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Notices

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Calendar of AMS Meetings

THIS CALENDAR lists all meetings which have been approved by the Council prior to the date this issue of the *Notices* was sent to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have yet been assigned. *Programs* of the meetings will appear in the issues indicated below. *First* and *second* 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 office of the Society in Providence. 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 submitted for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information consult the meeting announcement and the list of organizers of special sessions.

MEETING NUMBER	DATE	PLACE	ABSTRACT DEADLINE	ISSUE
799	November 12–13, 1982	East Lansing, Michigan	SEPTEMBER 13, 1982	November
800	November 19–20, 1982	Monterey, California	SEPTEMBER 20, 1982	November
801	January 5–9, 1983 (89th Annual Meeting)	Denver, Colorado	OCTOBER 12, 1982	January 1983
802	March 18–19, 1983	Norman, Oklahoma		
803	April 14–15, 1983	New York, New York		
804	April 29–30, 1983	Salt Lake City, Utah		
805	August 8–12, 1983 (87th Summer Meeting)	Albany, New York		
	January 25–29, 1984 (90th Annual Meeting)	Louisville, Kentucky		
	January 9–13, 1985 (91st Annual Meeting)	Anaheim, California		
	January 21–25, 1987 (93rd Annual Meeting)	San Antonio, Texas		

DEADLINES: Advertising: (January Issue) November 16 News/Special Meetings: (January Issue) November 1

Other Events Sponsored by the Society

January 3–4, 1983, AMS Short Course: Computer Communications, Denver, Colorado. This issue, page 564.
 April 12–13, 1983, AMS-SIAM Symposium on Inverse Problems, New York Statler Hotel, New York, New York

May 1983, Symposium on Some Mathematical Questions in Biology, Detroit, Michigan

June 5–August 13, 1983, AMS Summer Research Conferences, University of Colorado, Boulder, Colorado.
 This issue, page 582

June 20–July 1, 1983, AMS-SIAM Summer Seminar on Large-scale Computations in Fluid Mechanics, Scripps Institution of Oceanography, LaJolla, California. This issue, page 579.

July 11–29, 1983, AMS Summer Research Institute on Nonlinear Functional Analysis.

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Notices

of the American Mathematical Society

Volume 29, Number 6, October 1982

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U.S. Recipients of Fields Medals



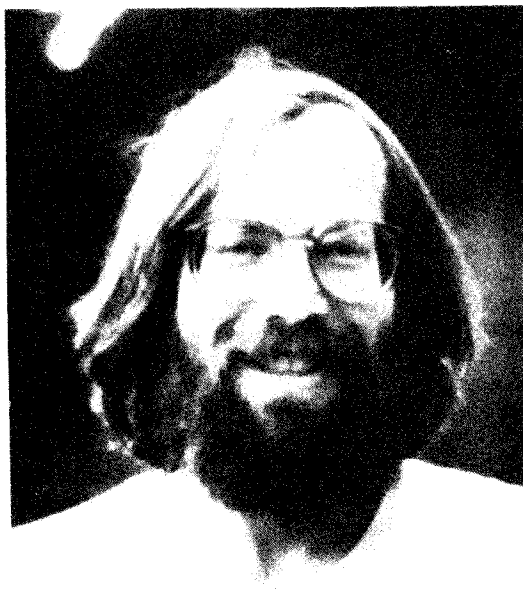
William P. Thurston



Shing-Tung Yau

Attempts to obtain a photograph of the third recipient of a Fields Medal, Alain Connes of France, for publication here were not successful. We hope to print one in the next issue of the *Notices* — Editors

Winner of the Nevanlinna Prize



Robert E. Tarjan

Fields Medals and Nevanlinna Prize

At the meeting of the General Assembly of the International Mathematical Union in Warsaw early in August, the names of recipients of the Fields Medals and the new Nevanlinna Prize in Information Science were announced.

Fields Medals are to be presented to ALAIN CONNES of the Institut des Hautes Études Scientifiques, WILLIAM P. THURSTON of Princeton University, and SHING-TUNG YAU of the Institute for Advanced Study and the University of California, San Diego. ROBERT E. TARJAN of Bell Laboratories, Murray Hill, is to be the first recipient of the Nevanlinna Prize. Present plans call for the awards to be made at the International Congress of Mathematicians, which is currently scheduled for August 1983 in Warsaw. At that time, lectures are to be presented on the work and accomplishments of each of the recipients.

ALAIN CONNES was born April 1, 1947 in Darguignan, France. In June 1973 he received a Doctorat d'État from University of Paris VI for a thesis written under the supervision of Jacques Dixmier. Connes was affiliated with the Centre National de la Recherche Scientifique from 1970 to 1974, he was at Queen's University, Ontario, Canada in 1974-1975 and held a faculty appointment at University of Paris VI from 1975 to 1977. In 1978-1979 he was a visiting member of the Institute for Advanced Study, Princeton, and since 1979 he has been a Professor at the Institut des Hautes Études Scientifiques, Bures-sur-Yvette. In 1975 he was awarded the Prix Aimeé Berthé, in 1976 the Prix Pecot-Vimont, in 1977 the Médaille d'Argent of the CNRS, in 1980 the Prix Ampère, and in 1981 the Prix de Electricité de France. In 1980 he was elected a Corresponding Member of the Académie des Sciences, in 1982 he and André Weil were the only mathematicians elected to full membership in the Académie, bringing the number of mathematicians who are full members of the Académie up to thirteen.

Among honors earned by WILLIAM P. THURSTON are the Society's Veblen Prize in Geometry in 1976 and the National Science Foundation's Waterman Award in 1979. The August 1979 issue of the *Notices* contains biographical and bibliographical information, as well as descriptions of Professor Thurston's work by H. Blaine Lawson and Dennis Sullivan (pages 293 to 296).

SHING-TUNG YAU received the Society's Veblen Prize in 1981. See the February 1981 (pages 162 to 164) issue of the *Notices* for biographical and bibliographic information, as well as the text of the citation of the Veblen

Prize Committee outlining the work for which he received that award.

ROBERT ENDRE TARJAN was born April 30, 1948 in Pomona, California. He was educated at the California Institute of Technology (B.S. in Mathematics, 1969) and Stanford University (M.S. in 1971 and Ph.D. in 1972, both in Computer Science). He was assistant professor of computer science at Cornell University, 1972 to 1974, Miller Research Fellow at the University of California, Berkeley, 1973 to 1975, and assistant and associate professor of computer science at Stanford University, from 1974 to 1981. Since September 1980 he has been a member of the technical staff at Bell Laboratories, Murray Hill, and since September 1981 an adjunct professor at New York University.

Fields Medals are awarded by the International Mathematical Union on the occasion of an International Congress of Mathematicians. The awards were established in accordance with the will of Professor J. C. Fields of the University of Toronto. Professor Fields died in 1932 and the first awards were made at the Congress in Oslo in 1936.

The 1936 recipients were Lars V. Ahlfors and Jesse Douglas. Later recipients were Atle Selberg and Laurent Schwartz in 1950; Kunihiko Kodaira and Jean-Pierre Serre in 1954; Klaus Roth and René Thom in 1958; Lars Hörmander and John Milnor in 1962; Michael Atiyah, Paul J. Cohen, Alexander Grothendieck and Stephen Smale in 1966; Alan Baker, Heisuke Hironaka, Sergei Novikov and John G. Thompson in 1970; Enrico Bombieri and David Mumford in 1974; and Pierre Deligne, Charles Fefferman, Gregori Aleksandrovitch Margulis and Daniel Quillen in 1978.

The following essays describe some of the achievements of the present recipients of these awards.

The Work of Alain Connes

Calvin C. Moore

To place Alain Connes's fundamental and pioneering contributions to operator algebras in context, recall that von Neumann and Murray in the 1930s and 1940s were led by, among other things, the spectral theory of operators on Hilbert space, and by considerations of constructing mathematical models for quantum mechanical

systems, to introduce what they called rings of operators—since renamed von Neumann algebras. These are weakly closed self adjoint algebras of operators on a Hilbert space, containing the identity operator. One of the main problems has been and remains the classification of these algebras as intrinsic algebraic and topological objects. One easily reduces this to the study of factor algebras—those with one dimensional center, or equivalently those which are simple in a well defined sense.

In their original papers, von Neumann and Murray introduced a type classification: type I algebras are those which turn out to have a Wedderburn type structure theory and they constitute the “expected” examples; for instance, the only factors of this kind are $B(H)$, the algebra of all bounded operators on a Hilbert space. The algebras of types II and III seemed rather more exotic and mysterious; for example one can have families of projections in a factor of type II whose generalized “dimensions” fill out an interval. The type II (and I) algebras are the ones possessing linear functionals with the formal properties of a trace. The factors of type II are either finite, called II_1 factors (these have an everywhere defined trace) or infinite, called II_∞ factors, where the trace is only densely defined. Type III factors, lacking such a trace, seemed especially intractable.

In a first attempt to classify factors not of type I, von Neumann and Murray introduced the notion of hyperfinite algebras—now called approximately finite algebras. These are the algebras that can be approximated by finite dimensional algebras in the sense that they are the weak closure of an ascending chain of finite dimensional algebras. This class of von Neumann algebras turns out to be of exceptional importance both for reasons internal to the subject and for applications.

Connes’s thesis [1] was already a major, stunning breakthrough in the classification problem. Building on work of Powers, Araki and Woods, and Krieger, Connes introduced his S -invariant for factors—a subset of $[0, \infty]$. This provides a subdivision of the type III algebras into subclasses of type III_λ , $0 \leq \lambda \leq 1$, and provided great structural insight. He further showed how to obtain these algebras for $\lambda \neq 1$ from type II algebras and their automorphisms. Takesaki, using more general crossed products, then proved this in all cases. In all this work an absolutely key tool without which one cannot get started is the Tomita-Takesaki theory of modular automorphisms. One upshot of Connes’s result is that classification in general comes down to classification of type II algebras and their (outer) automorphisms. Connes further realized that the type III algebra is approximately finite iff the type II algebra from which it is built is approximately finite.

Now one of the very early results of von Neumann and Murray was that, up to isomorphism, there is one and only one approximately

finite algebra of type II_1 . Connes consequently undertook in [2] an intensive study of the outer automorphisms of this algebra and of the associated II_∞ factor of infinite matrices over it. The amazing result is that up to conjugacy there are very few such automorphisms. With these results in hand, there remained one crucial point for the classification of approximately finite factors—whether the algebra of matrices over the unique II_1 approximately finite algebra is the only II_∞ approximately finite factor. This seemingly simple problem turns out to be enormously difficult, and Connes’s work in this area culminated in the affirmative resolution of this problem in [3]. In the process he established more, including the equivalence of several other important conditions, including injectivity, with approximate finiteness, and of course achieved the complete classification of all approximately finite factors except for those of type III_1 ; it is conjectured but unproved that there is just one such algebra. One elegant formulation of this classification, coming from a combination of this work with that of Krieger, is that the infinite approximately finite factors are in one-to-one correspondence with ergodic flows up to conjugacy (the flow of weights of the factor), and also in turn with ergodic transformations up to orbit equivalence. This classification is one of great simplicity and elegance, and one that had hardly seemed possible a decade earlier.

Since completing this work, Connes has gone on to the very fruitful study of the connections between operator algebras, foliations, and index theorems. Associated with a compact foliated manifold together with a transverse measure, there is a natural von Neumann algebra. Connes shows that the kernel and cokernel of a differential operator that is tangential to the leaves of the foliation, and that is tangentially elliptic in the obvious sense, can be viewed as projections in this von Neumann algebra. If one further assumes that the transverse measure is invariant, this produces a trace on this algebra, making it type II (or type I in degenerate cases). In particular there now is a numerical index, and Connes obtains in [4] a beautifully simple formula for this index in terms of topological data from the symbol, in complete analogy with the Atiyah-Singer theorem. Connes has recently announced in [5] a far more general and powerful version of the theorem, freed from assumptions about invariant transverse measures, and formulated, as it should be, in terms of the C^* algebra associated to the foliation and its K -theory.

Taken altogether Connes’s work in the last decade on operator algebras and its applications has transformed the subject and opened up entire new areas of research. In this short space we have discussed only some of the highlights of his many contributions.

[1] *Une classification des facteurs de type III*, Annales Scientifiques de l’Ecole Normale Supérieure (4) 6 (1973), 133–152.

[2] *Outer conjugacy classes of automorphisms of factors*, Annales Scientifiques de l'École Normale Supérieure (4) 8 (1975), 383–419.

[3] *Classification of injective factors, cases Π_1 , Π_∞ , Π_λ , $\lambda \neq 1$* , Annals of Mathematics (2) 104 (1976), 73–115.

[4] *Sur la théorie non-commutative de l'intégration*. Lecture Notes in Mathematics 725 (1979), 19–143 (Springer-Verlag).

[5] *Théorème de l'indice pour les feuilletages* (with G. Skandalis), Comptes Rendus des Séances de l'Académie des Sciences. Série 1. Mathématique. (Paris) 292 (18 May 1981), 871–876.

The Work of William P. Thurston

William Browder and W.-c. Hsiang

For half a century, the study of the topology of 2-dimensional manifolds has rested heavily on the geometric structures that can be introduced, e.g. as complex manifolds or Riemannian manifolds of constant curvature. Thurston's audacious idea is a 3-dimensional extension.

He considers eight basic kinds of geometries which might be introduced, based on certain homogenous spaces of Lie groups. The most interesting and useful of these is the Lobachevskian geometry, i.e. a space of constant negative curvature.

Conjecture of Thurston. The interior of any compact 3-dimensional manifold is the union of submanifolds, each of which carries a geometric structure of one of these eight types.

Such a manifold Thurston calls "geometric".

Thurston has proved this conjecture for many wide classes of 3-manifolds such as Haken manifolds (which includes knot complements).

The existence of this geometric structure makes available a whole range of new techniques to study 3-manifolds. For example, for hyperbolic manifolds (constant negative curvature) the Mostow rigidity theorem says the isomorphism type of the fundamental group determines the manifold up to isometry. One may use this type of result to study the group of homeomorphisms of a geometric 3-manifold, by reducing to problems about isometries. He shows that on a Haken manifold M^3 satisfying an additional condition called "homotopically atoroidal," $\pi_0(\text{Diff } M^3)$ (the set of isotopy classes of diffeomorphisms of S^3) is finite, and there is a splitting of groups $\pi_0(\text{Diff } M^3) \rightarrow \text{Diff}(M^3)$. A well-defined notion of volume may be used to play for 3-manifolds the role played by the Euler characteristic in 2-manifold theory.

Perhaps the most spectacular achievement of this program is the positive solution of the Smith conjecture: *Any periodic homeomorphism of S^3 fixing a simple closed curve is conjugate to a*

rotation. This result uses Thurston's geometric method plus the equivariant loop theorem of Meeks and Yau [8].

The Thurston method in 3-manifolds is closely related to the theory of Kleinian groups and Teichmüller spaces, in which Thurston has introduced novel methods from the theory of foliations of considerable interest to specialists in this area.

Thurston's earlier work in foliation theory, for which he was awarded the 1976 Veblen Prize, included a spectrum of results ranging from new constructions realizing uncountably many values of the Godbillon-Vey invariant, extending by new geometrical techniques the Haefliger foliation theory to closed manifolds, calculating homology of classifying spaces, etc. One dramatic consequence: Any closed manifold of Euler characteristic 0 admits a codimension 1 foliation. Reeb had produced such a foliation for S^3 thirty years ago, while other odd dimensional spheres were given such foliations in the 1970s through work of Lawson, Durfee and Tamura.

[1] W. Thurston, *Three dimensional manifolds, Kleinian groups and hyperbolic geometry*, Bulletin of the AMS (New Series) 6 (1982), 357–381.

[2] A. Fathi, F. Laudenbach, V. Poenaru, et al, *Travaux de Thurston sur les surfaces*, Astérisque, no. 66, 67, Société Mathématique de France, 1979.

[3] W. Thurston, *The geometry and topology of three-manifolds*, Princeton University Press (in preparation).

[4] W. Thurston, *The theory of foliations of codimension greater than one*, Commentarii Mathematici Helvetici 49 (1974), 214–231.

[5] W. Thurston, *existence of codimension-one foliations*, Annals of Mathematics (2) 104 (1976), 249–268.

[6] W. Thurston, *Foliations and groups of diffeomorphisms*, Bulletin of the AMS 80 (1974), 304–307.

[7] W. Thurston, *Noncobordant foliations of S^3* , Bulletin of the AMS 78 (1972), 511–514.

[8] W. H. Meeks III and S.-T. Yau, *Topology of three-dimensional manifolds and the embedding problems in minimal surface theory*, Annals of Mathematics (2) 112 (1980), 441–484.

The Work of Shing-Tung Yau

Louis Nirenberg

S.-T. Yau has done extremely deep and powerful work in differential geometry and partial differential equations. He is an analyst's geometer (or geometer's analyst) with enormous technical power and insight. He has cracked problems on which progress had been stopped for years. A few of his achievements:

1. **The Calabi Conjecture.** This comes from algebraic geometry and involves proving the existence of a Kähler metric, on a compact Kähler manifold, having a prescribed volume form. The

analytic problem is that of proving the existence of a solution of a highly nonlinear (complex Monge-Ampère) elliptic equation. Yau's solution is classical in spirit, via *a priori* estimates. His derivation of the estimates is a *tour de force* and the applications in algebraic geometry are beautiful.

2. **Positive Mass Conjecture**, from general relativity theory. This involves global Riemannian geometry and nonlinear elliptic partial differential equations. In joint work with R. Schoen, Yau settled this problem. The solution involves construction of global minimal surfaces and a study of their stability and behaviour near infinity. The work is very technical and highly ingenious.

3. **Real and complex Monge-Ampère equations**. In joint work with S. Y. Cheng, Yau gave a complete proof of the higher dimensional Minkowski problem (based partly on work of A. V. Pogorelov). They also constructed Einstein manifolds with given Ricci curvature in pseudoconvex domains in \mathbb{C}^n . Great technical power, and estimates, are involved here.

4. In a series of papers, some with P. Li, Yau obtained deep estimates on the first eigenvalue, as well as others, for the Laplace operator on a compact manifold (or manifold with boundary) under various hypotheses on the Ricci curvature—but in terms of little geometric information about the manifold. The arguments used are highly varied and most ingenious.

5. Using minimal surfaces Y. T. Siu and Yau gave a beautiful proof of the Frankel conjecture that a complete simply connected Kähler manifold with positive holomorphic bisectional curvature is biholomorphic to complex projective space. This was proved earlier by S. Mori with the aid of algebraic geometry.

6. With W. H. Meeks III, Yau used topological methods of 3-manifolds to settle some old problems in the classical theory of minimal surfaces. Conversely, they used minimal surface theory to obtain results in 3-dimensional topology: Dehn's lemma and equivariant versions of the loop and sphere theorems.

A remarkable aspect of some of Yau's work is his use of minimal surfaces in the way that, previously, people had used geodesics.

This usually involves extremely difficult technical problems—topological as well as analytic. In addition to great technical power and depth, his work shows remarkable courage.

The Work of Robert Tarjan

Jacob T. Schwartz

Robert Tarjan is a leading designer of combinatorial, and especially graph-theoretic, algorithms. His work is distinguished for uniting combinatorial insight and ingenious, economical data structures to produce combinatorial procedures of remarkable elegance and efficiency. Among these is the striking method (developed jointly with Hopcroft) for testing a graph for planarity (and constructing a planar imbedding if one exists) in time linearly proportional to the number of edges in the graph, for finding node "dominators" in rooted directed graphs, and for analyzing the loop structure of certain classes of directed graphs which play an important role in the global structural analysis of computer programs. He and his collaborators have also applied high efficiency graph-theoretic techniques to problems important in numerical analysis, including determination of optimal elimination orders for inversion of sparse matrices, and of advantageous dissection orders for planar graphs.

Tarjan has also contributed new data structures useful in high-efficiency algorithm design, for example combinatorial tree structures which can be used to keep sorted lists in order while elements are efficiently inserted into and deleted from them, and has repeatedly used such structures to obtain striking and unsuspected improvements in the efficiency of algorithms designed by other combinatorialists. He has also supplied refined analyses of the performance of many such algorithms. Finally, he is the author of several very valuable studies of the fundamental question of the extent to which computation time rises as the memory available for carrying out a computation is progressively constricted. These techniques make use of a combinatorial "pebbling" technique of which Tarjan and his collaborators and students are principal developers.

Report on the Meeting of the IMU General Assembly in Warsaw

G. D. Mostow

Chairman, US National Committee for Mathematics

The Ninth General Assembly of the IMU which convened on August 8 and 9, 1982 at Warsaw, Poland, was unique by virtue of its separation from the Ninth International Congress of the IMU whose existence has yet to be confirmed at the meeting of the IMU executive committee in November 1982. There were 79 participants from 37 countries. Attending in the U.S. delegation were David Blackwell, Frederick W. Gehring, G. Daniel Mostow (chairman), Elias M. Stein, and Stanislaw W. Ulam.

The meeting opened with an address by President Lennart Carleson who announced the 1982 winners of the Fields Medals and the winner of the newly established Nevanlinna Prize in Information Science. [See the previous article in this issue of the *Notices* for information about the recipients. EDITOR] President Carleson also announced that the site committee had accepted the invitation from the US National Academy of Sciences to hold the 1986 Congress of the IMU at the University of California in Berkeley.

By far the most debated issue on the IMU agenda was the item devoted to considerations that the executive committee should keep in mind at its forthcoming November meeting when it must decide either to confirm the convening of the 1983 Warsaw Congress or to cancel it. President Carleson requested that remarks be confined to considerations which had a bearing on the success of the Congress and, as the debate unfolded, he discouraged repetition of points that had already been made. Carleson's exhortation was more or less respected; nevertheless, the debate lasted three hours. There were 31 statements by 24 speakers. The statements fell largely into three categories:

1. The concern about comfort and costs at a Warsaw Congress was outweighed by concerns about imprisoned mathematicians. Various aspects of this view were expressed by Michael Atiyah of Oxford, C. Godbillon, C. Houzel, and J. L. Verdier of France and G. D. Mostow speaking for the US delegation.

2. Speakers from the USSR, East Germany, Bulgaria and Cameroon emphasized that the IMU had no right to impose policies on the Poles and that politics should be left out of IMU.

3. Speakers from Brazil, Canada and Hungary felt that the 1983 Congress should be held in Warsaw if the Poles wanted it.

The Polish delegation, which contains a former member of Solidarity, strongly urged that the Warsaw Congress be held. In the view of the American delegation, the most effective response to our report of widespread moral repugnance in the US at attending the Warsaw Congress while fellow mathematicians were imprisoned was the two sentence speech of the distinguished Polish number theorist, Andrzej Schinzel, who said "For two thousand years visits to prisoners in jail have been considered acts of charity. How can you say that it is moral to turn your back on them?" Spoken openly in the presence of the USSR delegation the effect was startling. Subsequently, Frank Adams of Cambridge University (UK) rose to say "I arrived at this Assembly undecided about the 1983 Congress. I have decided after this discussion to attend."

There is one additional element of the US position that won widespread approval by almost all participants: When the executive committee decides in November 1982 whether or not to proceed with the Warsaw Congress it will have available the status of the 156 scientists appearing on a list of reported prisoners compiled by the Human Rights Committee of the US National Academy of Sciences.

Information about the status of the 156 prisoners was requested by the chairman of the US delegation the day after the General Assembly in a meeting he attended at the Polish Ministry of Foreign Affairs. Of the 156 on the NAS list, he was informed, 23 remain interned, three are under arrest, and one is kept in a hospital. Regretably though, of the 27 mathematicians who, according to the Ministry's information, had been originally interned or arrested only 13 have been released.

The newly elected officers of the IMU are: President, J. Moser, Switzerland; Vice Presidents, L. Faddeev, USSR and J. P. Serre, France; Secretary, O. Lehto, Finland; and Members-at-large, S. Mizohata, Japan; G. D. Mostow, USA; C. Olech, Poland; J. Palis, Jr., Brazil; M. S. Narasimhan, India; and past president, L. Carleson.

Four Steele Prizes Awarded by the AMS in Toronto

Steele Prizes are awarded by the Society each year at the summer meeting; they are supported by income from the Leroy P. Steele Fund. The Steele Fund was created in 1970 by a bequest from Mr. Steele who left the bulk of his estate to the Society for the support of awards to be designated as in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein.

Four Steele Prizes were awarded at the summer meeting in Toronto, each of which is worth fifteen hundred dollars. There are three categories of awards:

(1) For a book or substantial survey or research-expository paper. Two awards were made in this category, one to LARS V. AHLFORS for his three books *Complex analysis*, *Lectures on quasi-conformal mapping*, and *Conformal invariants*; the other to TSIT-YUEN LAM for his book *Algebraic theory of quadratic forms* (1973), and four of his papers: K_0 and K_1 —an introduction to algebraic K -theory (1975), *Ten lectures on quadratic forms over fields* (1977), *Serre's conjecture* (1978), and *The theory of ordered fields* (1980).



