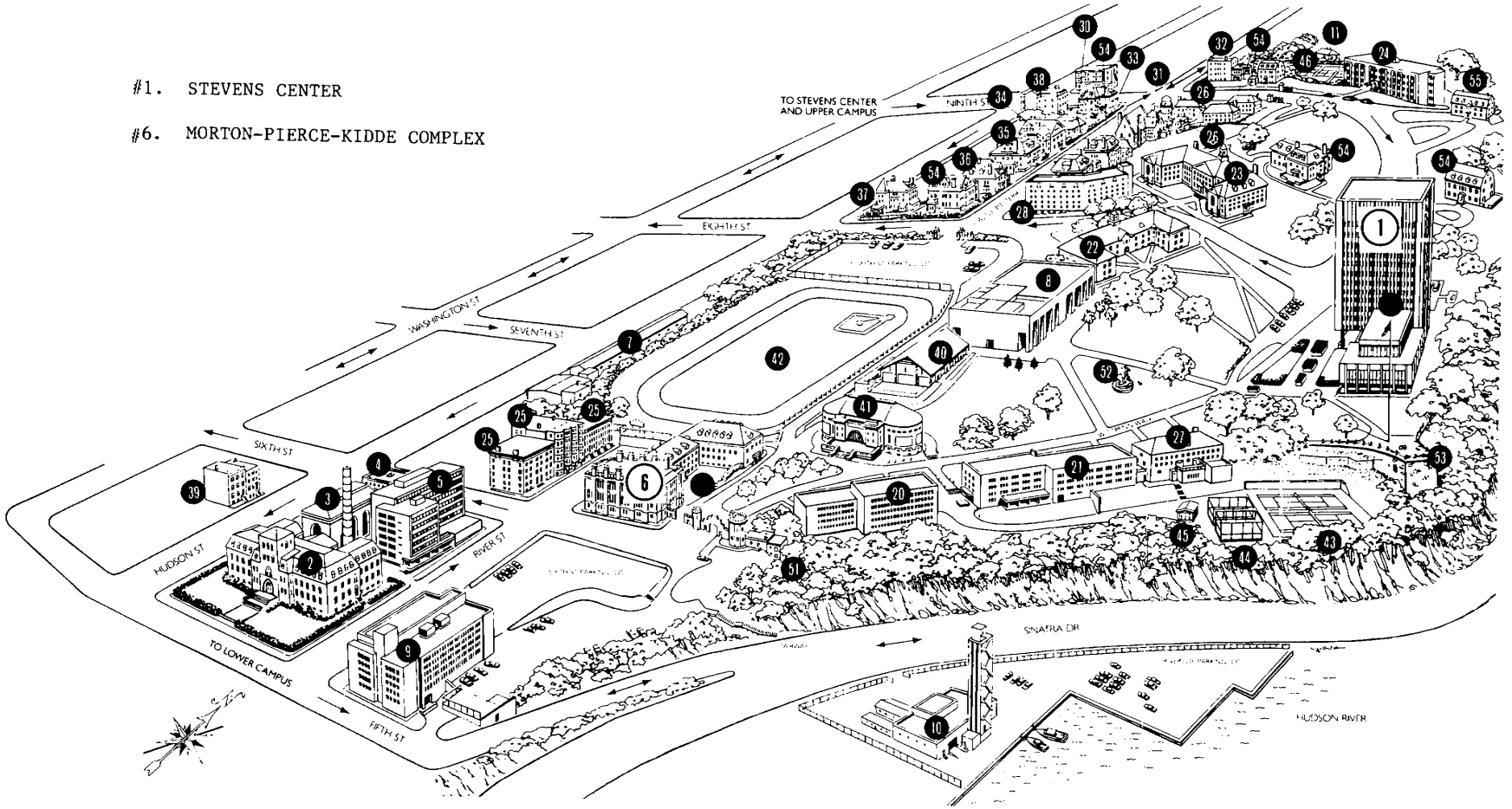
Accommodations

A block of rooms has been reserved at the Holiday Inn Harmon Meadow for Friday, October 20, and Saturday,

Stevens Institute of Technology

#1. STEVENS CENTER

#6. MORTON-PIERCE-KIDDE COMPLEX



October 21, at a special rate of $69 per night for a single or double. The special rate may be available for Sunday, October 22, but this is not guaranteed. The rooms will be held until October 7, 1989. To reserve a room at this special rate, individuals must call the Holiday Inn Harmon Meadow at 201-348-2000, ask for the sales office, and identify themselves as participants of the AMS meeting at Stevens Institute of Technology.

The Holiday Inn provides free return transportation to Newark Airport or Penn Station in Newark. Participants must ask for this service when making room reservations.

The Holiday Inn is located in a pleasant outdoor mall with several stores and restaurants and 14 movie theaters. It is approximately four miles from the Stevens campus to the mall and the Holiday Inn provides free shuttle service. The Holiday Inn has an exercise room and a car rental agency which offers cars for approximately $30 per day.

Travel

From Newark Airport

The Newark Airport is located about ten miles from both the Stevens campus and the Holiday Inn Harmon Meadow. Taxi service is available to both the Stevens campus and the Holiday Inn for approximately $25-$30. By bus, participants should take the #300 New Jersey Transit Airport Express to the Port Authority Bus Terminal in Manhattan at a cost of $7. This service runs every ten to fifteen minutes and takes approximately thirty minutes depending on the traffic. From the Port Authority Bus Terminal take the #126 New Jersey Transit bus to Hoboken ($1.70), or the #320 New Jersey Transit bus to Harmon Meadow ($2.15), with service every hour beginning at 8:20 a.m. until 9:20 p.m.

From Penn Station Manhattan

Go to the Port Authority Bus Terminal at 8th Avenue and 42nd Street and proceed as above, or take a PATH train from 6th Avenue and 33rd Street to Hoboken ($1 exact fare in bill or coins required). From the Hoboken terminal it is a walk of approximately one-half mile to the Stevens Center. The taxi fare to Stevens Center is $2.75.

By Car

Hoboken is located on the Hudson river across from Manhattan between the Lincoln and Holland Tunnels. The Holiday Inn Harmon Meadow is located off Route #3 approximately three miles west of the Lincoln Tunnel.

To Stevens from New York City: Take the Lincoln Tunnel. At the tunnel exit bear to the extreme right through the underpass marked Hoboken. Proceed south over a viaduct and turn left onto 14th Street. Go about four blocks to Washington Street and turn right. Take Washington Street for five blocks and turn left onto 9th Street. Go two blocks to Castle Point Terrace, turn right and park in the 8th Street Lot directly ahead.

To Stevens from the north: Take the New York State Thruway to the Garden State Parkway south. Take Exit 153 to Route 3 east toward the Lincoln Tunnel. Exit to the right at a sign marked Last Exit in New Jersey and turn right at the second traffic light. Proceed south over the viaduct as above.

To Stevens from the south and west: Take the New Jersey Turnpike to Exit 16E and follow signs toward the Lincoln Tunnel. Exit to the right at a sign marked Last Exit in New Jersey and turn right at the second traffic light. Proceed south over the viaduct as above.

To the Holiday Inn from New York City: Take the Lincoln Tunnel. Follow I-495 west to Route 3 west. Follow the signs for Harmon Meadow Boulevard, and make the second right (immediately before an EXXON station). Continue around the complex and make a right at the first stop sign. Make a left at the next stop sign. The entrance to the Holiday Inn is one half block ahead on the right.

To the Holiday Inn from the north: From Routes 80 and 95 or the George Washington Bridge take the New Jersey Turnpike south; where the turnpike divides take the eastern spur (toward the Lincoln Tunnel). Leave the turnpike at Exit 17. After the toll stay right and follow the service road marked by a sign for Route 3-Secaucus straight through the first light and turn right at the first stop sign. The entrance to the Holiday Inn is one half block ahead on the right.

To the Holiday Inn from the south and Newark Airport: Take the New Jesey Turnpike north; where the turnpike divides take the eastern spur (toward the Lincoln Tunnel). Leave the turnpike at Exit 16E. After the toll follow the service road marked by a sign for Secaucus straight through the first light and turn right at the first stop sign. The entrance to the Holiday Inn is one half block ahead on the right.

To the Holiday Inn from the west: Take Route 3 east and exit onto a service road at the sign marked Secaucus-N.J.Turnpike-Exit Only. Follow the service road and turn right onto Harmon Meadow Boulevard immediately after passing under the New Jersey Turnpike. Continue through a traffic light and turn right at the first stop sign. The entrance to the Holiday Inn is one half block ahead on the right.

Parking

Free parking is available in the 8th Street and 6th Street parking lots. (Please refer to the campus map).

Weather

October weather is usually pleasant in the Hoboken area. Meteorological averages for the month are 57°F and 3.1 inches of rain.

W. Wistar Comfort
Associate Secretary
Middletown, Connecticut

Muncie, Indiana
Ball State University
October 27 – 28

Second Announcement

The eight-hundred-and-fifty-second meeting of the American Mathematical Society will be held at Ball State University in Muncie, Indiana on Friday, October 27, and Saturday, October 28, 1989. This meeting will be held in conjunction with the Indiana Section of the Mathematical Association of America.

Joint Invited Addresses

By invitation of the Central Section Program Committee, and the Mathematical Association of America, there will be one joint invited address as follows:

SHELDON AXLER, Michigan State University, *Writing mathematics.*

Invited Addresses

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

LASZLO LEMPERT, Purdue University, *Imbedding pseudoconvex domains into a ball*, scheduled time to be announced.

KENNETH R. MEYER, University of Cincinnati, *Stability and chaos in almost periodic systems*, scheduled time to be announced.

PAUL S. MUHLY, University of Iowa, Iowa City, *Some recent advances in operator algebra*, scheduled time to be announced.

STEVEN SPERBER, University of Minnesota, Minneapolis, *p-adic analysis and exponential sums*, scheduled time to be announced.

Special Sessions

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

Number theory and algebraic geometry, ALAN ADOLPHSON, Oklahoma State University, and STEVEN SPERBER.

Statistics and probability, M. MASOOM ALI, Ball State University.

Complex analysis, DAVID E. BARRETT, University of Michigan, Ann Arbor, and LASZLO LEMPERT.

Extremally disconnected spaces and their applications, ANANDA GUBBI, Southwest Missouri State University.

Noncommutative algebra in geometry and arithmetic, DARRELL E. HAILE, Indiana University.

Triangular operator algebras, DAVID R. LARSON, Texas A&M University.

Function spaces and topology, KATHRYN FROST PORTER, Ball State University.

Differential equations, JOHN F. PORTER and T. K. PUTTASWAMY, Ball State University.

Contributed Papers

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

MAA Program

The MAA program will begin on Saturday, October 28, at 9:00 a.m. The MAA Business Meeting will begin at 3:05 p.m. In addition to the jointly sponsored Invited Address, the following MAA Invited Addresses are scheduled:

GERALD ALEXANDERSON, Santa Clara University, *Gaussian binomial coefficients.*

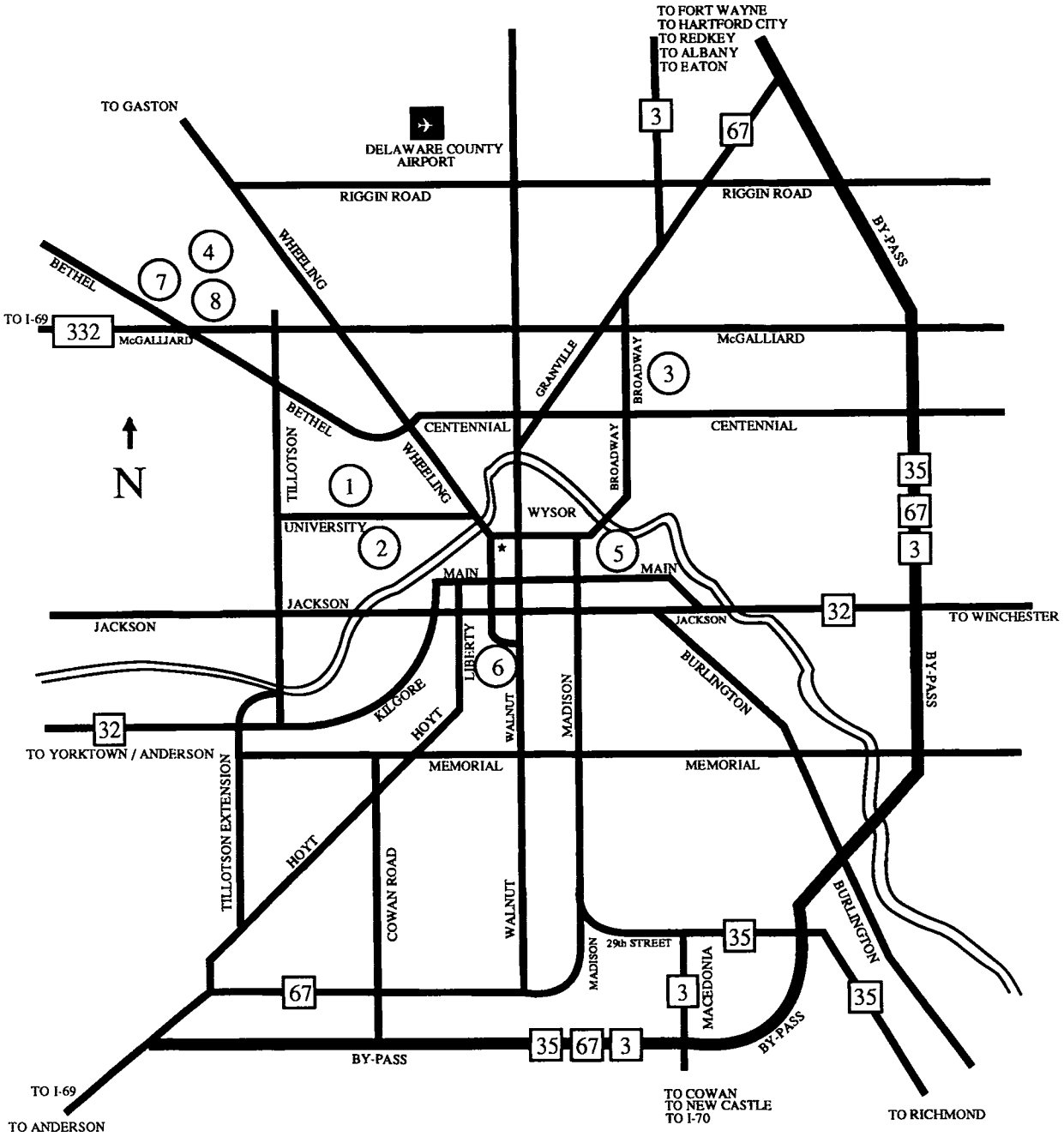
DANIEL GOTTLIEB, Purdue University, *Topology and the robot arm.*

ROBERT LOPEZ, Rose-Hulman Institute of Technology, *Teaching calculus and differential equations with the computer algebra system MAPLE.*

GLORIA OLIVE, Anderson University and the University of Otago, *Does Rudolf Steiner have the answer?*

GARY SHERMAN, Rose-Hulman Institute of Technology, *REU students get results in group theory.*

MUNCIE, INDIANA



Registration

The meeting registration desk will be located in the east end of the second floor corridor of the Pittenger Student Center on the Ball State University campus. The campus is located at the corner of University Avenue and McKinley Avenue. All sessions will be held in the Student Center. The meeting registration desk will be open from 8:00 a.m. to 5:00 p.m. on Friday, October 27, and from 8:00 a.m. to noon on Saturday, October 28.

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

Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Boulder meeting announcement on page 716 of the July/August 1989 issue of *Notices*.

Accommodations

Blocks of rooms have been set aside in several area motels and hotels. Participants should make their own reservations directly with the hotel or motel of their choice, and identify themselves as AMS members in order to obtain the special rates given below. Reservations should be made **no later than September 27, 1989.** After that date reservations will be accepted on a space-available basis. The rates are subject to a ten percent tax. Distances given below are driving distances measured from the Student Center.

Days Inn (three miles)
2000 North Broadway, Muncie, IN 47303
Telephone: 317-288-9953 Toll Free: 1-800-325-2525

Single $30 Double $37

Lees Inn (two-and-one-half miles)
3302 North Everbrook Lane, Muncie, IN 47304
Telephone: 317-282-7557 Toll Free: 1-800-733-5337

Single $43 Each additional occupant: $6
Includes continental breakfast.

Muncie Inn (one-and-one-half miles)
414 North Madison Street, Muncie, IN 47305
Telephone: 317-282-5981

Single $25 Double $34 Waterbed $35
Includes morning coffee.

Radisson Hotel (one-and-one-half miles)
420 South High Street, Muncie, IN 47305
Telephone: 317-741-7777 Toll Free: 1-800-333-3333

1–2 persons $42 3–4 persons $48
Includes buffet breakfast and two cocktails per occupant per evening.

Signature Inn (two-and-one-half miles)
3400 Chadam Lane, Muncie, IN 47305
Telephone: 317-284-4200 Toll Free: 1-800-822-5252

Single $43 Each additional occupant $6
Includes continental breakfast.

Student Center Pittenger Hotel
Ball State University, Muncie, IN 47306
Telephone: 317-285-1555 Use SUVON from Indiana campuses.

Single $33 Double $38
Each additional occupant $4
Located on the Ball State University campus.

Super 8 Motel (two-and-one-half miles)
3601 West Foxridge Lane, Muncie, IN 47304
Telephone: 317-286-4333 Toll Free: 1-800-843-1991

One person/one bed $30.88
Two persons/one bed $34.88
Two persons/two beds $37.88
Each additional occupant: $3

Food Service

There are a number of restaurants on campus and in the surrounding area. Complete listings will be available at the meeting registration desk. There will be several hundred visitors on campus on Friday, October 27, and it is anticipated that campus area dining facilities will be used to their capacities during the noon hour only. A buffet lunch will be served for participants and their guests in the Student Center at noon on Friday, October 27, and Saturday, October 28. It is recommended that participants have lunch at these buffets due to the tight schedule. There are no formal evening meals planned.

Travel

Please note: Eastern Standard Time is in effect in Indiana all year. Muncie is located approximately 60 miles northeast of downtown Indianapolis, and 75 miles from Indianapolis International Airport. A number of major airlines and several regional airlines serve Indianapolis. The American Eagle Commuter Airline flies twice daily each way between Chicago and the Muncie Airport, which is approximately four miles from campus. Interstate I-69 is approximately eight miles west of the campus and runs north from Indianapolis into Michigan. The shortest route from I-69 to the campus is from the exit at State Road #332.

There is direct bus service from the Indianapolis Airport to Muncie. Three buses per day are scheduled, leaving the airport at 11:20 a.m., 5:30 p.m., and 9:15 p.m., arriving in Muncie at 1:50 p.m., 7:35 p.m., and 11:20 p.m. respectively. The bus will be marked either "ABC" or "Summit". A university van will meet all three bus arrivals on Thursday, October 26, at the Muncie bus station. Those arriving by bus on other days should inform the Department of Mathematical Sciences, Ball State University, Muncie, Indiana, 47306, or call 317-285-8640 to make arrangements for service. The van will also meet the American Eagle flights from Chicago to the Muncie Airport on Thursday, October 26.

Parking

Parking near the Student Center on Friday, October 27, will be limited. Vans marked "AMS" will make stops at the hotel, motels, and Stadium Parking Lot starting on Friday morning at 7:45 a.m. The Stadium Parking Lot is west of the Ball State Stadium. The stadium is located at the northeast corner of Bethel and Tillotson Avenues, and is accessible from either east or west via McGalliard Road. From the west, McGalliard Road is also State Road 332 connecting with I-69.

On Saturday, October 28, there should be no difficulty parking near the Student Center. There is a parking structure south of the building, and a parking lot west of the building. Additional university lots are a block further south.

Weather

Autumn weather in Muncie is likely to be clear, with cool days and crisp nights. The average daily maximum temperature at this time is 60°F, and the average daily minimum temperature is 38°F. The average rainfall for the month of October is 2.56 inches.

Andy Roy Magid
Associate Secretary
Norman, Oklahoma

Los Angeles, California
University of California, Los Angeles
November 18 – 19

First Announcement

The eight-hundred-and-fifty-third meeting of the American Mathematical Society will be held at the University of California, Los Angeles on Saturday, November 18, and Sunday, November 19, 1989. This meeting will be held in conjunction with the Southern California Section of the Mathematical Association of America. All sessions will take place in the Mathematical Sciences Building on the UCLA campus.

Invited Addresses

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

BURTON I. FEIN, Oregon State University

STEPHEN M. GERSTEN, University of Utah, Salt Lake City

NICOLAS SPALTENSTEIN, University of Oregon, Eugene

THOMAS H. WOLFF, California Institute of Technology

Special Sessions

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

Geometric methods in combinatorial group theory, ROGER C. ALPERIN, San Jose State University, and KAREN VOGTMANN, Cornell University.

Algebraic topology, JAMES P. LIN, University of California, San Diego.

Quadratic forms and simple algebras, DAVID J. SALTMAN, University of Texas, Austin, and MURRAY M. SCHACHER, University of California, Los Angeles.

Harmonic analysis, THOMAS H. WOLFF.

Abstracts for these sessions should have been submitted by the July 26 deadline or three weeks before the deadline for contributed papers. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of the *Notices*.

Contributed Papers

There will also be sessions for contributed ten-minute papers.

Abstracts for these sessions should have been submitted by the August 16 deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and the Invited Speakers and Special Sessions section of the *Notices*.

Electronic Submission of Abstracts

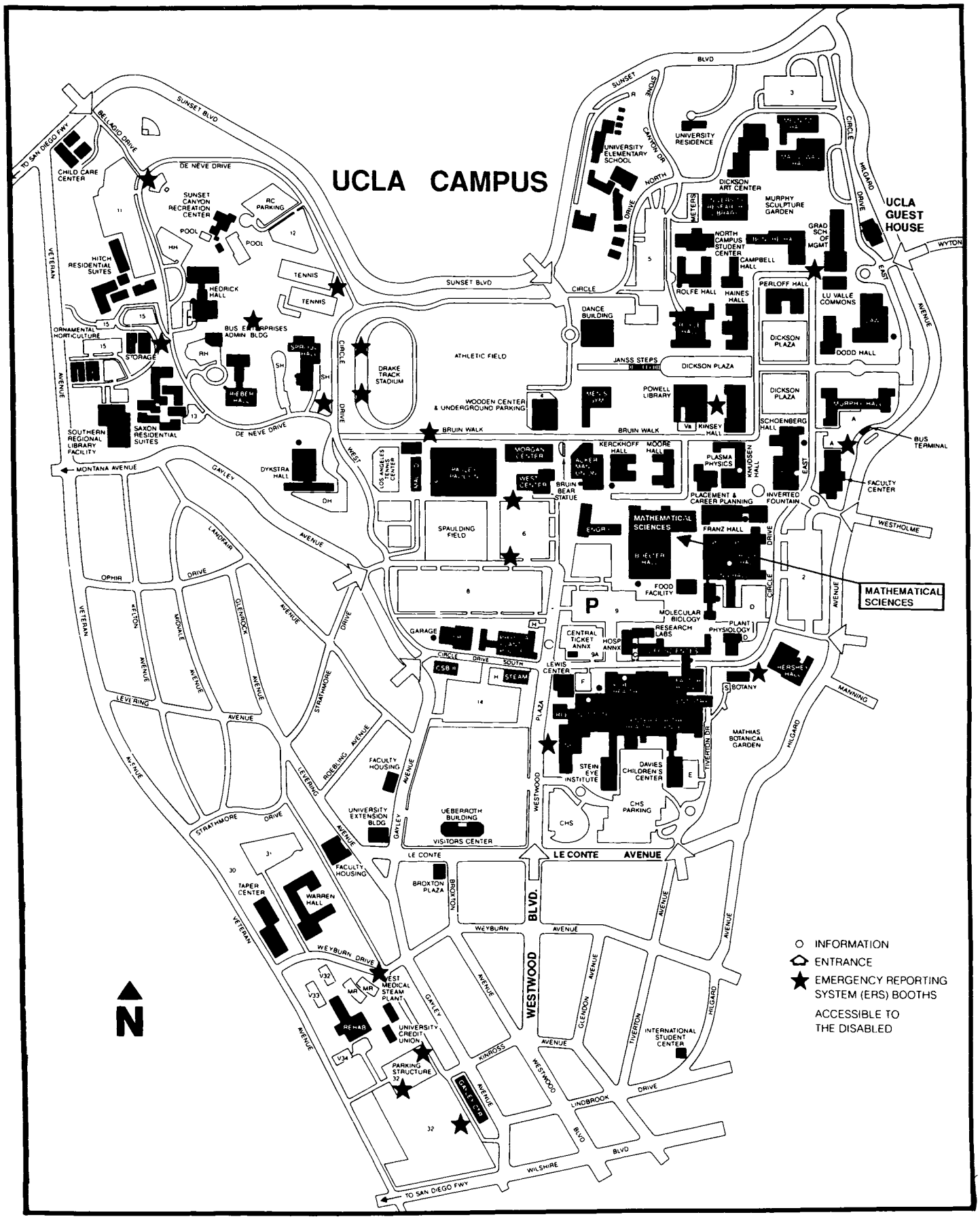
This service is now available to those who use the TEX typesetting system and can be used with abstracts of papers to be presented at the autumn sectional meetings of the AMS. Requests to obtain the package of files may be sent electronically on the Internet to **abs-request@math.ams.com**. Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: 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, AMS-TEX, or the LATEX package.

MAA Program

The Southern California Section of MAA will meet on Saturday, November 18. Program information will be announced later.

Registration

The meeting registration desk will be located in the Faculty Lounge in the Mathematical Sciences Building. The desk will be open from 8:00 a.m. until 4:00 p.m. on Saturday, and from 8:30 a.m. to noon on Sunday. The registration fees are $30 for members of the AMS, $45


UCLA CAMPUS
UCLA GUEST HOUSE
MATHEMATICAL SCIENCES
SUNSET BLVD
DE NEVE DRIVE
CHILD CARE CENTER
SUNSET CANYON RECREATION CENTER
RC PARKING
POOL
TENNIS
HITCH RESIDENTIAL SUITES
HEDRICK HALL
BUS ENTERPRISES ADMIN BLDG
ORNAMENTAL HORTICULTURE
STORAGE
SOUTHERN REGIONAL LIBRARY FACILITY
SAXON RESIDENTIAL SUITES
DYKSTRA HALL
MONTANA AVENUE
ATHLETIC FIELD
DRAKE TRACK STADIUM
WOODEN CENTER & UNDERGROUND PARKING
BRUIN WALK
SPAULDING FIELD
DANCE BUILDING
JANSS STEPS
DICKSON PLAZA
POWELL LIBRARY
KINSEY HALL
ROLFE HALL
HAINES HALL
CAMPBELL HALL
NORTH CAMPUS STUDENT CENTER
UNIVERSITY RESIDENCE
UNIVERSITY ELEMENTARY SCHOOL
DICKSON ART CENTER
MURPHY SCULPTURE GARDEN
GRAD SCH OF MGMT
PERLOFF HALL
LU VALLE COMMONS
DODD HALL
SCHOENBERG HALL
BUS TERMINAL
FACULTY CENTER
WESTHOLME
INVERTED FOUNTAIN
KNUDSEN HALL
PLASMA PHYSICS
PLACEMENT & CAREER PLANNING
KERCKHOFF HALL
MOORE HALL
MORGAN CENTER
WEST CENTER
BRUIN BEAR STATUE
LOS ANGELES CENTER
FRANZ HALL
FOOD FACILITY
MOLECULAR BIOLOGY RESEARCH LABS
PLANT PHYSIOLOGY
CENTRAL TICKET ANNX
HOSP ANNX
GARAGE
LEWIS CENTER
CSB II
STEAM
BOTANY
HERSHEY HALL
MATHIAS BOTANICAL GARDEN
STEIN EYE INSTITUTE
DAVIES CHILDREN'S CENTER
CHS
CHS PARKING
FACULTY HOUSING
UNIVERSITY EXTENSION BLDG
UEBERROTH BUILDING
VISITORS CENTER
LE CONTE AVENUE
TAPER CENTER
WARREN HALL
BROXTON PLAZA
WEYBURN AVENUE
WEYBURN DRIVE
WEST MEDICAL STEAM PLANT
UNIVERSITY CREDIT UNION
PARKING STRUCTURE 32
REHAB
INTERNATIONAL STUDENT CENTER
LINDBROOK DRIVE
WILSHIRE BLVD
TO SAN DIEGO FWY
WESTWOOD BLVD
GAYLEY AVENUE
HILGARD AVENUE
VETERAN AVENUE
LEVERING AVENUE
STRATHMORE DRIVE
LANDFAIR AVENUE
GLENROCK AVENUE
MIDVALE AVENUE
KELTON AVENUE
OPHIR DRIVE
ROEBLING AVENUE
TIVERTON DRIVE
GLENDON AVENUE
KINROSS AVENUE
MANNING AVENUE
WESTHOLME AVENUE
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INFORMATION
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for nonmembers, and $10 for students and unemployed mathematicians. There is a special one-day $15 fee for MAA members on Saturday only.

Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Boulder meeting announcement on page 716 of the July/August 1989 issue of *Notices*.

Accommodations

Blocks of rooms are being held **until October 17** at the following locations. Participants should make their own arrangements directly with the hotel of their choice and be sure to mention the joint AMS-MAA meeting at UCLA. Note that the rates do not include applicable taxes. The Claremont and Royal Palace hotels are located in Westwood Village within walking distance, adjacent to the south side of campus. The UCLA Guest House is on the campus.

Participants **must refer to AMS-MAA meeting** when making reservations at the following hotels.

Claremont Hotel
1044 Tiverton Avenue, Westwood 90024
Telephone: 213-208-5957

Single $35.50 Double $37.50
Twins $41.50

Royal Palace Westwood
1052 Tiverton Avenue, Westwood 90024
Telephone: 213-208-6677 or 800-248-6955 (California) or 800-631-0100 (Outside California)

Single $67 Double $73
All rooms have kitchenettes.

Participants **must refer to Reference #2905** when making reservations at the following hotel.

UCLA Guest House
(on UCLA campus)
Telephone: 213-825-2923

Queen bed $71
Two twin beds $71
Parlor room (sofa sleeper and kitchenette) $66
Two room suite (kitchenette, queen and sofa sleeper) $99

Food Service

Information will be provided at the meeting registration desk regarding availability of food service within walking distance.

Travel

The UCLA campus is located approximately 12 miles north of Los Angeles International Airport (LAX), which is served by all of the major airlines. The taxi fare from the airport to the UCLA campus is approximately $20 plus tip. There is no extra charge for additional passengers going to the same destination. The Super Shuttle, which provides door-to-door service, can be summoned by dialing number 35 from the courtesy phones in the baggage claim area. The bus should arrive within 15 minutes; the fare is $12 for one passenger plus tip. For information or advance reservations call 213-777-8000. From courtesy phones dial number 35.

The most economical transportation is via public bus from the LAX Transit Center at 96th Street and Vicksburg Avenue (1/4 mile northeast of the main airport exit). To reach the Transit Center from the terminal, wait next to the lower level roadway under a SHUTTLE BUS sign, which lists buses as A, B, C, etc. Board the free C or Lot C bus and exit the airport, getting off at its first stop outside of the airport just after it enters Parking Lot C. Walk 100 yards east to the LAX Transit Center. The fastest and most frequent service to UCLA is by the RTD #560 bus, which takes approximately 30 minutes to reach the campus and costs $1.20. (NOTE: Exact change in **coins** is required; no bills accepted!) Direct service to UCLA is also available Monday through Friday on the Culver City #6 bus, which takes approximately 50 minutes; the fare is 50 cents. All buses approach the campus from the south, up Westwood Boulevard, turning right (east) at LeConte Avenue. Exit the bus at the corner and walk north up Westwood to the Mathematical Sciences Building (Boelter Hall, approximately 3/4 mile on the right, beyond parking structure #9.) Participants planning to stay at the UCLA Guest House should stay on the bus to the end of the line.

Parking

Permits costing $4 per day are required for any cars parking on campus between the hours of 7:00 a.m. and 9:00 p.m. daily and may be obtained at any of the several parking kiosks around the campus. Visitors with permits from other University of California campuses may use these to park at UCLA, but must check in at a kiosk. The parking area closest to the Mathematical Sciences Building is Structure #9 on Westwood Boulevard; its kiosk is in the center of the Boulevard.

Lance W. Small
Associate Secretary
La Jolla, California

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.

Hoboken, NJ, October 1989

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

Muncie, IN, October 1989

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

Los Angeles, CA, November 1989

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

Louisville, KY, January 1990

Jon Barwise (AMS-MAA)
Sun-Yung Alice Chang
Charles W. Curtis (AMS-MAA)
George B. Dantzig (Gibbs Lecture)
Israel C. Gohberg
Mike Hopkins
Henryk Iwaniec
Janos Kollar
Israel M. Sigal
Barry Simon (AMS-MAA)
Shlomo Sternberg (Colloquium Lectures)
Nolan R. Wallach (AMS-MAA)

Fayetteville, AK, March 1990

Marcel F. Neuts (AMS-SIAM)
Vladimir I. Oliker
Mark A. Stern
Jonathan M. Wahl

Manhattan, KS, March 1990

J. Brian Conrey
Stewart B. Priddy
Jean-Pierre Rosay
Jang-Mei Wu

University Park, PA, April 1990

Robert T. Glassey
Carsten Grove
Lowell Jones
Gang Tian

Columbus, OH, August 1990

Michael G. Crandall (Progress in Mathematics Lecture)

Denton, TX, November 1990

Avner D. Ash

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.

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

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, Indiana
Central Section
Associate Secretary: Andy Roy Magid
Deadline for organizers: Expired
Deadline for consideration: Expired

Alan Adolphson and Steven Sperber, *Number theory and algebraic geometry*
M. Masoom Ali, *Statistics and probability*
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*
Kathryn Frost Porter, *Function spaces and topology*
John F. Porter and T. K. Puttaswamy, *Differential equations*

November 1989 Meeting in Los Angeles, California
Far Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: Expired
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, Kentucky
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: Expired
Joseph A. Ball and Israel C. Gohberg, *Linear operators, matrix functions and control*
Joseph G. Conlon, *The Schrödinger equation*
Raúl E. Curto and Paul S. Muhly, *Multivariable operator theory*
Ethan S. Devinatz and Mike Hopkins, *Homotopy theory*
Robert S. Doran, *Group representations and operator algebras*
Bruce R. Ebanks, *Functional equations and their applications*
Florence D. Fasanelli and Victor J. Katz, *History of mathematics*
Robert E. Fennell and Suzanne Marie Lenhart, *Control of infinite dimensional systems*
Naomi Fisher, Harvey B. Keynes and Philip D. Wagreich, *Mathematics and education reform* (AMS-MAA Session)
Carl H. FitzGerald and Ted J. Suffridge, *Geometric function theory in one and several complex variables*
Gary D. Jones, *Oscillation theory in ordinary differential equations*
Janos Kollar, *Algebraic geometry*
Efim D. Khalimsky, Yung Kong and Ralph D. Kopperman, *Topology in computer graphics and image processing*
Inessa Levi and W. Wiley Williams, *Semigroup theory*
Peter A. McCoy, *Function theoretic methods in differential equations*
Lynn McLinden and Jay S. Treiman, *Optimization and nonlinear analysis*
Hugh L. Montgomery, *Analytic number theory*
Peter A. Perry, *Geometric spectral and inverse spectral problems*
Philip E. Protter, *Markov processes and stochastic analysis*

March 1990 Meeting in Fayetteville, Arkansas
Southeast Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: November 21, 1989
J. Duncan and A. L. T. Patterson, *Banach algebras*
Colm A. O'Cinneide and Itrel E. Monroe, *Probability distributions of phase-type and applications*
Karl H. Hofmann and Jimmie D. Lawson, *Semi-groups in geometry and analysis*
Dima Khavinson, *On complex function theory of one and several complex variables*
Vladimir I. Oliker and Andrejs E. Treibergs, *to be announced*

March 1990 Meeting in Manhattan, Kansas
Central Section
Associate Secretary: Andy Roy Magid
Deadline for organizers: Expired
Deadline for consideration: November 21, 1989
Andrew G. Bennett, *Harmonic analysis and probability theory*
David J. Foulis and Richard J. Greechie, *Orthostructures*
David H. Hamilton and John F. Rossi, *Geometric function theory*
Lige Li, *Partial differential equations*
Satyagopol Mandal, *Commutative algebra*
Alexander G. Ramm, *Inverse problems and scattering theory*
Joseph M. Rosenblatt, *Ergodic theory*
Richard H. Schelp, *Graph theory*
George E. Strecker, *Applications of category theory*

April 1990 Meeting in University Park, Pennsylvania
Eastern Section
Associate Secretary: W. Wistar Comfort
Deadline for organizers: Expired
Deadline for consideration: January 4, 1990
Donald M. Davis, *Algebraic topology*

August 1990 Meeting in Columbus, Ohio
Associate Secretary: W. Wistar Comfort
Deadline for organizers: November 15, 1989
Deadline for consideration: April 27, 1990

November 1990 Meeting in Denton, Texas
Central Section
Associate Secretary: Andy Roy Magid
Deadline for organizers: February 15, 1990
Deadline for consideration: July 16, 1990

Information for Organizers

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

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

Each Invited Speaker is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the PCNM or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an *ex-officio* member of the committee and whose address may be found below). These proposals must be in the hands of the PCNM well in advance of the meeting and, in any case, at least nine (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 Section Program Committee. The processing of proposals for Special Sessions for Sectional Meetings is handled by the Associate Secretary for the Section, who then forwards the proposals to the Section Program Committee, which makes the final selection of the proposals. Each Invited Speaker at a Sectional Meeting is invited to organize a Special Session. Just as for national meetings, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline after which members can no longer send abstracts for consideration for presentation in that Special Session.

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

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

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
e-mail: g_small@math.ams.com
(Telephone 619-534-3590)

Central Section

Andy Roy Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
601 Elm PHSC 423
Norman, OK 73019
e-mail: g_magid@math.ams.com
(Telephone 405-325-2052)

Eastern Section

W. Wistar Comfort, Associate Secretary
Department of Mathematics
Wesleyan University
Middletown, CT 06457
e-mail: g_comfort@math.ams.com
(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
e-mail: g_cima@math.ams.com
(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.

Electronic submission of abstracts is now available to those who use the TEX typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to **abs-request@math.ams.com.** Requesting the files electronically 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, AMS-TEX, or the LATEX package.

Number of Papers Presented
Joint Authorship

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

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

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, RAY E. COLLINGS, Tri-County Technical College, South Carolina, and JOHN W. KENELLY, Clemson University, 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.

Special Computer Session of Contributed Papers

Computers in the Classroom: The time is right is being organized by DAVID P. KRAINES, Duke University, and VIVIAN Y. KRAINES, Meredith College. Presentations are invited on the use of microcomputers to enhance undergraduate mathematics classroom instruction. Proposals for the fifteen minute presentations should include (1) title, (2) a one-paragraph abstract (for distribution at the meeting), (3) a one-page outline of the presentation and (4) a list of the software and computer to be used. Also indicate if a color projection system is required and list any other special equipment needed. If noncommercial software is to be used, please include a copy. Submissions should be sent to **Vivian Y. Kraines**, Department of Mathematics and Computer Science, Meredith College, Raleigh, NC 27607-5298 **by October 20**. Participants will be notified by November 3 whether their submission has been accepted.

INTERNATIONAL CONGRESS OF MATHEMATICIANS

ICM-90 International Congress of Mathematicians KYOTO

Kyoto, JAPAN *August 21-29, 1990*

FIRST ANNOUNCEMENT

The Organizing Committee is pleased to announce that the next International Congress of Mathematicians will be held at the Kyoto International Conference Hall, from Tuesday, August 21 through Wednesday, August 29, 1990. It will be held under the auspices of the International Mathematical Union and under the sponsorship of the Science Council of Japan, the Mathematical Society of Japan, the Japan Society of Mathematical Education, The History of Science Society of Japan, The Institute of Actuaries of Japan, the Japan Society for Software Science and Technology, The Japan Statistical Society, and The Operations Research Society of Japan.

Mathematical Program

There will be about 16 invited one-hour expository addresses covering recent developments in major areas of mathematics, and approximately 140 invited 45-minute lectures divided into the following 18 sections:

1. Mathematical logic and foundations
2. Algebra
3. Number theory
4. Geometry
5. Topology
6. Algebraic geometry
7. Lie groups and representations
8. Real and complex analysis
9. Operator algebras and functional analysis
10. Probability theory and mathematical statistics
11. Partial differential equations
12. Ordinary differential equations and dynamical systems
13. Mathematical physics
14. Combinatorics
15. Mathematical aspects of computer science
16. Computational methods
17. Applications of mathematics to the sciences
18. History, teaching and the nature of mathematics

The International Commission on Mathematical Instruction will have several invited lectures.

All Ordinary Members of the Congress will have an opportunity to present ten-minute short communications; informal mathematical seminars may be organized on participant's initiative.

All invited lectures will be published in the Proceedings of ICM-90. A complimentary copy will be sent to each Ordinary Member after the Congress. Abstracts of the short communications will be distributed to Ordinary Members at the Congress free of charge.

English, French, German and Russian will be the official languages of the Congress.

Social Events

The Organizing Committee will arrange a reception on Tuesday, August 21; a traditional art performance theater in the late afternoon of Saturday, August 25; and a banquet on Wednesday, August 29. These events will be free to all registered Ordinary and Accompanying Members. Excursions and (pre- and post-Congress) tours will be arranged by Japan Travel Bureau, Inc. Sunday, August 26 will be set aside for optional excursions and no lectures will be scheduled on this day. Further details concerning these activities will appear in the Second Announcement.

Location of the Conference

The Kyoto International Conference Hall is located in the northern part of Kyoto City. The closest airport to Kyoto is Osaka International Airport, which is about 55 minutes from Kyoto by the limousine bus service. The buses leave the airport every 20 minutes between the hours of 7:55 a.m. to 9:30 p.m.

Kyoto is located 500km west of Tokyo. A rapid train service (Shinkansen) from Tokyo to Kyoto is available with about a 10 ~ 30 minutes interval between each train from the hours of 6 a.m. to 9 p.m. It takes about 2 hours and 45 minutes, and the current price is ¥12,970 one way.

Kyoto, surrounded by gracefully wooded hills, was the capital of Japan from 794 A.D. to 1868 A.D. Besides two magnificient Imperial Villas, Kyoto has about 400 Shinto shrines and 1,650 Buddhist temples which dot the entire city. Kyoto offers the innumerable cultural treasures and traditional crafts and attracts visitors from throughout the world as well as from within Japan. The city of Nara, which is an ancient capital and another renowned sightseeing center of old Japanese culture, can be reached within 30 minutes from Kyoto by an express train and makes an excellent one-day excursion.

The Official Carrier

Japan Air Lines (JAL) is the official carrier for the Congress. Please contact the nearest JAL overseas office for the appropriate air schedules.

The Official Travel Agent (Group Flights)

Japan Travel Bureau, Inc. (JTB) Kyoto Office has been appointed as the official travel agent for the Congress and will handle all travel arrangements related to the Congress including hotel accommodations and group flights. All inquiries should be addressed to the following:

Japan Travel Bureau, Inc.
Kyoto Office
Convention Dept.
Higashi-shiokoji-cho, Shimogyo-ku
Kyoto 600, JAPAN

Tel: (075) 361-7241
Fax: (075) 341-1028
Telex: J24418TOURIST (attn. KYOTO)

Accommodations

For participants and their accompanying members, a sufficient number of rooms have been reserved in Kyoto at various prices by Japan Travel Bureau, Inc., Kyoto. More precise information along with the hotel reservation form will be included in the Second Announcement.

Hotels in Kyoto

The specially discounted room rates (in yen), which includes the tax and service charges (but no meals), are as follows:

Class	Single with bath	Twin with bath
A	¥9,000 – ¥20,000	¥13,000 – ¥22,000
B	¥7,000 – ¥8,000	¥11,000 – ¥13,000
C	¥5,500 – ¥7,000	¥9,000 – ¥11,000
D	¥4,000 – ¥5,500	¥7,000 – ¥9,000
*E	4 beds in 1 room without bath ¥2,500 – ¥4,000/person	
Youth Hostel	4–8 beds in 1 room without bath ¥2,100 – ¥2,450/person	

*If you wish to book a room of Class E, please find 3 other people with whom you can share a room, and include their names on the application form in the Second Announcement.

Climate and Clothing

In late August, the average temperature in Kyoto is approximately 28°C (82°F) and the humidity is somewhat high. Light summer clothing is recommended. The Congress Hall and hotels are all well air-conditioned. No formal dress will be required on any occasion during the congress.

Second Announcement

The Second Announcement of ICM-90 will describe all the activities of the Congress in detail and provide instructions on how to complete the pre-registration process and obtain accommodations. It will provide more, although not complete, information on the scientific program, and give instructions regarding the submission of abstracts of short communications and the organization of informal seminars. The Second Announcement will also include advice on how to reach Kyoto and will be accompanied by a brochure describing the day trips and tours organized by Japan Travel Bureau.

If you wish to receive the Second Announcement, please complete the special form provided in the back of this issue of *Notices*.

The form must be received by ICM-90 in Kyoto no later than **October 15, 1989.** The Second Announcement will be mailed to you by ICM-90 before the end of 1989.

1989 AMS Elections

Candidates

OFFICERS

President Elect*
Michael Artin

Vice President (two to be elected)

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

Associate Secretaries*

Andy Roy Magid	Lance W. Small
(Central)	(Far Western)

Member-at-Large of the Council (five to be elected)

Sheldon Axler	Charles Herbert Clemens
Joan S. Birman	Amassa G. Fauntleroy
James W. Cannon	Edwin E. Floyd
Alexandre J. Chorin	Carl Pomerance
Frank H. Clarke	Shing-Tung Yau

Board of Trustees (one to be elected)

Ramesh A. Gangolli	John C. Polking

NOMINATING COMMITTEE FOR 1990
(Preferential Ballot, three to be elected)

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

EDITORIAL BOARDS COMMITTEE FOR 1990
(Preferential Ballot, two to be elected)

Linda Keen	Andrew M. Odlyzko
Carlos E. Kenig	Barry Simon

*Uncontested offices

Election Information

The ballots for election of members of the Council and Board of Trustees of the Society for 1990 will be mailed on or shortly after September 10, in order for members to receive their ballots well in advance of the November 10 deadline. Prior to casting their ballots members are urged to consult the following articles and sections of the Bylaws of the Society: article I, section 1; article II, sections 1, 2; article III, sections 1, 2, 3; article IV, sections 1, 2, 4; article VII, sections 1, 2, 5. The complete text of the Bylaws appears on pages 1155–1160 of the November 1987 issue of *Notices*. A list of the members of the Council and Board of Trustees serving terms during 1989 appears in the **AMS Reports and Communications** section of this issue.