Lars V. Ahlfors

(2) For a paper, whether recent or not, which has proved to be of fundamental or lasting importance in its field, or a model of important research. The 1982 recipient is JOHN W. MILNOR for his paper *On manifolds homeomorphic to the 7-sphere*, *Annals of Mathematics* (2) 64 (1956), pages 399 to 405.

(3) For the cumulative influence of the total mathematical work of the recipient, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students. The recipient in 1982 is FRITZ JOHN.

These prizes were awarded by the Council of the American Mathematical Society, acting on recommendations of the Committee on Steele Prizes. The Committee consisted of Stuart Antman, Robin Hartshorne, Rueben Hirsch, M. D. Kruskal, Louis Nirenberg, Alex Rosenberg (Chairman), Max M. Schiffer, Edwin H. Spanier, and Gail S. Young, Jr.

Each recipient was invited to respond to the award on its presentation at the Prize Session in Toronto. The text which follows reproduces the Committee's citations, the recipients' responses, and brief biographical sketches.

Lars V. Ahlfors

Citation. Lars V. Ahlfors is awarded a Steele Prize in the expository category for three of his books: *Complex analysis* (McGraw-Hill Book Company, New York, 1953) which, though quite elementary, has strongly influenced the style and teaching of complex analysis and is a masterpiece of lucid, clear and original exposition; and his two more advanced books *Lectures on quasiconformal mappings* (D. Van Nostrand Co., Inc., New York, 1966) and *Conformal invariants* (McGraw-Hill Book Company, New York, 1973). The latter, although brief, are beautifully written and cover a wealth of material.

Response. I am very proud to have received a Steele Prize, proud, above all, because it is a prize not for mathematics alone, but also for mathematical exposition. I have always been interested in teaching, and writing my first textbook was a real challenge. My *Complex analysis* has been successful, and I ascribe its success to the fact that it was the right book at the right time.

Personally, I learned my analysis from two great teachers, Ernst Lindelöf and Rolf Nevanlinna. My

book owes very much to Lindelöf who educated himself in the French tradition and who made me read the classical French treatises on analysis. I found them fascinating, but written in a language which was more literary than exact and quite unsuitable for young American students. By the time I wrote my book Bourbaki had already revolted against the old style, but I was by no means willing to bourbakize something as pretty as functions of a complex variable. The result was a compromise that made use of modern terminology only to the extent that it was already stabilized.

The other two books mentioned in the citation are quite different in that they are not primarily textbooks. The one on quasiconformal mappings is not only out of print, even the publishing company no longer exists in its original form. Those who are lucky enough to own a copy, should hold on to it. It is on the way to becoming a rare book.

The book on conformal invariants originated as a summer course at Oklahoma A&M. I was later persuaded to revise it and expand it to a short book. It would be all right, but unfortunately there are many misprints that make it hard to read. I don't want to blame the printers, but I wish I knew a way to make sure that the last corrected proof coincides with the printed version.

Let me end by thanking the Society for rewarding me for work that gave me great pleasure when it was in the making.

Biographical Sketch

Lars V. Ahlfors was born on April 18, 1907, in Helsinki, Finland. He received a Ph.D. from the University of Helsinki in 1930. He also holds the honorary degrees of A.M. (Harvard University, 1938), LL.D. (Boston College, 1951), Dr.Phil. (University of Zürich, 1977), and Sc.D. (University of London, 1978). He was adjunct in mathematics at the University of Helsinki from 1933 to 1936. He became assistant professor at Harvard University in 1936, then returned to the University of Helsinki as a professor in 1938. From 1945 to 1946 he was professor at the University of Zürich. Since 1946 he has been professor of mathematics at Harvard University. He was a Rockefeller Foundation Fellow in Paris in 1932.

Professor Ahlfors was member-at-large of the Council of the AMS from 1952 to 1954 and vice president of the Society in 1954 and 1955. He served on the *Transactions* Editorial Committee (1950 to 1955), the Committee to Select Gibbs Lecturers for 1952 and 1953, the Committee to Select Hour Speakers for Annual and Summer Meetings (1963-1964), and the Committees to Select the Winner of the Bôcher Prize for 1948, 1953, 1969 and 1970 (Chairman). He has also been AMS Representative to the Editorial Board of *Annals of Mathematics* (1958-1960).

Professor Ahlfors gave an invited address at the Annual Meeting of the Society in New York (December 1949) and 60-minute addresses at the

1962 International Congress of Mathematicians in Stockholm and the 1978 International Congress of Mathematicians in Helsinki. He has also spoken at a Special Session on Quasiconformal Mappings (Chicago, April 1968).

Professor Ahlfors received the Fields Medal in 1936 and the Wolf Foundation Prize in 1981. He is a member of the National Academy of Sciences, the Finnish Academy of Sciences, the Danish Royal Society, and the Swedish Royal Society. His major areas of research interest include theory of functions of a complex variable, conformal and quasiconformal mappings, and Riemann surfaces.

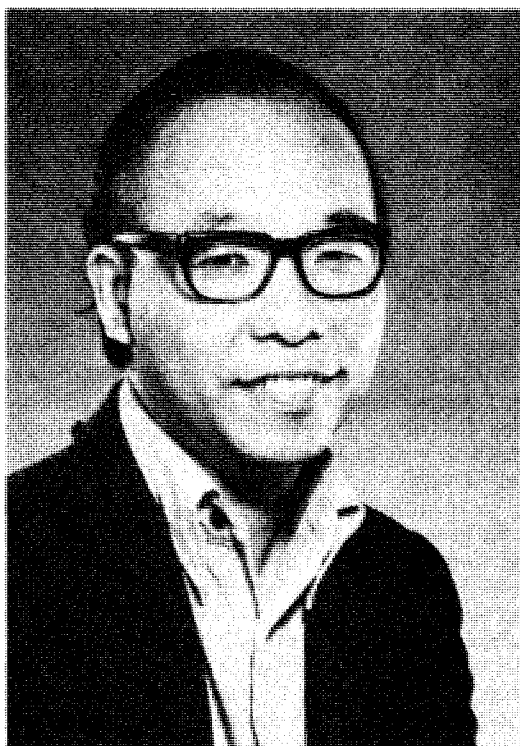
Tsit-Yuen Lam

Citation. In the five works listed below, Lam has given first rate expositions of the theory of quadratic forms, the solution of Serre's problem, and the modern theory of formally real fields. The current very active state of these areas is in no small measure due to Lam's writing. The five works are:

Algebraic theory of quadratic forms, Benjamin, 1973.

(Jointly with Man Keung Siu) *K_0 and K_1 — an introduction to algebraic K -theory*, American Mathematical Monthly 82 (1975), pages 329 to 364.

Ten lectures on quadratic forms over fields, Queen's Papers in Pure and Applied Mathematics, Number 46, Kingston, Ontario, 1977.



Tsit-Yuen Lam

Serre's conjecture, Lecture Notes in Mathematics, volume 635, Springer-Verlag, 1978.

The theory of ordered fields, Ring Theory and Algebra III, Lecture Notes in Pure and Applied Mathematics, Dekker, 1980.

Response. When I was in graduate school, I could not have dreamed that I would some day become a mathematical author. Yet, no later than five years into my professional career, I succumbed to the temptation of writing a book. Moreover, much to my chagrin, I found that this temptation, like other more earthly temptations, is decidedly of a recurring nature: now fifteen years into my career, I "logged in" at two books and three expository articles. In more sober moments, this leaves me wondering if I might not have overdone myself in the area of expository writing. The Steele Prize came as a surprise, but, more importantly, it also came as a great reassurance to me, from fellow mathematicians, that expository writing is indeed an effective means of stimulating research, and that, as such, it deserves to be reckoned as an integral part of our mathematical culture.

The five works cited for the prize award dealt with several different, but closely interrelated, subject matters, namely, the algebraic theory of quadratic forms, the theory of ordered fields, the solution of Serre's Conjecture, and classical algebraic K -theory. In accordance with the tradition of the Steele Prize award, I would like to take this opportunity to reminisce on some of the circumstances under which these works came into existence.

The algebraic theory of quadratic forms deals with the behavior of quadratic forms over arbitrary fields. Though this theory (in characteristic not 2) had already taken root in Witt's paper in 1937, the modern phase of its development began only in the late 60s with Pfister's penetrating work on the structure of the Witt ring. After reading Pfister's papers, and subsequently Milnor's paper relating quadratic form theory to his K -theory of fields, the great beauty and enormous potential of this area of investigation suddenly became clear to me. I began my own work in this area in the early 70s jointly with my talented student R. Elman, and it was in this period that I wrote my Benjamin notes on quadratic forms. This was my first expository work, so naturally I always tend to look at it with a degree of fondness and satisfaction.

A small dosage of the theory of ordered fields was in my Benjamin book, where it occupied one or two chapters, and was used primarily as a tool for studying quadratic forms. In the 70s, it gradually became clear that one may very well make the study of ordered fields an end in itself, in which case one can turn the table and use the theory of quadratic forms as a tool for studying ordered fields. This philosophy quickly led to the discovery of a plethora of new phenomena for formally real fields, including the now basic

notions of SAP fields, superpythagorean fields, and the intimate connections between orderings and valuations. While this study clearly has its origins in the classical work of Artin-Schreier, Krull and Lang, the recent beautiful developments have, in my opinion, opened a modern chapter in field theory, with potentially very important applications to real algebraic geometry. It was with much pleasure and personal satisfaction that I reported on the status of this area of study in my survey article mentioned in the citation.

As for the other works, my interest in classical algebraic K -theory and its applications to Serre's Problem dates back to the time when I wrote my doctoral dissertation. In these areas, everything I know was essentially taught to me by my teacher H. Bass. Like many a graduate student of my time, I had tried to work on Serre's Problem, but of course totally without success. In 1976, the spectacular solutions of this Problem found independently by Quillen and Suslin came to me as a great revelation. In their work, I was able to observe how a mathematician with deep insight can see through some of the key points in a problem which all previous workers had managed to ignore, and thereby obtained an elegant, but nevertheless direct, solution to a long-standing problem. I suppose I was not alone in having marvelled at the simplicity of the Quillen/Suslin solutions of Serre's Problem. In view of this, we would be remiss if we did not also make a serious attempt to understand the deeper historical currents which underlay these deceptively simple solutions. In my Springer Lecture Notes, I tried to give an account of Serre's Problem from a historical perspective, paying special attention to the sequence of mathematical developments which was inspired by this Problem, and which ultimately led to its full solution. This was a challenging exercise in mathematical exposition, but, to my great delight, it materialized into a wonderful and very rewarding learning experience.

I would like to thank M. K. Siu for his share of contributions to our joint article in the citation, and I thank Alex Rosenberg for suggesting that this article be written. My Kingston Notes on quadratic forms owed their existence to Grace Orzech and Paulo Ribenboim, and the survey article on ordered fields owed its existence to Bernie McDonald. (I plead guilty to my two books which I wrote of my own accord.) To all of these colleagues, my sincere thanks. Last but not least, I should like to record my great indebtedness to the many mathematicians from whose work my various expositions have drawn. Clearly, mathematical expositions can only thrive on good mathematics. As I read over my own expositions, it is evident that what I owe far surpasses what I can give. Therefore, while I am happy beyond words to receive the Steele Prize, I hope it is understood that the honor being conferred is at least equally shared by all the mathematicians whose work has made my expositions possible. In

conclusion, I would simply like to express my deep gratitude to the American Mathematical Society for this wonderful award.

Biographical Sketch

Tsit-Yuen Lam was born on February 6, 1942, in Hong Kong. He received a B.A. from the University of Hong Kong in 1963 and a Ph.D. from Columbia University in 1967. He was a fellow in mathematics at the University of Illinois, Urbana in the summer of 1967, and instructor at the University of Chicago in 1967-1968. He joined the faculty of the University of California, Berkeley as a lecturer in 1968, was assistant professor from 1969 to 1972, associate professor from 1972 to 1976, and was promoted to professor in 1976. Since 1975 he has twice been vice chairman of the department of mathematics. He was an Alfred P. Sloan Foundation Fellow from 1972 to 1974, and was a Miller Research Professor at Berkeley in 1978-1979. Currently he is a John Simon Guggenheim Foundation Fellow.

Professor Lam was a member of the AMS Committee on Translations from Chinese (Chairman, 1980 to 1982) and of the AMS-MAA Arrangements Committee for the San Francisco Meeting (January 1981). He gave addresses at the Symposium on Representation Theory of Finite Groups (Madison, April 1970) and in the Special Session on Quadratic Forms (Hawaii, March 1979). In August 1981, he was Principal Lecturer at an NSF Regional Conference at Carleton College in Northfield, Minnesota. He gave two Karcher Lectures in the Ring Theory and Algebra Conference at the University of Oklahoma in 1979, and was appointed Porcelli Lecturer at Louisiana State University in 1982.

Professor Lam's current research interests are field theory and quadratic forms. He is married and has three daughters.

John W. Milnor

Citation. The award for a paper "which has proved to be of fundamental or lasting importance in its field, or a model of important research" is made to John Milnor for his paper *On manifolds homeomorphic to the 7-sphere*, *Annals of Mathematics* (2) **64** (1956), pages 399 to 405, in which he exhibited a differentiable 7-manifold homeomorphic to the seven sphere but not diffeomorphic to it. This was the first example of two differentiable manifolds which are homeomorphic but not diffeomorphic.

Biographical Sketch

John Milnor was born February 20, 1931, in Orange, New Jersey. He was educated at Princeton University (A.B., 1951, and Ph.D., 1954) and remained at Princeton until 1967, first as Higgins Lecturer (1954-1955), then assistant professor, associate professor and professor of mathematics (1955 to 1962). In 1962 he became Henry Putnam University Professor, and he served as chairman of the department of mathematics from 1963 to 1966.

From 1968 to 1970 he was professor of mathematics at the Massachusetts Institute of Technology. Since 1970 he has been professor of mathematics at the Institute for Advanced Study. Professor Milnor held an Alfred P. Sloan Foundation Fellowship from 1955 to 1959. He was visiting professor at the University of California, Berkeley in 1959-1960, and visiting professor at the University of California, Los Angeles in 1967-1968.

Professor Milnor served as member-at-large of the Council of the AMS from 1964 to 1966, and as vice president from 1975 to 1977. He has been a member of the Nominating Committee for the 1967 Election, the Committee to Select Hour Speakers for Summer and Annual Meetings (1969-1970), the Committee on Steele Prizes (1970 to 1972), the Committee on National Awards and Public Representation (1972 to 1977), the Committee on Legal Aid (1975), the Committee to Select the Winner of the Veblen Prize (chairman) (1976), the Committee on Prizes (1977 to 1982), the *Colloquium* Editorial Committee (1979 to 1984, Chairman 1982), and served as an Associate Editor for Research Expository Articles in the *Bulletin* (1980 to 1982).

Professor Milnor gave a 30-minute address at the 1958 International Congress of Mathematicians in Edinburgh and a 60-minute address at the 1962 International Congress in Stockholm. He gave an invited address at the April 1959 meeting in New York. He has spoken at the AMS Symposia on Differential Geometry (Tucson, February 1960), on Mathematical Developments Arising from the Hilbert Problems (DeKalb, Illinois, May 1974), and on the Mathematical Heritage of Henri Poincaré (Bloomington, April 1980), and also at the Special Session on Differential Topology (Annual Meeting, Denver, January 1965) and the Summer Research Institute on Differential Geometry (Stanford, July 1973). He delivered the Colloquium Lectures at the Summer Meeting in Madison, Wisconsin, in August 1968.

Professor Milnor was awarded the Fields Medal in 1962 and the National Medal of Science in 1966. He is a member of the National Academy of Sciences and was a representative to the United States National Committee for Mathematics in 1972-1973. His major area of research interest is topology of manifolds.

Fritz John

Citation. The award "for the cumulative influence of the total mathematical work of the recipient, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students" is presented to Fritz John, whose work has had an enormous influence in many fields: (1) His significant and influential paper on convexity and inequalities, (2) Beautiful important work on ill-posed problems, (3) Difference schemes for parabolic problems that influenced all the subsequent work, (4) Fundamental, deep, work

in elasticity theory—justifying linear approximations to the nonlinear equations, (5) Mappings close to isometries, coming from elasticity theory, and which led to his definition of bounded mean oscillation, (6) Nonlinear hyperbolic problems, blow-up of solutions, or non-blow-up for large time—a series of beautiful papers.

Response. I am highly honored by this award of a Steele Prize by the American Mathematical Society. I just want to make a remark of a more personal nature about my work. The science of mathematics depends for its growth on the flow of information between its practitioners. The joy of discovering new results ought to be matched by the joy in studying the achievements of others. Unfortunately this latter enjoyment is made difficult by the overwhelming volume of mathematical output and the work involved in absorbing the content of even a single paper. Every mathematician has to compromise on the amount of energy he can devote to literature. I myself have been irresistably attracted to mathematical research almost since my childhood, but always was loath to spend the time needed to keep up with developments. This has severely limited my work. Fortunately there was a compensating factor. I was able to spend most of my mathematical life in the stimulating atmosphere of the Courant Institute of Mathematical Sciences at New York University, where I could draw freely on the knowledge and experience of my colleagues.

Biographical Sketch

Fritz John is professor emeritus of mathematics at the Courant Institute of Mathematical Sciences of New York University. He was born June 14, 1910, in Berlin, Germany, and received his Ph.D. in 1933 from the University of Göttingen.

In 1934-1935 he was a research scholar at Cambridge University. In 1935 he became assistant professor at the University of Kentucky, where he was promoted to the rank of associate professor in 1942. He then served as a mathematician for the U.S. War Department from 1943 to 1945 at the Ballistic Research Laboratory at Aberdeen Proving Ground. He became associate professor at New York University in 1946, professor in 1951, and held the Courant Chair at the Courant Institute of Mathematical Sciences at New York University for three years prior to retiring as professor emeritus in 1981. He held a Rockefeller Foundation Fellowship in 1942, a Fulbright Lectureship in 1955, and Guggenheim travel grants in 1963 and 1970. He was a Sherman Fairchild Distinguished Scholar at the California Institute of Technology in 1979 and a Senior U.S. Scientist Humboldt awardee in 1980. In 1950-1951 he served as director of research for the Institute of Numerical Analysis of the National Bureau of Standards.



Fritz John

Professor John has been a member of the *Proceedings* Editorial Committee (1962 to 1966) and the Committee to Select Hour Speakers for Eastern Sectional Meetings (1968-1969). He was an editor of *Communications on Pure and Applied Mathematics* (1966 to 1981), and a co-editor of *Mathematische Annalen* (1968 and 1979).

He gave an invited hour address at the April 1956 meeting of the Society in New York and a 30-minute address at the 1966 International Congress of Mathematicians in Moscow. He has also spoken at Symposia on Special Topics in Applied Mathematics (Evanston, Illinois, January 1953), on Partial Differential Equations (Berkeley, California, April 1960), and on Applications of Nonlinear Partial Differential Equations (New York, April 1964). He delivered the Gibbs Lecture at the Annual Meeting of the Society in Washington, D.C., January 1975.

Professor John was awarded the George David Birkhoff Prize in Applied Mathematics in 1973 (this prize is awarded jointly by the AMS and SIAM). He is a member of the National Academy of Sciences, the Deutsche Akademie der Naturforscher Leopoldina, the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. His major areas of research interest are partial differential equations, nonlinear elasticity, analysis, and geometry.

Mathematics and Mathematicians in World War II

J. Barkley Rosser

Mathematics Research Center, University of Wisconsin, Madison

What is mathematics? I take the entirely pragmatic view that if a person's associates thought the problem he or she was solving was a mathematical problem, then it was. Many of you will disagree with this. Indeed, many of the mathematicians involved in such enterprises during the War privately did not accept this definition. The attitude of many with the problems they were asked to solve was that the given problem was not *really* mathematics but, since an answer was needed urgently and quickly, they got on with it.

And there was another aspect. Problems that purported to require mathematical treatment were often not clearly formulated. A discussion between the person with the problem and a mathematician could result in a major reformulation. This usually resulted in a simplification. I shall count this also as mathematics.

Somewhat between these two types is a case which I shall cite. An aerial survey was made of the environs of Ft. Monroe, Virginia, from which a scaled image of the ground was to be prepared. What appears on the film is not a scaled image of the ground unless the camera is pointing exactly straight down, which it seldom is. A standard textbook of the time, written by an engineer, described a method for solving the "resection problem," namely computing a genuine scaled image of the ground from the aerial photographs. This was a tedious method of successive approximations, that could become ill-conditioned or even diverge. This method was in use when Marston Morse happened to visit Ft. Monroe. He pointed out that the print on the film is a projection of the ground. So here was a problem in solid projective geometry. Since a projective transformation is described by a quotient of two linear forms, one can get the solution of the "resection problem" *exactly* in

This article presents the text of Professor Rosser's address given at the Toronto meeting during the first segment of the AMS-MAA Joint Session on the History of Mathematics. The other address given that afternoon, *Homotopy theory: the first twenty-five years* by George W. Whitehead, will appear in the January 1983 issue of the *Bulletin*. The text of Jean Dieudonné's lecture on Bourbaki given in the second segment of the Joint Session will appear in the November issue of the *Notices*.

only *one* step by solving an appropriate set of simultaneous linear equations.

Few people, even among the mathematicians, realize what a towering structure the mathematical edifice is. The majority of people are decidedly non-mathematical, and indeed have no notion what mathematics is all about. For them, a mathematician is a person who is good at adding up bridge scores. However, even among non-professional mathematicians, there can be found various people who have mathematical capabilities to some degree. Engineers usually are fairly competent in calculus, some going beyond that a way. Theoretical physicists usually know a lot more, anywhere from the equivalent of an undergraduate major up to very comprehensive knowledge of mathematics and outstanding talent therein. Strangely, many mathematicians seem afflicted with a snobbishness that leads them to classify anything below the level of their current research as not *really* mathematics. This is very common, although it is obviously preposterous, as I now show by an example. Take the content of a junior year course in mathematics. It certainly is not chemistry, or animal husbandry, or high fashion. It is genuinely mathematics, and nothing else but.

Except in cryptanalysis, hardly any of the mathematics done for the War effort was of a higher level than this, and much was at lower levels. As I said, some did not go beyond getting the problem properly formulated. Although we had a six-day week during the War, several *hundred* mathematicians spent two to three years working diligently at such problems. Mathematically, this was not very satisfying. However, answers to these problems were crucial to the progress of the War. Without a person with competence to supply an answer by mathematics, the person with the problem would have had to resort to some scheme of experimental trial and error. This could be very expensive. Worse still, it could be very time-consuming, and everybody wished to get the War over as quickly as possible. So, though mathematicians turned up their noses at most of the problems brought to them, they did so privately, and labored enthusiastically to produce answers.

I have written to practically every mathematician still living who did mathematics for the War effort (there are still close to two hundred)

and I asked for an account of their mathematical activities during the War. Many did not answer. And many who answered said they did not really do any mathematics. I had a one-sentence answer from a man who said that he did not do a thing that was publishable. If we equate being mathematics to being publishable, then indeed very little mathematics was done for the War effort. But, without the unpublishable answers supplied by several hundred mathematicians over a period of two or three years, the War would have cost a great deal more and would have lasted appreciably longer.

I worked for three years during the War with a group that was charged with developing and producing rockets. I had a co-worker, R. B. Kershner, who was a very able mathematician. We were responsible for getting answers to the problems that arose that seemed too mathematical for the other people in the group. After a while some younger mathematicians were hired to help us. Kershner insisted to his dying day (which was fairly recent) that he never did an iota of mathematics during the War. True enough, the problems were mostly very pedestrian stuff, as mathematics. I was never required to appeal to the Gödel incompleteness theorem, or use the ergodic theorem, or any other key results in that league. One time the tedium was relieved when I had to do something with orthogonal polynomials, and I was glad to get out the Szegő tome [26] and bone up a bit. But mostly I was working out how fast our rockets would go, and where. On a good day, some problem would be up to the level of a junior course in mathematics.

Is OR (operations research) mathematics? Nowadays, the practitioners insist that it is a separate discipline, and I guess by now it is. It is certainly not now taught in departments of mathematics. But, it grew out of mathematics. At the beginning of OR, during the War, it was mathematics according to my definition above, although some of the very good operators were physicists and chemists. The Air Force Generals and Navy Admirals thought it was wonderful stuff. You could not have convinced one of them that it was not mathematics. Indeed, the Generals made special arrangements with the Applied Mathematics Group (AMG) at Columbia to recruit more mathematicians, teach them OR, and send them out to the field. There, though they remained civilians, they were attached directly to combat units.

I bring this up because I wish to give special attention to the steps taken to help bombers defend themselves against German fighter aircraft (and later Japanese). This was a very important endeavor because when Britain first tried sending fleets of bombers against German targets, the German fighters would sometimes shoot down more than half of a fleet of bombers on one sortie.