SUGGESTIONS FOR 1990 NOMINATIONS

Each year the members of the Society are given the opportunity to propose for nomination the names of those individuals they deem both qualified and responsive to their views and needs as part of the mathematical community. Candidates will be nominated by the Council to fill positions on the Council and Board of Trustees to replace those whose terms expire December 31, 1990. See the **AMS Reports and Communications** section of this issue for the list of current members of the Council and Board of Trustees. Members are requested to write their suggestions for such candidates in the appropriate spaces below.

REPLACEMENT BALLOTS

This year ballots for the AMS election will be mailed September 10, 1989, or within a day or two thereafter. The deadline for receipt of ballots in Providence is November 10, 1989.

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

To help alleviate this problem, the following replacement procedure has been devised: A member who has not received a ballot by October 10, 1989, or who has received a ballot but has accidentally spoiled it, may write after that date to the Secretary of the AMS, Post Office Box 6248, Providence, RI 02940, asking for a second ballot. The request should include the individual's member code and the address to which the replacement ballot should be sent. Immediately upon receipt of the request in the Providence office, a second ballot, which will be indistinguishable from the original, will be sent by first class or air mail. It must be returned in an inner envelope, which will be supplied, on the outside of which is the following statement to be signed by the member:

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

_____

signature

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

SUGGESTIONS FOR 1990 NOMINATIONS

Council and Board of Trustees

Vice President (1)

_____

Associate Secretaries (2)

_____

_____

Members-at-large of the Council (5)

_____

_____

_____

_____

_____

Member of the Board of Trustees (1)

_____

The completed form should be addressed to AMS Nominating Committee, Post Office Box 6248, Providence, RI 02940, to arrive no later than **November 10, 1989**.

Mathematical Sciences Meetings and Conferences

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

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.

September 1989

8–14. **COSMEX '89: International Conference on Stochastic Methods in Experimental Sciences**, Technical University of Wroclaw, Poland. (Nov. 1988, p. 1388)

10–16. **Transformationsgruppen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 762)

11–13. **Supercomputers: Emerging Applications in Manufacturing**, Minneapolis, MN. (Mar. 1989, p. 312)

11–14. **Analyse des Donnes**, Antibes, France. (Mar. 1989, p. 312)

11–14. **Calculus of Variations and Related Topics**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 762)

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)

11–17. **Conference on Foliations (in memory of Bruce L. Reinhart)**, University of Maryland, College Park, MD. (Jul./Aug. 1989, p. 762)

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-français de Mathématiques et d'Informatique, Université de Wuhan, 430072 Wuhan, People's Republic of China. (May/Jun. 1989, p. 598)

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)

17–22. **Twelfth Osterreichischer Mathematikerkongress**, Wien, Austria. (Jul./Aug. 1989, p. 762)

17–23. **Effiziente Algorithmen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 762)

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)

*24–27. **Annual Conference MANSW, Taking Maths into the 1990's**, Mudgee, NSW, Australia.

INFORMATION: Annual Conference Organizer, P.O. Box 536, Darlinghurst, NSW 2010, Australia.

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)

25–29. **Extrapolation et Approximation Rationelle**, Marseille, France. (Jul./Aug. 1989, p. 762)

*25–30. **Workshop: Quantum Groups, Operator Algebras and Duality and Their Applications to Physics**, Cortona, Italy.

INVITED SPEAKERS: L. Bonora, A. Connes, R. Cotta, C. D'Antoni, G. Dell'Antoni, F. Eidaleo, K. Fredenhagen, J. Fröhlich, F. Goodman, R. Herman, M. B. Landstad, R. Longo, Y. Nakagami, A. Ocneanu, M. Rosso, B. Schroer, G. Skandalis, M. Spera, F. Strocchi, M. Takesaki, I. T. Todorov, A. Wasserman, H. Wenzl, S. L. Woronowicz.

INFORMATION: S. Doplicher, Dipartimento di Matematica, Università di Roma "La Sapienza", Città Universitaria, 00185 Roma, Italy; Email: serdopli@irmunisa.bitnet.

26–28. **Third International Workshop on Distributed Algorithms**, La Colle-sur-Loup, France. (Feb. 1989, p. 182)

27–29. **Eighth Gamm Conference on Numerical Methods of Fluid Mechanics**, Delft, The Netherlands. (Jul./Aug. (1989, p. 763)

*27–29. **SIAM Workshop on Geophysical Inversion**, Houston, TX.

ORGANIZERS: J. B. Bednar, Amerada Hess Corporation, Tulsa.

INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; Phone: 215-382-9800; Fax: 215-386-7999.

*27–October 5. **International School on Lyapunov Functions Method/Irkutsk'89**, Irkutsk, USSR.

SPONSOR: International Association for Mathematics and Computers in Simulation (IMACS).

CONFERENCE TOPICS: Mathematical problems of the method of Lyapunov functions; elaboration of techniques and algorithms of construction of Lyapunov functions and comparison systems; development of stability theory for differential and integrodifferential equations with partial derivatives; application of the method of Lyapunov functions to investigation of diverse-type systems.

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

*28–29. **International Conference on Mathematics in Transport Planning and Control**, Cardiff, Wales.

INFORMATION: S. Wardle, Conference Officer, The Institute of Mathematics and its Applications, Maitland House, Warrior House, Southend-on-Sea, Essex SS1 2JY, England.

29–30. **Midwest Noncommutative Ring Theory**, Ohio University, Athens, OH. (Jul./Aug. 1989, p. 763)

29–October 1. **Sixth IFAC/IFIP/IFORS /IMACS Symposium on Information Control Problems in Manufacturing Technology**, Madrid, Spain. (Mar. 1989, p. 313)

October 1989

1–7. **Topologische Methoden in der Gruppentheorie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 763)

2–4. **Topics in Univalent Functions and Its Applications**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 763)

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. **Geometrie Algebrique Reelle**, Marseille, France. (Jul./Aug. 1989, p. 763)

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)

4–6. **First European Workshop on Hypercube and Distributed Computers**, Rennes, France. (Jul./Aug. 1989, p. 763)

6–7. **Conference on Issues in the Teaching of Calculus**, Miami University, Oxford, OH. (Apr. 1989, p. 494)

8–14. **Arbeitsgemeinschaft Geyer-Harder**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 763)

9–13. **Workshop on Geometric Phases in Geometric Phases in Mechanics**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (May/Jun. 1989, p. 599)

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. (May/Jun. 1989, p. 599)

15–18. **Fourth International Workshop on High-Level Synthesis**, Kennebunkport, ME. (Dec. 1988, p. 1590)

15–21. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 763)

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. (May/Jun. 1989, p. 599)

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)

17–20. **Hyperfunctions and Differential Equation**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 763)

19–20. **Workshop on Large-Scale Numerical Optimization**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (May/Jun. 1989, p. 599)

19–21. **Journées Mathématiques/Informatique**, Marseille, France. (Jul./Aug. 1989, p. 763)

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.

22–28. **Linear Operators and Applications**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 763)

22–28. **Second Osterreichisches Symposium Zur Geschichte der Mathematik**, Neuhofen a.d. Ybbs, Austria. (Jul./Aug. 1989, p. 763)

23–26. **Beijing International Conference on System Simulation and Scientific Computing**, Beijing, China. (Mar. 1989, p. 313)

25–27. **Evolution Equations and Applications to Nonlinear Problems**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 764)

25–28. **Workshop on Numerical Methods for Elliptic Systems**, Espoo, Finland. (May/Jun. 1989, p. 599)

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.

* 27–28. **Fourth Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference**, De Pere, WI.

INVITED SPEAKER: J. S. Frame, Michigan State University.
INFORMATION: R. Poss, St. Norbert College, De Pere, WI 54115; 414-337-3198.

29–November 4. **Computational Methods in Solid Mechanics**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 313)

* 30–November 1. **Thirtieth Foundations of Computer Science (FOCS)**, Research Park, NC.

SPONSORS: IEEE Computer Society.
INFORMATION: C. Papadimitriou, Dept. of Computer Science, Univ. of California, San Diego, La Jolla, CA 92093; Phone: 619-534-2086.

30–November 2. **Workshop on Homotopy Theory**, Mathematical Sciences Research Institute, Berkeley, CA. (Mar. 1989, p. 313)

30–November 2. **Differential Analysis and Differential Topology**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 764)

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. (May/Jun. 1989, p. 599)

* 3–5. **Conference on Low Dimensional Topology and Combinatorial Group Theory**, SUNYA, Albany, NY.

INVITED SPEAKERS: K. Brown, J. Cannon, M. Handel, W. Metzler, J. Morgan, P. Scott, P. Shalen.
INFORMATION: E. C. Turner, Dept. of Math. and Stat., SUNYA, Albany, NY 12222.

4–8. **Workshop on Geometric and Algebraic Integration Algorithms**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (May/Jun. 1989, p. 599)

5–11. **Fastringe und Fastkörper**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 764)

6–8. **On the Structure of Solutions to Partial Differential Equations**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 764)

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)

8–10. **Conference for Mathematics in Chemistry**, College Station, TX. (Jul./Aug. 1989, p. 764)

10–11. **Eighteenth Midwest Differential Equations Conference**, Southern Illinois University, Carbondale, IL. (Apr. 1989, p. 495)

10–11. **Conference on Women in Mathematics and the Sciences**, St. Cloud State University, St. Cloud, MN. (Jul./Aug. 1989, p. 764)

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. (May/Jun. 1989, p. 600)

13–17. **Workshop: Dynamical Issues in Combustion Theory**, Institute for Mathematics and its Applications, Minneapolis, MN. (Dec. 1988, p. 1591)

13–17. **Supercomputing '89**, Reno, NV. (Jul./Aug. 1989, p. 764)

15–17. **Geometry of Manifolds**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 764)

17–20. **Workshop on Classical and Quantum Transport in Hamiltonian Systems**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (May/Jun. 1989, p. 600)

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.

19–25. **Random Partial Differential Equations**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 764)

20–24. **Seminaire Sud-Rhodanien de Geometrie Differentielle**, Marseille, France. (Jul./Aug. 1989, p. 764)

26–December 2. **Methoden und Verfahren der Mathematischen Physik**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 764)

27–29. **Computer Algebra and Its Application to Investigations for Mathematics**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 764)

27–29. **The Recent Developments of High Technology and Mathematical Science (II)**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

29–December 1. **Numerical Analysis and Scientific Computing**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

December 1989

3–9. **Wiener-Hopf-Probleme, Topelitz-Operatoren und Anwendungen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 765)

4–6. **1989 Winter Simulation Conference**, Washington, DC. (May/Jun. 1989, p. 600)

4–6. **Studies on Decision Theory and Their Related Topics**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

4–7. **Research on Complex Analytic Geometry and Related Topics**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

4–8. **Fifth Aerospace Computer Security Applications Conference**, Tucson, AZ. (May/Jun. 1989, p. 600)

6–9. **Algebraic Number Theory**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

* 9. **Boston Celebration of the ASA150 Sesquicentennial**, Boston, MA.

INFORMATION: J. Efird, Dept. of Health Policy & Mgmt, Harvard Univ., 677 Huntington Ave, Boston, MA 02115; 617-732-2291.

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)

11–14. **Number Theory - Studies Related to Automorphic Forms**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

* 12–14. **Second Australian Supercomputer Conference**, University of Wollongong, NSW, Australia.

INFORMATION: J. Barry, Australian Nuclear Science and Technology Organisation, Private Mail Bag 1, Menai, NSW 2234, Australia.

17–23. **Theory and Numerical Methods for Initial-Boundary Value Problems**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

* 27–31. **Holiday Symposium on Braids and Knots**, New Mexico State University, Las Cruces, NM.

PROGRAM: This year's symposium is focused on braids and knots. There will be a series of ten lectures, two each day, by Professor J. Birman of Columbia University. There will be additional sessions for contributed papers, research ideas, and discussion. Some support may be available for a limited number of participants.
INFORMATION: R. J. Wisner, Braids and Knots Symposium, Dept. of Mathematical Sciences, New Mexico State University, Box 30001, Las Cruces, NM 88003-0001; 505-646-3901.

* 1990. **IMACS International Workshop on Massively Parallel Methods in Computational Physics**, Boulder, Colorado.

INFORMATION: K. E. Gustafson, Dept. of Mathematics, Box 426, Univ. of Colorado, Boulder, CO 80309, USA.

* 1990. **IMACS Conference on Computer Aided Design**, Yugoslavia.

INFORMATION: L. T. Grujic, Faculty of Mechanical Engineering, Belgrade Univ., P.O.Box 174, 11001, Belgrade, Yugoslavia.

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)

* 8–13. **Workshop on Variational Methods in Hamiltonian Systems and Elliptic Equations**, L'Aquila, Italy.

INVITED SPEAKERS: A. Ambrosetti, A. Bahri, V. Benci, H. Berestycki, H. Brezis, G. Dell'Antonio, I. Ekeland, D. Fortunato, M. R. Herman, H. Hofer, P. L. Lions, A. Marino, L. Modica, K. R. Meyer, J. Moser, L. Nirenberg, S. P. Novikov, P. H. Rabinowitz, M. Willem.
INFORMATION: M. Girardi or M. Matzeu, Dipartimento di Matematica Pura e Applicata-Università di L'Aquila- Via Roma Pal. Del Tosto - 67100 L'Aquila-Italy; or to F. Pacella, Dipartimento di Matematica, Università di Roma, La Sapienza, P.le A.moro 2, 00185 Roma, Italy; Email: pacella@irmunisa (bitnet).

* 10–13. **International Conference on Differential Equations and Applications to Biology and Population Dynamics**, Harvey Mudd College, Claremont, CA.

CONFERENCE TOPICS: Delay differential equations, difference equations, functional differential equations, infinite dimensional dynamical systems, epidemic models, physiological models.
INVITED SPEAKERS: K. Cooke, K. Hadeler, J. Hale, M. Iannelli, S. Levin, J. Mawhin, G. Sell, P. Waltman.
ORGANIZING COMMITTEE: S. Busenberg, Harvey Mudd College; R. Eldekin, Pomona College; M. Martelli, California State University Fullerton.
INFORMATION: Differential Equations Conference, Mathematics Department, Harvey Mudd College, Claremont, CA 91711.

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**, Inter-

national Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 600)

16–17. **AMS Short Course on Mathematical Questions in Robotics**, Louisville, KY.

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

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)

* 22–24. **ACM/SIAM Symposium on Discrete Algorithms**, San Francisco, CA.

ORGANIZERS: F.R.K. Chung, Bell Communications Research, Inc.; D. Johnson, AT&T Bell Laboratories.
INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; Phone: 215-382-9800; Fax: 215-386-7999.

22–26. **Workshop on Applications of Algebraic Topology to Geometry and Analysis**, Mathematical Sciences Research Institute, Berkeley, CA. (May/Jun. 1989, p. 600)

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. (May/Jun. 1989, p. 600)

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)

5–10. **Eighth International Seminar on Model Optimization in Exploration Geophysics, with a Workshop on Geophysical Data Inversion in Environmental Research and Planning**, Berlin-West, Free University of Berlin, Federal Republic of Germany. (Jul./Aug. 1989, p. 765)

* 11–15. **The Twenty-sixth Australian Applied Mathematics Conference**, Coolangatta, Queensland, Australia.

INFORMATION: V. G. Hart, Dept. of Mathematics, University of Queensland, St. Lucia, Queensland 4067, Australia.

11–17. **Funktiontheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

* 15–20. **American Association for the Advancement of Science Annual Meeting**, New Orleans, LA.

INFORMATION: AAAS, 1333 H St., N.W., Washington, DC 20005; 202-326-6640.

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. (May/Jun. 1989, p. 601)

22–23. **Twenty-first SIGCSE Technical Symposium**, Washington, D.C. (May/Jun. 1989, p. 601)

25–March 3. **Eigenwertaufgaben In Natur Und Ingenieurwissensachaften Und Ihre Numerische Behandlung**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

* 26–March 2. **IEEE Computer Society COMPCON Spring '90**, San Francisco, CA.

INFORMATION: COMPCON Spring'90, Computer Society of the IEEE, 1730 Massachusetts Ave., N.W., Washington, DC 20036-1903; 202-371-1013; Telex 7082500437 IEEECOMPSO.

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)

* 5–7. **Symposium on Symbolic Computation (on the occasion of the sixtieth birthday of Erwin Engeler)**, Zürich, Switzerland.

INVITED SPEAKERS: B. Buchberger, Johannes Kepler Universität; J. C. Davenport, University of Bath; S. Feferman, Stanford University; J. A. Goguen, Oxford University; G. H. Gonnet, University of Waterloo; D. Harel, The Weizmann Institute of Science; G. Longo, Università di Pisa; R. Milner, Edinburgh University; M. M. Richter, Universität Kaiserslautern; D. Scott, Carnegie-Mellon University; J. C. Shepherdson, University of Bristol.
ORGANIZING COMMITTEE: G. Jäger, H. Läuchli, U. Stammbach, N. Wirth.
INFORMATION: H. Läuchli, Symposium on Symbolic Computation, Mathematik, HG G 62.3, ETH-Zentrum, CH-8092 Zürich, Phone 01 256 34 25.

11–17. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

13–16. **Twenty-first Annual Iranian Mathematics Conference**, University of Isfahan, Iran. (Jul./Aug. 1989, p. 766)

14–19. **East European Category Seminar**, Predela, Bulgaria. (May/Jun. 1989, p. 601)

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)

19–22. **Eleventh Annual National Graphics Association Conference and Exposition**, Anaheim, CA. (Jul./Aug. 1989, p. 766)

19–24. **US-USSR Approximation Theory Conference**, University of South Florida, Tampa, FL. (Jul./Aug. 1989, p. 766)

20–23. **Directions in Matrix Theory**, Auburn, AL. (May/Jun. 1989, p. 601)

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)

* 26–29. **Workshop on Number Theory and Algorithms**, Berkeley, CA.

ORGANIZER: H. Lenstra.
INFORMATION: I. Kaplansky, Director, Mathematical Sciences Research Institute, 1000 Centennial Dr., Berkeley, CA 94720.

26–April 6. **Workshop on Group Theory from a Geometrical Viewpoint**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 601)

29–31. **Mathematical Sciences Institute Symposium on Mathematics as Art, Mathematics as a Consumer Good**, Cornell University, Ithaca, NY. (Jul./Aug. 1989, p. 766)

April 1990

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

1–7. **Design and Codes**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

* 1–14. **NATO Advanced Study Institute on "Generators and Relations in Groups and Geometries"**, Castelvecchio Pascoli (Lucca), Italy.

INVITED SPEAKERS: A. Caranti, Trento; A. M. Cohen, Amsterdam; L. Di Martino, Milano; E. W. Ellers, Toronto; M. Götzky, Kiel; H. Ishibashi, Sakado; M. Jarden, Tel Aviv; F. Knüppel, Kiel; T. J. Laffey, Dublin; H. Lausch, Würzburg; P. Plaumann, Erlangen; T. A. Springer, Utrecht; B. Zimmermann, Trieste.
INFORMATION: Organizing Committee of the NATO ASI meeting c/o K.Strambach, Universität Erlangen-Nürnberg, Mathematisches Institut, Bismarckstr. 1 1/2, D-8520 Erlangen, Federal Republic of Germany.

4–7. **Symposium on Distributions with Given Marginals (In Memory of Giuseppe Pompilj)**, Rome, Italy. (May/Jun. 1989, p. 601)

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

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

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

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.

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

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

May 1990

* 3–4. **Twenty-first Annual Pittsburgh Conference on Modeling and Simulation**, University of Pittsburgh, Pittsburgh, PA.

CONFERENCE TOPICS: Emphasis for the conference will be microprocessors, personal computer applications and software, artificial intelligence, expert systems, robotics and all aspects of control theory and applications, as well as social, economic, geography, regional science, and global modeling and simulation.
SPONSORS: School of Engineering, University of Pittsburgh; The Institute of Electrical and Electronic Engineers; The Systems, Man and Cybernetics Society; The Instrument Society of America; The Society for Computer Simulation; The International Association for Mathematics and Computers in Simulation.
CALL FOR PAPERS: Two copies of titles, authors, all author's addresses, abstracts and summaries should be submitted by January 31, 1990. The abstract should be approximately 50 words in length and the summary should be of sufficient length and detail to permit careful evaluation. Only papers not published previously will be considered. Identify one author as the correspondent for the paper.
INFORMATION: W. G. Vogt or M. H. Mickle, Modeling and Simulation Conference, 348 Benedum Engineering Hall, University of Pittsburgh, Pittsburgh, PA 15261.

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

* 7–10. **SIAM Conference on Applications of Dynamical Systems**, Orlando, FL.

SPONSOR: SIAM Activity Group on Dynamical Systems
ORGANIZER: Shui-Nee Chow, Michigan State University.
CALL FOR PAPERS: Abstract Deadline: November 28, 1989.
INFORMATION: Siam Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; Phone: 215-382-9800; Fax: 215-386-7999.

7–June 1. **College on Recent Developments and Applications in Mathematics and Computer Science**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 601)

13–19. **Abstrakte Konvexe Analysis**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

14–18. **Conference on Nonlinear Analysis and Partial Differential Equations**, Rutgers University, New Brunswick, NJ. (Jul./Aug. 1989, p. 767)

* 17–19. **Interface '90 (formerly Computer Science and Statistics: Symposium on Interface)**, East Lansing, MI.

SPONSORS: AMS, ASA, IASC, IMS, NCGA, ORA, SIAM.
INFORMATION: R. LePage, Dept. of Stat. & Probability, Michigan State Univ., East Lansing, MI 48824-1024.

20–26. **The Schrödinger Equation and Its Classical Counterparts**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

* 21–24. **The Simulation of Random Processes and Fields – Mathematics and Applications**, Portofino, Italy.

CONFERENCE TOPICS: Topics to be covered include mathematical questions and actual applications of computer simulations in various fields.
INVITED SPEAKERS: G. K. Ackers, A. Benveniste, M. Eigen, D. Griffeath, R. Holley, J. Hopfield, R. Kapral, R. May, A. Sokal, D. Stroock, A. T. Winfree.
INFORMATION: F. Marchetti, Università di Genova, Dipartimento di Matematica, v. L. B. Alberti 4, I-16132 Genova, Italy; Phone: (+39-10) 353-

8717; Fax: (+39-10) 353-8769; Email marketti@igecuniv (earn/bitnet).

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)

27–June 2. **Lyapunov-Exponents**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

June 1990

June 1990. **AMS-SIAM Summer Seminar on Vortex Dynamics and Vortex Methods**, Location on the west coast to be announced.

INFORMATION: B. Verducci, AMS, P.O. Box 6248, Providence, RI 02940.

*June/July 1990. **International IMACS Conference on Mathematical Modelling and Applied Mathematics**, Vilnius, USSR.

ORGANIZERS: USSR Academy of Sciences, Keldysh Institute of Applied Mathematics, Lithuanian SSR Academy of Science, Institute of Mathematics and Cybernetics.
INFORMATION: A. A. Samarskii, Keldysh Institute of Applied Mathematics,
USSR Academy of Sciences, Miusskaya pl.4, 125047 Moscow, USSR.

*1–8. **Third International IMACS Symposium on Orthogonal Polynomials and Their Applications**, Erice-Trapani (Sicily), Italy.

PROGRAM: Invited talks and short communications.
ORGANIZING COMMITTEE: C. Brezinski, Lille; L. Gori Nicolò-Amati, Rome; A. Laforgia, Palermo; G. Mastroianni, Potenza; G. Monegato, Turin;
P. G. Nevai, Columbus; A. Ronveaux, Namur.
INVITED SPEAKERS: R. Askey, T. S. Chihara, L. Gatteschi, W. Gautschi, T. H. Koornwinder, D. S. Lubinsky, A. Magnus, F. Marcellan, P. Maroni, E. B. Saff, H. Stahl, S. K. Suslov, V. Totik, W. Van Assche.
CALL FOR PAPERS: The deadline for short communications is November 30, 1989. The deadline for registration is March 1, 1990.
INFORMATION: L. Rodonò or L. Michelucci, Dipartimento di Matematica e Applicazioni, Università di Palermo, Via Archirafi 34, I-90123 Palermo, Italy; Phone: 39-91-6162824.

*3–6. **1990 Annual Meeting of the Statistical Society of Canada**, St. John's, Newfoundland, Canada.

INFORMATION: C. A. Field, Program Chairperson, Dept. of Mathematics, Statistics and Computing Science, Dalhousie University, Halifax, Nova Scotia B3H 4H8, Canada; or B. Sutradhar, Local Arrangements Chairperson, Dept. of Mathematics and Statistics, Memorial University of Newfoundland, St. John's, Newfoundland A1C 5S7, Canada.

3–9. **Graphentheorie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

*4–7. **Fifth Annual IEEE Symposium on Logic in Computer Science**, Philadelphia, PA.

PURPOSE: The symposium aims for wide coverage of theoretical and practical issues in computer science that relate to logic in a broad sense, including algebraic, categorical and topological approaches.
ORGANIZING COMMITTEE: M. Abadi, J. Barwise, A. Chandra, E. Engeler, J. Gallier, J. Goguen, D. Gries, Y. Gurevich, D. Johnson, D. Kozen, Z. Manna, A. Meyer (chair), J. Mitchell, C. Papadimitriou, R. Parikh, G. Plotkin, D. Scott.
SPONSORS: IEEE Technical Committee on Mathematical Foundations of Computing, Association for Symbolic Logic, European Association of Theoretical Computer Science.
CALL FOR PAPERS: Fifteen (15) copies of a detailed abstract—not a full paper—should be received by December 1, 1989. The entire extended abstract should not exceed ten (10) standard front doubled-spaced pages (2500 words). The title page of the submission should include a brief synopsis and author's name, address, phone number, and email address if available.
INFORMATION: J. C. Mitchell, LICS Program Chair, Dept. of Computer Science, Stanford University, Stanford, CA 94305, USA; Internet: jcm@cs.stanford.edu.

*4–8. **Workshop on Model Theory**, Berkeley, CA.

PROGRAM: This is the last of three workshops planned as part of the Mathematical Sciences Research Institute's yearlong 1989-1990 program on logic.
ORGANIZER: E. Hrushovski.
INFORMATION: I. Kaplansky, Director, Mathematical Sciences Research Institute, 1000 Centennial Dr., Berkeley, CA 94720.

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)

10–16. **Reelle Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

11–14. **Fourteenth Rolf Nevanlinna Colloquium**, University of Helsinki, Helsinki, Finland. (Jul./Aug. 1989, p. 767)

11–14. **World Organization of Systems and Cybernetics Eighth International Congress**, New York, NY. (Mar. 1989, p. 315)

*11–14. **Fifth SIAM Conference on Discrete Mathematics**, Atlanta, GA.

SPONSOR: Siam Activity Group on Discrete Mathematics.
ORGANIZER: P. Winkler, Emory University.
CALL FOR PAPERS: Abstract Deadline: January 5, 1990.
INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; Phone: 215-382-9800; Fax: 215-386-7999.

11–15. **Third International Conference on Hyperbolic Problems**, Uppsala, Sweden. (Jul./Aug. 1989, p. 767)

11–15. **Rigorous Results in Quantum Dynamics**, Liblice Castle, Czechoslovakia. (May/Jun. 1989, p. 602)

13–15. **Seventh Annual Quality and Productivity Research Conference**, Madison, WI. (Mar. 1989, p. 315)

13–22. **Free Boundary Problems: Theory and Applications**, Centre de Recherches Mathématiques, Université de Montréal, Canada. (Jul./Aug. 1989, p. 767)

17–23. **Partial Differential Equations in Complex Analysis**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

18–20. **Joint WNAR-IMS Regional Meeting**, Montana State University, Bozeman, MT. (Mar. 1989, p. 315)

24–30. **Mathematische Probleme in der Nichtlinearen Elastizität**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

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)

* 1–15. **International Symposium on Algebraic Topology - Adams Memorial Symposium**, University of Manchester, England.

PURPOSE: This symposium will commemorate the life and work of Frank Adams, who held the Fielden chair of pure mathematics at Manchester from 1964 to 1971, and will be centered on stable homotopy theory.
SPONSOR: SERC.
INFORMATION: J. Minshull, Dept. of Mathematics, Univ. of Manchester, Manchester M13 9PL; (Email: mbbmath@uk.ac.mcc.cms).

1–18. **Twentieth Summer Session on Probability Theory**, Saint-Flour (Cantal), France. (Mar. 1989, p. 315)

2–6. **Tenth Australian Statistical Conference/Second Pacific Statistical Congress**, Sydney, Australia. (Jul./Aug. 1989, p. 768)

* 2–6. **The Jónsson Symposium**, Laugarvatn, Iceland.

PURPOSE: This international conference honoring Bjarni Jónsson will survey the current state of research in universal algebra, lattice theory, algebraic logic, and related fields.
PROGRAM: The program will consist of invited talks and contributed papers.
INFORMATION: A. Pixley, Dept. of Mathematics, Harvey Mudd College, Claremont, CA 91711; Ch. Herrmann, FB4 AG1, Technische Hochschule Darmstadt, D-6100 Darmstadt, West Germany.

* 3–6. **Eleventh Dundee Conference on Ordinary and Partial Differential Equations**, Dundee, Scotland.

PURPOSE: The conference will bring together research workers with a common interest in differential equations and their applications. Particular attention will be focused on recent developments in the theory of nonlinear differential equations and their applications to biological phenomena, wave propagation and dynamical systems.
INVITED SPEAKERS: J. M. Ball, P. Binding, O. Diekmann, I. Ekeland, P. J. Holmes, G. Kreigsman, M. C. Mackey, R. E. Meyer, D. H. Sattinger, L. Tartar.
INFORMATION: R. J. Jarvis, Department of Mathematics & Computer Science, The University, Dundee DD1 4HN, Scotland, U.K.

8–14. **Variationsrechnung**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

9–11. **"Universita'di Genova - The Ohio State University Joint Conference" on New Trends in Systems Theory**, Genoa, Italy. (Jul./Aug. 1989, p. 768)

9–20. **Geometry and Topology of Four-Manifolds**, McMaster University, Hamilton, Ontario, Canada. (May/Jun. 1989, p. 602)

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. (May/Jun. 1989, p. 602)

16–20. **SIAM Annual Meeting**, Chicago, IL. (Nov. 1988, p. 1389)

22–28. **Konvexgeometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

* 26–29. **International Conference on New Trends in Geometric Function Theory and Applications**, University of Madras, Madras, India.

INVITED SPEAKERS: H. M. Srivastava, Canada; R. Srivastava, Canada; M. A. Nasr, Egypt; S. Ruscheweyh, FRG; O. Tammi, Finland; S. Owa, Japan; R. M. Porter, Mexico; J. Krzyz, Poland; J. M. Anderson, U.K.; D. K. Thomas, U.K.; C. H. Fitzgerald, USA; W. H. Fuchs, USA; A. W. Goodman, USA; E. P.Merkes, USA; S. S. Miller, USA; C. D. Minda, USA; M. O. Reade, USA; D. Sarason, USA; S. M. Shah, USA; H. Silverman, USA; E. M. Silvia, USA; D. Sundararaman, USA.
INFORMATION: R. Parvatham, Convener, International Conference - Geometric Function Theory, Ramanujan Institute for Advanced Study in Mathematics, University of Madras, Madras-600 005, India.

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)

13–17. **Fifth International Conference on Hadronic Mechanics and Nonpotential Interactions**, University of Northern Iowa, Cedar Falls, Iowa. (Jul./Aug. 1989, p. 768)

* 13–17. **Eleventh IFAC World Congress**, Tallin, USSR.

INFORMATION: IFAC Secretariat, Schlossplatz 12, A-2361 Laxenburg, Austria.

* 13–17. **Algebraic Geometry and Analytic Geometry**, Tokyo, Japan.

PURPOSE: The conference is intended to provide an overview of recent developments in algebraic, analytic and arithmetic geometry.
CONFERENCE TOPICS: Birational geometry and classification theory, geometry in positive and mixed characteristics, singularities, analytic and differential-geometric methods, vector bundles.
ORGANIZERS: K. Kato, T. Katsura, Y. Miyaoka, S. Mori, K. Saito, N. Sasakura.
INVITED SPEAKERS: P. Berthellot, S. Bloch, J. Carlson, H. Clemens, T. Ekedahl, T. Fujita, K. Hulek, Y. Kawamata, J. Kollár, Lê Dũng Tráng, B. Mazur, N. Mok, S. Mukai, C. Okonek, M. Reid, C.S. Seshadri, Y.-T. Siu, C. Soulé, J.H.M. Steenbrink, P.M.H. Wilson, D. Zagier.
INFORMATION: Y. Miyaoka, Dept. of Mathematics, Tokyo Metropolitan University, Fukazawa, Setagaya, Tokyo 158, Japan.

* 13–18. **Institute of Mathematical Statistics Fifty-third Annual Meeting(jointly with the Second World Congress of the Bernoulli Society)**, Uppsala, Sweden.

INFORMATION: L. Billard, Dept. of Statistics, Univ. of Georgia, Athens, GA 30602; 404-542-5232.

* 14–18. **The Asian Mathematical Conference 1990**, Hong Kong, China.

CONFERENCE TOPICS: Algebra and logic, analysis, geometry, applicable and discrete mathematics, probability and statistics.
ORGANIZING COMMITTEE: K. Y. Chan, (HKU) (Chairman); K. P. Shum, (CUHK); R. F. Turner-Smith (HK Polytechnic); H. K. Chow, (HK Polytechnic); T. H. Yao, (HKU).
INFORMATION: H. K. Chow, Assistant Secretary, Asian Mathematical Conference 1990, Dept. of Mathematical Studies, The Hong Kong Polytechnic, Hung Hom, Kowloon, Hong Kong; Telex: 38964 POLYX HK; Fax: (852)3-7643374.

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)

28–31. **Operations Research 1990, International Conference Operations Research**, Vienna, Austria. (Jul./Aug. 1989, p. 768)

30–September 4. **International Conference on Potential Theory**, Nagoya, Japan. (May/Jun. 1989, p. 602)

September 1990

* September/October 1990. **IMACS-GAMM Conference on Computer Arithmetic, Scientific Computation and Mathematical Modelling**, Bulgaria.

ORGANIZER: Bulgarian Academy of Sciences.
INFORMATION: U. Kulisch, Universitat Karlsruhe, Institut fur Angewandte Mathematik, Kaiserstrasse 12, Postfach 6980, D-7500 Karlsruhe 1, Germany.

IMACS Symposium on Modelling and Simulation of Electrical Machines, ENSEM - Nancy, France. (May/Jun. 1989, p. 602)

* 2–7. **Twelfth International Conference on Nonlinear Oscillations**, Cracow, Poland.

SPONSORS: Polish Academy of Sciences and Cracow University of Technology.
PURPOSE: The aim of the conference is to present the most recent advances in the field of nonlinear oscillations concerning mathematical methods of analysis, synthesis, optimization and the applications in the field of physics, structural mechanics, electrotechnics, electronics, biomechanics, chemistry and others.
CONFERENCE TOPICS: Analytical methods, qualitative methods, numerical methods, experimental techniques, physical and technical applications/mechanics, electrotechnics, electronics/biological, chemical, biomechanical and others.
ORGANIZERS: J. Niziol, S. Marcyzk, K. Arczewski, A. Bar, A. Chodacki, K. Gajewski, S. Michalowski, R. Palej, M. Pracik.
INFORMATION: S. Marczyk, Twelfth ICNO Secretariat, Cracow University of Technology, Institute of Mechanics and Machine Design, Al. Planu 6-Letniego 19A, 31-864 Cracow, Poland.

2–8. **Topologie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

3–6. **Fourth Asian Logic Conference**, Tokyo, Japan. (Mar. 1989, p. 316)

3–7. **IMACS Symposium on Intelligent Models in Systems Simulation**, Brussels, Belgium. (Mar. 1989, p. 316)

3–7. **Representation des Groupes et Analyse Complexe**, Marseille, France. (Jul./Aug. 1989, p. 768)

8–12. **Neuronet-90: IMACS International Symposium on Neural Nets and Neural Computers**, Prague, Czechoslovakia. (Please note change from May/Jun. 1989, p. 602)

9–15. **Surgery and L-Theory**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

10–October 5. **School on Qualitative Aspects and Applications of Nonlinear Evolution Equations**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 602)

10–14. **Mathematiker-Kongress**, Dresden, German Democratic Republic. (Jul./Aug. 1989, p. 769)

16–22. **Risikotheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

17–22. **DMV-Jahrestagung 1990**, Bremen, Federal Republic of Germany. (Jul./Aug. 1989, p. 769)

23–29. **Random Graphs and Combinatorical Structures**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

24–28. **International Symposium on Mathematical Theories**, San Sebastián, Spain. (Jul./Aug. 1989, p. 769)

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.

* 5–7. **Second SIAM Confernce on Linear Algebra in Signals, Systems & Controls**, San Francisco, CA.

SPONSOR: SIAM Activity Group on Linear Algebra.
ORGANIZERS: B. Datta, Northern Illinois University; D. Carlson, San Diego State University.
CALL FOR PAPERS: Abstract Deadline: May 16,1990.
INFORMATION: SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; Phone: 215-382-9800; Fax: 215-386-7999.

* 12–16. **Supercomputing '90**, New York, NY.

SPONSORS: IEEE Computer Society, ACM.
INFORMATION: Supercomputing '90, IEEE Computer Society, 1730 Massachusetts Ave.,N.W., Washington, DC 20036-1903; Phone: 202-371-1013; TWX 7082500437 IEEECOMPSO.

18–24. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25–December 1. **Stochastische Approximation Und Optimierungsprobleme In Der Statistik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25–December 1. **Lineare Modelle und Multivariate Statistische Verfahren**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 769)

December 1990

2–8. **Multigrid Methods**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

3–7. **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

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

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

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

Contents

1980 *Mathematics Subject Classifications*: 55-06; 55P42, 55P45, 55R45, 55T15, 18F25
ISBN 0-8218-5102-0, LC 89-15023
ISSN 0271-4132
368 pages (softcover), August 1989
Individual member $25, List price $41,
Institutional member $33
To order, please specify CONM/96N

DYNAMICS AND CONTROL OF MULTIBODY SYSTEMS
J. E. Marsden, P. S. Krishnaprasad, and J. C. Simo
(Contemporary Mathematics, Volume 97)

The study of complex, interconnected mechanical systems with rigid and flexible articulated components is of growing interest to both engineers and mathematicians. Recent work in this area reveals a rich geometry underlying the mathematical models used in this context. In particular, Lie groups of symmetries, reduction, and Poisson structures play a significant role in explicating the qualitative properties of multibody systems. In engineering applications, it is important

to exploit the special structures of mechanical systems. For example, certain mechanical problems involving control of interconnected rigid bodies can be formulated as Lie-Poisson systems. The dynamics and control of robotic, aeronautic, and space structures involve difficulties in modeling, mathematical analysis, and numerical implementation. For example, a new generation of spacecraft with large, flexible components are presenting new challenges to the accurate modeling and prediction of the dynamic behavior of such structures. Recent developments in Hamiltonian dynamics and coupling of systems with symmetries has shed new light on some of these issues, while engineering questions have suggested new mathematical structures.

These kinds of considerations motivated the organization of the AMS-IMS-SIAM Joint Summer Research Conference on Control Theory and Multibody Systems, held at Bowdoin College in August, 1988. This volume contains the proceedings of that conference. The papers presented here cover a range of topics, all of which could be viewed as applications of geometrical methods to problems arising in dynamics and control. The volume contains contributions from some of the top researchers and provides an excellent overview of the frontiers of research in this burgeoning area.

Contents

1980 *Mathematics Subject Classifications*: 55FXX, 70HXX, 70QXX
ISBN 0-8218-5104-7, LC 89-15019
ISSN 0271-4132
488 pages (softcover), August 1989
Individual member $28, List price $46,
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SOME MATHEMATICAL QUESTIONS IN BIOLOGY:MODELS IN POPULATION BIOLOGY

Alan Hastings, Editor

(Lectures on Mathematics in the Life Sciences, Volume 20)

Population biology has had a long history of mathematical modeling. The 1920s and 1930s saw major strides with the work of Lotka and Volterra in ecology and Fisher, Haldane, and Wright in genetics. In recent years, much more sophisticated mathematical techniques have been brought to bear on questions in population biology. Simultaneously, advances in experimental and field work have produced a wealth of new data. While this growth has tended to fragment the field, one unifying theme is that similar mathematical questions arise in a range of biological contexts.

This volume contains the proceedings of a symposium on Some Mathematical Questions in Biology, held in Chicago in 1987. The papers all deal with different aspects of population biology, but there are overlaps in the mathematical techniques used; for example, dynamics of nonlinear differential and difference equations form a common theme. The topics covered are cultural evolution, multilocus population genetics, spatially structured population genetics, chaos and the

dynamics of epidemics, and the dynamics of ecological communities.

Contents

1980 *Mathematics Subject Classifications*: 92A10, 92A15
ISBN 0-8218-1170-3, LC 89-15119
ISSN 0075-8523
136 pages (softcover), September 1989
Individual member $17, List price $28,
Institutional member $22
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GROUP ACTIONS AND INVARIANT THEORY
A. Bialynicki-Birula, J. Carrell, P. Russell, and D. Snow, Editors

(Conference Proceedings, Canadian Mathematical Society, Volume 10)

This volume contains the proceedings of a conference, sponsored by the Canadian Mathematical Society, on Group Actions and Invariant Theory, held in August, 1988 in Montreal. The conference was the third in a series bringing together researchers from North America and Europe (particularly Poland). The papers collected here will provide an overview of the state of the art of research in this area. The conference was primarily concerned with the geometric side of invariant theory, including explorations of the linearization problem for reductive group actions on affine spaces (with a counterexample given recently by J. Schwarz), spherical and complete symmetric varieties, reductive quotients, automorphisms of affine varieties, and homogeneous vector bundles.

Contents

1980 *Mathematics Subject Classifications*: 14-02, 14L30, 1406, 2006; 20G05, 14D25
ISBN 0-8218-6015-1, LC 89-17605
ISSN 0731-1036
240 pages (softcover), September 1989
Individual member $20, List price $33,
Institutional member $26
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THE METAPLECTIC REPRESENTATION, MP^C STRUCTURES AND GEOMETRIC QUANTIZATION
P. L. Robinson and J. H. Rawnsley

(Memoirs of the AMS, Number 410)

This work presents a detailed and unified account of the metaplectic representation and symplectic spinors, based on the Bargmann-Segal model of the canonical commutation relations. Though the standard Schrödinger model is customarily used in this context, the present approach enables the authors to explicitly describe the structure and pairing of vacuum states for positive polarizations. They develop a scheme for the geometric quantization of symplectic manifolds that involve half-forms defined by symplectic spinors

and that, following Hess, use Mp^c structures in place of the standard metaplectic structures. This scheme extends the standard scheme due to Kostant and Souriau and is applied to complex projective spaces and linear symplectic manifolds.

Contents

1980 *Mathematics Subject Classifications*: 22E70, 53C10, 53C57, 58F06, 81D07
ISBN 0-8218-2473-2, LC 89-15191
ISSN 0065-9266
93 pages (softcover), September 1989
Individual member $10, List price $16,
Institutional member $13
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3-MANIFOLDS WHICH ARE END 1-MOVABLE

Matthew G. Brin and T. L. Thickstun
(Memoirs of the AMS, Number 411)

While requiring only the basics of 3-manifold topology as background, this book introduces recent techniques that will certainly find further application and brings readers to the frontiers of the topology of noncompact 3-manifolds.

Traditional techniques for analyzing noncompact 3-manifolds involve study of its compact subsets. By contrast, this work utilizes certain open subsets called end reductions, which are "simple" approximations to a noncompact manifold that inherit many of the manifold's properties. In this work, the authors further their development of the concept of end reduction and use it to analyze all orientable, noncompact 3-manifolds in which loops near infinity homotop to infinity while staying near infinity (this is the proper homotopy condition "end 1-movable" of the title).

The class of manifolds examined here also includes the "missing boundary" manifolds. The authors provide a new characterization of orientable, missing boundary 3-manifolds and contribute some information about the open question of determining which covers of compact 3-manifolds are missing boundary manifolds.

Contents

1980 *Mathematics Subject Classifications*: 57N10; 57M10, 57N65
ISBN 0-8218-2474-0, LC 89-15146
ISSN 0065-9266
73 pages (softcover), September 1989
Individual member $9, List price $15,
Institutional member $12
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RINGS OF DIFFERENTIAL OPERATORS ON CLASSICAL RINGS OF INVARIANTS

T. Levasseur and J. T. Stafford
(Memoirs of the AMS, Number 412)

This book will provide readers with an understanding of the interrelationship between differential operators, invariant theory, and the primitive ideal theory of semisimple Lie algebras. The main topic concerns a study of rings of differential operators on classical rings of invariants, in the sense of Weyl's book, *The Classical Groups*. The authors consider three different classes of rings of invariants and show that, for each of these cases, the ring of differential operators is a simple factor ring of a certain enveloping algebra. In particular, the ring of differential operators is a simple Noetherian ring. They also demonstrate that, if $SO(k)$ acts in the natural way on the ring of complex polynomials in kn variables, then, for $k \leq n$, the ring of differential operators on $C[X]^{SO(k)}$is finitely generated as a module of a certain enveloping algebra.

Contents

Differential operators on the ring of $SO(k)$-invariants

Appendix. Gabber's Lemma

1980 *Mathematics Subject Classifications*: 17B35, 13N05, 14L30, 14M12, 17B20, 16A19, 16A33
ISBN 0-8218-2475-9, LC 89-15147
ISSN 0065-9266
117 pages (softcover), September 1989
Individual member $11, List price $19,
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UNIMODAL LOG-CONVAVE AND PÓLYA FREQUENCY SEQUENCES IN COMBINATORICS

Francesco Brenti

(Memoirs of the AMS, Number 413)

In recent years, considerable research has focused on unimodal or log-concave sequences that are of combinatorial interest. Although these two properties have simple definitions, proving that a sequence is unimodal or log-concave is often a difficult task requiring refined and sophisticated mathematical tools from such areas as representation theory, algebraic geometry, or classical analysis.

The main purpose of this book is to show the theory of total positivity can be very useful in studying this area. In the first part of the book, after discussing some combinatorial motivations, the author studies some of the fundamental linear transformations that preserve the log-concavity or Pólya frequency properties of a sequence. This part forms the theoretical core of the work and may be read independently from the rest. In fact, this rich and powerful theory can be applied to any situation in which log-concavity and unimodality questions arise. The second part of the book is devoted to applications to several combinatorial situations, yielding many new results and solutions to some problems that had resisted attack with other techniques. Both parts of the book point to many conjectures, open problems, and directions for further study.