I first summarize a report by Edwin Hewitt [10]. He was in an OR group attached to the

Eighth Bomber Command. Hewitt has worked in topology, measure theory, functional analysis, and harmonic analysis. So he is a highly qualified mathematician. Of course, he was not so well qualified during the War, but it did not matter because none of those specialties would have been of any use for the mathematical problems that he had to solve for his OR duties.

For defense, the B-17 bomber had about a dozen machine guns, and gunners, aboard. Later bombers had considerably more. The theory was that if a German fighter appeared, all gunners on that side of the bomber would start shooting at it. It was hoped that such a concentration of firepower would finish off the fighter quite promptly. But it did not work that way at first.

The British had OR before we got there, and had found what the trouble was. When a person on the ground shoots at a bird in flight, he aims in front of where the bird is at the time he pulls the trigger, hoping that by the time the bullet gets up there the bird will have advanced to the point he aimed at. So, the gunners manning the machine guns in the bombers were all aiming ahead of the attacking fighters. Because the bombers were flying at high speed, that was the wrong place to aim. To show this is utterly trivial, merely a matter of vector addition. But it must have been mathematics. At least, none of the generals, colonels, majors, etc., had thought of it. To figure out where you should have aimed was harder, though Kershner (and I fear many in the audience) would scorn to call it mathematics either. Just look up the ballistics of machine gun bullets, and then any mathematician can do it without much trouble. But the gunners could not be expected to.

To help the gunners aim right, the following scheme had been adopted. The window through which a gunner looks was divided into zones. If a gunner sees a fighter through a particular zone, he is supposed to aim a certain amount off from where he sees the fighter, the distance off and direction depending on which zone he sees the fighter through. These distances and directions were printed on mimeographed "poop sheets," and were supposed to be memorized by the gunner.

This system had been adopted by the British. When the Americans got their bombers into the combat area, they adopted it too. In fact, near the end of the War, I visited a Texas airfield where a similar system for aiming rockets from a plane was being taught.

Of course, the zones for one type of bomber have to be different from those of another type. Hewitt undertook the calculations for both the B-17 and the B-24. Not only did the zones have to be devised, but the instructions on the "poop sheet" for where to fire for each zone had to be calculated. Although these calculations were absolutely indispensable and crucial, it turned

out that a major part of Hewitt's duties was lecturing to the newly arriving Americans on how to use the "poop sheet" and emphasizing the overriding importance of learning what was on it. In arranging these lectures, and many other matters, Hewitt was much helped by the head of his group. This was a lawyer named John M. Harlan. He could not provide any mathematical assistance at all, but he later became a Justice of the Supreme Court, and was very well qualified at arranging things.

This zone system improved the situation quite a bit, but was obviously far from perfect. So the people in the Applied Mathematics Group (AMG) at Columbia tried to think of something better.

I shall cite details sent me by Daniel Zelinsky [32]. He was an algebraist, and after the War did a thesis under A. A. Albert on the arithmetic of some nonassociative algebras. None of this training helped him specifically in calculating where to aim machine guns from bombers.

The sights on the guns were just fixed reticules aligned in the direction of the gun barrel. For a start, one sight was made movable, and a simple linkage attached. The inputs to the linkage were the speed of the bomber (set manually after reading a dial installed in the bomber) and the angle between the gun and the axis of the bomber (set mechanically as part of the linkage). The linkage then was supposed to move the reticule so that if you look through the reticule and see the fighter, the gun is aimed (approximately) correctly. Zelinsky says it didn't take any real mathematical talent to figure how to put that linkage together. I will not say it did, but somebody had to use something resembling mathematics somewhere in the process.

Zelinsky doesn't know if the linkage ever got to the battle front. At the end of the War, they were getting around to moving the reticule by an elementary analog computer. Zelinsky says the design of this made for more interesting mathematics.

Let us look at a third attempt to help the gunners aim correctly. An outfit called the Jam Handy Organization constructed movie films depicting what the gunner would see, and where he should aim. The prospective gunner would study these films enough times to learn to aim correctly.

To simulate the fighter, they had a small scale replica. A movable camera would take still pictures of this. The camera and replica were repositioned between each picture so that when the pictures were run through in sequence a movie was produced showing the fighter in action.

To calculate where the camera and replica should be for each picture is not merely an application of spherical trigonometry. If the fighter was in a turn, you needed differential equations and elementary differential geometry to tell where it would be heading, and at what

inclination. And then, of course, you had to calculate where the gunner should be aiming, and mark it on each picture.

Regardless of how simple Kershner or some of the more snobbish mathematicians might think this to be, the Jam Handy Organization thought they had better hire two mathematicians. They were William M. Borgman and Edwin W. Paxson. These belong to an earlier generation, and are probably not known to most of the audience. However, they were very capable mathematicians, and accustomed to much more sophisticated problems. Naturally, they knocked off the Jam Handy problems in a breeze. Indeed, they wrote comprehensive reports on how to solve them, with formulas for the key quantities, and all that. These reports are still on file at the Jam Handy Organization [12], in case they should ever have to do a similar enterprise. At the time, they were classified SECRET, and there has never been a question of publishing them.

On page 613 of [21] are described some studies made by the Applied Mathematics Panel of the defense of B-29s against fighters. I do not know the extent to which these studies were affected by, or integrated with, any of the three projects I have just described. Wartime security greatly hampered intercommunication of results.

I might point out that the Navy similarly had OR groups helping them with anti-submarine tactics, and other matters. See [19]. Here, at least for airplanes attacking submarines, the problem was not one of defense of the plane, but of tactics. Incidentally, for the OR groups attached to bomber outfits, a very important consideration was tactics. OR could tell the best number of planes to send against a target, the best spacing for dropping the bombs, and such [20]. This could make very considerable differences in the effectiveness of bombing.

I had better leave the details of bombing, and get to the general picture. Not only do we have to decide what mathematics is, but what time span we should cover, and what nations to consider. We really have to start in the thirties, and run until about the mid fifties, when OR and computer science actually separated off from mathematics proper. We restrict attention to the USA effort.

The services have contrived to keep going similar types of support since the War. The RAND Corporation and the Center for Naval Analyses receive all sorts of problems directly from the services, to which they try to give answers. Congress was persuaded to pass a special act authorizing the services to support basic research. They now maintain the Office of Naval Research, the Army Research Office at Durham, and the Air Force Office of Scientific Research, under which they give grants to universities, and that sort of thing.

Very importantly, modern computers did not really get into action until the War was over. For

several years after the War, the military poured a lot of money into computer development. At first, the software for this was largely in the hands of mathematicians, but gradually computer science evolved as a separate discipline.

Before the War, Hitler made things so unpleasant for the Jews that many left. Although the USA was in a depression, perhaps 150 very good mathematicians were able to find support in the USA during the thirties. See [5] and [22]. This was quite a help, as the demand for mathematicians ran very high during the War. An incidental result was the founding of *Mathematical Reviews*, just before the War.

Early in the thirties, the WPA, to help relieve unemployment, set up a project to compute mathematical tables [16]. This employed a number of mathematicians. As the War came nearer, and then during the War, the need for computations increased, so that the project grew, and was eventually taken over by the National Bureau of Standards. Finally, after the War, when large computers appeared in some numbers, the project became obsolete, and was discontinued.

By about two years before the War, preparations were being made for our entry. A broad overall description of the scientific activities during the War can be found in [2]. It scarcely mentions any mathematical activity.

A reason for this is that, except in cryptanalysis, which is still cloaked in secrecy, there was not any sensational breakthrough in mathematics comparable to the atomic bomb in physics, or radar, or the proximity fuze. Although mathematics pervaded all the scientific studies, and was often indispensable for progress, the problems, considered as mathematics, were seldom very formidable. As we noted earlier, most could have been solved by theoretical physicists, and many by smart engineers. But theoretical physicists and smart engineers were even more critically needed for many other things. So some hundreds of mathematicians were pressed into service, mostly on leave from their schools. Reasonable, though sketchy, accounts of the mathematical activities can be found in [21] and [30]; the latter is primarily an account of statistical activities. As far as that goes, the present account is more sketchy than complete.

Actually, the most sensational achievements of mathematics during the War were probably in ciphers and code breaking. This is still heavily covered with secrecy, and little can be told. [13] tells a lot, but doesn't really get to the heart of the matter. One incident has been publicized in [15]. A cryptanalytic breakthrough enabled the USA to win a major naval battle at Midway Island. The Japanese later pinpointed this as the turning point of the naval war between Japan and the USA [6]. Note the title of [6]. The British have relaxed the secrecy on their work with ciphers and the like. A flood of books has appeared, each "telling all." You could start with [31] and [14].

With hundreds of mathematicians on leave from their schools to work on military-related problems, the schools were in short supply, even with the 150 or so mathematicians who had immigrated from Germany. Of course, enrollments were way down, with most men being drafted. However, because of the high technology of the War, the military wished special mathematical training for many in the services. This seldom went above algebra and trigonometry, but the schools were hard pressed to supply the needed teaching. During the War, I heard that Agnew, then chairman at Cornell, was seen one Saturday afternoon at the intersection of the two main streets of Ithaca, accosting passersby. He would ask, "Do you know the difference between algebra and trigonometry?" If the answer was "Yes", he said, "You're hired." Agnew says he did not really do this, but he was tempted. However, he scrounged around, and found faculty members, say from the music department, or wives of such, who, on a whim, had taken calculus and so could teach algebra or trigonometry. Thereby, he managed to get all his classes taught. See [33].

How did those hundreds of mathematicians get dispersed into all sorts of wartime activities? During World War I, Aberdeen Proving Ground had chanced to hire a number of mathematicians and had found them very helpful. Hence, as World War II came near, they got Oswald Veblen to join the staff, primarily to recruit mathematicians. Altogether, they got somewhere over twenty, plus assorted astronomers, physicists, and what have you. This collection of talent more or less rewrote the science of gun ballistics. [17] pretty much covers what evolved.

The Office of the Chief of Ordnance enlisted Marston Morse, who did a similar thing on a much smaller scale with OCO. They had considerable rivalry with Aberdeen, but managed to cooperate sufficiently that they were somewhat helpful to each other. With the tight security there was during the War, such cooperation was not easy.

If you think this does not sound very systematic, you are right. Before the War, there was set up the NDRC (National Defense Research Committee). It had divisions devoted to research in various areas; there was not one for mathematics, nor was there any provision for getting mathematicians into any of the divisions. Later, an umbrella was thrown over NDRC, namely OSRD (Office of Scientific Research and Development), but still no provision for mathematics.

I got into Division 3 of NDRC, devoted to rockets, because a chemist friend of mine told them I might be of some use. They interviewed me and offered me a job, which I took. I wrote [24] and [25], mostly while there, but published afterward. That steered me into computer software. There I could use my early training in symbolic logic and I am still involved. I also consulted on rocket work, up to helping with the Apollo (man on the

moon) Project. My training as a logician did not help with rocketry.

Other divisions of NDRC acquired mathematicians in a similarly haphazard way. Some never did.

The Naval Research Laboratory, Frankford Arsenal, and various other outfits, did like Aberdeen and OCO, and recruited on their own. Commercial outfits did likewise.

Finally, in spite of considerable opposition from somebody high in NDRC, it was decided that NDRC would establish an Applied Mathematics Panel (AMP) [1]. This was fragmented all over the place, but mostly at universities through contracts with AMP. There were Applied Mathematics Groups, Statistics Research Groups, at least one Bombing Research Group (BRG), and I don't know what else.

The theory was that the various Groups of the AMP would recruit able mathematicians. People in the military with mathematical problems would submit them to AMP, which would assign them to the appropriate Group. But there were deviations from this. Stewart Cairns was reassigned from the BRG individually as consultant to the Army Air Forces Board in Orlando, Florida. There he remained as the only mathematician throughout most of the War. A special letter from General Eubank commended him for his help. And recall that the AMG at Columbia was asked to recruit mathematicians and train them in OR for assignment to the Air Force.

However, there is no question that AMP recruited a lot of mathematicians and solved a lot of problems. The collection of their reports, in the National Archives, takes up 45 feet of shelf space.

There were various special cases. Some were cases in which a mathematician either enlisted or was drafted. When his talents were found out, he was usually transferred to a suitable laboratory. S. C. Kleene and J. H. Curtiss are examples. The Bureau of Ordnance happened already to have a mathematics division under R. S. Burington when the War broke out. It was simply expanded. See also [7] for another case.

During the War, Bell Aircraft Corporation developed the first airplane to exceed the speed of sound. It was much helped in this by a group of seven mathematicians. Maybe one or two were primarily aerodynamicists, and all became fairly competent at aerodynamics before the War ended. They were William H. Pell, Wilhelm S. Ericksen, John Giese, Paco Lagerstrom, V. M. Morkovin, Wilbur L. Mitchell, and John van Lonkhuyzen. They seemed to work as a team in a way that is not too common among mathematicians.

While we are on the subject of aircraft, you might note [23].

As recounted in [30], admonitions and training by statisticians resulted in significant improvements in the quality of manufactured goods.

The War produced a big surge in numerical analysis. Everybody wished to have numbers. All existing texts were carefully studied, and people began to invent new methods. There began to be great pressure to build mechanical calculators which would be faster than the desk-top models which had been in existence for many years. Incidentally, in the thirties Vannevar Bush invented the analog computer, which was very good for many types of problems. For a while, analog computers were much in vogue. Two were installed at Aberdeen during the War to help with computation of ballistic tables.

A start on the development of digital computers was made as early as 1937 by Stibitz at Bell Laboratories, using phone relays. Some of his later models were actually used in War-related problems. See the essay by Stibitz in [18].

George David Birkhoff appreciated the role that computing might have, and by using a bequest that Harvard had and a lot of help from IBM, he financed the construction of a large calculator, MARK I, at Harvard by Howard Aiken, which was dedicated in 1944. The Navy was much impressed by this calculator, and ordered three more improved models for installation at Naval laboratories. A very few details are given in the essay by Garrett Birkhoff in [18].

However, it is the electronic digital computer which has utterly transcended all these early attempts. In 1935, Alan Turing described how to build a computing machine, the so-called "Turing machine." John von Neumann got into the act with proposals for how to go about building such a machine using electronic components. At that point, electronics had not quite evolved enough to build one, but the Army poured money into electronic development. See two essays, one by Eckert and one by Mauchly in [18]. Finally, just about at the end of the War, the ENIAC was completed and installed at Aberdeen, to compute firing tables. This was not quite a "Turing machine," because the computer could not change the instructions for a program. However, by 1950 the very first "Turing machines" appeared in the USA. About that time, with the influence of Turing, the English managed to complete one. John von Neumann finally managed to get his operating in 1952. See [8] and [18].

At first, the people who knew enough to operate the computers were mostly mathematicians, preponderantly numerical analysts. As there got to be more computers, and the rules for software began to develop, there began to be computer scientists. Probably what marked the real beginning of computer science as a separate discipline was the realization that computers could be used for information manipulation and storage, and not solely as "number crunchers." By the mid fifties, computer science had broken off from mathematics proper. And now we have PAC-MAN!

In the development of the atomic bomb, there was such a concentration of distinguished physicists, many of them theoretical, that there was not much need to call for mathematicians [11]. However, there were a few mathematicians involved, specifically John von Neumann and Stan M. Ulam [28]. However, the atomic bomb was finished with very little help from professional mathematicians.

After a bit, work began on the hydrogen bomb. It was far harder to develop the hydrogen bomb than it had been for the atomic bomb. By 1949, a possible method of construction had been thought of. But, would it work? Ulam, with help from another mathematician, Cornelius Everett, undertook to find out by a hand computation. Others undertook to find out by computing on the ENIAC, then the fastest computer available. Ulam and Everett finished their hand calculations before answers were available from the ENIAC. They said it would not work. Of course, nobody believed them. But finally the ENIAC gave the same answer!

Teller, on page 272 of [27], says of Ulam's calculations: "In a real emergency the mathematician still wins—if he is really good."

After a while, a better idea for making a hydrogen bomb was thought of. Ulam's calculations showed that it should work. By now, a better computer than the ENIAC was available, the SEAC at the National Bureau of Standards. It confirmed Ulam. See page 273 of [27]. By the time the hydrogen bomb was actually built, a computer called the MANIAC had been built at Los Alamos and von Neumann had his computer at the Institute for Advanced Study in Princeton. They all got into the act. However, let us not forget that a human mathematician was able to beat an electronic computer two different times.

I have related a few points of how mathematicians affected the War effort. How did the War effort affect mathematicians? As I have related above, two new branches of the mathematical sciences, OR and computer science, grew out of mathematics proper in about ten years, and have now split off from mathematics proper.

How about changes in mathematics itself? In talking about acceptance tests, a Navy Captain asked the following. Suppose acceptance tests are to be performed on a hundred items chosen from a large shipment. If six items are defective, the shipment is to be rejected. The Captain pointed out that if six defectives turn up in the first fifty tests, there is no need to make the other fifty tests. He asked if it was not possible to make something like this part of the statistical theory? Starting from this suggestion, Abraham Wald worked out the theory of sequential analysis. See [29] and [30]. Not only did this greatly improve the conduct of acceptance tests, but there were many other useful consequences, so that it is now an important branch of statistics.

George B. Dantzig worked during the War as Chief of the Combat Analysis Branch of the Air Force. As military operations became more complex, planning became more difficult. At the end of the War, one program required seven months of study to be sure it did not contain contradictory instructions. After the War, the Air Force funded a study to try to improve planning methods. In 1947, Dantzig invented what is now called linear programming. See [4]. This is based on a generalization of the Leontief "input-output" matrix, and can cope with problems that were formerly almost intractable. The first test of linear programming was done by the old WPA computing group. It had not yet been dissolved, and was then at the National Bureau of Standards. It took 120 man days of calculation on desk calculators. With modern electronic "Turing machines," such a calculation requires a matter of minutes. As all large organizations have complex planning requirements, linear programming is now much used, and is an important technique in mathematics.

In order to be able to use the ENIAC efficiently after it was delivered to Aberdeen, I. J. Schoenberg invented a way of smoothing functions. This was based on a mathematical analysis of the shapes assumed by splines; splines were flexible strips which were forced into curves for designing the hulls of ships. Now known as "spline functions," generalizations of the theory of splines have assumed great importance in many branches of numerical analysis. See [3] and [9].

With the advent of the electronic calculator, numerical analysts now accomplish feats that could hardly have been imagined forty years ago. The solution to the four color problem, and verification that the first 170,000,000 zeros of the Riemann zeta function off the real axis have real part equal to 0.5 are particularly striking cases.

References

If the number of the document is followed by A, as 7.A, this means that a copy of the document is on file in the Archives of American Mathematics at the Humanities Research Center, P.O. Box 7219, The University of Texas, Austin, Texas 78712.

1. *Summary technical report*, Applied Mathematics Panel, NDRC, 1946. Deposited in National Archives. Volume 1. *Mathematical studies relating to military physical research*, edited by I. S. Sokolnikoff; Volume 2. *Analytical studies in aerial warfare*, edited by Mina Rees; Volume 3. *Probability and statistical studies in warfare analysis*, edited by S. S. Wilks. "Classification cancelled per memorandum, Acting Secretary of Defense, dated August 2, 1960."

These three volumes give the authors, titles, and identification numbers of all reports written by the members of the AMP. Not only are the three volumes in the National Archives, in NARS RG 227, but the reports as well, occupying 45 feet of shelf space.

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6. Mitsuo Fuchida and Masatake Okumiya, *Midway, the battle that doomed Japan*, copyrighted by the U.S. Naval Institute, Annapolis, 1955. A Japanese version of the Battle of Midway. A paperback edition was put out by Ballantine Books, 1958.
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11. R. G. Hewlett and O. E. Anderson, Jr., *A history of the U.S. Atomic Energy Commission*, volume 1, *The new world, 1939–1946*, volume 2, *Atomic shield, 1947–1952*, Pennsylvania State University Press, University Park, PA, 1962.
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17. E. J. McShane, J. L. Kelley, and F. V. Reno, *Exterior ballistics*, University of Denver Press, Denver, CO, 1953, xvi + 834 pages.
18. N. Metropolis, J. Howlett, and Gian-Carlo Rota, *A history of computing in the twentieth century*, Academic Press, New York, 1980.
19. Philip M. Morse, *In at the beginnings: A physicist's life*, MIT Press, Cambridge, MA, 1977, 375 pages plus many photographs. This book is an autobiography; there are chapters which describe Morse's war work.
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Queries

262. Randolph C. Rach (Electron Dynamics Division, Hughes Aircraft Company, P.O. Box 2999, Torrance, CA 90509). I would like references to solution techniques, and proofs of existence and uniqueness for systems of two second-order differential equations with four boundary conditions. Who is working on such problems?

263. R. Gurevič (Maurice Thorez, 33, apt. 205, Leningrad 194223, USSR). One of the routine mathematical incantations is "... we see that \mathcal{F} is a filter of subsets of S ; let \mathcal{U} be an ultrafilter containing \mathcal{F} ...", where \mathcal{F} is an explicitly defined set of sets, say, \mathcal{F} is defined by a set theoretic formula with parameters like "given a ring K " or "given topological space X ". The Axiom of Choice tells us that there are a lot of ultrafilters. However I have never seen a proof $\text{ZFC} \vdash (\mathcal{F} \text{ is a nonprincipal ultrafilter})$ with an explicitly defined \mathcal{F} . Instead I was always able to find a proof $\text{ZFC} \vdash (\mathcal{F} \text{ is not maximal})$ for any explicitly defined nonprincipal filter \mathcal{F} . Is there any theorem describing the situation?

Conjecture 1. For any set theoretic formula $\phi(x)$ $\text{ZFC} \vdash (\phi(\cdot) \text{ is a nonprincipal filter} \Rightarrow \phi(\cdot) \text{ is not maximal})$.

Conjecture 2. For any set theoretic formula $\phi(x)$ ZFC is consistent with " $\phi(\cdot)$ is not a nonprincipal ultrafilter" (where $\phi(\cdot) = \{x | \phi(x)\}$).

I feel that both conjectures should have versions with ϕ 's with parameters saying that $\phi(\cdot, y)$ is not a nonprincipal ultrafilter. How should such stronger conjectures be formulated? In this connection I wish to note that there is an axiom substituting AC to some extent which provides examples of explicitly defined ultrafilters.

264. Albert A. Mullin (506 Seaborn Drive, Huntsville, AL 35806). Are there constructive versions of the Heine-Borel theorem in the sense that for special classes sets (convex, ...) one can get a bound on the cardinality of a finite subcovering of an arbitrary (open) covering?

Responses

The replies below have been received to queries published recently in the *Notices*. The editor would like to thank all who reply.

248. (vol. 28, p. 607, November 1981, Herbert E. Salser) Can one find a fourth-degree polynomial $f = f(x, y)$, with arbitrarily prescribed values for f, f_x, f_y at 5 distinct points? **Reply:** The answer is no. For the proof one considers a general case where no three of the five points are collinear, and a special case where some three points are collinear. Details are available on request to the Queries column. (Contributed by Don Coppersmith)

256. (vol. 29, p. 326, June 1982, Ilie Hodor) For a Sturm-Liouville problem $(pf')' + \lambda rf = 0$ on $[x_1, x_2]$, $f'(x_1) = f'(x_2) = 0$, $x_0 \in (x_1, x_2)$, $r > 0$ on (x_1, x_0) , < 0 on (x_0, x_2) , what are the completeness properties of the eigenfunctions of f^{+n} (resp. f^{-n}) to positive (resp. negative) eigenvalues? **Reply:** The f^{+n} are complete on $L^2((x_1, x_0), r(x)dx)$, the f^{-n} on $L^2((x_0, x_2), -r(x)dx)$ (R. Beals, *J. Math. Phys.* **22** (1981), 954-960). Results of this type are known as "partial range completeness". They play a role in transport theory, etc. Some other references: K. M. Case, *Ann. Phys.* **9** (1960), apparently the first such result; E. W. Larsen and G. J. Habetler, *Comm. Pure Appl. Math.* **26** (1973); H. G. Kaper, C. G. Lekkerkerker and H. Hejtmank, *Spectral methods in linear transport theory*, Birkhäuser, to appear. (Contributed by R. Beals, H. G. Kaper, and P. F. Zweifel)

261. (vol. 29, p. 406, August 1982, H. Samelson) What is the reference to "The intersection of a decreasing sequence of simplices is a simplex"? **Reply:** V. A. Borovikov, *Uspehi Mat. Nauk* **7** (52) (1952), 179-180. (Contributed by R. Grünbaum)

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A-21

We would like to include an addendum to our communication published in the April 1982 *Notices*.

On 19 March 1982, the Yale University administration informed the National Science Foundation that "Yale cannot accept the award [of NSF to Lang] at this time."

Robert H. Szczarba
Chairman, Department
of Mathematics
Yale University

EDITORS' NOTE. This letter supplements the material submitted by Professor Szczarba and printed in the April issue of the *Notices*, pages 253ff. Lang had been reported as willing to sign a statement that all expenditures under his grant were made in accordance with appropriate purposes set forth in the proposal and grant letter. It was not known whether NSF would accept this alternative to time-&-effort reports. Apparently the University was then unwilling to accept the grant.