Contents

1980 *Mathematics Subject Classifications*: 05A20; 05A15, 05A10, 05C20, 06A10, 11B73, 15A04, 26C10, 30C15
ISBN 0-8218-2476-7, LC 89-15137
ISSN 0065-9266
106 pages (softcover), September 1989
Individual member $10, List price $17,
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ACTIONS OF LINEARLY REDUCTIVE GROUPS ON AFFINE PI-ALGEBRAS

Nikolaus Vonessen

(Memoirs of the AMS, Number 414)

Aimed at researchers and advanced graduate students interested in ring theory and invariant theory, this book introduces readers to a new and quite beautiful area of noncommutative invariant theory.

The author examines this subject in the setting of affine PI-algebras, extending both the theory of actions of finite groups on noncommutative rings and commutative invariant theory. The work focuses the action of a linearly reductive group G on a finitely generated PI-algebra R. One of the book's major results is that the fixed ring R^G is finitely generated, provided that R is Noetherian. Other topics explored here include localization, the behavior of prime ideals in the ring extension $R^G \subset R$, and actions by inner automorphisms. The author also shows that many of the results obtained actually characterize linearly reductive groups, for some results are false in prime characteristic if the acting group is reductive rather than linearly reductive. This situation contrasts with commutative invariant theory, where, in prime characteristic, most results can also be proven for reductive groups.

Contents

1980 *Mathematics Subject Classifications*: 16A74; 16A38, 16A33, 16A16, 20G99
ISBN 0-8218-2477-5, LC 89-15148
ISSN 0065-9266
106 pages (softcover), September 1989
Individual member $10, List price $17,
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UEDA THEORY: THEOREMS AND PROBLEMS
Amnon Neeman
(Memoirs of the AMS, Number 415)

Ueda explored the question of which algebraic varieties over the complex numbers give rise to Stein manifolds. Affines are one obvious example, but there are others. In 1983, Ueda defined an invariant that "measures" the Steinness of a Zariski open subset of a compact complex surface. The purpose of this book is to study this fascinating and mysterious homological invariant by exploring its functoriality properties, variational properties, and higher dimensional generalizations. The author sets Ueda's invariant in the right formal framework, permitting formulation of many problems and conjectures indicating that further study might reveal truly surprising and interesting phenomena. Aimed at researchers in several complex variables and in algebraic geometry, the book requires familiarity with coherent analytic sheaves and the solution of the Levi problem, as well as some basic knowledge of algebraic geometry.

Contents

1980 *Mathematics Subject Classifications*: 32E10, 14J15, 32J15, 32C35
ISBN 0-8218-2478-3, LC 89-15176
ISSN 0065-9266
123 pages (softcover), September 1989
Individual member $11, List price $19,
Institutional member $15
To order, please specify MEMO/415N

BOUNDARY VALUE PROBLEMS OF MATHEMATICAL PHYSICS. XIII
O. A. Ladyzhenskaya, Editor
(Proceedings of the Steklov Institute, Volume 179)

This book brings together eleven papers by leading Soviet experts in the area of mathematical physics. The main topics covered fall into two general areas: the theory of nonlinear problems for partial differential equations, and the study of spectral and other properties of linear differential operators generated by various problems of mathematical physics.

Papers in the first area cover such topics as sharp estimates of Hölder norms for ∇u on the boundary for functions satisfying quasilinear inequalities of elliptic or parabolic type; problems of hydrodynamics; and the existence of nontrivial dynamics on the entire infinite-dimensional phase space for a certain class of systems of classical dynamics. Among the topics in the second area are the Maxwell system in domains with boundary, and the investigation of scattering data for the Schrödinger operator for large values of the wave number and coupling constant.

Contents

V. A. Solonnikov, *Solvability of the problem of effluence of a viscous incompressible fluid into an infinite open basin*
V. I. Shubov, *On the dynamics of infinite classical anharmonic systems with constraints*
D. R. Yafaev, *The eikonal approximation for the Schrödinger equation*

1980 *Mathematics Subject Classifications*: 35B45, 35B65, 35J05, 35J10, 35J25, 35J60, 35K20, 35P20, 35P25, 47F05, 53A05, 76A10, 76D05, 78A99, 82A05, 82A60
ISBN 0-8218-3127-5, LC 67-6187
ISSN 0081-5438
266 pages (hardcover), September 1989
Individual member $77, List price $128,
Institutional member $102
To order, please specify STEKLO/179N

ASYMPTOTIC METHODS OF THE THEORY OF STOCHASTIC DIFFERENTIAL EQUATIONS
A. V. Skorokhod
(Translations of Mathematical Monographs, Volume 78)

Written by one of the foremost Soviet experts in the field, this book is intended for specialists in the theory of random processes and its applications. The author's 1982 monograph on stochastic differential equations, written with Iosif Il'ich Gikhman, did not include a number of topics important to applications. The present work begins to fill this gap by investigating the asymptotic behavior of stochastic differential equations. The main topics are ergodic theory for Markov processes and for solutions of stochastic differential equations, stochastic differential equations containing a small parameter, and stability theory for solutions of systems of stochastic differential equations.

Contents

1980 *Mathematics Subject Classifications*: 60-02, 60H10, 60J60; 60H15, 60J25, 28D10, 34F05, 47D07, 47A35, 60J75, 35R60, 34K20
ISBN 0-8218-4531-4, LC 89-17698
ISSN 0065-9282
328 pages (hardcover), September 1989
Individual member $71, List price $119,
Institutional member $95
To order, please specify MMONO/78N

ARITHMETIC PROGRESSION: FROM HILBERT TO SHELAH
Ronald L. Graham

In this lively and absorbing videotaped lecture, Graham explores connections between arithmetic progressions and combinatorics over the past century. Arithmetic progressions are among the most basic structures in number theory, and their combinatorial properties now form an important branch of combinatorics. The starting point for the talk is a 1927 theorem of van der Waerden connecting partitions of the integers and finite arithmetic progressions, and Graham shows how this theorem is related to a purely combinatorial result of Hales and Jewett. The work of Schur, Rado, Ramsey, Szemerédi, and Furstenberg come into play as Graham shows how different combinatorial areas interact. A surprising connection is drawn between Hilbert's "irreducibility theorem" of 1892 and Shelah's 1988 result, which gives a new bound on van der Waerden's theorem. Sprinkling the talk with intriguing problems and $1000 conjectures, Graham brings his impressive command of contemporary research in combinatorics together with a historical perspective and talent for clarity of exposition to make this an especially appealing and accessible lecture.

1980 *Mathematics Subject Classification*: 05
VHS format, approx. one hour,
September 1989
Price $59
To order, please specify VIDGRAHAM/N

TRANSONIC FLOW AND MIXED EQUATIONS
Cathleen S. Morawetz

In this videotaped lecture, Cathleen Morawetz brings a wealth of distinguished research experience to bear on recent developments in the area of transonic flow and the associated differential equations. The talk begins with a short review of mixed equations (for many cases, including transonic flight, flow is governed partly by elliptic and partly by hyperbolic equations) and moves on to a discussion of compressible flow. Morawetz vividly illustrates the phenomenon of shocks in transonic flow and describes computations made in the 1970s that showed that these shocks could be smoothed by clever design. Though there is still no full mathematical theory for solutions with small shocks, Morawetz describes the DiPerna-Tartar-Murat method of compensated compactness, which has proved a fruitful tool. In addition, she discusses some new bounds that have been deduced for transonic flow.

1980 *Mathematics Subject Classifications*: 35M05, 76H05, 35G30, 76G99
VHS format, approx. one hour,
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COMBINED MEMBERSHIP LIST

This CML is a comprehensive directory of the membership of the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. The list is distributed as a privilege of membership to AMS members in even-numbered years and the MAA members in odd-numbered years. The CML is an invaluable reference for keeping in touch with colleagues and for making connections in the mathematical sciences community in the U.S. and abroad.

There are two lists of individual members. The first is a complete alphabetical list of all members in all three organizations. For each member, the CML provides his or her address, title, department, institution, and telephone number (if available), electronic address (if indicated), and also indicates the mathematical organizations to which the individual belongs. The second lists individual members according to their geographic locations. In addition, the CML lists all academic and institutional members and provides addresses and telephone numbers of mathematical sciences departments.

1980 *Mathematics Subject Classification*: 00
ISBN 0-8218-0140-6
400 pages (softcover), September 1989
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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)

HIGHER DIMENSIONAL COMPLEX GEOMETRY
Herbert Clemens, Janos Kollar, and Shizefumi Mori
(Astérisque, Number 166)

This work consists of the twenty-four lectures which comprised a summer seminar in higher dimensional complex geometry. The seminar took place during the months of July and August, 1987, at the University of Utah. The first sixteen lectures give an introduction to Mori's program for finding minimal models of complex projective manifolds of dimension three or more. The central theme is the investigation of varieties on which the canonical class is not numerically effective. Lectures seventeen to twenty examine the geometry of the period mapping and, more generally, harmonic mappings from compact Kähler manifolds to a large class of symmetric spaces. The last four lectures consist in a study of the existence and behavior of curves of low genus on generic projective manifolds with sufficiently ample canonical class.

ISSN 0303-1179
144 pages (softcover), September 1989
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MOUVEMENT BROWNIEN À PLUSIEURS PARAMÈTRES: MESURE DE HAUSDORFF DES TRAJECTOIRES
A. Goldman
(Astérisque, Number 167)

The function $\phi(x) = x^{2p} \log\log(1/x)$ is shown to be exact Hausdorff measure function for the range of a transient Levy Brownian motion with p-dimensional time; this result settles a question asked by P. Levy. In connexion with this problem, some prediction estimates and an evaluation of the distribution of the absolute maximum are obtained.

ISSN 0303-1179
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AMS Reports and Communications

Recent Appointments

Committee members' terms of office on standing committees expire on December 31 of the year given in parentheses following their names, unless otherwise specified.

Vladislav V. Goldberg has been appointed to the *Advisory Committee for the Russian-English Dictionary* by President William Browder. Other members of the committee are Joseph N. 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, Anatole Katok, George Mackey, John McCarthy, Boris Mityagin, Eric John Fyfe Primrose, Boris Schein, Lawrence A. Shepp, Ben Silver (ex officio), and Smilka Zdrakovska.

Nancy Anderson, Richard A. Askey, Robert S. Doran, Dorothy McGarry, James Rovnyak, George Seligman, Mary Ann Southern, and Jack Weigel have been appointed by President William Browder to an ad hoc *Library Committee*. Professor Rovnyak will serve as chairman.

Robert M. Thrall and Daniel H. Wagner were appointed to a *Committee on Cooperative Symposia* by then President, G. D. Mostow.

Frank Carroll, W. Wistar Comfort (ex officio), Joseph C. Ferrar, William J. Friel, William H. Jaco (ex officio), James R. Leitzel, Carolyn Mahoney, Kenneth A. Ross (ex officio), and Andrew Sterrett have been appointed by William Browder (AMS), and Lida K. Barrett (MAA) to the *Committee on Local Arrangements for the Columbus Meeting August 8-11, 1990.* Professor Leitzel will serve as chairman.

Donna L. Beers (AMS, 1991) has been appointed by President William Browder to the AMS-MAA *Committee on Employment and Educational Policy.* Continuing members of the committee are Morton Brown (MAA, 1989), Stefan A. Burr (AMS, 1989), Edward A. Connors (AMS, 1991), chairman, Philip C. Curtis, Jr. (MAA, 1990), David J. Lutzer (MAA, 1989), James W. Maxwell (ex officio), and James J. Tattersall (MAA, 1990).

Cathleen S. Morawetz was appointed by then President G. D. Mostow as representative to Section A of the *American Association for the Advancement of Science.* The term expires on February 12, 1992.

Statistics on Women Mathematicians Compiled by the AMS

At its August 1985 meeting, the Council of the AMS approved a motion to regularly assemble and report in *Notices* information on the relative numbers of men versus women in at least the following categories: membership in the AMS; invited hour addresses at AMS meetings; speakers at special sessions at AMS meetings; and members of editorial boards of AMS journals.

It was subsequently decided that this information would be gathered by determining the sex of the individuals in the above categories based on name identification and that additional information on the number of Ph.D.'s granted to women would also be collected using the AMS-MAA Annual Survey. Since name identification was used, the information for some categories necessitated the use of four classifications:

Male: names that were obviously male;

Female: names that were obviously female;

Unknown: names that could not be identified as clearly male or female (e.g., only initials given); and

Foreign: foreign names that could not be identified as clearly male or female.

The following is the fourth reporting of this information. Updated reports will appear annually in *Notices.*

Members of the AMS Residing in the U.S.

Male:	12,935	72%
Female:	2,615	15%
Unknown:	1,395	8%
Foreign:	960	5%
Total checked:	17,905	

Invited Hour Address Speakers at AMS Meetings (1979–1988)

Male:	360	92%
Female:	29	7%
Unknown:	1	1%
Foreign:	0	0%
Total checked:	391	

Speakers at Special Sessions at AMS Meetings (1984–1988)

Male:	2,873	80%
Female:	227	6%
Unknown:	287	8%
Foreign:	204	6%
Total checked:	3,591	

Trustees and Council Members

	1988		1987		1986		1985	
Total:	56		65		65		71	
Male:	46	82%	52	80%	56	86%	61	86%
Female:	10	18%	13	20%	9	14%	10	14%

Members of Editorial Boards of AMS Journals

	1988		1987		1986		1985		1984		1983		1982		1981		1980		1979	
Total:	161		133		109		102		93		90		83		85		82		82	
Male:	148	92%	125	94%	104	95%	94	92%	85	91%	84	93%	77	93%	79	93%	77	94%	78	95%
Female:	13	8%	8	6%	5	5%	8	8%	8	9%	6	7%	6	7%	6	7%	5	6%	4	5%

Ph.D.'s Granted to U.S. Citizens

	1988		1987		1986		1985		1984		1983		1982		1981		1980		1979	
Total:	363		362		386		396		433		455		519		567		578		596	
Male:	287	79%	289	80%	304	79%	315	80%	346	80%	366	80%	431	83%	465	82%	491	85%	503	84%
Female:	76	21%	73	20%	82	21%	81	20%	87	20%	89	20%	88	17%	102	18%	87	15%	93	16%

Officers and Committee Members

Numbers to the left of headings are used as points of reference in a index to AMS committees which follows this listing. Primary and secondary headings are:

Terms of members expire on December 31 of the year given unless otherwise specified.

1. Officers

President	William Browder	1990
Ex-President	G. D. Mostow	1989
Vice-Presidents	Sun-Yung Alice Chang	1990
	Barry Simon	1989
	William P. Thurston	1989
Secretary	Robert M. Fossum	1990
Former Secretary	Everett Pitcher	1990
Associate Secretaries	Joseph A. Cima	1990
	W. Wistar Comfort	1990
	Andy Roy Magid	1989
	Lance W. Small	1989
Treasurer	Franklin P. Peterson	1990
Associate Treasurer	Steve Armentrout	1990

1.1. Liaison Committee

All members of this committee serve *ex officio.*

Chairman	William Browder
	Robert M. Fossum
	Franklin P. Peterson

2. Council

2.0.1. Officers of the AMS

President	William Browder	1990
Ex-President	G. D. Mostow	1989
Vice-Presidents	Sun-Yung Alice Chang	1990
	Barry Simon	1989
	William P. Thurston	1989
Secretary	Robert M. Fossum	1990
Former Secretary	Everett Pitcher	1990
Associate Secretaries*	Joseph A. Cima	1990
	W. Wistar Comfort	1990
	Andy Roy Magid	1989
	Lance W. Small	1989
Treasurer	Franklin P. Peterson	1990
Associate Treasurer	Steve Armentrout	1990

2.0.2. Representatives of Committees

American Journal of Mathematics	M. Salah Baouendi	1989
Bulletin	Roger E. Howe	1990
Colloquium	Raoul H. Bott	1990
Journal of the AMS	Michael Artin	1991
Committee to Monitor Problems in Communication	Richard S. Palais	1990
Mathematical Reviews	Melvin Hochster	1989
Mathematical Surveys and Monographs	M. Susan Montgomery	1990
Mathematics of Computation	Walter Gautschi	1989
Proceedings	William J. Davis	1991
	Andrew M. Odlyzko	1989
Science Policy Committee	Ronald G. Douglas	1989
Transactions and Memoirs	Ronald L. Graham	1989

2.0.3. Members-at-Large

Jonathan L. Alperin	1991	Yiannis N. Moschovakis	1989
Fan R. K. Chung	1991	Linda A. Ness	1989
Lawrence J. Corwin	1991	Michael C. Reed	1991
Richard K. Guy	1990	Marc A. Rieffel	1989
Rhonda J. Hughes	1990	Hugo Rossi	1991
Robion C. Kirby	1990	Harold M. Stark	1990
Irwin Kra	1990	William A. Veech	1989
H. Blaine Lawson, Jr.	1989	Carol S. Wood	1989
Albert Marden	1990		

* Only one Associate Secretary at a time is a voting member of the Council, namely the cognizant Associate Secretary for the scientific sessions.

2.1. Executive Committee of the Council

Chairman	William Browder	*ex officio*
	Robert M. Fossum	*ex officio*
	Irwin Kra	1990
	G. D. Mostow	*ex officio*
	Hugo Rossi	1992
	William P. Thurston	1991
	William A. Veech	1989

3. Board of Trustees

	Steve Armentrout	*ex officio*
	William Browder	*ex officio*
	Ramesh A. Gangolli	1989
Secretary	Frederick W. Gehring	1992
	Ronald L. Graham	1991
Chairman	M. Susan Montgomery	1990
	Franklin P. Peterson	*ex officio*
	Paul J. Sally, Jr.	1993

4. Committees

4.1. Committee of the Council

Ad Hoc Committee

4.1.1. Commmittee to Review the Procedures of the Council in Considering Issues

	Robert M. Fossum
	Albert Marden
Chairman	Marian B. Pour-El
	Harold M. Stark

4.2. Editorial and Communications Committees

4.2.1. Abstracts Editorial Committee

All members of this committee serve *ex officio.*

	Joseph A. Cima
	W. Wistar Comfort
Chairman	Robert M. Fossum
	Andy Roy Magid
	Lance W. Small

4.2.2. American Journal of Mathematics, Society's Representatives

Chairman	M. Salah Baouendi	1989
	David Gieseker	1991

4.2.3. Bulletin (New Series)

	Morris W. Hirsch	1989
Chairman	Roger E. Howe	1990
	Murray H. Protter	1991

Associate Editors for Research Announcements

William B. Arveson	1990	Ronald L. Graham	1990
Spencer Bloch	1990	Victor W. Guillemin	1990
Gergory L. Cherlin	1989	Frank S. Quinn III	1990
Percy Alec Deift	1990	Peter B. Shalen	1990
Michael D. Fried	1990	Nolan R. Wallach	1990

Associate Editors for Research – Expository Articles

Lenore Blum	1989	David A. Vogan, Jr.	1989
Barry Mazur	1989	Alan D. Weinstein	1989
Richard S. Palais	1990	Guido L. Weiss	1990

4.2.4. Colloquium

Chairman	Raoul H. Bott	1990
	Charles L. Fefferman	1991
	H. Jerome Keisler	1989

4.2.5. Committee to Monitor Problems in Communication

	Sheldon Axler	1989
Consultant	Nancy Gubman	
	Arthur M. Jaffe	1991
	Richard G. Larson	1990
	William H. Jaco	*ex officio*
	Paul G. Nevai	1991
Chairman	Richard S. Palais	1990
	Marian B. Pour-El	1989

4.2.6. Contemporary Mathematics

	Richard W. Beals	1991
Chairman	Daniel M. Burns, Jr.	1989
	Sylvain E. Cappell	1991
	David Eisenbud	1989
	Jonathan Goodman	1990
	Gerald J. Janusz	1989
	Jan Mycielski	1990
	Michael E. Taylor	1991

4.2.7. Journal of the AMS

Chairman	Michael Artin	1992
	H. Blaine Lawson, Jr.	1991
	Richard B. Melrose	1990
	Wilfried Schmid	1990
	Robert E. Tarjan	1992

Associate Editors

James G. Arthur	1992	Joe Harris	1990
Peter Bickel	1990	Hendrik W. Lenstra, Jr.	1991
Gerd Faltings	1991	Andrew Majda	1992
Charles L. Fefferman	1992	Hugh L. Montgomery	1990
Michael H. Freedman	1990	Paul H. Rabinowitz	1991
Daniel Friedan	1991	Karen Uhlenbeck	1992
Ronald L. Graham	1992	W. Hugh Woodin	1990

4.2.8. Mathematical Reviews

	Leonard D. Berkovitz	1991
Chairman	Melvin Hochster	1989
	John L. Selfridge	1991
	Hans F. Weinberger	1990

4.2.9. Mathematical Surveys and Monographs

	Victor W. Guillemin	1989
	David S. Kinderlehrer	1991
Chairman	M. Susan Montgomery	1990
	———	1991

4.2.10. Mathematics of Computation

Chairman	Walter Gautschi	1989
	Donald Goldfarb	1990
	Andrew M. Odlyzko	1991
	John E. Osborn	1989

Associate Editors

James Bramble	1989	René Schoof	1989
Bille C. Carlson	1989	Larry L. Schumaker	1991
James W. Demmel	1991	Ridgway Scott	1989
Eugene Isaacson	1989	Daniel Shanks	1990
Heinz-Otto Kreiss	1990	Frank Stenger	1989
James N. Lyness	1989	Hans J. Stetter	1991
Harald Niederreiter	1990	G. W. Stewart	1989
Syvert P. Nørsett	1990	Vidar C. Thomée	1989
Frank W. J. Olver	1989	Lars B. Wahlbin	1989
Stanley J. Osher	1989	Hugh C. Williams	1991
Carl Pomerance	1989	John W. Wrench, Jr.	1990

4.2.11. Notices

	Robert J. Blattner	1990
	Michael C. Crandall	1992
Chairman	Robert M. Fossum	*ex officio*
	Lucy J. Garnett	1990
	D. J. Lewis	1992
	Nancy K. Stanton	1990
	Robert E. L. Turner	1992
	Donovan Van Osdol	*ex officio*

Associate Editors

Special Articles	Ronald L. Graham
	Jeffrey C. Lagarias

4.2.12. Proceedings

	William W. Adams	1992
	J. Marshall Ash	1992
	Maurice Auslander	1992
	Andreas Blass	1992
	Thomas H. Brylawski	1989
	Dennis Burke	1989
	Frederick R. Cohen	1991
Chairman	William J. Davis	1991
	Clifford J. Earle, Jr.	1992
	Palle E. T. Jorgensen	1992
	Barbara Lee Keyfitz	1991
	R. Daniel Mauldin	1989
	Kenneth R. Meyer	1991
	Paul S. Muhly	1990
	Andrew M. Odlyzko	1989
	George C. Papanicolaou	1991
	Louis J. Ratliff, Jr.	1991
	Jonathan M. Rosenberg	1991
	William D. Sudderth	1991
	James E. West	1991
	Warren J. Wong	1991

4.2.13. Proceedings of Symposia in Applied Mathematics

	Giles Auchmuty	1989
	Alexandre Chorin	1991
	Björn E. J. Dahlberg	1991

4.2.14. Transactions and Memoirs

	James E. Baumgartner	1991
	James W. Cannon	1989
	Ralph L. Cohen	1990
	Eugene B. Fabes	1992
Chairman	Ronald L. Graham	1989
	Jerry L. Kazdan	1990
	Roger D. Nussbaum	1991
	Carl Pomerance	1991
	David J. Saltman	1990
	Masamichi Takesaki	1989
	Audrey A. Terras	1991
	Robert J. Zimmer	1990

Associate Editor

	Burgess Davis	1989

4.2.15. Translation from Chinese

	Sun-Yung Alice Chang
	S.-Y. Cheng
Chairman	Tsit-Yuen Lam
	Tai-Ping Liu
	Chung-Chun Yang

4.2.16. Translation from Japanese

	Shoshichi Kobayashi
Chairman	Katsumi Nomizu

Standing Committees

4.2.17. Advisory Committee for the Russian-English Dictionary

	Joseph N. Bernstein	
Chairman	Ralph P. Boas	
	James R. Bunch	
	Courtney S. Coleman	
	Joseph L. Doob	
	Bogdan Dudzik	
	Eugene Dynkin	
	Mark I. Freidlin	
	Vladislav V. Goldberg	
	Paul R. Halmos	
	Edwin Hewitt	
	John R. Isbell	
	Anatole Katok	
	George Mackey	
	John McCarthy	
	Boris Mityagin	
	Eric John Fyfe Primrose	
	Boris Schein	
	Lawrence A. Shepp	
	Ben Silver	*ex officio*
	Smilka Zdrakovska	

4.2.18. Editorial Boards

	Carlos E. Kenig	1989
	Haynes R. Miller	1990
	Richard M. Schoen	1990
	Barry Simon	1989
Chairman	Daniel Zelinsky	1991

4.2.19. History of Mathematics

	Richard A. Askey	1991
Chairman	Peter L. Duren	1990
	Harold M. Edwards	1991
	Uta C. Merzbach	1989

4.2.20. Subcommittee on Russian Mathematical History

	V. I. Arnol'd
	Richard A. Askey
	S. G. Gindikin
	Igor Dolgachev
	N. K. Nikol'skii
Chairman	Allen Shields

4.2.21. Reprinted Books

	Eugenio Calabi
	Charles W. Curtis
Chairman	Oscar S. Rothaus

4.2.22. University Lecture Series

	Theodore W. Gamelin
	Donald S. Ornstein
Chairman	Hugo Rossi
	Leonard L. Scott

Ad Hoc Committee

4.2.23. AMS Publications in Applied Mathematics

	Steve Armentrout
	Ramesh A. Gangolli
	Hans F. Weinberger

4.3. Committees of the Board of Trustees

4.3.1. Agenda and Budget

All members of this committee serve *ex officio*.

	Steve Armentrout
	William Browder
	Robert M. Fossum
	M. Susan Montgomery
	Franklin P. Peterson
	William A. Veech

4.3.2. Appeals Committee on Discounted Subscriptions

Consultant	Carol-Ann Blackwood	
Consultant	Melvin Hochster	
	William H. Jaco	*ex officio*
Chairman	Morton Lowengrub	
	Franklin P. Peterson	
	Paul J. Sally, Jr.	

4.3.3. Audit

	Paul J. Sally, Jr.	1989
	M. Susan Montgomery	1990

4.3.4. Computer Operations and Facilities, Visiting Committee on

	Jill P. Mesirov	1991
Chairman	S. Tucker Taft	1989
	Peter J. Weinberger	1990

4.3.5. Corporate Relations

Chairman	Ramesh A. Gangolli
	Maria M. Klawe
	Oscar S. Rothaus

4.3.6. Endowment

	Andrew M. Gleason
Chairman	W. Ted Martin
	Cathleen S. Morawetz

4.3.7. Investment

	Steve Armentrout	*ex officio*
	Ramesh A. Gangolli	1989
Chairman	Franklin P. Peterson	*ex officio*

4.3.8. Legal Aid

	Steve Armentrout
	Todd Dupont
	Murray Gerstenhaber

4.3.9. Liaison Committee

All members of this committee serve *ex officio*.

Chairman	William Browder
	Robert M. Fossum
	Franklin P. Peterson

4.3.10. Long Range Planning

All members of this committee serve *ex officio*.

	Robert M. Fossum
	William H. Jaco
Chairman	Irwin Kra
	M. Susan Montgomery
	Franklin P. Peterson
	William P. Thurston

4.3.11. Membership

Chairman	Frederick W. Gehring	1990
	Melvin Henriksen	1990
	Irwin Kra	1990
	Jill P. Mesirov	1989
	Hugo Rossi	1991

4.3.12. The Publication Program

	Steve Armentrout	1990
Chairman	Peter L. Duren	1989
	Robert M. Fossum	*ex officio*
	Ramesh A. Gangolli	1989
	William H. Jaco	*ex officio*
Consultant	Mary C. Lane	
	Cathleen S. Morawetz	1991
	Andrew M. Odlyzko	1989

	Hugo Rossi	1989
	Paul J. Sally, Jr.	1989

4.3.13. Salaries

	Steve Armentrout	*ex officio*
Chairman	Ronald L. Graham	
	M. Susan Montgomery	*ex officio*
	Franklin P. Peterson	*ex officio*

4.3.14. Staff and Services

Chairman	Steve Armentrout	*ex officio*
	Franklin P. Peterson	*ex officio*
	Paul J. Sally, Jr.	

Ad Hoc Committee

4.3.15. Institutional Membership

Consultant	Carol-Ann Blackwood	
	Ramesh A. Gangolli	
Chairman	Frederick W. Gehring	
	William A. Veech	

4.4. Internal Organization of the American Mathematical Society

Standing Committees

4.4.1. Archives

	Andrew M. Gleason	
	Franklin P. Peterson	
Chairman	Everett Pitcher	

4.4.2. Committee on Committees

	M. Salah Baouendi	1990
	William Browder	*ex officio*
	Robert M. Fossum	*ex officio*
	Morris W. Hirsch	1990
	Rhonda J. Hughes	1990
	Irwin Kra	1990
	Philip Kutzko	1990
Chairman	Julius L. Shaneson	1990

4.4.3. Nominating Committee

	Roger C. Alperin	1989
	Joan S. Birman	1990
	Ronald DeVore	1989
Chairman	Jane P. Gilman	1989
	James E. Humphreys	1990
	Victor L. Klee, Jr.	1990
	Leonard L. Scott	1989
	Alan D. Weinstein	1990

Ad Hoc Committees

4.4.4. Election Scheduling

	Jane P. Gilman	
	Irwin Kra	
Chairman	William P. Thurston	
	William A. Veech	
	James A. Voytuk	

4.4.5. Electronic Exchange of Information (CEEI)

	Joe P. Buhler	
	William H. Jaco	
	Maria M. Klawe	
	Richard G. Larson	
	Andrew M. Odlyzko	
Chairman	Richard S. Palais	

4.4.6. Library Committee

	Nancy Anderson	
	Richard A. Askey	
	Robert S. Doran	
	Dorothy McGarry	
Chairman	James Rovnyak	
	George Seligman	
	Mary Ann Southern	
	Jack Weigel	

4.4.7. Vending Software

	Peter Doyle	
	Sidnie Feit	
Chairman	Robert M. Fossum	
	Barry Simon	

4.4.8. 1988 Election Tellers

	Lawrence H. Riddle	
	Peter M. Winkler	

4.5. Program and Meetings

Standing Committees

4.5.1. Program Committee for National Meetings

	James G. Arthur	1991
	Robert M. Fossum	*ex officio*
	Peter B. Gilkey	1990
	George A. Hagedorn	1990
Chairman	Hugh L. Montgomery	1989
	Peter Sarnak	1991
	Jean E. Taylor	1991

4.5.2. Central Section Program Committee

	David Drasin	1989
	Dennis A. Hejhal	1990
	Andy Roy Magid	*ex officio*
	Mark Mahowald	1990
Chairman	Robert J. Zimmer	1989

4.5.3. Far Western Section Program Committee

	Sun-Yung Alice Chang	1990
	Ronald J. DiPerna	1989
Chairman	William M. Kantor	1989
	John R. Stallings	1990
	Lance W. Small	*ex officio*

4.5.4. Northeastern Section Program Committee

Chairman	Ruth M. Charney	1989
	W. Wistar Comfort	*ex officio*
	Detlef Gromoll	1990
	Jerry L. Kazdan	1990
	Walter A. Strauss	1990

4.5.5. Southeastern Section Program Committee

	Joseph A. Cima	*ex officio*
Chairman	Patrick B. Eberlein	1989
	Ronald F. Gariepy	1989
	Ray A. Kunze	1990
	William Pardon	1990

4.5.6. Agenda for Business Meetings

	M. Salah Baouendi	1990
Chairman	Robert M. Fossum	
	Carol L. Walker	1990

4.5.7. Gibbs Lecturers for 1989 and 1990, Committee to Select

	Jane Cronin Scanlon	
Chairman	Thomas Crawford Spencer	
	Shmuel Winograd	

4.5.8. Progress in Mathematics

Chairman	Armand Borel	1991
	Paul H. Rabinowitz	1990
	Hugo Rossi	1990
	John T. Tate	1989
	Alan D. Weinstein	1991

4.6. Status of the Profession

Standing Committees

4.6.1. Academic Freedom, Tenure, and Employment Security

	Jerome A. Goldstein	1989
	Thomas G. Kurtz	1990
Chairman	Barbara L. Osofsky	1990
	Robert R. Phelps	1989
	Charles E. Rickart	1991
	Gail S. Young	1989

4.6.2. Academic Review

	Frederick W. Gehring	
	Frank L. Gilfeather	
	Andrew M. Gleason	
Chairman	J. K. Goldhaber	
	David A. Sanchez	

4.6.3. Human Rights of Mathematicians

	Michael I. Brin	1990
	Bettye Anne Case	1989
	Patrick X. Gallagher	1989
	Herman R. Gluck	1989
	Leon A. Henkin	1988
	Neal I. Koblitz	1988
	Joel L. Lebowitz	1990
Chairman	Alice T. Schafer	1990

4.6.4. Liaison Committee on Education in Mathematics

	John A. Dossey	
	Melvin Hochster	
	Rogers J. Newman	
	Louise A. Raphael	
Chairman	Paul J. Sally, Jr.	
	James D. Stasheff	
	Lynn A. Steen	

4.6.5. Professional Ethics

	C. Edmund Burgess	1990
	Harold M. Edwards	1991
	Frank L. Gilfeather	1990
Chairman	Linda Keen	1989
	George B. Seligman	1991

4.6.6. Science Policy

	Hyman Bass	1990
	William Browder	*ex officio*
Chairman	Ronald G. Douglas	1989
	Frank L. Gilfeather	1990
	James G. Glimm	1989
	William H. Jaco	*ex officio*
	Ronald L. Lipsman	1989
	Jerrold E. Marsden	1991
	Cathleen S. Morawetz	1991
	John C. Polking	1990
	Oscar S. Rothaus	1991
	David A. Sanchez	1989
	William P. Thurston	1989
	William A. Veech	1989
	David A. Vogan, Jr.	1991

4.6.7. Service to Mathematicians in Developing Countries

Chairman	Raymond G. Ayoub
	James A. Donaldson
	James Eells
	Donald M. Hill

Ad Hoc Committees

4.6.8. Applied Mathematics

	Constantine M. Dafermos
	David S. Kinderleher
	Eduardo Daniel Sontag
Chairman	Jean E. Taylor

4.6.9. Cooperation with the Chinese

	S.-Y. Cheng
	Ronald L. Graham
Chairman	Richard S. Palais

4.6.10. Coordinating Committee for the Doctoral Program in Mathematics

Chairman	R. Creighton Buck
	Franklin P. Peterson
	Murray H. Protter

4.6.11. Fellowship Policy

George E. Andrews
Kenneth Millet
Chairman — M. Susan Montgomery
M. Beth Ruskai
Paul J. Sally Jr.

4.6.12. NCTM Standards

William Browder
Chairman — Edward A. Connors
Robert M. Fossum
Harvey B. Keynes
Jean E. Taylor
William P. Thurston
Philip D. Wagreich

4.7. Prizes and Awards

Standing Committees

4.7.1. Centennial Fellowships

Terms expire on June 30

Chairman	Frederick J. Almgren, Jr.	1989
	David Eisenbud	1990
	Lawrence Craig Evans	1990
	Dorian Goldfeld	1989
	Victor L. Klee, Jr.	1990
	John W. Morgan	1989
	Karen Vogtmann	1990

4.7.2. National Awards and Public Representation

Chairman	William Browder	*ex officio*
	Robert M. Fossum	*ex officio*
	G. D. Mostow	*ex officio*
	David Mumford	1989

4.7.3. Subcommittee on Appointments of the Committee on National Awards and Public Representation

	Robert M. Fossum	*ex officio*
Chairman	Irwin Kra	
	John C. Polking	

4.7.4. Steele Prizes

Terms expire on June 30

	Frederick J. Almgren, Jr.	1989
	Luis A. Caffarelli	1990
	Charles L. Fefferman	1991
	Jun-ichi Igusa	1991
Chairman	William S. Massey	1989
	Frank A. Raymond	1989
	Neil J. A. Sloane	1990
	Louis Solomon	1989
	Richard P. Stanley	1989
	Michael E. Taylor	1990

Ad Hoc Committees

4.7.5. Automatic Theorem Proving, Committee to Recommend Winners of Prizes for

Chairman — David Mumford
Jacob T. Schwartz
John L. Selfridge

4.7.6. Bôcher Prize for 1989, Committee to Select the Winner of

Paul J. Cohen
Chairman — Richard B. Melrose
Louis Nirenberg

4.8. Institutes and Symposia

Standing Committee

4.8.1. Cooperative Symposia

Robert M. Thrall
Daniel H. Wagner

4.8.2. Liaison Committee with AAAS

Hyman Bass
James McKenna
Cathleen S. Morawetz
Warren Page
Gian-Carlo Rota
Alan D. Weinstein

4.8.3. Summer Institutes and Special Symposia

Terms expire on February 28

Chairman	Steven L. Kleiman	1990
	Haynes R. Miller	1991
	Raghavan Narasimhan	1991
	Paul H. Rabinowitz	1989
	Thomas Crawford Spencer	1990
	Robert B. Warfield, Jr.	1989

4.9. Joint Committees

4.9.1. AMS-AAAS-MAA Committee on Opportunities in Mathematics for Underrepresented Minorities

	Manuel P. Berriozabal	1989
	Sylvia T. Bozeman	1989
	James A. Donaldson	1989
Chairman	Gloria F. Gilmer	1989
	Shirley Malcom	*ex officio*
	Rogers J. Newman	1989
	Clarence E. Stephens	1989
Consultant	Argelia Veléz-Rodriguez	

4.9.2. AMS-ASA-IMS-MAA-NCTM-SIAM Committee on Women in the Mathematical Sciences

NCTM members' terms expire April 1 of the year given.

	Grace M. Burton (NCTM)	1990
	Marjorie M. Enneking (NCTM)	1989
Chairman	Susan Geller (AMS)	1991
	Marjorie G. Hahn (IMS)	
	Mary Hesselgrave (MAA)	1991
	Jeanne W. Kerr (AMS)	1989
	Patricia Kenschaft (AWM)	
	Jeanne LaDuke (MAA)	1989
	Suzanne Marie Lenhart (AMS)	1989
	Betty K. Lichtenberg (NCTM)	1989
	Edith Luchins (MAA)	1991
	Joyce R. McLaughlin (SIAM)	1990
	Ingram Olkin (IMS)	
	Anne Parkhurst (ASA)	
	Janet Peterson (SIAM)	1988
	Linda Petzold (SIAM)	1989
	Alice T. Schafer (MAA)	1988
	Bhama Srinivasan (AMS)	1989

4.9.3. AMS-ASL-IMS-SIAM Committee on Translations from Russian and Other Slavic Languages

Chairman	Peter Landweber (AMS)	1989

AMS Subcommittee Members

Consultant	V. I. Arnol'd	
	Joseph N. Bernstein	1990
	Charles V. Coffman	1988
	Allen Devinatz	1988
Consultant	S. G. Gindikin	
	Vladislav V. Goldberg	1988
	John R. Isbell	1988
	Anatole Katok	1990
Consultant	Askol'd Georgievic Khovanskii	
Chairman	Peter Landweber (AMS)	1989
	L. G. Makar-Limanov	1989
	Paul G. Nevai	1989
Consultant	N. K. Nikol'skii	
Acquisition Editor	Smilka Zdravkovska	

ASL Subcommittee Members

	Vladimir Lifschitz	1990
Chairman	Elliott Mendelson	1989
	Gregory Minc	1990
	B. F. Wells	1989

IMS Subcommittee Members

Chairman	M. I. Freidlin
	B. Pittel
	A. Rukhin
	W. J. Studden

4.9.4. AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences

Terms expire on June 30

	William B. Arveson (AMS)	1989
	John A. Burns (SIAM)	1990
	Martin Golubitsky (SIAM)	1990
	Daniel J. Kleitman (AMS)	1989
	Anthony W. Knapp (AMS)	1992
Chairman	Ingram Olkin (IMS)	1990
	Emanuel Parzen (IMS)	1991
	Mary Ellen Rudin (AMS)	1989
	Stephen G. Simpson (AMS)	1990
	Gregg J. Zuckerman (AMS)	1992
	_____(AMS)	1990

4.9.5. AMS-MAA Arrangements Committee for the Louisville Meeting January 17–20, 1990

	Martin Brown	
	Joseph A. Cima	*ex officio*
	William Fenton	
	Leon Harkleroad	
	William H. Jaco	*ex officio*
Chairman	John Oppelt	
	Kenneth A. Ross	*ex officio*
	Carol Russell	
	Elaine Salvo	
	Sandy Spears	
	Wiley Williams	
	Jeffrey Allen Wright	

4.9.6. AMS-MAA Joint Program Committee for the Louisville Meeting

	Hugh L. Montgomery (AMS)
	David P. Roselle (MAA)
	Mary Ellen Rudin (MAA)
Chairman	Peter Sarnak (AMS)

4.9.7. AMS-MAA Arrangements Committee for the Columbus Meeting August 8-11, 1990

	Frank Carroll	
	W. Wistar Comfort	*ex officio*
	Joseph C. Ferrar	
	William J. Friel	
	William H. Jaco	*ex officio*
Chairman	James R. Leitzel	
	Carolyn Mahoney	
	Kenneth A. Ross	*ex officio*
	Andrew Sterrett	

4.9.8. AMS-MAA Joint Meetings Committee

All members of this committee serve *ex officio.*

Consultant	H. Hope Daly
	Robert M. Fossum
Chairman	William H. Jaco
	Kenneth A. Ross
	Alfred B. Willcox

4.9.9. AMS-MAA Committee on Employment and Educational Policy

	Donna L. Beers (AMS)	1991
	Morton Brown (MAA)	1989
	Stefan A. Burr (AMS)	1989

Chairman	Edward A. Connors (AMS)	1991
	Philip C. Curtis, Jr. (MAA)	1990
	David J. Lutzer (MAA)	1989
	James W. Maxwell	*ex officio*
	James J. Tattersall (MAA)	1990

4.9.10. Data Subcommittee

Chairman	Edward A. Connors	1990
Consultant	Lincoln K. Durst	
	John D. Fulton	1991
	James F. Hurley	1991
	Charlotte Lin	1989
	Don O. Loftsgaarden	1990
	David J. Lutzer	1990
	James W. Maxwell	*ex officio*
	Donald E. McClure	1990
	Donald C. Rung	1989

4.9.11. Employment Concerns Subcommittee

	Morton Brown	1989
Chairman	Barnet M. Weinstock	1989

4.9.12. Short Course Subcommittee

Chairman	Stefan A. Burr	1989
	R. Peter DeLong	1991
	Lisl Novak Gaal	1989
	Robert P. Kurshan	1990
	Barbara L. Osofsky	1991
	Marjorie L. Stein	1990
	James J. Tattersall	1990

4.9.13. AMS-MAA Committee on Teaching Assistants and Part Time Instructors (TA/PTI)

	Thomas F. Banchoff
Chairman	Bettye Anne Case
	John P. Huneke
	David Kraines
	Thomas T. Read
	Robert H. Szczarba

4.9.14. AMS-MAA-SIAM Joint Committee on Employment Opportunities

Chairman	Ronald M. Davis (MAA)	1990
	James W. Maxwell	*ex officio*
	Brian J. McCartin (SIAM)	1989
	S. Brent Morris (AMS)	1991
	Marc A. Rieffel (MAA)	1991
	Donald C. Rung (AMS)	1990
	Leon H. Seitelman (SIAM)	1991

4.9.15. AMS-MAA-SIAM Joint Administrative Committee

All members of this committee serve *ex officio*.

	Lida K. Barrett (MAA)
	I. Edward Block (SIAM)
	James W. Daniel (SIAM)
Chairman	Robert M. Fossum (AMS)
	William H. Jaco (AMS)
	Franklin P. Peterson (AMS)
	Kenneth A. Ross (MAA)
	Alfred B. Willcox (MAA)
	Shmuel Winograd (SIAM)

4.9.16. AMS-MAA-SIAM Joint Policy Board for Mathematics (see 1989 Mathematical Sciences Professional Directory, page 26)

4.9.17. AMS-SIAM Committee on Applied Mathematics

	Constantine M. Dafermos	1989
	James M. Hyman	1990
Chairman	George C. Papanicolaou	1989
	Lawrence A. Shepp	1991
	Gilbert Strang	1991
	Robert F. Warming	1990

4.9.18. AMS-SIAM Committee to Screen Applicants for Graduate Study from the People's Republic of China

	David Benney
	Robert Bryant

4.9.19. AMS-SIAM Committee to Select the Winner of the Wiener Prize of 1990

	Elliott H. Lieb
Chairman	I. M. Singer
	Stephen Smale

4.9.20. AMS-SIAM-SMB Committee on Mathematics in the Life Sciences

	Jack D. Cowan	1991
	Michael C. Mackey	1989
	Marc Mangel	1992
	James Murray	1992
	Hans G. Othmer	1988
Chairman	Richard E. Plant	1988
	John M. Rinzel	1989

5. Representatives

5.0.1. Advisory Board of the National Translations Center of the John Crerar Library

Ralph P. Boas

5.0.2. American Association for the Advancement of Science

Section A	Cathleen S. Morawetz	February 12, 1992
Section L	Richard A. Askey	February 12, 1992
Section Q	Jerry L. Bona	February 12, 1992
Section T	Martin D. Davis	February 12, 1992

5.0.3. Commission on Professionals in Science and Technology

Edward A. Connors

5.0.4. Committee on the American Mathematics Competition

Term expires on June 30

Guido L. Weiss 1990

5.0.5. **Conference Board of the Mathematical Sciences**

William Browder 1990

5.0.6. **Fulkerson Prize Committee**

Alan J. Hoffman

5.0.7. **U.S. National Committee on Theoretical and Applied Mechanics**

Term expires on October 31

Constantine M. Dafermos 1992

6. Index

Miscellaneous

Personal Items

Theodore W. Anderson, professor emeritus of statistics and economics at Stanford University, received an honorary Doctor of Science degree from Northwestern University at the commencement ceremonies in June, 1989.

James Coykendall IV, of the California Institute of Technology, received that institution's E. T. Bell Undergraduate Mathematics Research Prize for a paper on Picard groups of polynomial rings.

Howard A. Levine, of Iowa State University, has been appointed chairman of the mathematics department at that institution.