Review Panels

I was very happy to see in the November 1981 *Notices* a report of a review of the Mathematical Sciences Section of the NSF, written by William G. Rosen. This innovation is good, and I should like to see more such reports.

I was a little surprised, however, that no mention was made in the *Notices* of the then forthcoming meeting of the panel to review the program in geometry and topology in the Mathematical Sciences Section of the NSF. This meeting was held on 10 December 1981. In fact, I telephoned to the NSF, and I was told that the announcement of this meeting had been published in the *Federal Register*.

I do not know how many mathematicians have the time to read the *Federal Register*, but I do not. So why not publish information about such review panels in the *Notices*? I understand that each program of the Mathematical Sciences Section is reviewed biennially.

Perhaps the AMS could prevail on the NSF Mathematical Sciences Section to send to the *Notices* announcements of all the review panels. If the NSF Mathematical Sciences Section is unable or unwilling to do so, then perhaps the AMS could have someone search for notices of review panels and publish the information in the *Notices*.

Alfred Gray
University of Maryland

EDITORS' NOTE. Professor Gray's suggestion that employees of the Society should scan the

Federal Register for listings of meetings of NSF panels is quite impractical since the long lead time required to publish the *Notices* makes it impossible to get to him the information he wants before the meetings take place. A further problem appears to be that the specific meeting which he mentioned is closed to the public since it is one in which individual proposals are discussed and evaluated, so that even if he knew when the meeting was, he could not attend unless he is a member of the panel. See the statement by William G. Rosen in the box on page 249 of the April 1982 *Notices*. In this issue of the *Notices* there is another report from Dr. Rosen in which he gives more precise information on the date and location of the fall meeting of the Advisory Committee. See the box on page 525 of this issue. Dr. Rosen has very kindly expressed his willingness to alert readers of the *Notices* to any meetings of general interest for which information can be published in advance. The editors are pleased to assist with communication between the Foundation staff and members of the Society and have opened these pages to Dr. Rosen and his colleagues for just this purpose.

Policy on Letters to Editor

Readers who wish to respond to letters published in this issue are urged to do so before November 1, 1982. Responses received by that date may be edited to reduce repetition and will be considered for publication in the February 1983 issue.

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

The committee reserves the right to edit letters.

The *Notices* does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in the *Bulletin of the American Mathematical Society* will be considered for publication.

Letters should be mailed to the Editor of the *Notices*, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, and will be acknowledged on receipt.

Persi Diaconis named MacArthur Prize Fellow

The John D. and Catherine T. MacArthur Foundation has announced the selection of nineteen new Prize Fellows, the first of two groups expected to be named during 1982. Persi Diaconis, Department of Statistics, Stanford University is the only mathematical scientist in the present group.

The appointment covers five years and carries a total stipend of \$192,000 in Diaconis' case (the awards vary with the age of the recipient and range from \$24,000 to \$60,000 per year).

Persi Diaconis was born in New York City on January 31, 1945. After graduating from high school at the age of 14, he ran away from home to become a professional magician and card player. Ten years later he entered college in order to learn the mathematics he needed to understand probability theory. He graduated from City College, New York, in 1971 and earned his Ph.D. (in statistics) from Harvard in 1974. He has been at Stanford since 1974, first as assistant professor of statistics, and subsequently as an associate professor.

Diaconis's specialties include probabilistic number theory, data analysis and the foundations of statistical inference. He has made contributions to combinatorial problems, such as the theory of card shuffling, and to the evaluation of clinical trials, including drug testing and parapsychological research. His experience as a magician has provided him with some unusual insights into a number of these research problems.

Rollo Davidson Trust

The Trustees of the Rollo Davidson Trust announce that they have awarded Rollo Davidson Prizes for 1982 to each of the following:

PERSI DIACONIS, of the Department of Statistics, Stanford University, who is distinguished for his work on exchangeability and on data analysis, alone and in collaboration.

RUBEN AMBARZUMIAN, of the Institute of Mathematics, Academy of Sciences of the Armenian S.S.R., who is distinguished for his fundamental contributions to combinatorial integral geometry.

This is the seventh year in which awards have been made by the Trust, which is supported by royalties associated with the two books *Stochastic analysis* and *Stochastic geometry* published as a memorial tribute to Rollo Davidson in 1973 and 1974, and by donations to the Trust.

Salem Prize

The Salem Prize for 1982 was awarded to Alexei B. Aleksandrov of the University of Leningrad, for his work on analytic functions and particularly his discovery of inner functions for several variables. The Prize, established in 1968, is given every year to a young mathematician who is judged to have done outstanding work in the field of interest of Salem, primarily on Fourier series and related topics. The recipient was Nicholas Varopoulos in 1968, Richard Hunt in 1969, Yves Meyer in 1970, Charles Fefferman in 1971, Thomas Körner in 1972, E. M. Nikišin in 1973, Hugh Montgomery in 1974, William Beckner in 1975, M. R. Herman in 1976, S. B. Bočkarëv in 1977, Björn E. Dahlberg in 1978, Gilles Pisier in 1979, Stylianos Pichorides in 1980 and Peter Jones in 1981. The jury consisted of Professors L. Carleson, J.-P. Kahane, Ch. Pisot and E. M. Stein.

Stampacchia Prize Shared by Six Mathematicians

Edoardo Vesentini, director of the Scuola Normale Superiore in Pisa, has announced the winners of the first Guido Stampacchia Prize of five million lira (cf. *Notices*, April 1981, page 291). He reports that the selection committee considered thirty-seven papers submitted by twenty-two authors for the competition. The Committee noted that its decision was difficult because of the high quality of the papers which had been submitted.

The Committee decided unanimously to award the prize to MICHAEL AIZENMAN, HANS WILHELM ALT, LUIS A. CAFFARELLI, GIANNI DAL MASO, AVNER FRIEDMAN and BARRY SIMON for the following papers:

AIZENMAN and SIMON, *Brownian Motion and Harnack inequality for Schrödinger operators*, Communications on Pure and Applied Mathematics, volume 35 (1982), pages 209 to 273.

ALT and CAFFARELLI, *Existence and regularity for a minimum problem with free boundary*, Journal für die Reine und Angewandte Mathematik, volume 325 (1981), pages 105 to 144.

ALT, CAFFARELLI and FRIEDMAN, *Axially symmetric jet flows*, Archive for Rational Mechanics and Analysis (to appear).

ALT, CAFFARELLI and FRIEDMAN, *Asymmetric jet flows*, Communications on Pure and Applied Mathematics, volume 35 (1982), pages 29 to 68.

ALT, CAFFARELLI and FRIEDMAN, *Jet flows with gravity*, Journal für die Reine und Angewandte Mathematik, volume 331 (1982), pages 58 to 103.

DAL MASO, *Asymptotic behaviour of minimum problems with bilateral obstacles*, *Annali di Matematica Pura ed Applicata* (4), volume 129 (1981), pages 327 to 366.

The prize was created by the Scuola Normale Superiore, with financial support from the National Research Council, to honor the memory of Professor Stampacchia. Monographs or substantial papers, if published during 1980 or 1981 or unpublished, on new problems in differential equalities or inequalities, or in the calculus of variations in the presence of unilateral constraints were eligible for consideration in the competition. These fields were those in which Stampacchia did much of his later work.

R. L. Wilder, 1896–1982

Raymond Louis Wilder died at the age of 85 on July 7, 1982, in Santa Barbara, California.

Ray Wilder's distinguished career included important research contributions as well as generous and devoted service to the mathematical community. He presented the Society's Colloquium Lectures at the Summer Meeting in 1942, and subsequently published them under the title *Topology of manifolds* as volume 32 of the AMS Colloquium Publications. He served the Society as a vice president in 1950 and 1951, as president-elect in 1954, as president and presiding officer of the Board of Trustees in 1955 and 1956, and ex-president in 1957. In 1973 he received a Lester R. Ford Award and the Distinguished Service Award of the Mathematical Association of America. He was president of the Association in 1965 and 1966.

He earned bachelor and master degrees from Brown University (1920 and 1921) and a Ph.D. (in 1923) from the University of Texas where he studied with R. L. Moore. He received honorary degrees from Bucknell (1955), Brown (1958) and Michigan (1980). For just over forty years (1926 to 1967) he was a member of the mathematics faculty of the University of Michigan in Ann Arbor and was its first Research Professor. After his retirement from Michigan, he held a visiting appointment at the University of California, Santa Barbara.

He served the Society as a member of numerous committees, including the Colloquium Editorial Committee (1947 to 1952) and the Executive Committee (1952 to 1956), and he was an associate editor of the *Transactions* from 1941 to 1949. He gave invited addresses in April 1932 at the meeting in Chicago and at the Society's semicentennial celebration in 1938. He gave his retiring presidential address at the Cincinnati meeting in January 1958 and the Gibbs Lecture at the New Orleans meeting in January 1969.

In addition to his work in topology (a subject on which he wrote numerous research papers), he was interested in the history and foundations of mathematics and wrote two books on these

AMS Research Fellowships

Invitation for Applications, 1983-1984

The deadline for applications is December 1, 1982; awards will be announced by late January 1983.

The stipend for these postdoctoral fellowships in 1983-1984 will be \$24,000 for eleven months of full-time research or its equivalent, plus an incidental expense allowance of \$1,000. Given the opportunity, a Fellow may elect to hold a half-time Research Instructorship, with a teaching responsibility not exceeding one course per term, while holding the Fellowship at half stipend. Fellowships are open to individuals who have recently received a Ph.D. degree, regardless of age, and who are citizens or permanent residents of a country in North America. Fellowships may be held at any institution the Fellow selects, or at more than one in succession, and there is flexibility in the choice of time interval(s) in which the Fellow may draw funds.

For further information and application forms, write to Dr. William J. LeVeque, Executive Director, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.

AMS Research Fellowship Fund

Request for Contributions

The AMS Research Fellowship Fund was established in 1973. From this fund AMS Research Fellowships are awarded annually to individuals who have received the Ph.D. degree, who show unusual promise in mathematical research, and who are citizens or permanent residents of a country in North America.

Twenty-six Research Fellowships have been awarded including one granted for 1982-1983 and two for 1981-1982 (see the announcements in the April 1982 *Notices*, page 247 and in the April 1981 issue, page 256). The number of fellowships awarded depends on the contributions the Society receives. The Society contributes a minimum of \$9,000 to the Fund each year, matching one-half of the funds in excess of \$18,000 raised from other sources, up to a total contribution by the Society of \$20,000. Each member of the Society is requested to contribute to the Fund.

Contributions to the AMS Research Fellowship Fund are tax deductible. Checks should be made payable to the American Mathematical Society, clearly marked "AMS Research Fellowship Fund," and sent to the American Mathematical Society, Post Office Box 1571, Annex Station, Providence, Rhode Island 02901.

subjects: *Introduction to the foundations of mathematics* (Wiley 1952, second edition 1965) and *Evolution of mathematical concepts, an*

elementary study (Wiley 1968). In the 1977 edition of *American Men & Women of Science*, he listed his research interests as cultural anthropology and culturological history of mathematics.

His interests in mathematical and related questions remained active to his last days. He will be sorely missed by his many students, colleagues and friends.

Mandelbrot and Stein Elected to American Academy of Arts and Sciences

Seventy-eight scholars, scientists, public figures, and artists have been elected to membership in the American Academy of Arts and Sciences. In addition, the academy elected ten foreign honorary members. The new members include Benoit B. Mandelbrot, fellow, IBM Thomas J. Watson Research Center, Yorktown Heights, New York, and Elias M. Stein, professor of mathematics, Princeton University.

Bulletin (New Series)

In 1979 the Society began to publish the *Bulletin (New Series)*, with a new format that included the "research-expository" articles which now appear at the beginning of each issue. In order to encourage mathematicians of high caliber to write these articles, the Society applied for a grant from the National Science Foundation from which \$1,000 stipends could be paid for suitable manuscripts; the grant was received in March of 1979 and provided for 12 such stipends each year for three years.

The Society wishes to acknowledge this support from the Foundation, and to recognize the contributions of the following authors, to whom these stipends have been awarded by the Editorial Committee of the *Bulletin*:

DANIEL GORENSTEIN, *The classification of finite simple groups I, Simple groups and local analysis* (January 1979); R. O. WELLS, JR., *Complex manifolds and mathematical physics* (March 1979); DONALD E. KNUTH, *Mathematical typography* (March 1979); IVAR EKELAND, *Nonconvex minimization problems* (May 1979); RICHARD P. STANLEY, *Invariants of finite groups and their applications to combinatorics* (May 1979); PHILLIP A. GRIFFITHS, *Complex analysis and algebraic geometry* (July 1979); CHARLES W. CURTIS, *Representations of finite groups of Lie type* (September 1979); D. H. FOWLER, *Ratio in early Greek mathematics* (November 1979); LOUIS AUSLANDER and R. TOLIMIERI, *Is computing with the finite Fourier transform pure or applied mathematics* (November 1979); RICHARD MANDELBAUM, *Four-dimensional topology: An introduction* (January 1980); PETER D. LAX and RALPH S. PHILLIPS, *Scattering theory for*

automorphic functions (March 1980); DAVID H. SATTINGER, *Bifurcation and symmetry breaking in applied mathematics* (September 1980); ROGER E. HOWE, *On the role of the Heisenberg group in harmonic analysis* (September 1980); RAOUL H. BOTT, *Marston Morse and his mathematical works* (November 1980); BRANKO GRÜNBAUM and G. C. SHEPHARD, *Tilings with congruent tiles* (November 1980); EUGENE B. DYNKIN, *Markov processes and random fields* (November 1980); STEPHEN SMALE, *The fundamental theorem of algebra and complexity theory* (January 1981); PIERGIORGIO ODIFREDDI, *Strong reducibilities* (January 1981); IRWIN KRA, *Canonical mappings between Teichmüller spaces* (March 1981); LOUIS NIRENBERG, *Variational and topological methods in nonlinear problems* (May 1981); BRUCE C. BERNDT and RONALD J. EVANS, *The determination of Gauss sums* (September 1981); LIPMAN BERS, *Finite dimensional Teichmüller spaces and generalizations* (September 1981); HARRY FURSTENBERG, *Poincaré recurrence and number theory* (November 1981); MURRAY R. CANTOR, *Elliptic operators and decomposition of tensor fields* (November 1981); JOHN W. MILNOR, *Hyperbolic geometry: The first 150 years* (January 1982); DENNIS SULLIVAN, *Discrete conformal groups and measurable dynamics* (January 1982); SERGE LANG, *Units and class groups in number theory and algebraic geometry* (May 1982); WILLIAM P. THURSTON, *Three dimensional manifolds, Kleinian groups and hyperbolic geometry* (May 1982); ROBERT J. ZIMMER, *Ergodic theory, group representations, and rigidity* (May 1982); J. WILLIAM HELTON, *Non-Euclidean functional analysis and electronics* (July 1982); RICHARD S. HAMILTON, *The inverse function theorem of Nash and Moser* (July 1982); HYMAN BASS, EDWIN H. CONNELL and DAVID WRIGHT, *The Jacobian conjecture: Reduction of degree and formal expansion of the inverse* (September 1982); ELIAS M. STEIN, *The development of square functions in the work of A. Zygmund* (September 1982); BARRY SIMON, *Schrödinger semigroups* (November 1982); GEORGE W. WHITEHEAD, *Fifty years of homotopy theory* (January 1983); R. MICHAEL BEALS, CHARLES FEFFERMAN and ROBERT GROSSMAN, *Strictly pseudo-convex domains in C^n* (March 1983).

National Research Council Senior and Postdoctoral Research Associateships

The National Research Council announces its 1983 Research Associateship Awards Programs for research in the sciences and engineering to be conducted in 18 federal research institutions at laboratories located throughout the United States. The programs provide Ph.D. scientists and engineers of unusual promise and ability with

opportunities for research on problems largely of their own choosing, yet compatible with the research interests of the supporting laboratory. Initiated in 1954, the Associateship Programs have contributed to the career development of more than 3,500 scientists ranging from recent Ph.D. recipients to distinguished senior scientists.

Approximately 250 new full-time associateships will be awarded on a competitive basis in 1983 for research in chemistry, engineering, and mathematics, and in the earth, environmental, physical, space, and life sciences. Most of the programs are open to both U.S. and non-U.S. nationals, and to both recent Ph.D. degree holders and senior investigators.

Awards are made in most programs for a year with possible extensions through a second year. Senior applicants who have held the doctorate at least five years may request shorter tenures. In a few programs, initial awards are made for two years with a possible third year of contractual support at an academic institution.

Stipends range from \$23,500 a year for recent Ph.D.'s to a maximum of \$50,000 a year for senior associates. A stipend supplement up to \$5,000 may be available to awardees holding recognized doctoral degrees in engineering, computer science, or certain areas of earth geological sciences. Allowances are made for relocation and for limited professional travel. The host federal laboratory provides the associate with programmatic assistance including facilities, support services, and necessary equipment.

Applications to the Research Council for current programs must be postmarked no later than January 15, 1983. Awards will be announced in April.

Information on specific research opportunities and federal laboratories, as well as application materials, may be obtained from Associateship Programs, JH 610-D3, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418; 202-334-2760. —NRC Release

Gödel's Collected Works

A comprehensive edition of the works of the eminent logician Kurt Gödel is currently being prepared under the auspices of the Association for Symbolic Logic. The Editorial Board consists of Solomon Feferman (editor-in-chief), John W. Dawson, Jr., Stephen C. Kleene, Gregory H. Moore, Robert M. Solovay, and Jean van Heijenoort. All of Gödel's published works as well as his doctoral dissertation will be included in this edition. Those works not originally printed in English will appear both in the German original and in English translation. In addition, the editors hope to include material from Gödel's *Nachlaß* (possibly in a second volume). By way of introduction, the edition will include a biography of Gödel together with a survey of his work and its

significance. Furthermore, each article or group of articles will be prefaced with an historical note. It is the aim of the editors to render this edition of the greatest possible scientific, philosophical, and historical interest.

The editors wish to include a selection of Gödel's professional correspondence, only a small amount of which has already been published, and would greatly appreciate hearing from anyone who possesses or knows of such correspondence. Any information regarding photographs of Gödel would also be most welcome. Communications should be sent to Solomon Feferman, Department of Mathematics, Stanford University, Stanford, California 94305.

Institute for Advanced Study Memberships

The School of Mathematics will grant a limited number of memberships, some with financial support, for research in mathematics at the Institute during the academic year 1983-1984. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree. Application blanks may be obtained from the Administrative Officer of the School of Mathematics, Institute for Advanced Study, Princeton, New Jersey 08540, and should be returned (whether or not funds are expected from some other source) by December 31, 1982. An Equal Opportunity/Affirmative Action Employer.

Institute for Retraining in Computer Science

Under the auspices of the Joint ACM-MAA Committee on Retraining for Computer Science, a Summer Institute for Retraining Mathematicians to Teach Computer Science is being established at Clarkson College. The first class is planned for June 1983.

The retraining program will consist of two summers in residence at Clarkson plus a large programming project to be completed back at the home institution during the intervening year. In addition, participants will be expected to teach an introductory computer science course during that year.

The curriculum will emphasize modern methods of structured programming and top-down design plus a strong exposure to the fundamental concepts in the growing field of computer science. Course syllabi will take full advantage of the mathematical background of the participants.

At the end of the first summer, participants will be qualified to teach a two-semester introductory sequence in programming and computer science, including some material on data structures. After the full program, they will be qualified to teach

about half of the ACM Core Curriculum in computer science (*ACM Curriculum '78*, Communications of ACM, March 1979, pages 147 to 166). This includes most of the material for a computer science minor in a mathematics department as recommended in the 1981 CUPM Report, *Recommendations for a general mathematical sciences program*, Mathematical Association of America, 1981. Also, they will have learned a considerable amount of computer science beyond this level.

In addition to a mathematics background and college teaching experience, participants will be expected to have some familiarity with programming and a personal commitment to continue in college teaching. There should be facilities on the home campus adequate for instruction in the computer science curriculum.

It is possible that funding will be available to defray all or part of the participants' costs. Details will be announced later.

For more information and application forms write Ed Dubinsky, Department of Mathematics and Computer Science, Clarkson College of Technology, Potsdam, New York 13676.

First Class or Air Mail Delivery of Abstracts and Notices

In order to assure that information about meetings will arrive in time, arrangements for first class or air mail delivery of *Notices* and *Abstracts* may be made. For first class mail (U.S. and Canada only), there is a subscription surcharge in 1983 of \$7 per year for *Abstracts* and of \$8 per year for *Notices*.

Air mail rates for delivery to other countries may be obtained from the Membership and Sales Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940 (401-272-9500).

U.S. Students Strong in International Mathematical Olympiad

A team of four talented high school students tied for third place honors in competition with teams from 30 nations in the 23rd International Mathematical Olympiad (IMO) held in Budapest, Hungary on July 9 and 10, 1982. One U.S. team member, Noam D. Elkies of New York City, won an individual first prize for his score of 40 out of a possible 42 on the IMO examination. Two students, Brian Hunt of Silver Spring, Maryland and Washington Taylor IV of Cambridge, Massachusetts received individual second prizes, and the fourth team member, Douglas S. Jungreis of North Woodmere, New York received a third prize.

The IMO, which annually brings together teams of high school students from all parts of the world, has been held recently in London, England

and Washington, D.C. Teams from the U.S. have consistently scored in the top five and have taken first place on two occasions.

The IMO is based on a challenging examination requiring both broad knowledge and great mathematical ingenuity. In a tough and close competition this year the following teams captured top honors: First Place, West Germany with a team score of 145; Second Place, USSR with a team score of 137; tied for Third Place, U.S.A. and East Germany with team scores of 136; Fifth Place, Vietnam with a team score of 133. Hungary, the host nation, came in Sixth with a score of 125.

The U.S. team is chosen on the basis of performance in the U.S.A. Mathematical Olympiad (USAMO) held this year on May 4. The team and four other USAMO winners were honored on June 8 at the Eleventh USAMO Awards Ceremony in Washington, D.C. Following the Awards festivities the U.S. team members attended a rigorous three-week training session held at the U.S. Naval Academy in Annapolis.

The Mathematical Olympiad activities are sponsored by five national societies in the mathematical sciences. Financial support is provided by IBM, the Army Research Office, the Office of Naval Research, and Hewlett-Packard.

—MAA News Release

SIAM Lecturers and Consultants in Applied Mathematics

Lecturers and consultants in applied mathematics will be available throughout the 1982-1983 academic year in programs sponsored by the Society for Industrial and Applied Mathematics (SIAM).

The SIAM Visiting Lectureship Program, now in its 24th year, is intended to promote a deeper understanding of applied mathematics in the scientific community, particularly in colleges and universities. The list of more than 70 lecturers (more than a third from industry and government) includes mathematicians with a wide range of interests in applied mathematics, statistics and computer science. They are prepared to give formal lectures at undergraduate and advanced levels, to confer with students and faculty, and to discuss teaching methodology, curriculum matters, employment and other concerns.

The SIAM Visiting Consultants Panel was organized to offer assistance in the development of applied mathematics programs at both the undergraduate and graduate levels. The panelists have been particularly active in course and program development during the last eight years.

Both programs are described in a brochure which may be obtained from Hugh B. Hair, SIAM Services Manager, 1405 Architects Building, 117 South 17th Street, Philadelphia, PA 19103; 215-564-2929.

—SIAM Release

Mathematical Sciences Postdoctoral Research Fellowships, With Research Instructorship Option

The format of this fellowship program has been changed significantly to provide the recipient with increased flexibility in the manner in which he or she can perform as a Fellow. In particular, the stipend portion of the awards will consist of support for two nine-month academic years and six summer months over three summers. The awardee will have two options for the academic years' stipend: as full-time support for any eighteen academic-year months in a three-year period (the Research Fellowship Option), or as a combination of full-time and half-time support over a period of three academic years, usually as one academic year full-time and two academic years half-time (the Research Instructorship Option). The stipend will be paid at the rate of \$2,200 per full-time month or \$1,100 per half-time month, for a total of \$52,800 for the eighteen academic-year months and six summer months. Deadline for applications is December 3, 1982; awards will be announced in early February 1983. Applications will be accepted in core mathematics, applied mathematics, and statistics. For further details write to Alvin I. Thaler, Program Director for Special Projects, Mathematical Sciences Section, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550.

Research Proposals Mathematical Sciences Section

The purpose of this announcement is to focus attention on the preparation of NSF research proposals. Prospective applicants are referred to the brochure *Grants for Scientific and Engineering Research* (NSF 81-79 or NSF 81-79F) available from institutional research offices or directly from NSF (Forms and Publications, NSF, Washington, DC 20550).

Applicants should allow six to nine months for review and processing. Proposals may be submitted at any time. Those requesting support beginning in the summer of 1983 should be received at the Foundation by October 25, 1982.

The requested duration should be appropriate to the scope of the project. Requests for two or three years' support are suggested. A separate itemized budget for each year together with a summary budget should be provided.