Russell Manning, of the California Institute of Technology, received that institution's Morgan Ward Prize in recognition of a paper giving a recursive development of the Catalan number formula.

Ellen Torrance has been promoted to Assistant Vice-President and Associate Actuary at First Colony Life Insurance Company in Lynchburg, Virginia.

Deaths

Gunnar Bodvarsson, of Corvallis, Oregon, died on May 9, 1989, at the age of 72. He was a member of the Society for 36 years.

Jewell Hughes Bushey, Professor Emeritus of Hunter College, died on May 5, 1989, at the age of 93. She was a member of the Society for 69 years.

Robert Cameron, Professor Emeritus of the University of Minnesota, died on June 17, 1989, at the age of 81. He was a member of the Society for 59 years.

Robin W. Chaney, of Western Washington University, died on March 3, 1989, at the age of 50. He was a member of the Society for 28 years.

Myrle V. Cross, Jr., of Costa Mesa, California, died on April 27, 1989, at the age of 61. He was a member of the Society for 18 years.

Robert W. Hafner, of IBM, Rolling Meadows, Illinois, died on June 1, 1989, at the age of 59. He was a member of the Society for one year.

Franklin Wesley Kokomoor, Professor Emeritus of the University of Florida, died on April 30, 1989, at the age of 98. He was a member of the Society for 60 years.

Howard R. Siepman, of the Baxter Healthcare Corporation, Rould Lake, Illinois, died on April 24, 1989, at the age of 30. He was a member of the Society for 7 years.

Sergeĭ L. Sobolev, of the Novosibirsk Academy of Sciences, died on January 3, 1989, at the age of 80. He was a member of the Society for 17 years. (See the News and Announcements section of this issue of *Notices*.

Avgustin Tuzhilin, of the College of Staten Island (CUNY), died on September 24, 1988, at the age of 54. He was a member of the Society for 8 years.

Visiting Mathematicians

(Supplementary List)

The list of visiting mathematicians includes both foreign mathematicians visiting in the United States and Canada, and Americans visiting abroad. Note that there are two separate lists.

American Mathematicians Visiting Abroad

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Hinkley, David V. (U.S.A.)	University of Oxford	Statistics	9/89 - 5/90
Palka, Bruce P. (U.S.A.)	Mittag-Leffler Institute	Complex Analysis	9/89 - 5/90

Visiting Foreign Mathematicians

Amitsur, Shimshon (Israel)	University of Texas, Austin	Algebra	9/89 - 1/90
Arazy, Jonathan (Israel)	University of Kansas	Functional Analysis	8/89 - 7/90
Beiglbock, Wolf D. (West Germany)	University of Texas, Austin	Theoretical Physics	9/89 - 1/90
Belaga, Schlomo E. (France)	Université du Québec à Montréal		8/89 - 6/90
Boyadzhiev, Khristo (Bulgaria)	Ohio University	Operator Theory	1/90 - 6/90
Cassandro, Marzio (Italy)	University of Texas, Austin	Mathematical Physics	9/89 - 1/90
Cohen, Arjeh M. (The Netherlands)	University of Michigan	Representation Theory	9/89 - 12/89
Engelking, Ryszard (Poland)	Ohio University	Topology	9/89 - 12/89
Globevnik, Josip (Yugoslavia)	University of Washington	Complex Analysis	8/89 - 6/90
Gritzman, Peter (West Germany)	University of Washington	Combinatorial Geometry	9/89 - 3/90
Hari, Vjeran (Yugoslavia)	University of Kansas	Numerical Analysis	8/89 - 7/90
Hogan, Jeffrey A. (Australia)	University of Texas, Austin	Harmonic Analysis	9/89 - 5/90
Horak, Peter (Czechoslovakia)	University of Nebraska-Lincoln	Combinatorics	9/89 - 5/90
Hurri, Ritva (Finland)	University of Texas, Austin	Complex Analysis	1/90 - 5/90
Kanev, Vassil I. (Bulgaria)	University of Michigan	Algebraic Geometry	1/90 - 5/90
Kondo, Shigayuki (Japan)	University of Michigan	Algebraic Geometry	9/89 - 12/89
Liao, Ming (People's Republic of China)	University of Michigan	Probability	9/89 - 5/90
Lickorish, W.B. Raymond (United Kingdom)	University of Texas, Austin	Geometric Topology	9/89 - 1/90
Lu, Chunqing (People's Republic of China)	SUNY at Buffalo	Applied Mathematics	8/89 - 6/90
Lu, Kun-Liang (China)	University of Nebraska-Lincoln	Statistics	9/89 - 5/90
Macdonald, Ian G. (England)	University of Michigan	Representation Theory and Combinatorics	9/89 - 12/89
Mendoza, Geraldo (Venezuela)	University of Washington	Partial Differential Equations	1/90 - 6/90
Muleshkov, Angel (Bulgaria)	University of Texas, Austin	Applied Mathematics	9/89 - 1/90

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Nečas, J. (Czechoslovakia)	Northern Illinois University	Partial Differential Equations	8/89 - 12/89
Nečasová, Z. (Czechoslovakia)	Northern Illinois University	Operations Research	8/89 - 12/89
Prasad, Gopal (India)	University of Michigan	Representation Theory	9/89 - 12/89
Peretz, Ronen (Israel)	University of Michigan	Analysis	9/89 - 6/90
Qi, Duan (People's Republic of China)	University of Arkansas	Spline Theory	9/89 - 8/90
Ruess, Wolfgang (West Germany)	University of Arkansas	Functional Analysis	7/89 - 9/89
Shephard, Geoffery (England)	University of Washington	Geometry	9/89 - 12/89
Spiez, Stanislaw (Poland)	University of Washington	Topology	3/90 - 6/90
Syrjanen, Ritva (Finland)	University of Michigan	Complex Analysis	9/89 - 12/89
Takai, Hiroshi (Japan)	SUNY at Buffalo	Functional Analysis	8/89 - 6/90
Terdik, Gyorgy (Hungary)	University of Arkansas	Time Series	8/89 - 6/90
Ulger, Ali (Turkey)	University of Arkansas	Banach Algebras	8/89 - 6/90
Zhou, Hao-Xuan (People's Republic of China)	SUNY at Buffalo	Topology	8/89 - 6/90

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 6/30/89	Backlog of Printed Pages 12/31/88	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	5	6	8
Aequationes Math.	4	640	100	0	9	6	11	15
Alg. Groups Geom.	4	600	0	0	6	8	9	10
Algorithmica	4	576	120	432	12	9	12	12
Amer. J. Math.	6	1200	0	0	8-12	14	15	20
Ann. of Math.	6	1320	700	600	12	13	16	17
Ann. Probab.	4	1600	300	250	12	10	11	12
Ann. Sci. École Norm. Sup.	4	648	47	0	13	7	7	9
Ann. Statist.	4	1750	225	180	10	10	12	14
Appl. Math. Letters	4*	400	0	50	3		NA	
Appl. Math. Optim.	6	672	180	185	12	9	12**	14
Arch. Hist. Exact Scis.	8	800	0	0	11	10	NA	13
Arch. Math. Logic	3	200	0	0	8	6	8	9
Arch. Rational Mech. Anal.	16	1600	0	0	10	9	9	11
Bull. Austral. Math. Soc.	6	1000	400	200	12	12	13	14
Canad. J. Math.	6	1152	0	0	8-10	10	12	19
Canad. Math. Bull.	4	512	640	288	21	14	16	21
Circuits Systems Signal Proc.	4	512	0	0	4	8	11	13
Comm. Algebra	12	3000	1602	2220	12	11	14	17
Comm. Math. Phys.	24	5184	0	0	8	8	9	11
Comm. Partial Diff. Equations	12	1600	200	0	10	6	8	10
Comp. Math. Appl.	24	2400	1000	1200	10	8	9	10
Computing	8	720	280	180	9	8	14	15
Constr. Approx.	4	448	100	112	8	12	16	18

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages 6/30/89	Backlog of Printed Pages 12/31/88	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	375	370	15	15	18	22
Duke Math. J.	6	1800	150	150	9	7	8	10
Houston J. Math.	4	600	600	500	18		***	
Illinois J. Math.	4	704	897	858	26	26	27	28
IMA J. Appl. Math.	6	510	0	0	12	6	9	12
IMA J. Math. Appl. Med. Biol.	4	350	NR	80	NR		NA	
IMA J. Math. Control Inform.	4	350-400	NR	NR	NR	11	11	12
IMA J. Numer. Anal.	4	600	100	0	14	10	11	21
Indiana Univ. Math. J.	4	1000	80	NR	9.5	7	9	14
Inst. Hautes Études Sci. Publ. Math.	2	400	0	0	15	13	19	22
Internat. J. Math. Math. Sci.	4	832	100	125	NR	9	18	21
Invent. Math.	12	2700	0	0	8	11	13	14
Israel J. Math.	12	1500	350	700	8	9	10	14
J. Algorithms	4	NR	NR	NR	NR	13	13**	14
J. Amer. Math. Soc.	4	1000	0	0	NA	9	11	15
J. Appl. Math. Simulation	4	340	180	100	4		NA	
J. Assoc. Comput. Mach.	4	1000	300	250	12	8	9	9
J. Austral. Math. Soc. Ser. A	6	1100	600	600	22	16	20	24
J. Austral. Math. Soc. Ser. B	4	512	256	0	15	7	9	10
J. Classification	2	300	0	0	6		NA	
J. Comput. System Sci.	6	950	200	800	12-14		NA	
J. Differential Geom.	6	1500	1300	1200	10	12	15	18
J. Integral Equations Appl.	4	700	0	0	8		NA	
J. Math. Biol.	6	720	0	0	6.5	5	6	7
J. Math. Phys.	12	3000	0	0	5	4	5**	5
J. Nigerian Math. Soc.	1	100	NR	0	NR		NA	
J. Operator Theory	4	800	0	NR	12	13	15	19
J. Symbolic Logic	3†	1350†	100	††	16	17	18	20
Linear Algebra Appl.	16	4800	600	600	10-12	8	9**	9
Manuscripta Math.	12	1536	0	0	6	4	5	5
Math. Ann.	16	2816	0	0	15-17	8	12	15
Math. Comput. Modelling	16	1600	500	900	10	8	9**	9
Math. Comp.	4	1500	260	50	12	10	12	14
Math. Control Signals Sys.	4	400	1000	400	NA		NA	
Math. Oper. Res.	4	724	360	400	18	17	17	19
Math. Programming Ser. A	6	720	240	166	15	14	16	19
Math. Social Sci.	6	600	180	90	12	12	12	17
Math. Systems Theory	4	256	0	0	6	5	6	7
Math. Z.	12	2016	0	0	13-14	12	19	24
Mem. Amer. Math. Soc.	6	2800	0	0	2	10	15	33
Michigan Math. J.	3	480	130	130	15	7	9	10
Monatsh. Math.	8	704	0	0	9	8	10	10
Numer. Funct. Anal. Optim.	12	1300	0	0	5	5	8	8
Numer. Math.	12	1488	0	0	5	5	6	9
Oper. Res.	6	1008	420	315	10-15	17	19	23
Pacific J. Math.	10	2000	NR	NR	12	13	15	18
Probab. Theor. Relat. Fields	12	1680	0	0	12	10	17	24
Proc. Amer. Math. Soc.	12	3200	572	0	12	10	11	14
Proc. London Math. Soc.	6	NR	NR	NR	NR	13	16	20
Quart. Appl. Math.	4	800	200	200	12	10	13	16

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages 6/30/89	Backlog of Printed Pages 12/31/88	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	96	64	12-18	15	17	20
Quart. J. Mech. Appl. Math.	4	640	0	NA	13	13	16	19
Results Math.	4	768	0	0	6	7	9	12
Rocky Mountain J. Math.	4	1000	2000	2000	20		***	
Semigroup Forum	6	768	200	128	5	10	11	12
SIAM J. Appl. Math.	6	1800	500	556	22	11	12**	13
SIAM J. Comput.	6	1350	200	270	18	10	10**	12
SIAM J. Control Optim.	6	1500	350	215	20	8	8**	10
SIAM J. Discrete Math.	4	600	50	0	9	6	7**	7
SIAM J. Math. Anal.	6	1650	430	388	22	9	9**	12
SIAM J. Matrix Anal. Appl.	4	680	150	30	9	7	7**	10
SIAM J. Numer. Anal.	6	1650	550	639	22	12	14**	15
SIAM J. Sci. Statist. Comput.	6	1200	400	400	20	9	9**	11
SIAM Rev.	4	680	0	50	6-9	5	7**	9
Topology Appl.	9†††	1000†††	500	1100	14	15	18	19
Trans. Amer. Math. Soc.	12	5000	200	200	16	18	18	22

NR means no response received.
NA means not available or not applicable.
* The frequency of this journal will increase according to demand (number of papers accepted) to maintain: a zero backlog, a within three month publication schedule, and TEX typeset quality.
** From date accepted.
*** This journal recently ended a moratorium on the acceptance of new papers; latest issue consists of pre-moratorium papers.
† Usually four issues per year, however the December 1990 issue will be a 30-year index. Its pages are not counted in the 1350 page estimate for the other three issues.
†† 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.
††† For 1990: Twelve issues and 1320 pages per year.

New Members of the AMS

ORDINARY MEMBERS

Dumitru I Acu, Sibiu, Romania
Winfred P Adams, Farmington, NM
Lateef A Adelani, St Louis, MO
Jawad Yusuf Al-Khal, Washington, DC
Jusuf Alajbegović, Swinburne Inst of Tech, Melbourne, Australia
Anne H Allen, Bennington, VT
Julius A Archibald, SUNY, Plattsburgh
N S Asaithambi, Mississippi State Univ, Mississippi State
Jonathan James Ashley, Univ of Washington, Seattle
Christopher Eugene Barat, Providence, RI
Susan Barton, Pennsylvania State Univ, Media
Marcelle Bessman, Frostburg, MD
Marvin L Bittinger, Carmel, IN
Doug J Blount, Univ of Utah, Salt Lake City
Glen A Bookhout, Broomfield, CO
Branislav Boricic, Belgrade, Yugoslavia
Margaret L Brandeau, Stanford Univ, CA
Erwin A Brüning, Princeton Univ, NJ
G Binthan Burah, London, England
John C Burkhart, Toledo, OH
Jan O Case, Samford Univ, Birmingham, AL
Su-Han Chan, Nepean, Ontario Canada
Yi-Ying Chen, California State Univ San Bernardino
David W Cribb, USAF Academy, CO
Joseph D Cron, Fairfield, CT
Jack L Crowell, Delta College, University Center, MI
George Tinsley Davies, St Petersburg, FL
Kenrick L Dillah, New York, NY
Miao Ding, Shanghai Jiaotong Univ, People's Republic of China
Jack Edmonds, Univ of Waterloo, Ontario Canada
Wade Ellis Jr, San Jose, California
Alain Escassut, Univ Blaise Pascal, Aubiere, France
Leigh A Fiedler, Moline, IL
Christopher P Foley, Chicago, IL
John Erik Fornaess, Princeton Univ, NJ
Norman A Frechette, New Bedford, MA
Shirley M Frye, Scottsdale School Dist, Phoenix, AZ
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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

BROWN UNIVERSITY

BROWN UNIVERSITY, Providence, RI 02912. Two professorships at the Associate Professor level or above, with tenure, to begin July 1, 1990. Salary to be negotiated. Preference to be given to applicants with research interests consonant with those of the present members of the Department. For one of the positions preference will be given to those with research interest in Algebraic Geometry, Differential Geometry, or related fields. Candidates should have a distinguished research record and a strong commitment to teaching. Qualified individuals are invited to send a vita and at least three letters of recommendation, no later than November 1, 1989, to Professor Robert Accola, Executive Officer, Department of Mathematics, Brown University, Providence, RI 02912. Brown University is an Equal Opportunity/Affirmative Action employer.

UNIVERSITY OF VIRGINIA

The Department of Applied Mathematics at the University of Virginia seeks a numerical analyst with a strong interest in partial differential equations and their physical applications. The Department, which cooperates closely with other departments within the School of Engineering and Applied Science where it is located and with the Mathematics Department in the College of Arts and Science, has active research progams in continuum mechanics, control theory, and numerical analysis/scientific computing. The successful candidate will be able to support and direct doctoral students in this latter area, to collaborate with faculty, and to teach a range of applied mathematics courses. EOE/AA.

Applications should be sent to
James G. Simmonds, Chair
Department of Applied Mathematics
Thornton Hall
University of Virginia
Charlottesville, VA 22903

UNIVERSITY OF CALIFORNIA LOS ANGELES Department of Mathematics

TEMPORARY POSITIONS

(1) Two E. R. Hedrick Assistant Professorships. Applicants must show very strong promise in research and teaching. Salary $37,000. Three year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by January 1, 1990.

(2) Two or three Research Assistant Professorships in Computational and Applied Mathematics. Applicants must show very strong promise in research and teaching. Salary $37,000. Three year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by January 1, 1990.

(3) One or two Assistant Professorships in the Program in Computing (PIC). Applicants must show very strong promise in teaching and research, preferably in the general area of Logic, Language and Computation. Teaching load: four quarter programming courses and an advanced quarter course of the candidate's choice per year. Two year appointment, possibly renewable once or twice. Salary range: $37,000–$44,000. Preference will be given to applications completed by January 1, 1990.

(4) One or two Lectureships in the Program in Computing (PIC). Applicants must show very strong promise in the teaching of programming. Teaching load: five quarter programming courses per year. One year appointment, possibly renewable up to four times. Salary depends on experience, begins at $31,200.

(5) Subject to administrative approval, a few adjunct assistant professorships. Two year appointments. Strong research and teaching background required. Salary $32,400–$36,500 per year. Teaching load: five quarter courses per year.

(6) Several positions for visitors and lecturers. To apply, write to Alfred W. Hales, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555. Attn: Staff Search.

UCLA is an equal opportunity/affirmative action employer.

POSITIONS AVAILABLE

UNIVERSITY OF UTAH
Department of Mathematics
invites applications for the following positions:

1. At least four full time tenure track appointments on any of the professorial levels. The Department is particularly interested in applicants who work in the areas of geometry, algebra, topology, group representation theory, applied mathematics, and scientific computing. Selection will be based on research expertise and teaching ability. Applications will be accepted until January 31, 1990 or until the positions are filled.
2. Two or more nonrenewable three-year Instructorships. Persons of any age receiving Ph.D. degrees in 1989 or 1990 are eligible. Applicants will be selected on the basis of ability and potential in teaching and research. Starting salary this academic year is $29,500; cost of living increases are contingent on action by the State Legislature. Duties consist of teaching five courses during the three quarter academic year. Applications will be accepted until December 31, 1989 or until the positions are filled.
3. One or more visiting positions of one year or less. Selection criteria are teaching ability and potential contribution to our research environment. Applications will be accepted until January 31, 1990 or until the positions are filled.

Applications must include curriculum vitae, bibliography and three letters of reference. (Instructorship applications must also include an abstract of the thesis and either a list of graduate courses completed or a transcript of graduate work.)

Please send your application to:
COMMITTEE ON STAFFING
DEPARTMENT OF
MATHEMATICS
UNIVERSITY OF UTAH
233 JWB
SALT LAKE CITY, UTAH 84112

The University of Utah is an equal opportunity-affirmative action employer.

THE AIR FORCE FLIGHT DYNAMICS LABORATORY
and
THE AIR FORCE INSTITUTE OF TECHNOLOGY
announce the
1990–1991
FLIGHT CONTROL
DISTINGUISHED VISITING PROFESSOR PROGRAM

The Air Force Institute of Technology (AFIT) at Wright-Patterson Air Force Base, Dayton, Ohio announces the opportunity to join the AFIT graduate faculty as a Distinguished Visiting Professor in the Department of Electrical and Computer Engineering in the School of Engineering.

RESPONSIBILITIES

The responsibilities of the AFIT Distinguished Visiting Professor include providing academic leadership in teaching and research in association with AFIT faculty and students, and initiating and conducting research and consultation with the Flight Dynamics Laboratory, Air Force Wright Research and Development Center.

QUALIFICATIONS

The person appointed as Distinguished Visiting Professor should be an eminent faculty member at a prestigious university. Selection will be based upon the individual's experience, proposed teaching program and research areas. Areas of special interest and activity at AFIT are: Flight Control Systems, Control Systems for Reconfigurable Aircraft, Design of Robust Multivariable Control Systems, Quantitative Feedback Theory Design, Output Digital Feedback Design Technique for Multivariable Tracking Systems, H_∞ Control Theory, and Adaptive Control and Estimation. Applicants are expected to have a Ph.D and be a professional contributor in the area of flight control. Consideration will be given to applicants who have extensive flight control experience within industry and government.

RESEARCH SUPPORT

Two powerful hybrid computers (EAI SIMSTARS) are the heart of AFIT's flight control laboratory. A high fidelity, full flight envelope, real-time aircraft simulator is developed for academic and research use. Overall, AFIT's computer resources equal or exceed those found at other universities. An office, laboratory, the use of modern computers, and other service support will be provided for the visiting professor and may include support for a limited number of visiting professor's doctoral students.

PERIOD OF APPOINTMENT AND SALARY

The initial period of appointment is for one full year. A shorter period and the starting date are negotiable, but should be prior to October 1, 1990. Extension for a second year may be possible. Salary is commensurate with qualifications. A per diem allowance is also paid.

APPLICATION

A resume of qualifications and experience, including a list of significant publications and any need for support of Ph.D students can be submitted anytime prior to February 28, 1990 to:

Capt. RANDALL N. PASCHALL
Department of Electrical and
Computer Engineering
Air Force Institute of Technology
(AFIT/ENG)
Wright-Patterson AFB, Ohio
45433-6583
Phone:(513) 255-3576

The Flight Control Distinguished Visiting Professor Program is made possible through a grant from the Air Force Wright Research and Development Center's Flight Dynamics Laboratory.

AFIT is an Equal Opportunity and Affirmative Action Employer.

THE CITY UNIVERSITY OF NEW YORK
John Jay College of Criminal Justice
Department of Mathematics

Assistant Professor, tenure-track position, January 1990. Requirements: Ph.D.; demonstrated potential for research; strong commitment to teaching. Computer science, numerical analysis or operations research background preferred. John Jay College of Criminal Justice, located in Manhattan, is a senior college in CUNY. Send resume, graduate transcript, relevant reprints, dissertation abstract and three letters of reference to Samuel Graff, Chairperson, Department of Mathematics, John Jay College of Criminal Justice, 445 West 59 Street, New York, NY 10019 by December 1, 1989. Minorities and women are encouraged to apply. AA/EOE Employer.

POSITIONS AVAILABLE

UNIVERSITY OF BRITISH COLUMBIA
Mathematics, Dept., Room 121
1984 Mathematics Road
Vancouver, B.C.,
Canada, V6T 1Y4

The Mathematics Department is seeking an outstanding candidate for a tenure track Assistant Professorship to begin 1 July 1990. Our highest priority is for a candidate in differential geometry. If there is no suitable applicant in this field, we will also consider candidates in the field of Lie algebras. For an exceptionally well-qualified candidate, this position may be upgraded to a junior Associate Professorship. Applicants should have a proven research record of high quality and have demonstrated interest and ability in teaching. Preference will be given to candidates who have one or more years of postdoctoral experience. This position is subject to final budgetary approval. The salary will be commensurate with experience and research record. Applicants should send a C.V. including list of publications, statement of research and teaching interests and arrange for three letters of recommendation to be sent directly to: The Head, Department of Mathematics, University of British Columbia, Vancouver, B.C. Canada V6T 1Y4. Applications must be received before January 1, 1990. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

THE UNIVERSITY OF
WESTERN ONTARIO
Department of Mathematics

Applications are invited for a tenure track appointment at the Assistant or Associate Professor level. Preference will be given to candidates in algebra whose research has strong connections to one of the following areas: algebraic geometry, algebraic number theory, Lie theory, representation theory of finite groups. A solid research and publication record is expected. The successful candidate will be expected to contribute to the department's research programme and, in particular, supervise graduate students. In addition, the candidate should have commitment to and aptitude for teaching undergraduate and graduate courses.