Proposal cover sheets should display prominently in the upper left-hand corner, but separately from the title, the first two digits

Information from the Mathematical Sciences Section, NSF

Deadlines for FY 1983. *November 15, 1982.* Regional Conferences in the Mathematical Sciences. It is anticipated that the deadline for proposals for Regional Conferences in the Mathematical Sciences to be funded in FY 1983 will be November 15, 1982. Administrative details regarding these conferences are not yet clear. Such information as exists may be obtained from the Special Projects Program, Mathematical Sciences Section, NSF (202-357-9764). (See announcement below.)

December 1, 1982. Scientific Computing Research Equipment for the Mathematical Sciences. Contact the Special Projects Program, Mathematical Sciences Section, NSF (202-357-9764). (See announcement below.)

December 10, 1982. Mathematical Sciences Postdoctoral Research Fellowships. Contact the Special Projects Program, Mathematical Sciences Section, NSF (202-357-9764). (See announcement below.)

Target Date for FY 1983. *October 25, 1982.* Scientific Research Project Support in the Mathematical Sciences. Contact William G. Rosen, Head, Mathematical Sciences Section, NSF (202-357-7341). (See announcement below.)

Mathematical Sciences Advisory Subcommittee. The Advisory Subcommittee for Mathematical Sciences will meet Friday and Saturday, October 29 and 30, 1982, in Room 338 at NSF. Further information may be obtained by calling William G. Rosen, Head, Mathematical Sciences Section (202-357-7341).
—W. B. Rosen

of the 1980 Mathematics Subject Classification used in *Mathematical Reviews*. Individual topics proposed for research should be identified with the appropriate full Subject Classification codes. Include, also, the probable program assignment (Classical Analysis, Modern Analysis, Geometric Analysis, Topology, Foundations, Algebra and Number Theory, Applied Mathematics, Statistics, or Probability).

Particular attention must be paid to the required 200-word summary of work being proposed, following the format of the NSF Project Summary Form (see NSF 81-79, page 18, or NSF 81-79F, page 45). The summary must satisfy the following conditions:

- (a) it must be self-contained;
- (b) the pertinent subfield of science (e.g., algebraic number theory, global analysis, decision

theory, etc.) should be stated explicitly in the first sentence;

(c) symbols should not be used;

(d) first person pronouns and such phrases as "proposer" and "it is proposed" should be avoided; in their place, use "principal investigator" and "Professor X plans to," etc.; and

(e) the summaries should be expressed, insofar as possible, in language that can be understood by a scientifically literate reader.

Summaries of awards will be published. **Proposals with summaries which are too short, unintelligible, or otherwise inappropriate will be returned.** Delays can be avoided by paying careful attention to this important element of the proposal.

Recent Ph.D. recipients should be aware of the difficulties faced by reviewers in commenting on the applicant's ability to complete the proposed research and focus on the elements of good proposal writing, whether applying alone or together with others. These include a clear description of proposed research and of methods to be used, as well as evidence of past research accomplishments. With each copy of the proposal include summaries of theses and preprints of completed research not yet available in readily accessible journals. Junior investigators are urged to show drafts of their proposals to experienced senior members of their department for comment.

In addition, each proposal should contain:

(1) a full description of all other current research or pending applications for such, for all proposed investigators. In case there is no other support and no other application is pending or contemplated, the proposal must contain an unequivocal and explicit statement to that effect (e.g., "None of the listed investigators has any other research support and no other application is pending or contemplated"). This must include all possible sponsors, not just NSF;

(2) in requests for renewed support, reference to the previous award should include a summary of what was proposed, what was accomplished, and what tasks remain. Estimates both of total expenditures and commitments under the existing award up to the new starting date and of the projected residual balance, if any, must be included;

(3) justification for unusual items of support; in particular this should be done in requests for partial support of sabbatical leaves, dedicated computation equipment, etc.;

(4) a bibliography of important publications relevant to the proposed research; and

(5) *curricula vitae* of the proposed investigators, including for each, a chronological list of publications.

The telephone numbers of the department and the principal investigator(s) should be listed. Inclusion of the principal investigator's home

telephone number has proved to be particularly useful.

Checklist for proposal submission:

Cover page (use requested format)

Appropriate boxes on cover page checked

All required signatures (principal investigator, co-principal investigators, and organizational)

Table of contents

Project summary

Summary of progress to date and its relation to proposed work (renewals only)

For each investigator:

Detailed description of proposed research

Bibliography of pertinent literature

Curriculum vitae

Current list of main publications of senior personnel (major publications currently in press may be listed)

Budget in requested format

Current and pending support statement

List or description of available facilities and major items of equipment to be used in the proposed research

Required number of copies of the proposal, including the original signed copy

Residual Funds Statement, if required

Ten copies of the proposal and any attachments should be addressed to: Data Support Services Section, National Science Foundation, Washington, DC 20550.

William G. Rosen, Head
Mathematical Sciences Section

Proposals for Regional Conferences in the Mathematical Sciences

The National Science Foundation is seeking proposals from prospective host institutions in the U.S. for five-day regional conferences, each to feature 10 lectures by a distinguished guest lecturer on a subject of current research interest in the mathematical sciences. Topics for conferences may be concerned with any of the subdisciplines of the mathematical sciences. An applying institution should have at least a minimal research competence in the area of its proposal. The conferences should be planned for a summer week in 1983 (not earlier than May 1) or held during a recess in the succeeding academic year. The objective of the project is to stimulate and broaden mathematical research activity. The organization of the conferences, evaluation of proposals, and arrangements for publication of expository papers based on the guest speakers' lectures are expected to be carried out by the Conference Board of the Mathematical Sciences under contract with the Foundation. The conference awards themselves, however, are made by the NSF.

Each conference must plan for a single principal guest lecturer from outside the host institution and about twenty-five other participants. It is expected that the lecturer will give two lectures per day during the five days of the conference, with the remainder of the time available for study, informal discussion, and exchange of ideas.

Participants in a conference receive allowances for travel and subsistence under the host institution's

grant from the Foundation for the conference. In addition, the principal lecturer receives from the Conference Board a fee for delivering his lectures and second fee for organizing these into a substantial expository paper. The Conference Board arranges for editing and publication of these papers.

Proposals by prospective host institutions (twenty copies) should be sent directly to Data Support Systems Branch, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550, and must be received by November 15, 1982. Proposals will be evaluated by a panel of the Conference Board and awards of conference grants will be made by the National Science Foundation with advice of the panel.

During most of the eleven years since the establishment of the regional conference program, many more proposals of very high quality were submitted to the NSF than could be funded. In the past two years, however, the number of such proposals has diminished markedly. As a result, only six conferences were held in 1982. Funding is expected to be available for ten conferences in 1983 and it is hoped that enough proposals of very high quality will be submitted so that a suitable selection can be made.

Inquiries regarding details of proposals for these regional conferences should be addressed to the Conference Board of the Mathematical Sciences, 1529 Eighteenth Street, N.W., Washington, D.C. 20036.

Graduate Fellowships for 1983-1984

The National Research Council will again advise the National Science Foundation in the selection of candidates for the Foundation's program of Graduate Fellowships. Panels of eminent scientists and engineers appointed by the National Research Council will evaluate qualifications of applicants. Final selection of the Fellows will be made by the Foundation, with awards to be announced in March 1983.

Eligibility in the NSF Graduate Fellowship Program is limited to those individuals who, at the time of application, have not completed more than 20 semester hours (30 quarter hours), or equivalent, of study in any of the science and engineering fields listed below following completion of their first baccalaureate degree in science or engineering. Subject to the availability of funds, new fellowships awarded in the Spring of 1983 will be for periods of three years, the second and third years on certification to the Foundation by the fellowship institution of the student's satisfactory progress toward an advanced degree in science or engineering.

These fellowships will be awarded for study or work leading to master's or doctoral degrees in the mathematical, physical, biological, engineering, and social sciences, and in the history and philosophy of science. Awards will not be made in clinical, law, education, or business fields, in history or social work, for work leading to medical, dental, or public health

degrees, or for study in joint science-professional degree programs. Applicants must be citizens of the United States, and will be judged on the basis of ability. The annual stipend for Graduate Fellows will be \$6,900 for a twelve-month tenure with no dependency allowances.

Applicants will be required to take the Graduate Record Examinations designed to test aptitude and scientific achievement. The examinations, administered by the Educational Testing Service, will be given on December 11, 1982 at designated centers throughout the United States and in certain foreign countries.

The deadline for submission of applications for NSF Graduate Fellowships is November 24, 1982. Further information and application materials may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, DC 20418.

—NRC Release

Minority Graduate Fellowships for 1983-1984

The National Research Council will again advise the National Science Foundation in the selection of candidates for the Foundation's program of Minority Graduate Fellowships. Panels of eminent scientists and engineers appointed by the National Research Council will evaluate qualifications of applicants. Final selection of Fellows will be made by the Foundation, with awards to be announced in March 1983.

The NSF Minority Graduate Fellowship Program is open only to persons who are citizens or nationals of the United States at the time of application, and who are members of an ethnic minority group underrepresented in the advanced levels of the Nation's science talent pool—i.e., American Indian, Native Alaskan (Eskimo or Aleut), Black, Mexican American/Chicano, Puerto Rican, or Native Pacific Islander (Polynesian or Micronesian).

Eligibility is limited to those individuals who, at the time of application, have not completed more than 20 semester hours (30 quarter hours), or equivalent, of study in any of the science and engineering fields listed below following completion of their first baccalaureate degree in science or engineering. Subject to the availability of funds, new fellowships awarded in the Spring of 1983 will be for periods of three years, the second and third years contingent on certification to the Foundation by the fellowship institution of the student's satisfactory progress toward an advanced degree in science or engineering.

These fellowships will be awarded for study or work leading to master's or doctoral degrees in the mathematical, physical, biological, engineering, and social sciences, and in the history and philosophy of science. Awards will not be made in clinical, law, education, or business fields, in history or social work, for work leading to medical, dental, or public health degrees, or for study in joint science-professional

degree programs. Applicants will be judged on the basis of ability. The annual stipend for Minority Graduate Fellows will be \$6,900 for a twelve-month tenure with no dependency allowances.

Applicants will be required to take the Graduate Record Examinations designed to test aptitude and scientific achievement. The examinations, administered by the Educational Testing Service, will be given on December 11, 1982 at designated centers throughout the United States and in certain foreign countries.

The deadline for submission of applications for NSF Minority Graduate Fellowships is November 24, 1982. Further information and application materials may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, DC 20418. -NRC Release

Competition for Three Fellowship Programs

The National Science Foundation (NSF) plans to award approximately 600 fellowships in the spring of 1983 for advanced study to help meet the continuing national need for qualified scientific personnel. Included are 500 NSF Graduate Fellowships (see announcement above), 50 NSF Minority Graduate Fellowships (see announcement above), and 50 NATO Postdoctoral Fellowships, subject to availability of funds. Application materials now are available for all three programs.

Competition for these fellowship awards is open to citizens and nationals of the United States. Awards are made on the basis of merit for full-time graduate study in all fields of science, including interdisciplinary and multidisciplinary science areas.

NSF Graduate Fellowships are awarded for full-time study leading to a master's or doctoral degree in science, including the social sciences, mathematics and engineering, at any non-profit United States or foreign institution of higher education offering advanced degrees in science or engineering. Fellows receive a stipend of \$6,900 for 12 months of tenure (\$575 per month). A cost-of education allowance of up to \$4,000 per year is provided to the institution chosen by the Fellow in lieu of tuition and fee charges. Graduate Fellowships are renewable for up to three years subject to satisfactory academic progress and the availability of NSF funds. Application is limited to individuals with no more than 20 semester or 30 quarter hours credit of postbaccalaureate study in science at the time of application.

NSF Minority Graduate Fellowships are available to students of minority groups underrepresented in the sciences, who may apply to either or both of the graduate-level fellowship programs. Other eligibility requirements, stipends and allowances for Minority Graduate Fellowships are the same as for the NSF Graduate Fellowship program.

North Atlantic Treaty Organization (NATO) Postdoctoral Fellowships are awarded for advanced study outside the US in a country that is either

a member of or cooperating with NATO. These fellowships were established by NATO to advance science and technology and to promote closer collaboration among NATO nations. Each member country administers these fellowships for its own nationals; NSF administers this NATO-funded program in the US at the request of the Department of State. The fellowships provide a stipend of \$1,500 per month for periods of tenure up to 12 months. Limited travel support and a monthly allowance of \$100 per dependent, up to a maximum of three, are available.

Program Information:

NSF Graduate Fellowships Announcement (SEPE 83-10) and application forms, now available; Application deadline, November 24, 1982; Award date, mid-March 1983. Copies of the announcement and application materials are available from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, DC 20418; 202-334-2872.

NSF Minority Graduate Fellowships Announcement (SEPE 83-12) and application forms, now available; Application deadline, November 24, 1982; Award date, mid-March 1983. Copies of the announcement and application materials are available from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, DC 20418; 202-334-2872.

NATO Postdoctoral Fellowships Announcement (NSF 82-49) and application forms, now available; Application deadline, November 9, 1982; Award date, late February 1983.

Copies of the announcement and application materials are available from Fellowships Section, Office of Scientific and Engineering Personnel and Education, National Science Foundation, Washington, DC 20550; 202-357-7536.

-NSF News Release

Cooperative Research Centers

A manual describing how University/Industry cooperative Research Centers work and how to get one started has been published by the National Science Foundation's Division of Industrial Science and Technological Innovation.

The Centers are university-based, typically interdisciplinary, programs of research supported jointly by a number of companies. The program stimulates industrial support of university research through the establishment of centers that create long-term collaboration between the university and industry in research areas of mutual interest. Research programs are co-funded by groups of industrial firms in areas that are compatible with university research objectives and also responsive to industry needs.

The NSF views each center as an experiment and funds an independent evaluation to study each center's operation and assess its outcome.

Six Industry/University Cooperative Centers are now operating; one already is self-sufficient.

The newly published Practice Manual was produced because interest in the centers has increased rapidly and now exceeds the capability of the NSF either to provide one-on-one guidance to all prospective centers or financial support to all potentially attractive cases.

Copies of the manual may be obtained free from Louis G. Tournazky, Division of Industrial Science and Technological Innovation, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550.

Scientific Computing Research Equipment

NSF's Division of Mathematical and Computer Sciences plans to continue for the second year the award of a limited number of grants for the purchase of computing equipment for research in the mathematical sciences.

Grants will be made only to U.S. graduate-degree-granting institutions with departments or research programs in mathematics, applied mathematics, or statistics. Proposals involving inter-institutional or inter-departmental sharing arrangements are welcome. These grants are intended for purchase of special-purpose equipment dedicated to the support of research in the mathematical sciences. The equipment should be necessary for the pursuit of specific research projects, rather than intended to provide general computing capacity.

These grants are intended for researchers whose research has been handicapped or limited due to lack of access to suitable equipment.

The deadline for applications for such grants is December 1, 1982.

Questions concerning proposals should be directed to Dr. Alvin Thaler, Program Director for Special Projects, Mathematical Sciences Section (202-357-9764).
—*NSF Bulletin*

New Cooperative Science Program with the United Kingdom

NSF and the United Kingdom Science and Engineering Research Council have agreed to jointly support bilateral seminars and cooperative research projects. The U.S. deadline for application is November 1, 1982. For additional information, contact Marilyn Rurak, Division of International Programs (202-357-7554).
—*NSF Bulletin*

U.S.-Israel Binational Science Foundation

Support for cooperative research to be performed primarily in Israel is awarded by the U.S.-Israel Binational Science Foundation in Jerusalem on the basis of applications for cooperative research grants.

Deadline for receipt of proposals in Jerusalem has been advanced to November 15, 1982. U.S. scientists may obtain information and application forms from international offices of the U.S. agencies related to their research. For information from NSF, contact R. R. Ronkin, Division of International Programs (202-357-7613).
—*NSF Bulletin*

Positions Open in NSF

NSF's Division of Mathematical and Computer Sciences is seeking qualified applicants for positions in the Mathematical Sciences which periodically become available. The positions are filled on a one- or two-year rotational basis and are excepted from the competitive civil service. The salaries are negotiable and range from \$39,689 to \$57,500 per annum (GS-14/15 equivalent). The openings are expected to be in the fields of modern analysis, applied mathematics, geometric analysis, and statistics and probability. Applicants should have a Ph.D. or equivalent experience and training in an appropriate field, plus six years of successful scientific research experience. A broad general knowledge of the field and some administrative experience are also required.
—*NSF Bulletin*

MATHEMATICAL SCIENCES ADMINISTRATIVE DIRECTORY

This directory, published annually, lists key personnel—officers and committee members—of 31 professional mathematical organizations and of a selected group of government agencies, editors of over 100 journals, over 3,000 heads of academic departments in the mathematical sciences, and heads

of mathematical units in nonacademic organizations. Information includes current addresses (including telephone numbers in many cases), terms of office, and other pertinent information for the organizations represented.

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Mathematical Psychology and Psychophysiology

Edited by Stephen Grossberg, Boston University

Understanding the mind and its neural substrates has long been one of the most challenging and important scientific problems confronting humanity. Experimental and theoretical progress in this area has recently accelerated to the point that our knowledge of brain processes is undergoing a revolutionary transformation. This volume contains articles by the invited speakers at a joint American Mathematical Society—Society for Industrial and Applied Mathematics Symposium on Mathematical Psychology and Psychophysiology in Philadelphia on April 15-16, 1980 at which several of the theoretical approaches to this area were reviewed.

The articles include contributions to a variety of topics and employ a variety of mathematical tools to explicate these topics. The topics include studies of de-

velopment, perception, learning, cognition, information processing, psychophysiology, and measurement. The mathematical tools include algebraic, stochastic, and dynamical system models and theorems. Despite this diversity, the reader can discover an underlying coherence among the papers. Various concepts and formal laws reoccur in several different subjects. Distinct mathematical tools often probe different levels of the same underlying physical mechanisms.

Showing the conceptual and mathematical interconnectedness of several approaches to the fundamental scientific problem of understanding mind and brain is a significant contribution of this volume. Its interdisciplinary approach permits a deeper understanding of theoretical advances as it formally structures a broad overview of important data.

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American Mathematical Society

P. O. Box 1571, Annex Station, Providence, Rhode Island 02901

College Park, October 30–31, 1982, University of Maryland

Program of the 797th Meeting

The seven hundred ninety-seventh meeting of the American Mathematical Society will be held at the University of Maryland, College Park, on Saturday and Sunday, October 30–31, 1982. All sessions will be held in the Mathematics Building, and the adjacent Physics Building.

Invited Addresses

By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there will be four invited one-hour addresses. The speakers and the titles of their lectures are as follows:

ROBERT FEFFERMAN, University of Chicago, *Fourier analysis with several parameters*.

DORIS FISCHER-COLBRIE, Columbia University, *Minimal submanifolds and their role in geometry*.

ALPHONSE VASQUEZ, Graduate School and University Center, City University of New York, *Hilbert modular varieties*.

SCOTT WOLPERT, University of Maryland, College Park, and Harvard University, *The Kähler geometry of Teichmüller space*.

Special Sessions

By invitation of the same committee, there will be thirteen sessions of selected twenty-minute papers.

Number theory, WILLIAM W. ADAMS and LAWRENCE C. WASHINGTON, University of Maryland, College Park. The speakers are Greg W. Anderson, David M. Bressoud, W. Dale Brownawell, Henri Cohen, Gary Cornell, Benedict H. Gross, David Harbater, H. Kisilevsky, Andrew Klapper, Marvin I. Knopp, Jeffrey C. Lagarias, Francis Oisín McGuinness, Julia Mueller, M. Ram Murty, Carl Pomerance, H. M. Stark, and H. C. Williams.

Riemannian geometry, A. ADEBOYE, Howard University, and ALFRED GRAY, University of Maryland, College Park. The speakers will be Lance D. Drager, Alfred Gray, Leon Karp and McKenzie Y. Wang.

Differential equations, KATHY ALLIGOOD, University of Maryland, College Park. The speakers will be Rita Iannacci, J. Mallet-Paret, Mario U. Martelli, S. E. Newhouse, Zbigniew Nitecki, Roger D. Nussbaum, Stephan E. Pelikan, Helena S. Wisniewski, and James A. Yorke.

The legacy of Norbert Wiener, JOHN J. BENEDETTO, University of Maryland, College Park, and PESI R. MASANI, University of Pittsburgh. The speakers will be J. Bass, John J. Benedetto, George Benke, Stamatis Cambanis, Ward R. Evans, Edwin Hewitt, G. Kallianpur, Ka-Sing Lau, P. Masani, Robert R. Nelson, A. M. Odlyzko, Harry Pollard, and Guido Weiss.

Lie groups and generalized classical special functions, LAWRENCE C. BIEDENHARN, Duke

University. The speakers will be Richard Askey, L. Auslander, Kenneth Baclawski, Johan G. F. Belinfante, Charles F. Dunkl, Loyal Durand, Jacques Faraut, Philip Feinsilver, Daniel Flath, Bruno Gruber, Kenneth I. Gross, R. A. Gustafson, Robert Hermann, Wayne J. Holman III, F. T. Howard, Yehiel Ilamed, Kenneth D. Johnson, Tom H. Koornwinder, W. D. Lichtenstein, James D. Louck, Willard Miller, Jr., S. C. Milne, Walter G. Morris, Walter Schempp, Michael F. Singer, Audrey A. Terras, and Jacob Towber.

Differential geometry and 3-manifolds, R. BROOKS, WALTER D. NEUMANN, and SCOTT WOLPERT, University of Maryland, College Park. The speakers will be Mark D. Baker, Christopher B. Croke, Clifford J. Earle, David Gabai, William M. Goldman, Nancy Hingston, Irwin Kra, Francis D. Loneragan, Bernard Maskit, Howard A. Masur, Walter D. Neumann, Don B. Zagier, and Wolfgang Ziller.

Harmonic analysis, ROBERT FEFFERMAN. The speakers will be J. M. Ash, William Beckner, D. L. Burkholder, Anthony Carbery, Michael Christ, R. Coifman, E. B. Fabes, Allan Greenleaf, Henry Helson, David Jerison, R. L. Jones, Max Jodeit, Jr., Jeff E. Lewis, P. Masani, Benjamin Muckenhoupt, Umberto Neri, Wade C. Ramey, Walter Rudin, Cora Sadosky, Yoram Sagher, Elias M. Stein, Mitchell Taibleson, Peter A. Tomas, Stephen Wainger, Richard L. Wheeden, and J. Michael Wilson.

Mathematical physics, EVANS M. HARRELL, Johns Hopkins University. The speakers will be Tadeusz Balaban, Michael F. Barnsley, Barry A. Cipra, David W. Fox, Robert Nyden Hill, Ira Herbst, Martin Klaus, Mark A. Kon, Richard B. Lavine, John D. Morgan III, John F. Pierce, Penny D. Smith, Lawrence E. Thomas, and C. Eugene Wayne.

Minimal submanifolds in differential geometry, DAVID HOFFMAN, University of Massachusetts, Amherst. The speakers will be William K. Allard, F. J. Almgren, Jr., Michael T. Anderson, Antonio C. Asperti, Marcos Dajczer, James Eells, David Hoffman, H. Blaine Lawson, Jr., Tilla Klotz Milnor, Frank Morgan, Brian Smyth, Chuu Lian Terng, and Brian White.

Complex analysis, JOHN R. QUINE, Florida State University. The speakers will be Carlos A. Berenstein, B. A. Case, J. A. Cima, David Drasin, David H. Hamilton, Linda Keen, Albert E. Livingston, T. H. MacGregor, Peter A. McCoy, Sanford Miller, B. G. Osgood, Dorothy B. Shaffer, Herb Silverman, E. Silvia, and David E. Tepper.

Representation theory and automorphic forms, J. A. SHALIKA, Johns Hopkins University. The speakers will be Avner Ash, Leslie Cohn, Y. Flicker, B. Brent Gordon, A. W. Knap, I. Piatetski-Shapiro, Steve Rallis, Paul J. Sally, Jr., Freydoon Shahidi,

J. A. Shalika, D. Shelstad, Birgit Speh, and Gregg J. Zuckerman.

Topology of algebraic and analytic varieties, ALPHONSE VASQUEZ. The speakers will be James C. Alexander, Paul Baum, William Browder, Edwin Connell, Howard Garland, Robert Hardt, Peter Haskell, George R. Kempf, Henry B. Laufer, Ronnie Lee, Richard Mandelbaum, Jack Morava, Alphonse T. Vasquez, Karen Vogtmann, and Steven H. Weintraub.

Model theory, CAROL WOOD, Wesleyan University. The speakers will be Steven A. Buechler, Zoe Chatzidakis, Kevin J. Compton, Lou van den Dries, Laurence Kirby, Julia F. Knight, L. Lipshitz, James Loveys, Angus Macintyre, Alan H. Mekler, Anand Pillay, Mike Prest, David Rosenthal, Dan Saracino, James Schmerl, Stephen G. Simpson, and Rick L. Smith.

Contributed Papers

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

Other Organizations

The Association for Women in Mathematics (AWM) will have an informal meeting at 8:30 on Sunday morning in the Rotunda of the Mathematics Building, at which time coffee and doughnuts will be served. A scientific session will follow at 9:00 a.m. The name of the speaker and location of the session are not yet available.

Participants should note that the Mid-Atlantic Model Theory Conference will be meeting at College Park starting at 2:00 p.m. on Friday, October 29. There will be hour talks by WARD HENSON of the University of Illinois and VICTOR HARNIK, University of Haifa and University of Notre Dame.

Registration

The registration desk will be located in the Rotunda (lobby) of the Mathematics Building. It will be open from 8:30 a.m. to 4:30 p.m. on Saturday, and from 8:30 a.m. to 12:30 p.m. on Sunday. The registration fees will be \$10 for members, \$16 for nonmembers, and \$5 for students and unemployed mathematicians.

Accommodations

Blocks of rooms are being held for participants at the following area motels. Individuals should have made reservations prior to the cut-off date of **October 1**. Rates do not include the 5 percent Maryland tax. Distances to the Mathematics Building are shown in parentheses.

Best Western Maryland Inn (.75 miles)
8601 Baltimore Avenue 20740
Telephone: 301-474-2800

Single \$36 Double \$42

Centre for Adult Education (1 mile)
University Boulevard & Adelphi Road 20742
Telephone: 301-454-2325

Single \$37 Double \$45

This hotel is on the campus of the University of Maryland, but only has rooms available for the night of October 30.

Quality Inn (.8 miles)
7200 Baltimore Avenue 20740
Telephone: 301-864-5820

Single \$36.50 Double \$42.50

Although rooms **have not been blocked** at the following motels, and current rates are not available, they are included here for information purposes.

Best Western Royal Pine Motel (1.25 miles)
9113 Baltimore Avenue 20740
Telephone: 301-345-4900

Holiday Inn College Park (1.4 miles)
9137 Baltimore Avenue 20740
Telephone: 301-345-5000

Holiday Inn Capitol Beltway (2.4 miles)
10000 Baltimore Avenue 20740
Telephone: 301-345-6700 or 800-238-8000

Food Service

A cafeteria located in the Adult Education Center will be open from 8:00 a.m. to 7:00 p.m. on Saturday, and from 8:30 a.m. to 9:00 p.m. on Sunday. In addition, many restaurants located on Baltimore Avenue are within easy walking distance of the Mathematics Building. A list of restaurants will be available at the registration desk.

Parking

Two large lots are located close to the Mathematics Building, and there are no parking restrictions on Saturday or Sunday. One lot is off Baltimore Avenue near Campus Drive; the other is off Stadium Drive.

Travel

College Park is located northeast of the capitol building. The best route for those coming by car is to take exit 27 off the Beltway (Interstate 495), which is Baltimore Avenue (Route 1), and proceed southwest for about two and one-half miles.

The most convenient airport for those arriving by air is Baltimore-Washington International, where limousine service leaves at regular intervals all day and brings passengers to the Greenbelt Terminal building, where passengers transfer to smaller vehicles which stop at the motels listed above. The fare is \$11 for one passenger, or \$16.50 for anywhere from two to five passengers.

Limousine service is also available from National and Dulles Airports; however, reservations must be made 24 hours in advance by calling 301-622-0700. The fare is \$10 per person from National and \$15 from Dulles Airports.

Participants coming by train should take the red line metro to Silver Springs. Leave the train at Brookland, and then take the R-2 bus line marked Calverton.

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Program of the Sessions

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

Abstracts of papers presented in AMS sessions at this meeting will be found in the October 1982 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

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

Saturday, 8:00 a.m.

Special Session on Harmonic Analysis, I

Mathematics Building, Room 3206

- 8:00– 8:20 (1) *Fourier transformation as integration with respect to a vector measure*. P. MASANI, University of Pittsburgh, Pittsburgh (797-43-113)
- 8:25– 8:45 (2) *Parametrixes for a class of totally characteristic operators*. JEFF E. LEWIS*, University of Illinois, Chicago, and CESARE PARENTI, Istituto Matematico S. Pincherle, Italy (797-35-14)
- 8:50– 9:10 (3) *The failure of L^p estimates for harmonic measure in chord-arc domains*. Preliminary report. DAVID JERISON, Massachusetts Institute of Technology (797-30-17)
- 9:15– 9:35 (4) *Applications of vector valued inequalities of Grothendieck type to moment and weighted problems*. Preliminary report. MISCHA COTLAR, Universidad Central de Venezuela, Caracas, and CORA SADOSKY*, Howard University (797-42-18)
- 9:40–10:00 (5) *Some exotic maximal operators*. ALLAN GREENLEAF, Massachusetts Institute of Technology (797-42-19)
- 10:05–10:25 (6) *Cocycles on compact groups with ordered duals*. HENRY HELSON, University of California, Berkeley (797-42-20)
- 10:30–10:50 (7) *Invariant algebras in the ball*. WALTER RUDIN, University of Wisconsin, Madison (797-32-32)

Saturday, 8:00 a.m.

Special Session on Lie Groups and Generalized Classical Special Functions, I

Physics Building, Room 1412

- 8:00– 8:20 (8) *Sieved Jacobi polynomials*. Preliminary report. RICHARD ASKEY, University of Wisconsin, Madison (797-33-03)
- 8:25– 8:45 (9) *Special functions, differential algebra and linear system theory*. ROBERT HERMANN, Association for Physical and Systems Mathematics, Inc. (797-33-103)
- 8:50– 9:10 (10) *Special functions for the symmetric space of positive matrices*. AUDREY A. TERRAS, University of California, San Diego (797-33-89)
- 9:15– 9:35 (11) *Orthogonal polynomials with a Z_3 -symmetry*. Preliminary report. CHARLES F. DUNKL, University of Virginia (797-33-99)
- 9:40–10:00 (12) *Generalized special functions and the Wigner transform*. Preliminary report. L. AUSLANDER*, R. TOLIMIERI and S. WINOGRAD, Graduate School, City University of New York (797-33-108)
- 10:05–10:25 (13) *The BCH formula: Application of special functions to Lie algebras*. Preliminary report. JOHAN G. F. BELINFANTE, Georgia Institute of Technology (797-33-117)
- 10:30–10:50 (14) *Representation theory of Meixner polynomials*. PHILIP FEINSILVER, Southern Illinois University, Carbondale (797-33-144)

Saturday, 8:25 a.m.

Special Session on Number Theory, I

Mathematics Building, Room 0306

- 8:25– 8:45 (15) *Heuristics on class groups of quadratic fields*. Preliminary report. HENRI COHEN, University of Maryland, College Park (797-10-139) (Introduced by William W. Adams)
- 8:50– 9:10 (16) *Some results concerning nearest integer continued fractions in $Q(\sqrt{D})$ and $Q(\sqrt[3]{D})$* . H. C. WILLIAMS, University of Manitoba (797-12-41)
- 9:15– 9:35 (17) *On the distribution of round numbers*. CARL POMERANCE, University of Georgia (797-10-55)
- 9:40–10:00 (18) *Applications of analytic number theory in the counting of finite groups*. M. RAM MURTY*, McGill University, and V. KUMAR MURTY, Institute for Advanced Study (797-10-105)

- 10:05–10:25 (19) *Exponential growth of the rank of the class group of the maximal real subfield of cyclotomic fields.* GARY CORNELL, University of Connecticut, Storrs (797-12-178)
- 10:30–10:50 (20) *Cohomology of the units in certain Z_p -extensions.* Preliminary report. H. KISILEVSKY, Concordia University (797-12-167)

Saturday, 8:25 a.m.

Special Session on Model Theory, I

Mathematics Building, Room 0304

- 8:25– 8:45 (21) *Countable models of stable theories.* ANAND PILLAY, McGill University (797-03-154)
- 8:50– 9:10 (22) *Geometry in superstable theories, I.* STEVEN A. BUECHLER, Yale University (797-03-114)
- 9:15– 9:35 (23) *On uniqueness of envelopes in \aleph_0 -categorical, \aleph_0 -stable structures.* Preliminary report. JAMES LOVEYS, Simon Fraser University (797-03-153)
- 9:40–10:00 (24) *Recursive definability in ω -stable theories of finite rank.* Preliminary report. JULIA F. KNIGHT*, University of Notre Dame, and ALISTAIR H. LACHLAN, Simon Fraser University (797-03-104)
- 10:05–10:25 (25) *Degrees of recursively saturated models of PA.* ANGUS MACINTYRE* and DAVID MARKER, Yale University (797-03-173)
- 10:30–10:50 (26) *Categoricity results for $L_{\infty\kappa}$ -free algebras.* PAUL C. EKLOF, University of California, Irvine, and ALAN H. MEKLER*, Simon Fraser University (797-03-98)

Saturday, 8:50 a.m.

Special Session on Minimal Submanifolds in Differential Geometry, I

Mathematics Building, Room 0307

- 8:50– 9:10 (27) *Complete area-minimizing hypersurfaces in non-compact manifolds.* MICHAEL T. ANDERSON, Rice University (797-53-107)
- 9:15– 9:35 (28) *Minimal surfaces in 3-manifolds of positive scalar curvature.* H. BLAINE LAWSON, JR., State University of New York, Stony Brook (797-53-212)
- 9:40–10:00 (29) *Stationary surfaces with boundary on a tetrahedron.* BRIAN SMYTH, University of Notre Dame (797-53-215)
- 10:05–10:25 (30) *Generalized Bonnet transforms for Weingarten hypersurfaces in pseudo-Riemannian space forms.* Preliminary report. CHUU-LIAN TERNG, Northeastern University (797-53-213)
- 10:30–10:50 (31) *When is a map a Gauss map?* DAVID HOFFMAN*, University of Massachusetts, Amherst, and ROBERT OSSERMAN, Stanford University (797-53-141)

Saturday, 8:50 a.m.

Special Session on Mathematical Physics, I

Physics Building, Room 1410

- 8:50– 9:10 (32) *L^2 -exponential lower bounds to solutions of the Schrödinger equation.* RICHARD FROESE and IRA HERBST*, University of Virginia, MARIA HOFFMANN-OSTENHOF and THOMAS HOFFMANN-OSTENHOF, University of Vienna, Austria (797-35-80) (Introduced by Evans M. Harrell)
- 9:15– 9:35 (33) *Properties of resonance eigenfunctions.* Preliminary report. RICHARD B. LAVINE, University of Rochester (797-81-05)
- 9:40–10:00 (34) *On H_2^+ for small internuclear separation.* MARTIN KLAUS, Virginia Polytechnic Institute and State University (797-81-85) (Introduced by Evans M. Harrell)
- 10:05–10:25 (35) *On the analytic structure of ψ for an atom or molecule in an analytic potential.* ROBERT NYDEN HILL, University of Delaware, (797-81-21)
- 10:30–10:50 (36) *Convergence properties of Fock's expansion for helium atom eigenfunctions.* Preliminary report. JOHN D. MORGAN III, University of Delaware, (797-46-22) (Introduced by Robert Nyden Hill)

Saturday, 8:50 a.m.

Special Session on Complex Analysis, I

Mathematics Building, Room 0303

- 8:50– 9:10 (37) *A free boundary problem.* DAVID E. TEPPER, Baruch College, City University of New York (797-30-01)
- 9:15– 9:35 (38) *Optimal estimation of the derivative of bounded analytic functions.* T. J. RIVLIN, IBM Watson Research Center, and DOROTHY B. SHAFFER*, Fairfield University (797-30-08)
- 9:40–10:00 (39) *Support points of families of analytic functions.* D. J. HALLENBECK, University of Delaware, and T. H. MACGREGOR*, State University of New York, Albany (797-30-11)

- 10:05–10:25 (40) *On some explicit deconvolution formulas*. Preliminary report. CARLOS A. BERENSTEIN, University of Maryland, College Park (797-32-12)
- 10:30–10:50 (41) *Proper holomorphic mappings*. Preliminary report. J. A. CIMA*, University of North Carolina, Chapel Hill, and T. J. SUFFRIDGE, University of Kentucky (797-30-132)

Saturday, 9:00 a.m.

Session on Analysis

Mathematics Building, Room 0103

- 9:00– 9:10 (42) *On uniqueness theorem for dock problems*. SHIH-LIANG WEN* and M. S. K. SASTRY, Ohio University, Athens (797-76-24)
- 9:15– 9:25 (43) *Series expansions of means*. H. W. GOULD and M. E. MAYS*, West Virginia University (797-10-77)
- 9:30– 9:40 (44) *On continuity of variation and the Fourier transform of measures*. PETER H. MASERICK, Pennsylvania State University, University Park (797-43-101)
- 9:45– 9:50 (45) *On the Abel summability of the linear predictor of a stationary stochastic process*. Preliminary report. MOHSEN POURAHMADI, Northern Illinois University (797-60-102)
- 9:55–10:05 (46) *On closed operators with the spectral decomposition property*. I. ERDELYI*, Temple University, and WANG SHENGWANG, Nanjing University, People's Republic of China (797-47-125)
- 10:10–10:20 (47) *Some coefficient results for a class of analytic functions containing functions with positive real part*. Preliminary report. EDWARD J. MOULIS, United States Naval Academy (797-30-214)
- 10:25–10:35 (48) *The number π , just a special case after all*. TOM STEHNEY, Pennsylvania State University, New Kensington (797-51-166) (Introduced by David M. Wells)

Saturday, 9:15 a.m.

Special Session on Representation Theory and Automorphic Forms, I

Mathematics Building, Room 0101

- 9:15– 9:35 (49) *Eichler-Shimura relations for $U(3)$* . Y. FLICKER, Princeton University (797-22-189)
- 9:40–10:00 (50) *On the L -functions associated to exterior squares*. J. A. SHALIK, Johns Hopkins University (797-22-190)
- 10:05–10:25 (51) *Intertwining operators for $SL(r)$ over a p -adic field*. FREYDOON SHAHIDI, Purdue University (797-22-191)
- 10:30–10:50 (52) *Supercuspidal representations of SL_n over a p -adic field*. PAUL J. SALLY, JR.*, University of Chicago, and A. MOY, Yale University (797-22-216)

Saturday, 11:00 a.m.

Invited Address

Physics Building, Room 1412

- 11:00–12:00 (53) *Fourier analysis with several parameters*. ROBERT A. FEFFERMAN, University of Chicago (797-42-13)

Saturday, 1:00 p.m.

Invited Address

Physics Building, Room 1412

- 1:00– 2:00 (54) *Hilbert modular varieties*. ALPHONSE T. VASQUEZ, Graduate School and University Center, City University of New York (797-32-176)

Saturday, 2:10 p.m.

Special Session on Minimal Submanifolds in Differential Geometry, II

Mathematics Building, Room 0307

- 2:10– 2:30 (55) *On the structure of the family of minimal submanifolds of a sphere*. Preliminary report. WILLIAM K. ALLARD, Duke University (797-53-195)
- 2:35– 2:55 (56) *Multiple valued functions and minimal surfaces*. Preliminary report. F. J. ALMGREN, JR., Princeton University (797-49-161)
- 3:00– 3:20 (57) *Examples of unoriented area-minimizing surfaces*. FRANK MORGAN, Rice University (797-49-140)
- 3:25– 3:45 (58) *Existence of least-area mappings of N -dimensional domains*. Preliminary report. BRIAN WHITE, Courant Institute, New York University (797-49-200)

Saturday, 2:10 p.m.

Special Session on Number Theory, II

Mathematics Building, Room 0306

- 2:10– 2:30 (59) *The Cassels pairing in a family of elliptic curves*. FRANCIS OISIN MCGUINNESS, University of Virginia (797-12-72)

- 2:35– 2:55 (60) *Galois extensions of arithmetic power series rings*. Preliminary report. DAVID HARBATER, University of Pennsylvania, Philadelphia (797-12-181)
- 3:00– 3:20 (61) *Heegner points on $X_0(N)$* . Preliminary report. BENEDICT H. GROSS, Brown University (797-12-15)
- 3:25– 3:45 (62) *Canonical subgroups of formal groups and Selmer group estimates*. Preliminary report. ANDREW KLAPPER, Clark University (797-12-75)
- 3:50– 4:10 (63) *The motivic interpretation of the generalized Jacobi sum Hecke characters*. GREG W. ANDERSON, Harvard University (797-10-169)

Saturday, 2:10 p.m.

Special Session on Topology of Algebraic and Analytic Varieties, I Mathematics Building, Room 0106

- 2:10– 2:30 (64) *Unramified extensions*. EDWIN CONNELL, University of Miami (797-14-52)
- 2:35– 2:55 (65) *Weighted partitions and cycles*. Preliminary report. GEORGE R. KEMPF, Johns Hopkins University (797-14-58)
- 3:00– 3:20 (66) *A special case of Zariski's multiplicity question*. Preliminary report. HENRY B. LAUFER, State University of New York, Stony Brook (797-32-120)
- 3:25– 3:45 (67) *The codimension of a point in étale affine space*. JACK MORAVA, Johns Hopkins University (797-14-121)
- 3:50– 4:10 (68) *Complete intersection surfaces*. RICHARD MANDELBAUM*, University of Rochester, and ANATOLY LIBGOBER, University of Illinois, Chicago Circle (797-32-96)

Saturday, 2:10 p.m.

Special Session on Mathematical Physics, II Physics Building, Room 1410

- 2:10– 2:30 (69) *The Julia set for $(Z - \lambda)^2$, $-\infty < \lambda < \infty$* . MICHAEL F. BARNESLEY, Georgia Institute of Technology (797-70-147)
- 2:35– 2:55 (70) *Renormalization and field theory*. TADEUSZ BALABAN, Harvard University (797-35-163) (Introduced by Evans M. Harrell)
- 3:00– 3:20 (71) *Phase transitions for the ground states of quantum lattice systems*. JAMES R. KIRKWOOD and LAWRENCE E. THOMAS*, University of Virginia (797-81-119)
- 3:25– 3:45 (72) *The roughening transition in surface models with non-local potentials*. Preliminary report. JOHN Z. IMBRIE, Harvard University, and C. EUGENE WAYNE*, Institute for Mathematics and its Applications, Minneapolis (797-82-93) (Introduced by Evans M. Harrell)
- 3:50– 4:10 (73) *The partition function of the d -dimensional Ising model: a one variable integral formula*. ISAAC GOLDBIRSHCH, Massachusetts Institute of Technology, and BARRY A. CIPRA*, Applied Mathematics, Inc. (797-82-81)

Saturday, 2:10 p.m.

Special Session on Lie Groups and Generalized Classical Special Functions, II Physics Building, Room 1412

- 2:10– 2:30 (74) *Matrix elements of irreducible representations of $SU(2) \times SU(2)$ and vector-valued orthogonal polynomials*. TOM H. KOORNWINDER, Mathematical Centre, Amsterdam, The Netherlands (797-33-145)
- 2:35– 2:55 (75) *Volterra algebras and the spherical Laplace transform on hyperboloids*. Preliminary report. JACQUES FARAUT, Université Louis Pasteur, France (797-43-160) (Introduced by Lawrence C. Biedenharn)
- 3:00– 3:20 (76) *Extensions of the Euler and Cauchy beta integrals via root systems*. Preliminary report. WALTER G. MORRIS, University of Wisconsin, Madison (797-33-159)
- 3:25– 3:45 (77) *Schur functions and the invariant polynomials characterizing $U(n)$ tensor operators*. R. A. GUSTAFSON and S. C. MILNE*, Texas A&M University, College Station (797-33-158)
- 3:50– 4:10 (78) *Indecomposable representations of the Heisenberg-Weyl group and their realization in terms of special functions*. BRUNO GRUBER*, Southern Illinois University, Carbondale, H. D. DOEBNER, Technische Universität Clausthal, Federal Republic of Germany, and PHILIP J. FEINSILVER, Southern Illinois University, Carbondale (797-33-157)
- 4:15– 4:35 (79) *Matrices of irreducible representations of $IU(n)$* . Preliminary report. WAYNE J. HOLMAN III, Bell Laboratories, Naperville (797-33-156)
- 4:40– 5:00 (80) *Group theoretical basis for addition and product formulas for Gegenbauer and Jacobi functions of the second kind*. Preliminary report. LOYAL DURAND, University of Wisconsin, Madison (797-33-182)

Saturday, 2:10 p.m.

Special Session on Model Theory, II

Mathematics Building, Room 0304

- 2:10– 2:30 (81) *Power series solutions of algebraic differential equations.* J. DENEFF, University of Leuven, Belgium, and L. LIPSHITZ*, Purdue University (797-03-155)
- 2:35– 2:55 (82) *Definable groups in characteristic 0 are algebraic groups.* LOU VAN DEN DRIES, Stanford University (797-03-170) (Introduced by Carol Wood)
- 3:00– 3:20 (83) *Free profinite groups.* ZOE CHATZIDAKIS, Yale University (797-03-53)
- 3:25– 3:45 (84) *Positive primitive types in module theory.* MIKE PREST, Northern Illinois University (797-03-127)
- 3:50– 4:10 (85) *QE commutative nilrings.* DAN SARACINO*, Colgate University, and CAROL WOOD, Wesleyan University (797-03-126)
- 4:15– 4:35 (86) *The order indiscernibles of divisible ordered abelian groups.* DAVID ROSENTHAL, Ithaca College (797-03-71)

Saturday, 2:10 p.m.

Special Session on The Legacy of Norbert Wiener, I

Mathematics Building, Room 0201

- 2:10– 3:00 (87) *Fourier transforms large and small.* EDWIN HEWITT, University of Washington (797-42-02)
- 3:05– 3:25 (88) *Stationary measures and the simplification of generalized harmonic analysis.* P. MASANI, University of Pittsburgh, Pittsburgh (797-43-115)
- 3:30– 3:50 (89) *Spectral analysis of continuous pseudo-measures.* Preliminary report. WARD R. EVANS, Catholic University of America (797-42-56)
- 3:55– 4:15 (90) *Some new developments on generalized harmonic analysis.* KA-SING LAU, University of Pittsburgh, Pittsburgh (797-42-50)
- 4:20– 4:40 (91) *The uncertainty principle and spectral estimation.* JOHN J. BENEDETTO, University of Maryland, College Park (797-42-09)
- 4:45– 5:05 (92) *The Wiener-Plancherel formula in \mathbb{R}^n .* Preliminary report. JOHN J. BENEDETTO, University of Maryland, College Park, GEORGE BENKE*, Georgetown University, and WARD R. EVANS, Catholic University (797-42-65)

Saturday, 2:10 p.m.

Special Session on Harmonic Analysis, II

Mathematics Building, Room 3206

- 2:10– 2:30 (93) *New proofs for the maximal ergodic theorem and Hardy-Littlewood's weak type result for their maximal operator.* R. L. JONES, DePaul University (797-42-26)
- 2:35– 2:55 (94) *Concentrating an exponential sum on a subset of the torus.* J. M. ASH* and R. L. JONES, DePaul University, and B. SAFFARI, Université de Paris XI, France (797-42-27)
- 3:00– 3:20 (95) *Weak types.* YORAM SAGHER, Syracuse University and University of Illinois, Chicago (797-42-28)
- 3:25– 3:45 (96) *Hardy's inequality with weights in two dimensions.* BENJAMIN MUCKENHOUT, Rutgers University, New Brunswick (797-26-30)
- 3:50– 4:10 (97) *The boundedness of the maximal Bochner-Riesz operator for $L^4(\mathbb{R}^2)$.* ANTHONY CARBERY, University of California, Los Angeles (797-42-31)
- 4:15– 4:35 (98) *Extendability of functions with fractional orders of differentiability.* MICHAEL CHRIST, Princeton University (797-42-34) (Introduced by Robert Fefferman)
- 4:40– 5:00 (99) *Cesàro and Riesz means at the critical index on spheres.* Preliminary report. LEONARDO COLZANI, University of Milan, Italy, MITCHELL TAIBLESON* and GUIDO WEISS, Washington University (797-42-37)

Saturday, 2:10 p.m.

Special Session on Complex Analysis, II

Mathematics Building, Room 0303

- 2:10– 2:30 (100) *A sharp form of the Ahlfors's distortion theorem.* Preliminary report. DAVID H. HAMILTON, University of Maryland, College Park (797-30-74)
- 2:35– 2:55 (101) *A class of meromorphic starlike functions.* ALBERT E. LIVINGSTON, University of Delaware (797-30-116)
- 3:00– 3:20 (102) *Estimates for the Poincaré metric.* B. G. OSGOOD, Harvard University (797-30-165)
- 3:25– 3:45 (103) *Subordination to convex functions.* Preliminary report. H. SILVERMAN, College of Charleston, and E. SILVIA*, University of California, Davis (797-30-29)

3:50– 4:10 (104) *Order of starlikeness for multipliers of univalent functions.* HERB SILVERMAN, College of Charleston (797-30-23)

Saturday, 2:10 p.m.