The appointment, which is subject to the availability of funds, is scheduled to begin on July 1, 1990. Applicants should forward a curriculum vitae and names of at least three referees to

Dr. Richard Kane, Chairman
Department of Mathematics,
Middlesex College
The University of Western Ontario
London, Ontario N6A 5B7
Canada

The closing date for application is December 1, 1989. In accordance with Canadian Immigration requirements, this advertisement is directed to Canadian citizens and permanent residents of Canada.

"An Equal Opportunity Employer"

THE UNIVERSITY OF FLORIDA
Department of Mathematics

In each of the next several years, the Department of Mathematics intends to fill a substantial number of tenure-track faculty positions with mathematicians of exceptional caliber. Outstanding candidates from all academic ranks and all areas of pure and applied mathematics are invited to apply for these positions. Applications from junior candidates with post-doctoral experience are especially welcome.

First preference will be given to candidates who will facilitate Department goals of establishing strong working groups in partial differential equations, algebraic geometry and number theory. Secondary preference will be given to candidates who will fit well into currently functioning groups. In particular, it is likely that one position will be filled this year by an algebraist.

Senior candidates should have distinguished research records, and junior candidates are expected to have made significant research contributions. Every candidate is expected to possess a strong commitment to teaching. Candidates should forward a resume (including a list of publications) and should arrange for at least four letters of recommendation to be sent to:

David A. Drake, Chair
Department of Mathematics
University of Florida
201 Walker Hall
Gainesville, Florida 32611

All applications for the academic year 1990–1991 should be complete by December 31, 1989. The University of Florida is an equal opportunity employer and energetically solicits applications from women and minority candidates.

POSITIONS AVAILABLE

DARTMOUTH COLLEGE

Senior Position in Mathematics. Associate or Full Professor position available beginning in 1990–91. Candidates should have established and recognized research program, proven ability to attract external research support, and interest in building and leading a strong research group. Appointee will participate in the recruitment for several junior positions. Proven record of excellence in teaching at both the undergraduate and graduate levels and committment to professional interaction with faculty and Ph.D. students required. Applications are welcome in all fields of mathematics. Department has special interests in algebra, combinatorics, geometry/topology, and probability/statistics. Dartmouth provides grants to new faculty members for research-related expenses, a generous sabbatical program, and moderate teaching loads. The review of applications will begin on January 1, 1990. Send a letter of application, a curriculum vitae, the names of four people who have agreed to write letters of recommendation, and a description of research interests to: Mathematics Senior Search Committee Chair, Department of Mathematics and Computer Science, Bradley Hall, Dartmouth College, Hanover, NH 03755. Dartmouth is firmly committed to Affirmative Action and strongly encourages applications from minorities and women.

TEXAS CHRISTIAN UNIVERSITY

The Dept. of Mathematics invites applications for two tenure track positions at the Assistant Professor rank beginning August, 1990. The Ph.D. degree in a core area of mathematics is required. Duties include teaching (approx. 9 hrs. per semester) and the active pursuit of a research program. Salary will be commensurate with qualifications. Send letter of application, resume, and three letters of reference to: Victor A. Belfi, Chairman, Dept. of Mathematics, P.O. Box 32903, TCU, Fort Worth, TX 76129. Deadline for applications December 15, 1990. TCU is an AA/EOE.

TRINITY UNIVERSITY
Position Announcement

Trinity University invites applications and nominations for a tenure-track position in mathematics, appointment beginning August, 1990. The appointment will be made at the rank of Assistant Professor. Responsibilities include teaching nine credit hours per semester, continuing scholarly activity, assisting in curriculum development, advising, and committee service. Minimum qualifications are the Ph.D. in Mathematics with excellence in and strong commitment to teaching.

Founded in 1869, Trinity University occupies a modern campus overlooking the San Antonio skyline. Purposely small and selective, with about 2500 students, Trinity stresses a high quality, undergraduate liberal arts and science program; in particular, the Mathematics Department does not offer graduate courses. San Antonio is a city of approximately 850,000 people situated in a metropolitan area of 1.2 million.

Closing date for applications is December 29, 1989. Send vita, graduate transcripts and three letters of reference to:

Professor William F. Trench
Department of Mathematics
Trinity University
715 Stadium Drive
San Antonio, Texas 78212

Trinity University is an equal opportunity affirmative action employer.

THE OHIO STATE UNIVERSITY
Department of Mathematics
Research Instructorships in Mathematics

Applications are invited for the position of research instructor in mathematics for the academic year 1990–91. Candidates should hold a Ph.D. (or equivalent) in mathematics and show strong research promise.

Please send credentials and have letters of recommendation sent to Professor Joseph Ferrar, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. The Ohio State University is an Equal Opportunity/Affirmative Action Employer.

WAKE FOREST UNIVERSITY
The Z. Smith Reynolds Professorship in Mathematics

Wake Forest University announces the establishment of a distinguished professorship made possible by the Z. Smith Reynolds Foundation. The scholar selected to fill this position must have an established record of recognized scholarship and a commitment to teaching and research in a university setting. Duties include teaching, continuing a program of research, contributing to the intellectual life of the Department of Mathematics and Computer Science, and fostering the mathematical growth of gifted undergraduates. The position, which carries both tenure and the rank of professor, could be filled as early as the fall semester of 1990.

Wake Forest University is a comprehensive university with 5000 students, 3500 of whom are in the undergraduate college. The Department of Mathematics and Computer Science has 17 permanent positions, 13 of which are in mathematics, and offers majors in mathematics and computer science and an MA in mathematics.

Inquiries, nominations, and applications should be directed to:

Professor Richard Carmichael,
Chair
Department of Mathematics and
Computer Science
P.O. Box 7311
Wake Forest University
Winston-Salem, NC 27109 USA

Evaluation of applicants will begin in late winter and will continue until the position is filled. AA/EO employer.

WILLIAMS COLLEGE
Department of Mathematics
Williamstown, Massachusetts 01267

Three anticipated positions, probably at the rank of assistant professor, for Fall 1990. Strong Commitment to both teaching and scholarship is essential.

Please have a vita and three letters of recommendation on teaching and research sent to Frank Morgan, Chair. Evaluation of applications will continue until positions are filled.

AA/EOE

POSITIONS AVAILABLE

OREGON STATE UNIVERSITY

The Andreotti Assistant Professor position in mathematics will become available September 16, 1990. Salary depends on qualifications. Closing date is December 15, 1989. Write to:

Professor Bent Petersen, Chair
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Oregon State University
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B. I. Fein
R. Higdon
R. M. Schori

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
TENURED POSITION

We invite applications for one or more positions effective July 1, 1990, at tenure level (Associate or full Professor), subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Demonstrated leadership in research is expected of applicants. Applicants should send a curriculum vitae, list of publications, a few selected reprints or preprints, and the names of three references to Andrew J. Casson, Vice Chair for Faculty Affairs at the above address. We should receive this material no later than October 1, 1989. The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA SANTA CRUZ

The Mathematics Department at the University of California, Santa Cruz is recruiting for a position in algebra or number theory. The teaching load is 4 one-quarter courses per year. Rank: Assistant Professor I-III. Minimum Qualifications: Ph.D. in Mathematics. Demonstrated achievements in, or potential for, research, teaching and professional service, commensurate with experience. Salary: $32,400-$34,900. Effective: July 1, 1990. Applicants should send vitae, information about their research and teaching experience and four letters of recommendation commenting on their teaching and research, to–Recruitment Committee, Mathemtics Department, University of California, Santa Cruz, CA 95064. Closing Date: December 31, 1989. Please refer to #190-890 in your reply. UCSC IS AN EEO/AA/IRCA EMPLOYER

OREGON STATE UNIVERSITY

Assistant Professor positions in Algebra/Number Theory, Numerical Analysis, Geometric-Topology/Dynamical Systems, and Differential Geometry will become available September 16, 1990. Salary depends on qualifications. Closing date December 15, 1989. Write to:

Professor Bent Petersen
Staff Selection Committee
Department of Mathematics
Oregon State University
Corvallis, Oregon 97331-4605

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STAFF SELECTION COMMITTEE
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RUTGERS UNIVERSITY-NEWARK
Professor of Mathematics

The Department of Mathematics and Computer Science anticipates an opening at the Rank of Professor I or Professor II beginning Fall 1990. Candidates should exhibit outstanding research accomplishments. Salary and teaching load are negotiable. Applicants from all fields are invited. Areas of research interest in the department include number theory, representation theory and automorphic forms, Lie algebras, transformation groups, low dimensional topology and Teichmuller theory. Nominations and applications should be sent to: Jane Gilman, Chair, Department of Mathematics, Rutgers University, Newark, New Jersey 07102. The closing date for applications is 1/15/90 but applications will be considered until the position is filled. AA/EOE.

UNIVERSITY OF OTTAWA

The Department of Mathematics will have two or three tenure-track openings at the assistant or asociate level starting July 1, 1990. Applicants in all branches of mathematics and statistics who hold a doctorate and have demonstrated research potential are invited. The teaching attached to one of the posts will be in French. For the other(s), ability to teach in English and French is required for tenure but one language suffices for the initial appointment. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. Applicants should send a resume and have at least three letters of recommendation sent directly to: W. D. Burgess, Dept. Math., University of Ottawa, Ottawa, CANADA K1N 6N5. Deadline: December 15, 1989.

POSITIONS AVAILABLE

BRYN MAWR COLLEGE

Applications are invited for two positions in Mathematics, to start September 1990, one open as to rank and tenured or tenure-track, and one at Assistant Professor rank, tenure-track. One of the positions must be filled with a person taking responsibility in the joint computer science program with Haverford College. Preferred specialties: geometry, algebra, applied mathematics, or computer science. Strong research record and excellence in teaching expected. Women and minority candidates are especially encouraged to apply. Please direct application and three letters of recommendation to: F. Cunningham, Jr., Faculty Search, Department of Mathematics, Bryn Mawr College, Bryn Mawr, PA 19010. Closing date January 1, 1990. Bryn Mawr College is an EO/AA employer.

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

Applications are invited for four tenure track positions for the Fall of 1990. Three positions at the assistant professor level in areas of interest to the faculty and possibly one at the associate professor level, will be available. A Ph.D. by the Fall of 1990 is required. Candidates in Mathematics Education and Applied mathematics (especially with experience in industry) are encouraged to apply, but candidates in all areas of mathematics with a commitment to both teaching and research will be considered. Responsibilities include teaching 9-12 hours, depending on research and/or other contributions. Send vita and three letters of recommendation to Jerry Rosen, Hiring Committee Chair, Dept. of Mathematics, California State University, Northridge, CA 91330 by Feb. 15 for full consideration. Women and minorities are especially encouraged to apply. CSUN is located in a Northwestern suburb of Los Angeles and is in close proximity to Cal. Tech., U.S.C., and U.C.L.A. (15 mins. away).

AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER

UNIVERSITY COLLEGE LONDON

The College is exploring the possibility of filling the Astor Chair in Pure Mathematics. The last three holders of the chair have been Professor H. Davenport F.R.S., Professor C. A. Rogers F.R.S. and Professor P. M. Cohn F.R.S. Nominations and enquiries are invited. The college is looking for a mathematician with an excellent record in one of the main stream branches of pure mathematics. It would especially welcome nominations of distinguished mathematicians in number theory or analysis of any related field.

A vacant lectureship is available so that an incoming Astor Professor could help in appointing a suitable candidate in his/her field.

Please contact:

Dr. D. H. Roberts F.R.S.
Provost
University College London
Gower Street
London WC1E 6BT
England

UNIVERSITY OF MIAMI
Chairperson
Department of Mathematics and Computer Science

We are seeking a distinguished mathematician with a strong record in research. The department is firmly committed to excellence in research and teaching, has enjoyed substantially increased outside funding in recent years, and anticipates several new faculty appointments in the near future. The new chairperson would play a major role in the further development and enhancement of our program.

Applicants should submit curriculum vitae and the names and addresses of four references to: Prof. Chris Cosner, Chair, Search Committee, Department of Mathematics and Computer Science, P.O. Box 249085, University of Miami, Coral Gables, FL 33124. The appointment could be effective as early as Spring 1990, so immediate applications are encouraged. However, applications will be accepted until the position is filled.

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BAYLOR UNIVERSITY
Endowed Chair of Mathematics

The Mathematics Department is accepting applications for the Ralph and Jean Storm Chair for research in mathematics. We are seeking a mathematician with an established record of excellence in research and a strong interest in teaching. The teaching load is three hours per semester. The starting date is negotiable.

The Department offers the BA, BS, and MS degrees. The department has an enrollment of 2500 students and the University has 11,000 students. Baylor is located in Waco, Texas, which is 100 miles from Dallas and 100 miles from Austin. Baylor University is an Affirmative Action/Equal Opportunity Employer and is under the patronage and general direction of the Baptist General Convention of Texas. Send vita to Howard L. Rolf, B.U. Box 7328, Baylor University, Waco TX 76798-7328.

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Department of Mathematics

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To apply, write to Alfred W. Hales, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555. Attn: Staff Search. UCLA is an equal opportunity/affirmative action employer.

POSITIONS AVAILABLE

THE OHIO STATE UNIVERSITY
Department of Mathematics

The Department of Mathematics of The Ohio State University hopes to fill several positions, both visiting and permanent, effective Autumn Quarter 1990. Candidates in all areas of applied and pure mathematics are invited to apply. Significant research accomplishments or exceptional research promise, and evidence of good teaching ability, will be expected of successful applicants.

Please send credentials and have letters of recommendation sent to Professor Joseph Ferrar, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. Review of resumes will begin immediately.

The Ohio State University is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF PITTSBURGH

Positions (ranks open, and subject to funding) in partial differential equations and in applied mathematics (emphasis on scientific computing) expected during the coming year. One of these appointments may be made early in the year. Applicants should have outstanding research accomplishment or potential, and demonstrate excellence in teaching. Junior applicants should have a resume and at least three letters of recommendation sent to Stuart Hastings, Chairman, Department of Mathematics and Statistics, University of Pittsburgh, Pittsburgh, PA 15260. More senior applicants can write to the same address. The University of Pittsburgh is an Equal Opportunity/Affirmative Action Employer. Women and minorities are especially encouraged to apply.

PUBLICATIONS

Curvature Geometry Workshop, Lancaster 1989
Proceedings, Edited by C. T. J. Dodson
Contains papers presented by
L. Vanhecke, F. Tricerri, C. T. J. Dodson, S. M. Salamon, M. Fernandez, L. A. Cordero, C. M. Wood, A. F. Swann, P. Bueken. AMS Subject Classifications: 53B 53C 55R 57R
In LaTeX, Softcover, 195 pages ISBN 0 901272 66 3
ULDM Publications, Mathematics Department, Lancaster University, Lancaster LA1 4YF, England. Fax 0524 381707
email mathematics@uk.ac.lancs.cent1.
Price Postfree, Prepaid £12 Europe, US$ 25 elsewhere. Cheques payable to Lancaster University.

MATH SCI PRESS, 53 Jordan Rd., Brookline, MA 02146, 617-738-0307, TOPICS IN PHYSICAL GEOMETRY, by R. Hermann, $80. In Preparation: Geometric Aspects of Computer Science.

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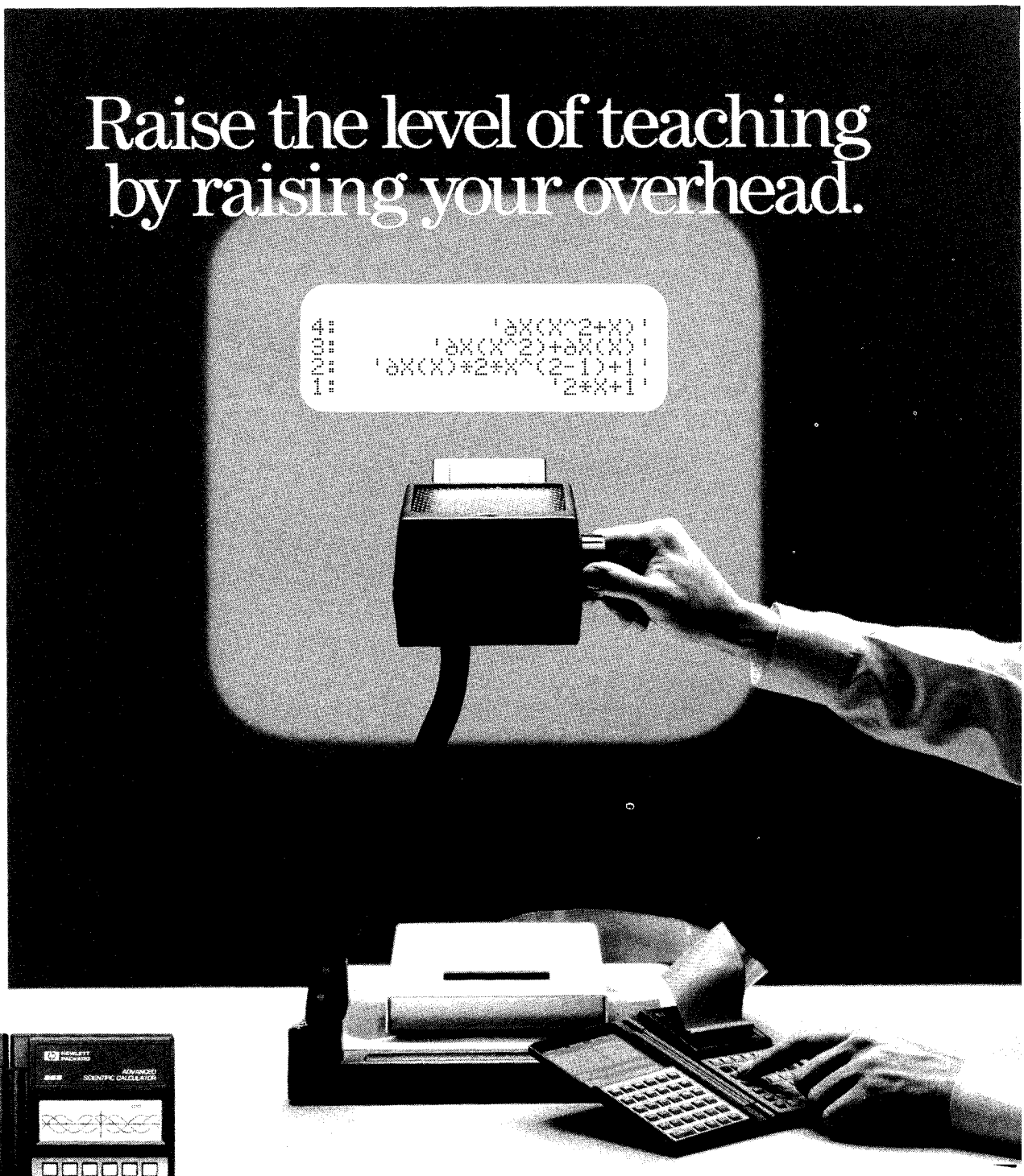

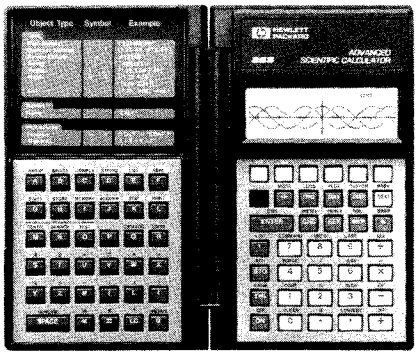

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DEAN
College of Science
The University of Texas at Arlington

The University of Texas at Arlington invites applicants and nominations for Dean of the College of Science. UTA is a major university (enrollment 24,000) located in the center of the Dallas/Ft. Worth metropolitan area (three million population). The university is a member of the University Research Associates consortium. The College of Science consists of the departments of Biology, Chemistry, Geology, Mathematics, Physics, and Psychology and offers a wide range of bachelors, masters and doctoral degrees. The college currently has 120 faculty, 550 graduate students and 2150 undergraduates.

Applicants should have an earned doctorate and credentials suitable for a tenured faculty appointment in one of the departments in the college. The successful applicant will be expected to lead a strong research and educational program, and should possess exceptional qualities of leadership and technical strength as well as demonstrated communication and managerial skills. The new dean should be prepared for a unique opportunity to lead a significant expansion in personnel and facilities due to the needs of the rapidly developing North Texas area, including the anticipated establishment of the nearby superconducting supercollider. Inquiries and letters of application, accompanied by a curriculum vita, should be sent to:

Prof. Robert Mitchell
Dean of Science Search Committee
Box 19016
University of Texas at Arlington
Arlington, Texas 76019
(telephone: 817-273-3472; fax: 817-273-2548).

Applications received by Nov. 15, 1989 will receive first consideration for on-campus interviews. The anticipated starting date is September 1, 1990. The University of Texas at Arlington is an Equal Opportunity/Affirmative Action Employer.

Chairperson: Department of Mathematics

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Send resume by Nov. 30, 1989 to: Personnel Box M.

NJIT **New Jersey Institute of Technology**
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International Congress of Mathematicians, Kyoto, Japan, 1990

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   degree date Institution

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   6. Algebraic geometry
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   8. Real and complex analysis
   9. Operator algebras and functional analysis
   10. Probability theory and mathematical statistics
   11. Partial differential equations
   12. Ordinary differential equations and dynamical systems
   13. Mathematical physics
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   17. Applications of mathematics to the sciences
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7. Other positions held (professional, scientific, teaching, administrative):

Name of Institution or Organization	Title of Position	Dates

8. Scholarships, fellowships, or comparable awards. Specify tenure, institution, and field of study:

9. Academic honors (membership in honorary societies, graduation honors, etc.):

10. Please list all publications appearing in print in the last 5 years, with complete page numbers. List, if appropriate, your doctoral dissertation, and papers accepted for publication. (If additional sheets are used, please submit in quadruplicate).

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INTERNATIONAL TRAVEL GRANT APPLICATION

11. Travel outside U.S. for professional purposes since January 1,1985:

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12. Have you requested or been granted funds which might be used for travel to this Congress? If so, give details:

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13. List research support from all sources in the last 5 years, including any current support; specify sponsor, title or identification of award, and amount and duration:

14. List research proposals which have been submitted and/or are pending at this time; specify sponsor:

15. This item is **optional** and is suggested for junior mathematicians (those within 6 years of their doctorate) only. Junior mathematicians are **urged** to have senior professional mathematicians (no more than 2) write in their behalf concerning their ability, and the value of attendance at this Congress to the research and professional interests of such junior mathematicians. These supporting letters should be sent to the address in the upper right hand corner of page 1 of this application.

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12 Field theory and polynomials
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14 Algebraic geometry
15 Linear and multilinear algebra; matrix theory
16 Associative rings and algebras
17 Nonassociative rings and algebras
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19 K-theory
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26 Real functions
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30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytic spaces
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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
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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
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82 Statistical physics, structure of matter
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Graph Colouring and Variations

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