Special Session on Differential Geometry and 3-Manifolds, I Mathematics Building, Room 0103

- 2:10– 2:30 (105) *Link complements and the homology of arithmetic subgroups of $\mathrm{PSL}_2(\mathbb{C})$.* MARK D. BAKER, Institut des Hautes Études Scientifiques, France (797-51-223)
- 2:35– 2:55 (106) *On the volume of metric balls.* CHRISTOPHER B. CROKE, University of Pennsylvania (797-53-95)
- 3:00– 3:20 (107) *Families of open Riemann surfaces.* CLIFFORD J. EARLE*, Cornell University, and ROBERT S. FOWLER, Pennsylvania State University, Media (797-32-92)
- 3:25– 3:45 (108) *The topological embedding problem.* DAVID GABAI, Institute for Advanced Study (797-57-42)
- 3:50– 4:10 (109) *Uniformizing closed 3-manifolds as quotients of convex domains in RP^3 by groups of collineations.* Preliminary report. WILLIAM M. GOLDMAN, Massachusetts Institute of Technology (797-53-62)
- 4:15– 4:35 (110) *Equivariant Morse theory and closed geodesics.* NANCY HINGSTON, University of Pennsylvania (797-53-49)
- 4:40– 5:00 (111) *Self-maps of Riemann surfaces.* Preliminary report. IRWIN KRA, State University of New York, Stony Brook (797-30-46)

Saturday, 2:10 p.m.

Special Session on Representation Theory and Automorphic Forms, II Mathematics Building, Room 0101

- 2:10– 2:30 (112) *A formula for minimal K -types.* A. W. KNAPP, Cornell University (797-22-16)
- 2:35– 2:55 (113) *Endoscopic groups.* D. SHELSTAD, Rutgers University NCAS and the Institute for Advanced Study (797-22-33)
- 3:00– 3:20 (114) *Injectivity of lifting problems.* STEVE RALLIS, Ohio State University, Columbus (797-22-73) (Introduced by J. A. Shalika)
- 3:25– 3:45 (115) *Automorphic cohomology of discrete groups and representation theory of reductive groups.* Preliminary report. BIRGIT SPEH, Cornell University (797-22-83)
- 3:50– 4:10 (116) *Ghost classes.* Preliminary report. AVNER ASH, Ohio State University, Columbus (797-22-76)

Saturday, 2:10 p.m.

Special Session on Differential Equations, I

Mathematics Building, Room 421

- 2:10– 2:30 (117) *Entropy and volume growth rates.* Preliminary report. S. E. NEWHOUSE, University of North Carolina, Chapel Hill (797-58-134)
- 2:35– 2:55 (118) *Elliptic eigenvalue problems and the Krein-Rutman Theorem.* ROGER D. NUSSBAUM, Rutgers University, New Brunswick (797-34-209)
- 3:00– 3:20 (119) *Singularly perturbed delay equations in optical and biological models: global continuation of periodic solutions to singular equations.* J. MALLET-PARET, Michigan State University (797-39-198)
- 3:25– 3:45 (120) *Unbounded connected components of solutions of Functional Differential Equations.* Preliminary report. MARIO U. MARTELLI, Bryn Mawr College (797-34-206)
- 3:50– 4:10 (121) *Transient chaos.* Preliminary report. JAMES A. YORKE, University of Maryland, College Park (797-34-207)

Saturday, 3:50 p.m.

Session on Topology

Mathematics Building, Room 0307

- 3:50– 4:00 (122) *Simplicial cohomology is Hochschild cohomology.* MURRAY GERSTENHABER*, University of Pennsylvania, and S. D. SCHACK, State University of New York, Buffalo (797-55-36)
- 4:05– 4:15 (123) *A Gauss-Bonnet theorem for a smooth simplicial complex.* Preliminary report. GERALD R. CHACHERE, Howard University (797-57-180)
- 4:20– 4:30 (124) *Higher dimensional knot theory.* S. J. LOMONACO, JR., Institute for Defense Analyses (797-57-199)
- 4:35– 4:45 (125) *The bifurcation of periodic orbits of one-dimensional maps.* LOUIS BLOCK* and DAVID HART, University of Florida (797-54-205)

4:50– 5:00 (126) *The étale cohomology of certain p -torsion sheaves.* WILLIAM HAWKINS, University of the District of Columbia (797-14-175)

Saturday, 4:10 p.m.

Session on Differential Equations

Mathematics Building, Room 421

- 4:10– 4:20 (127) *Picone-type theorems for hyperbolic differential equations.* Preliminary report. KURT KREITH, University of California, Davis (797-35-48)
- 4:25– 4:35 (128) *Integrals of graded isobaric systems of O.D.E.'s.* Preliminary report. LAWRENCE GOLDMAN, Stevens Institute of Technology (797-34-78)
- 4:40– 4:50 (129) *Multipoint boundary value problem for nonlinear differential equations.* JESUS RODRIGUEZ, North Carolina State University (797-34-82)

Sunday, 8:00 a.m.

Special Session on the Legacy of Norbert Wiener, II

Mathematics Building, Room 0201

- 8:00– 8:45 (130) *Linear filters, Wiener and non-Wiener.* Preliminary report. HARRY POLLARD, Purdue University, Lafayette (797-49-06)
- 8:50– 9:10 (131) *A generalization of Wiener's theorem on Fourier-Stieltjes transforms.* ROBERT R. NELSON, Mary Washington College (797-43-100)
- 9:15– 9:35 (132) *Nonlinear filtering and prediction: Wiener's work and its later developments.* G. KALLIANPUR, University of North Carolina, Chapel Hill (797-60-64) (Introduced by John J. Benedetto)
- 9:40–10:00 (133) *Applications of generalized harmonic analysis.* J. BASS, Université de Paris VI, France (797-76-10) (Introduced by Pesi R. Masani)
- 10:05–10:25 (134) *Prediction of stable processes: spectral and moving average representations.* Preliminary report. STAMATIS CAMBANIS* and A. REZA SOLTANI, University of North Carolina, Chapel Hill (797-60-39) (Introduced by John J. Benedetto)
- 10:30–10:50 (135) *An extension of the Wiener-Masani theorem.* GUIDO WEISS, Washington University, St. Louis (797-46-194)
- 11:00–11:20 (136) *Spectrum analysis of zeros of the Riemann zeta function.* A. M. ODLYZKO, Bell Laboratories, Murray Hill (797-10-142)

Sunday, 8:00 a.m.

Special Session on Lie Groups and Generalized Classical Special Functions, III Physics Building, Room 1412

- 8:00– 8:20 (137) *Multipole potentials for $SU(n)$ and $SO(n)$.* Preliminary report. W. D. LICHTENSTEIN, University of Georgia (797-22-47)
- 8:25– 8:45 (138) *Radar detection, quantum mechanics, and nilpotent harmonic analysis.* Preliminary report. WALTER SCHEMPF, Universität Siegen, Federal Republic of Germany (797-43-07)
- 8:50– 9:10 (139) *Special functions obtained by variable separation of the Helmholtz equation on the n -sphere and in n -dimensional Euclidean space.* WILLARD MILLER, JR.*, University of Minnesota, Minneapolis, and E. G. KALNINS, University of Waikato, New Zealand (797-22-69)
- 9:15– 9:35 (140) *On realizations of Lie algebras and polynomials in noncommuting indeterminates.* YEHIEL ILAMED, Soreq NRC, Israel (797-17-87)
- 9:40–10:00 (141) *An algebra of operators on a representation of sl_3 .* Preliminary report. DANIEL FLATH, Duke University (797-17-88) (Introduced by Lawrence C. Biedenharn)
- 10:05–10:25 (142) *Theory of $SU(3)$ canonical tensor operators.* Preliminary report. JAMES D. LOUCK*, Los Alamos National Laboratory, and LAWRENCE C. BIEDENHARN, Duke University (797-20-130)
- 10:30–10:50 (143) *The shape-algebra and zonal polynomials.* JACOB TOWBER, Yale University (797-22-218) (Introduced by Lawrence C. Biedenharn)

Sunday, 8:25 a.m.

Special Session on Differential Geometry and 3-Manifolds, II

Mathematics Building, Room 0103

- 8:25– 8:45 (144) *The action of the mapping class group of a handlebody on a space of foliations.* HOWARD A. MASUR, University of Illinois, Chicago Circle (797-57-179)
- 8:50– 9:10 (145) *Some locally free Kleinian groups.* BERNARD MASKIT, State University of New York, Stony Brook (797-30-61)

- 9:15– 9:35 (146) *Zeta-functions of number fields at $s = 2$ and volumes of hyperbolic 3-manifolds*. Preliminary report. DON B. ZAGIER, University of Maryland, College Park (797-12-63) (Introduced by Walter D. Neumann)
- 9:40–10:00 (147) *Asymptotic behavior of the length of closed geodesics*. WOLFGANG ZILLER, University of Pennsylvania (797-53-94)
- 10:05–10:25 (148) *Volumes of hyperbolic 3-manifolds*. Preliminary report. WALTER D. NEUMANN* and DON ZAGIER, University of Maryland, College Park, and Max-Planck-Institut für Mathematik, Federal Republic of Germany (797-51-60)
- 10:30–10:50 (149) *A candidate for a counterexample to the 3-dimensional Poincaré conjecture*. Preliminary report. FRANCIS D. LONERGAN, Webster, Massachusetts (797-55-35)

Sunday, 8:25 a.m.

Special Session on Harmonic Analysis, III

Mathematics Building, Room 3206

- 8:25– 8:45 (150) *Weighted norm inequalities for fractional integrals*. RICHARD L. WHEEDEN*, Rutgers University, New Brunswick, and JAN-OLOF STRÖMBERG, University of Tromsø, Norway (797-42-38)
- 8:50– 9:10 (151) *Approximate identities and $H^1(R)$* . Preliminary report. AKIHITO UCHIYAMA and J. MICHAEL WILSON*, University of Chicago (797-42-40) (Introduced by Robert Fefferman)
- 9:15– 9:35 (152) *Convexity, convolution and symmetry*. Preliminary report. WILLIAM BECKNER, University of Chicago (797-42-54)
- 9:40–10:00 (153) *Boundary behavior of bounded holomorphic functions along maximally complex submanifolds*. WADE C. RAMEY, Massachusetts Institute of Technology (797-32-57)
- 10:05–10:25 (154) *The Titchmarsh integral and singular integrals of L^1 functions*. MAX JODEIT, JR., University of Minnesota, Minneapolis (797-42-67)
- 10:30–10:50 (155) *Multilinear Littlewood-Paley estimates and applications to p.d.e.* E. B. FABES* and C. E. KENIG, University of Minnesota, Minneapolis, and D. S. JERISON, Massachusetts Institute of Technology (797-42-68)

Sunday, 8:25 a.m.

Special Session on Number Theory, III

Mathematics Building, Room 0306

- 8:25– 8:45 (156) *Kronecker's limit formula and elliptic functions*. H. M. STARK, University of California, San Diego (797-12-168)
- 8:50– 9:10 (157) *Modular integrals on $\Gamma_0(N)$ with rational period functions*. Preliminary report. MARVIN I. KNOPP, Temple University (797-10-138)
- 9:15– 9:35 (158) *Big counterexamples to Artin's conjecture*. W. DALE BROWNAWELL, Pennsylvania State University, University Park (797-10-177)
- 9:40–10:00 (159) *Gaps between sign changes of $S(t)$* . JULIA MUELLER, Fordham University (797-10-222)
- 10:05–10:25 (160) *The set of primes dividing the Lucas numbers has natural density $2/3$* . Preliminary report. JEFFREY C. LAGARIAS, Bell Laboratories, Murray Hill (797-10-04)
- 10:30–10:50 (161) *A constructive proof of the q -analog of Pfaff-Saalschutz*. GEORGE E. ANDREWS and DAVID M. BRESSOUD*, Pennsylvania State University, University Park (797-10-66)

Sunday, 8:25 a.m.

Special Session on Mathematical Physics, III

Physics Building, Room 1410

- 8:25– 8:45 (162) *Bounds for sloshing eigenvalues by conformal mapping*. DAVID W. FOX, Air Force Office of Scientific Research (797-65-146) (Introduced by Evans M. Harrell)
- 8:50– 9:10 (163) *Generalized Morse theory in the context of elastostatics: a prototypical problem*. JOHN F. PIERCE, Johns Hopkins University (797-73-97)
- 9:15– 9:35 (164) *Generalized Schrödinger semigroups*. DAVID GURARIE, Oregon State University, and MARK A. KON*, Boston University (797-46-197)
- 9:40–10:00 (165) *Removable singularities, nonlinear elliptic systems and weighted Sobolev spaces*. PENNY D. SMITH, Johns Hopkins University (797-35-148)
- 10:00–10:50 Problem Session

Sunday, 8:30 a.m.

The Association for Women in Mathematics

Mathematics Building, Rotunda

- 8:30– 9:00 Informal Meeting
- 9:00– Scientific Session

Sunday, 8:50 a.m.

Special Session on Complex Analysis, III

Mathematics Building, Room 0303

- 8:50– 9:10 (166) *Univalent solutions of Briot-Bouquet differential equations*. Preliminary report. SANFORD MILLER*, State University of New York, Brockport, and PETRU MOCANU, Babeş-Bolyai University, Romania (797-30-43)
- 9:15– 9:35 (167) *A new holomorphic parameter for the Teichmüller space of a punctured torus*. LINDA KEEN, Herbert H. Lehman College, City University of New York (797-30-84)
- 9:40–10:00 (168) *Characterization of solutions to the generalized Cauchy-Riemann system*. PETER A. MCCOY, United States Naval Academy (797-30-45)
- 10:05–10:25 (169) *Entire functions having prescribed asymptotic values and functions*. DAVID DRASIN, Purdue University (797-30-149)
- 10:30–10:50 (170) *On the Bazilevičness of certain functions*. B. A. CASE* and J. R. QUINE, Florida State University (797-30-150)

Sunday, 8:50 a.m.

Special Session on Model Theory, III

Mathematics Building, Room 0304

- 8:50– 9:10 (171) *Applications of a Tauberian theorem to finite model theory*. KEVIN J. COMPTON, Wesleyan University (797-03-90)
- 9:15– 9:35 (172) *Peano arithmetic and hyper-Ramsey logic*. Preliminary report. JAMES SCHMERL, University of Connecticut, Storrs (797-03-172)
- 9:40–10:00 (173) *The 2-3 problem and ultrafilters on the coded sets*. LAURENCE KIRBY, Baruch College, City University of New York (797-03-171) (Introduced by Carol Wood)
- 10:05–10:25 (174) *Subsystems of second order arithmetic*. STEPHEN G. SIMPSON, Pennsylvania State University, University Park (797-03-128)
- 10:30–10:50 (175) *Model theory within second order arithmetic*. RICK L. SMITH, University of Florida (797-03-217)

Sunday, 8:50 a.m.

Special Session on Topology of Algebraic and Analytic Varieties, II

Mathematics Building, Room 0106

- 8:50– 9:10 (176) *On the de Rham invariant of fibered manifolds*. JAMES C. ALEXANDER, University of Maryland, College Park (797-55-122)
- 9:15– 9:35 (177) *The uniform continuity of the logarithm of a holomorphic function with a Lipschitz twisting null set*. Preliminary report. ROBERT HARDT, University of Minnesota, Minneapolis (797-32-204)
- 9:40–10:00 (178) *A variation of Chern-Weil theory*. Preliminary report. HOWARD GARLAND, Yale University (797-53-151)
- 10:05–10:25 (179) *Index theory of curves*. Preliminary report. PETER HASKELL, Purdue University (797-55-152)
- 10:30–10:50 (180) *K homology and Riemann-Roch*. PAUL BAUM, Brown University (797-55-187)

Sunday, 9:15 a.m.

Special Session on Minimal Submanifolds in Differential Geometry, III

Mathematics Building, Room 0307

- 9:15– 9:35 (181) *On the construction of certain minimal immersions*. JAMES EELLS, University of Warwick, England (797-53-109)
- 9:40–10:00 (182) *Surfaces in Minkowski 3-space on which mean curvature vanishes*. Preliminary report. TILLA KLOTZ MILNOR, Rutgers University, New Brunswick (797-53-162)
- 10:05–10:25 (183) *Rigidity of complete minimal submanifolds*. Preliminary report. MARCOS DAJCZER, IMPA, Rio de Janeiro, Brazil (797-53-221)
- 10:30–10:50 (184) *Surfaces with constant non-zero normal curvature*. Preliminary report. ANTONIO C. ASPERTI, State University of New York, Stony Brook (797-53-220) (Introduced by David Hoffman)

Sunday, 9:15 a.m.

Special Session on Representation Theory and Automorphic Forms, III

Mathematics Building, Room 0101

- 9:15– 9:35 (185) *Continuous cohomology and Hodge numbers*. GREGG J. ZUCKERMAN*, Yale University, and DAVID A. VOGAN, Massachusetts Institute of Technology (797-22-111)

- 9:40–10:00 (186) *The Selberg trace formulas for products of $SU(1,2)$* . LESLIE COHN, Rutgers University, New Brunswick (797-22-118)
- 10:05–10:25 (187) *Kuga fiber varieties, intersection numbers and Siegel modular forms*. Preliminary report. B. BRENT GORDON, University of Maryland, College Park (797-10-133)
- 10:30–10:50 (188) *Cuspidal automorphic representations associated to parabolic subgroups*. I. PIATETSKI-SHAPIO, Yale University and Tel-Aviv University, Israel (797-22-188) (Introduced by G. D. Mostow)

Sunday, 9:15 a.m.

Special Session on Differential Equations, II

Mathematics Building, Room 421

- 9:15– 9:35 (189) *On the structure of quasi-attractors*. Preliminary report. ZBIGNIEW NITECKI, National Science Foundation and Tufts University (797-58-210)
- 9:40–10:00 (190) *Periodic solutions of generalized Liénard equations with delay*. ESPEDITO DE PASCALE and RITA IANNACCI*, Università della Calabria, Italy (797-34-211) (Introduced by Mario U. Martelli)
- 10:05–10:25 (191) *Global asymptotic volume estimates with examples*. HELENA S. WISNIEWSKI, Rochester Institute of Technology (797-58-219)
- 10:30–10:50 (192) *Random maps of the interval*. Preliminary report. STEPHAN E. PELIKAN, University of Maryland, College Park (797-34-208) (Introduced by James A. Yorke)

Sunday, 11:00 a.m.

Invited Address

Physics Building, Room 1412

- 11:00–12:00 (193) *Minimal submanifolds and their role in geometry*. DORIS FISCHER-COLBRIE, Columbia University (797-53-86)

Sunday, 1:00 p.m.

Invited Address

Physics Building, Room 1412

- 1:00– 2:00 (194) *The Kähler geometry of Teichmüller space*. SCOTT WOLPERT, University of Maryland, College Park, and Harvard University (797-30-129)

Sunday, 1:00 p.m.

Special Session on Lie Groups and Generalized Classical Special Functions, IV Physics Building, Room 1410

- 1:00– 1:20 (195) *Solving n th order homogeneous linear differential equations in terms of 2nd order differential equations*. Preliminary report. MICHAEL F. SINGER, North Carolina State University (797-12-143)
- 1:25– 1:45 (196) *Integers related to the Bessel function $J_1(x)$* . Preliminary report. F. T. HOWARD, Wake Forest University (797-33-183)
- 1:50– 2:10 (197) *Boundary values of harmonic functions*. Preliminary report. KENNETH D. JOHNSON, University of Georgia (797-22-184)
- 2:15– 2:35 (198) *Generalised Bessel functions in harmonic analysis, physics and statistics*. KENNETH I. GROSS*, University of Wyoming, and DONALD ST. P. RICHARDS, University of North Carolina, Chapel Hill (797-33-186)
- 2:40– 3:00 (199) *An umbral calculus for Biedenharn-Milne G -functions*. R. A. GUSTAFSON* and S. C. MILNE, Texas A&M University, College Station (797-33-193)
- 3:05– 3:25 (200) *A combinatorial algorithm for computing intertwining numbers over $SU(n)$* . Preliminary report. KENNETH BACLAWSKI, Haverford College (797-22-196)

Sunday, 2:10 p.m.

General Session

Mathematics Building, Room 0201

- 2:10– 2:30 (201) *Hecke theory over arbitrary number fields*. Preliminary report. ROBERT STYER, Temple University (797-10-44)
- 2:25– 2:35 (202) *On involutions in a finite Bol loop*. V. S. RAMAMURTHI, University of Ife, Nigeria (797-20-110)
- 2:40– 2:50 (203) *Semigroups and automata*. Preliminary report. STEVEN F. TARACEVICZ, United States Naval Academy (797-68-124) (Introduced by Bao Ting Lerner)

- 2:55– 3:05 (204) *Necessary and sufficient conditions for single-peakedness along a linearly ordered set of policy alternatives.* PETER J. COUGHLIN*, University of Maryland, College Park, and MELVIN J. HINICH, Virginia Polytechnic Institute and State University (797-90-174) (Introduced by Charles R. Johnson)

Sunday, 2:10 p.m.

Special Session on Harmonic Analysis, IV

Mathematics Building, Room 3206

- 2:10– 2:30 (205) *An H^p theory for symmetric spaces.* Preliminary report. PETER A. TOMAS, University of Texas, Austin (797-42-112) (Introduced by Robert Fefferman)
- 2:35– 2:55 (206) *Some new function spaces with application to nonlinear analysis.* R. COIFMAN*, Yale University, YVES MEYER, École Polytechnique, Palaiseau, France, and E. M. STEIN, Princeton University (797-42-164)
- 3:00– 3:20 (207) *Temperatures of C^1 domains.* Preliminary report. UMBERTO NERI, University of Maryland, College Park (797-35-201)
- 3:25– 3:45 (208) *Hilbert transforms along curves.* STEPHEN WAINGER, University of Wisconsin, Madison (797-44-202)
- 3:50– 4:10 (209) *Maximal functions in \mathbf{R}^n , for large n .* ELIAS M. STEIN, Princeton University (797-42-224)
- 4:15– 4:35 (210) *The unconditional constant of the Haar basis of L^p .* D. L. BURKHOLDER, University of Illinois, Urbana (797-42-25)

Sunday 2:10 p.m.

Special Session on Riemannian Geometry

Mathematics Building, Room 0304

- 2:10– 2:30 (211) *Inverse questions in stochastic differential geometry.* ALFRED GRAY*, University of Maryland, College Park, and MARK A. PINSKY, Northwestern University (797-53-106)
- 2:35– 2:55 (212) *Global symbol calculus for pseudodifferential operators on manifolds and local differential geometry.* LANCE D. DRAGER, Georgia Institute of Technology (797-58-91)
- 3:00– 3:20 (213) *Global properties of Brownian motion on complete Riemannian manifolds.* LEON KARP, University of Michigan, Ann Arbor (797-53-137)
- 3:25– 3:45 (214) *On normal homogeneous Einstein metrics.* Preliminary report. MCKENZIE Y. WANG*, McMaster University, and WOLFGANG ZILLER, University of Pennsylvania (797-53-131)

Sunday, 2:10 p.m.

Special Session on Topology of Algebraic and Analytic Varieties, III

Mathematics Building, Room 0106

- 2:10– 2:30 (215) *Finite groups acting on varieties.* WILLIAM BROWDER, Princeton University (797-55-123)
- 2:35– 2:55 (216) *The holomorphic Lefschetz formula and the Siegel modular variety of degree 2.* RONNIE LEE and STEVEN H. WEINTRAUB*, Yale University (797-14-192)
- 3:00– 3:20 (217) *The Lefschetz number of an involution on the space of harmonic cusp forms of SL_3 .* Preliminary report. RONNIE LEE*, Yale University, and JOACHIM SCHWERMER, Bonn University, Federal Republic of Germany (797-55-51) (Introduced by Alphonse Vasquez)
- 3:25– 3:45 (218) *Some arithmetic quotients of hyperbolic three-space.* Preliminary report. KAREN VOGTMANN, Columbia University (797-55-203)
- 3:50– 4:10 (219) *Explicit resolution of cusps in Hilbert modular threefolds.* ALPHONSE T. VASQUEZ, Graduate School and University Center, City University of New York (797-55-185)

University Park, Pennsylvania

Raymond G. Ayoub
Associate Secretary

Baton Rouge, November 12–13, 1982, Louisiana State University

Program of the 798th Meeting

The seven hundred ninety-eighth meeting of the American Mathematical Society will be held at Louisiana State University in Baton Rouge, Louisiana, on Friday and Saturday, November 12–13, 1982. Sessions will be held in Pleasant Hall and the LSU Student Union.

Invited Addresses

By invitation of the Committee to Select Hour Speakers for Southeastern Sectional Meetings, there will be four invited one-hour addresses. The speakers, their titles, and times of presentations are:

J. THOMAS BEALE, Tulane University, *Some existence questions for the equations of surface waves*, 11:00 a.m. Friday.

ERIC BEDFORD, Indiana University, Bloomington, *Topics on holomorphic mappings*, 4:30 p.m. Friday.

JON F. CARLSON, University of Georgia, *Cohomology and varieties of modules over group algebras*, 8:30 a.m. Saturday.

WILLIAM PARDON, Duke University, *Lower K-theory and singularities*, 1:30 p.m. Saturday.

Special Sessions

By invitation of the same committee, there will be six special sessions of selected twenty-minute papers.

Nonlinear partial differential equations, GILES AUCHMUTY, University of Houston. The speakers include Giles Auchmuty, Ilya J. Bakelman, Clyde E. Collins, J. R. Dorroh, Lawrence C. Evans, William E. Fitzgibbon, Jerome A. Goldstein, Martin Golubitsky, Richard A. Graff, Louis N. Howard, Daniel S. Levine, Basil Nicolaenko, R. E. Showalter, Michael W. Smiley, Gary A. Sod, Fred B. Weissler, and Lewis Wheeler.

Universal algebra and combinatorics, TREVOR EVANS, Emory University. The speakers are Stephen D. Comer, Dwight A. Duffus, Bernhard Ganter, C. C. Lindner, N. S. Mendelsohn, Kevin T. Phelps, Robert W. Quackenbush, and Robert Roth.

Representations of finite groups, EDWARD GREEN, Virginia Polytechnic Institute. The speakers are J. L. Alperin, David W. Burry, Leonard Chastkofsky, Pamela A. Ferguson, William H. Gustafson, Andy R. Magid, Brian J. Parshall, and Leonard Scott.

Several complex variables, MORRIS KALKA, Tulane University. The speakers include Al Boggess, Daniel Burns, Chong Kyu Han, Gary A. Harris, Reese Harvey, Steven G. Krantz, John M. Lee, Ngaiming Mok, Theodore Shifrin, Albert L. Vitter, S. M. Webster, Pit-Mann Wong, and William R. Zame.

Continuum theory, LEX OVERSTEEGEN, University of Alabama, Birmingham. The speakers are Harold Bell, Andrew C. Connor, James F. Davis, Ralph Ford, G. R. Gordh, Jr., W. T. Ingram,

James Keesling, K. Kuperberg, Wayne Lewis, John C. Mayer, James T. Rogers, Jr., Michel Smith, and David C. Wilson.

Applications of algebraic K-theory to topology, FRANK QUINN, Virginia Polytechnic Institute. The speakers include Douglas R. Anderson, David W. Carter, Kevin R. Coombes, W. C. Hsiang, Frank Quinn, Allen Scholnick, and Neal W. Stoltzfus.

Contributed Papers

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

Registration

The meeting registration desk will be located in the lobby of Pleasant Hall, and will be open from 10:00 a.m. to 4:00 p.m. on Friday, and from 9:00 a.m. to 2:00 p.m. on Saturday. The registration fees are \$10 for members, \$16 for nonmembers, and \$5 for students and unemployed mathematicians.

Accommodations

Rooms have been blocked for participants at Pleasant Hall and at the Prince Murat Motor Inn. Individuals should make their own reservations prior to the cut-off date of **October 25**. Pleasant Hall is by far the most convenient place to stay; none of the others are within reasonable walking distance of the LSU campus, but all are within 5 miles of the campus. The AMS meeting should be mentioned at either Pleasant Hall or the Prince Murat. None of the quoted rates include the applicable 8 percent tax.

Pleasant Hall

LSU Campus (70803)
Telephone: 504-387-0297

Single \$26 Double \$31.50

Prince Murat Motor Inn

1480 Nicholson Drive (70802)
Telephone: 504-387-1111
(call collect for reservations)

Single \$27 Double \$36

Although rooms **have not been blocked** at the following, they are included here for information purposes.

Rodeway Inn

2445 S. Acadian Thruway (70808)
Telephone: 504-925-8141
(or 1-800-228-2000 for reservations)

Single \$34 Double \$40

Howard Johnson's East

2365 College Drive (70808)
Telephone: 504-925-2451
(or 1-800-654-2000 for reservations)

Single \$37 Double \$42

Baton Rouge Hilton

5500 Hilton Avenue (70808)

Telephone: 504-924-5000

Single \$59

Double \$71

Sheraton Baton Rouge

4728 Constitution Avenue (70808)

Telephone: 504-925-2244

Single \$63

Double \$73

Food Service

Food is available at the LSU Student Union and at numerous restaurants within easy walking distance. Pleasant Hall maintains a snack bar.

Entertainment

There will be a beer party on Friday evening at the LSU Faculty Club. Tickets will be available at the registration desk for \$2 per person.

Parking

There is a large double parking lot in front of Pleasant Hall. It should provide ample parking on Saturday, but on Friday some people may have to park at Hart lot next to Kirby Smith Hall. To reach

the Hart lot, take the first right turn past Pleasant Hall; this is Infirmary Road. Proceed one block to the intersection just beyond the Student Health Service Building and turn left into the drive that runs alongside the Student Health Service Building. Follow this drive to the parking lot (see insert map).

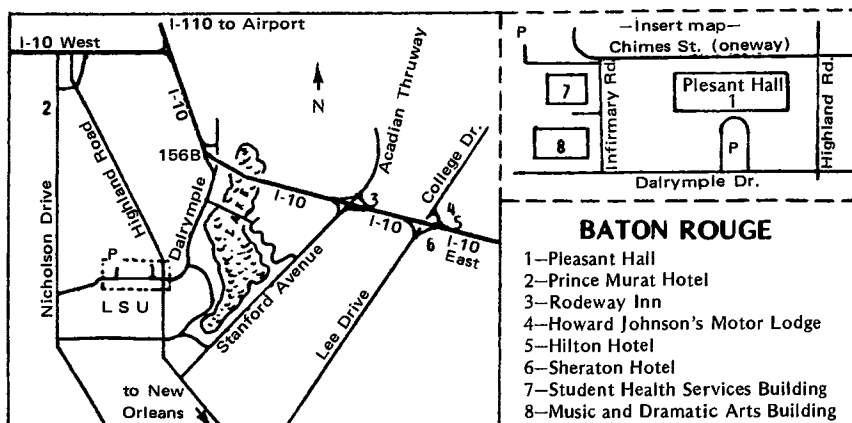
Travel

Baton Rouge is 80 miles northwest of New Orleans on I-10. To reach Pleasant Hall, take I-10 exit 156B and proceed south on Dalrymple Drive. Pleasant Hall is the first building on the right after crossing Highland Road (see map).

Baton Rouge is served by Delta, Republic, Texas International, Royale, and American Airlines. There are numerous regular flights to Baton Rouge from Chicago, Dallas, Houston, New Orleans, and Atlanta. Airport Limousine service to Pleasant Hall is \$5 per person.

Avis, Dollar, Hertz, National and Thrifty car rental agencies have offices at the airport.

Both Greyhound and Trailways provide bus service to Baton Rouge, but there is no train service.



Presenters of Papers

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

●Invited one-hour lecturer

*Special session speaker

*Alperin, J. L., 35
*Anderson, D. R., 49
Andrus, J. F., 2
*Auchmuty, G., 13
*Bakelman, I. J., 11
●Beale, J. T., 1
●Bedford, E., 33
*Bell, H., 67
*Boggess, A., 22
*Burns, D., 17
*Burry, D. W., 87
●Carlson, J. F., 34
*Carter, D. W., 48
*Chastkofsky, L., 38
*Collins, C. E., 15
*Comer, S. D., 25
Connor, A. C., 40
*Connor, A. C., 84
*Coombes, K. R., 50
Daffer, P. Z., 3
*Davis, J. F., 64
*Dorroh, J. R., 53

*Duffus, D. A., 24
*Evans, L. C., 12
*Ferguson, P. A., 37
*Fitzgibbon, W. E., 55
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Program of the Sessions

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

Abstracts of papers presented in AMS sessions at this meeting will be found in the October 1982 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

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

Friday, 11:00 a.m.

Invited Address

Pleasant Hall, Room 148

- 11:00–12:00 (1) *Some existence questions for the equations of surface waves.* J. THOMAS BEALE, Tulane University (798-35-84)

Friday, 1:00 p.m.

General Session, I

Pleasant Hall, Room 146

- 1:00– 1:10 (2) *Convergence and accuracy properties of the method of quasilinearization.* JAN F. ANDRUS, University of New Orleans (798-65-36)
- 1:15– 1:25 (3) *Limit theorems for exchangeable random elements in a Banach space with the bounded approximation property.* PETER Z. DAFFER, Vanderbilt University (798-60-54)
- 1:30– 1:40 (4) *Discrete approximation of strongly continuous semigroups.* Preliminary report. W. T. WATKINS* and G. EDGAR PARKER, Pan American University (798-47-61)
- 1:45– 1:55 (5) *Extending sequences of square roots of functions on compact sets to strongly continuous semigroups.* Preliminary report. G. EDGAR PARKER* and W. T. WATKINS, Pan American University (798-47-62)
- 2:00– 2:10 (6) *Multisolute network flow problems with pressure.* Preliminary report. J. B. GARNER*, Louisiana Tech University, and R. B. KELLOGG, University of Maryland, College Park (798-34-59)
- 2:15– 2:25 (7) *Mathematical analysis of facilitated diffusion problems.* RUTH E. HANNA* and J. B. GARNER, Louisiana Tech University (798-34-60)
- 2:30– 2:40 (8) *Non-factorization theorems in Hardy and weighted Bergman spaces of the unit ball of C^n ($n > 1$).* M. SEETHARAMA GOWDA, University of Mississippi (798-32-67)
- 2:45– 2:55 (9) *Fractal dimension.* Preliminary report. MARGARET M. LASALLE, University of Southwestern Louisiana (798-54-57)
- 3:00– 3:10 (10) *Gear specific multicohort analysis on several age classes.* Preliminary report. S. EUGENE SIMS, Louisiana Tech University (798-92-50)

Friday, 1:00 p.m.

Special Session on Nonlinear Partial Differential Equations, I

Pleasant Hall, Room 130

- 1:00– 1:20 (11) *Boundary value problems for elliptic Monge-Ampère equations and reconstruction of hypersurfaces by their Gaussian curvature.* Preliminary report. ILYA J. BAKELMAN, Texas A&M University, College Station (798-35-29)
- 1:30– 1:50 (12) *Viscosity solutions of Isaacs' equations.* E. N. BARRON, Loyola University, LAWRENCE C. EVANS*, University of Maryland, College Park, and R. JENSEN, University of Kentucky (798-35-12)
- 2:00– 2:20 (13) *Dual variational principles for nonlinear elliptic boundary value problems.* GILES AUCHMUTY, University of Houston, Houston (798-49-26)
- 2:30– 2:50 (14) *Traveling wave solutions to systems modeling combustion with multistep chemistry.* HENRI BERESTYCKI, BASIL NICOLAENKO*, and BRUNO SCHEURER, Los Alamos National Laboratory (798-35-87)
- 3:00– 3:20 (15) *Length and diffusion dependence in FitzHugh-Nagumo equations.* Preliminary report. CLYDE E. COLLINS, Louisiana State University, Baton Rouge (798-35-11)
- 3:30– 3:50 (16) *Bifurcating periodic solutions for a class of age-structured predator-prey systems.* DANIEL S. LEVINE, University of Houston, Houston (798-35-30)

Friday, 1:00 p.m.

Special Session on Several Complex Variables, I

LSU Union, Red River Room

- 1:00– 1:20 (17) *Boundary asymptotics for Kähler-Einstein metrics*. Preliminary report. DANIEL BURNS, University of Michigan, Ann Arbor (798-32-58)
- 1:30– 1:50 (18) *Some results on the differential geometry of complex submanifolds*. ALBERT L. VITTER, Tulane University (798-32-43)
- 2:00– 2:20 (19) *Characterization of certain domains in C^n with non-compact automorphism groups*. STEVEN G. KRANTZ, Pennsylvania State University, University Park (798-32-01)
- 2:30– 2:50 (20) *Regularity of CR mappings between real analytic generic CR submanifolds*. S. M. WEBSTER, University of Minnesota, Minneapolis (798-32-40)
- 3:00– 3:20 (21) *A Stein manifold topologically but not holomorphically equivalent to a domain in C^n* . E. L. STOUT, University of Washington, and WILLIAM R. ZAME*, State University of New York, Buffalo (798-32-34)
- 3:30– 3:50 (22) *One sided and two sided extension results for CR functions in higher codimension*. Preliminary report. AL BOGGESE, Texas A&M University, College Station (798-32-06)
- 4:00– 4:20 (23) *On umbilical hypersurfaces*. Preliminary report. PIT-MANN WONG, University of Notre Dame (798-32-51)

Friday, 1:00 p.m.

Special Session on Universal Algebra and Combinatorics, I

LSU Union, International Room

- 1:00– 1:20 (24) *Automorphisms and products of ordered sets*. DWIGHT A. DUFFUS, Emory University (798-05-42)
- 1:30– 1:50 (25) *Constructions of color schemes*. STEPHEN D. COMER, The Citadel (798-05-10)
- 2:00– 2:20 (26) *Magic squares and magic algebras*. Preliminary report. ROBERT W. QUACKENBUSH, University of Manitoba (798-05-24)
- 2:30– 2:50 (27) *Quasigroup identities and orthogonal arrays*. C. C. LINDNER, Auburn University, Auburn (798-05-09)

Friday, 1:30 p.m.

Special Session on Continua Theory, I

LSU Union, Vieux Carré

- 1:30– 1:50 (28) *Concerning functions of the pseudo-arc onto itself*. MICHEL SMITH, Auburn University, Auburn (798-54-69) (Introduced by Lex Oversteegen)
- 2:00– 2:20 (29) *Discrete open mappings which are homeomorphisms*. Preliminary report. DAVID C. WILSON, University of Florida (798-54-64)
- 2:30– 2:50 (30) *Inaccessibility, essential maps, and shape theory*. BEVERLY L. BRECHNER, University of Florida, JOHN C. MAYER*, Universities of Florida and Saskatchewan, and E. D. TYMCHATYN, University of Saskatchewan (798-54-66)
- 3:00– 3:20 (31) *Locally connected homogeneous non-representable continua*. K. KUPERBERG, Oklahoma State University, Stillwater (798-54-63)
- 3:30– 3:50 (32) *Infinite-dimensional spaces*. Preliminary report. JAMES KEESLING, University of Florida (798-54-65)

Friday, 4:30 p.m.

Invited Address

Pleasant Hall, Room 148

- 4:30– 5:30 (33) *Topics on holomorphic mappings*. ERIC BEDFORD, Indiana University, Bloomington (798-32-76)

Saturday, 8:30 a.m.

Invited Address

Pleasant Hall, Room 148

- 8:30– 9:30 (34) *Cohomology and varieties of modules over group algebras*. JON F. CARLSON, University of Georgia (798-20-73)

Saturday, 9:35 a.m.

Special Session on Representations of Finite Groups, I

Pleasant Hall, Room 48B

- 9:35–10:05 (35) *Characters in blocks with cyclic defect groups*. J. L. ALPERIN, University of Chicago (798-20-37)

- 10:15–10:45 (36) *Units in p -adic group rings*. Preliminary report. LEONARD SCOTT, University of Virginia (798-20-55)
- 10:55–11:25 (37) *Complex linear groups of relatively small degree*. PAMELA A. FERGUSON, University of Miami (798-20-77)
- 11:35–12:05 (38) *How to compute projective characters of finite Chevalley groups*. Preliminary report. LEONARD CHASTKOFISKY, University of Georgia (798-20-33)

Saturday, 9:45 a.m.

General Session, II

Pleasant Hall, Room 48A

- 9:45–9:55 (39) *The group of homeomorphisms of a compact metric space X as a subspace of $2^{X \times X}$* . JUDY KENNEDY, Auburn University, Auburn (798-54-79)
- 10:00–10:10 (40) *Monotone open maps on uniquely arcwise connected continua*. ANDREW C. CONNOR, Auburn University, Auburn (798-54-83) (Introduced by Ralph Ford)
- 10:15–10:25 (41) *A classification of locally flat embeddings of Q -manifolds*. Preliminary report. W. O. NOWELL, JR., Auburn University, Montgomery (798-57-78)
- 10:30–10:40 (42) *Equational classes of partial algebras*. ISIDORE FLEISCHER, Université de Montréal (798-08-32) (Introduced by S. Bulman-Fleming)
- 10:45–10:55 (43) *N -rings and ACC on colon ideals*. WILLIAM J. HEINZER*, Purdue University, and DAVID C. LANTZ, Colgate University (798-13-53)
- 11:00–11:10 (44) *Algebras generated by idempotents*. Preliminary report. DAVID B. CHOATE and HENRY E. HEATHERLY*, University of Southwestern Louisiana (798-16-13)
- 11:15–11:25 (45) *Products of simple groups, II*. Preliminary report. GARY L. WALLS, University of Southern Mississippi (798-20-68)
- 11:30–11:40 (46) *The icosahedron puzzle group*. Preliminary report. DARWIN E. PEEK, Trinity University (798-20-74) (Introduced by Kenneth E. Hummel)
- 11:45–11:55 (47) *Embedding of regular semigroups in wreath products, I: Left regular semigroups*. Preliminary report. RONSON J. WARNE, University of Alabama, Birmingham (798-20-75) (Introduced by R. J. Crittenden)

Saturday, 9:45 a.m.

Special Session on Applications of Algebraic K-Theory to Topology, I

Pleasant Hall, Room 48C

- 9:45–10:25 (48) *Lower K -theory of integral group rings*. DAVID W. CARTER, University of Virginia (798-16-21)
- 10:45–11:05 (49) *Semifree topological actions of finite groups on spheres*. DOUGLAS R. ANDERSON*, Syracuse University, and ERIK K. PEDERSEN, Odense University, Denmark (798-57-05)
- 11:15–11:35 (50) *Relative algebraic K -theory and applications*. KEVIN R. COOMBES, Massachusetts Institute of Technology (798-55-04)
- 11:45–12:05 (51) *Novikov's conjecture for cocompact discrete subgroups of a Lie group*. Preliminary report. F. T. FARRELL, University of Michigan, Ann Arbor, and W. C. HSIANG*, Princeton University (798-57-03)

Saturday, 9:45 a.m.

Special Session on Nonlinear Partial Differential Equations, II

Pleasant Hall, Room 130

- 9:45–10:05 (52) *A porous media system*. Preliminary report. R. E. SHOWALTER, Brown University (798-35-16)
- 10:15–10:35 (53) *A semigroup treatment of mixed problems*. Preliminary report. J. R. DORROH, Louisiana State University, Baton Rouge (798-35-18)
- 10:45–11:05 (54) *The existence of local semiflows for nonlinear differential equations in Banach spaces, and applications to partial differential equations*. RICHARD A. GRAFF, MITRE Corporation (798-35-23) (Introduced by Giles Auchmuty)
- 11:15–11:35 (55) *A two dimensional model for turbulence*. WILLIAM E. FITZGIBBON, University of Houston, Houston (798-35-49)
- 11:45–12:05 (56) *Single point blow-up for a semilinear initial value problem*. Preliminary report. FRED B. WEISLER, University of Texas, Austin (798-35-46)
- 12:15–12:35 (57) *Nonexistence results for the heat equation with a potential singular at the origin*. Preliminary report. JEROME A. GOLDSTEIN, Tulane University (798-35-47)

Saturday, 9:45 a.m.

Special Session on Several Complex Variables, II

LSU Union, Red River Room

- 9:45–10:05 (58) *Local holomorphic invariants for real submanifolds of \mathbb{C}^2* . Preliminary report. GARY A. HARRIS, Texas Tech University (798-32-15)
- 10:15–10:35 (59) *The $\bar{\partial}$ -Neumann kernel for the ball*. REESE HARVEY* and JOHN C. POLKING, Rice University (798-32-52)
- 10:45–11:05 (60) *Higher asymptotics of the complex Monge-Ampère equation and geometry of CR-manifolds*. JOHN M. LEE, Harvard University (798-32-44)
- 11:15–11:35 (61) *The geometry of algebraic surfaces in five-space*. Preliminary report. THEODORE SHIFRIN, University of Georgia (798-14-38)
- 11:45–12:05 (62) *Analyticity of CR equivalences between real hypersurfaces in \mathbb{C}^n of degenerate Levi forms*. Preliminary report. CHONG KYU HAN, Columbia University (798-32-02)
- 12:15–12:35 (63) *An embedding theorem for complete Kähler manifolds of positive bisectional curvature*. NGAIMING MOK, Princeton University (798-32-39)

Saturday, 9:45 a.m.

Special Session on Continua Theory, II

LSU Union, Vieux Carré

- 9:45–10:05 (64) *Atriodic acyclic continua and class W*. Preliminary report. JAMES F. DAVIS, Texaco Bellaire Research Laboratory (798-54-70)
- 10:15–10:35 (65) *Aposyndetic homogeneous continua as bundle spaces*. JAMES T. ROGERS, JR., Tulane University (798-55-28)
- 10:45–11:05 (66) *Monotone decompositions of hereditarily unicoherent continua via set functions and quasi-orders*. G. R. GORDH, JR.*, Guilford College, and ELDON J. VOUGHT, California State University, Chico (798-54-48)
- 11:15–11:35 (67) *The fixed point index and the plane fixed point problem*. Preliminary report. HAROLD BELL, University of Cincinnati (798-54-56)
- 11:45–12:05 (68) *Boundary component (BC) continua*. ANDREW C. CONNOR and RALPH FORD*, Auburn University, Auburn (798-54-71)

Saturday, 9:45 a.m.

Special Session on Universal Algebra and Combinatorics, II

LSU Union, International Room

- 9:45–10:05 (69) *Varieties of algebras and the construction of t -designs*. Preliminary report. KEVIN T. PHELPS, Georgia Institute of Technology (798-05-14) (Introduced by C. C. Lindner)
- 10:15–10:35 (70) *Commutative Moufang exponent 3 loops of nilpotence class larger than 2*. ROBERT ROTH, Emory University (798-05-35)
- 10:45–11:05 (71) *Algebraic representation of a class of directed graphs*. N. S. MENDELSON*, R. PADMANABHAN and B. WOLK, University of Manitoba (798-05-31)
- 11:15–11:35 (72) *Recent interest in small Steiner triple and quadruple systems*. BERNHARD GANTER, Technische Hochschule Darmstadt, Federal Republic of Germany, and Emory University (798-05-45)
- 11:45–12:05 Problem Session

Saturday, 1:30 p.m.

Invited Address

Pleasant Hall, Room 148

- 1:30– 2:30 (73) *Lower K-theory and singularities*. WILLIAM PARDON, Duke University

Saturday, 2:35 p.m.

Special Session on Applications of Algebraic K-Theory to Topology, II

Pleasant Hall, Room 48C

- 2:35– 2:55 (74) *Equivariant mapping cylinders in topological group actions*. FRANK QUINN, Virginia Polytechnic Institute and State University (798-57-08)
- 3:05– 3:25 (75) *Algebraic invariants of diffeomorphisms of surfaces*. NEAL W. STOLTZFUS, Louisiana State University, Baton Rouge (798-57-07)
- 3:35– 3:55 (76) *Categories of fractions and localizations*. Preliminary report. ALLEN SCHOLNICK, McNeese State University (798-18-27)
- 4:05– 4:25 Problem Session

Saturday, 2:35 p.m.

Special Session on Nonlinear Partial Differential Equations, III

Pleasant Hall, Room 130

- 2:35– 2:55 (77) *Abstract wave equations with a singular nonlinear forcing term.* MICHAEL W. SMILEY* and H. A. LEVINE, Iowa State University (798-35-82)
- 3:05– 3:25 (78) *Slowly varying convection.* LOUIS N. HOWARD, Florida State University (798-76-80)
- 3:35– 3:55 (79) *The effects of symmetry groups on bifurcation problems.* Preliminary report. MARTIN GOLUBITSKY, Arizona State University (798-58-85)
- 4:05– 4:25 (80) *Spatial evolution of fully developed flows.* Preliminary report. LEWIS WHEELER, University of Houston, Houston (798-76-25)
- 4:35– 4:55 (81) *A numerical model of axisymmetric turbulent flows in reciprocating internal combustion engines.* GARY A. SOD, Tulane University (798-65-20) (Introduced by Giles Auchmuty)
- 5:05– 5:25 Problem Session

Saturday, 2:35 p.m.

Special Session on Continua Theory, III

LSU Union, Vieux Carré

- 2:35– 2:55 (82) *Homeomorphism group of the pseudo-arc.* WAYNE LEWIS, Texas Tech University (798-54-22)
- 3:05– 3:25 (83) *Mappings onto atriodic continua.* W. T. INGRAM, University of Houston, Houston (798-54-81)
- 3:35– 3:55 (84) *A characterization of hereditary indecomposable continua.* ANDREW C. CONNOR, Auburn University, Auburn (798-54-72) (Introduced by Ralph Ford)
- 4:05– 4:25 Problem Session

Saturday, 2:35 p.m.

Special Session on Representations of Finite Groups, II

Pleasant Hall, Room 48B

- 2:35– 3:05 (85) *Brumund's dissertation.* WILLIAM H. GUSTAFSON, Texas Tech University (798-20-41)
- 3:15– 3:45 (86) *Group algebras of algebraic groups.* Preliminary report. ANDY R. MAGID, University of Oklahoma (798-20-19)
- 3:55– 4:25 (87) *Induction of modules from local subgroups.* Preliminary report. DAVID W. BURRY, University of Hartford (798-20-86)
- 4:35– 5:05 (88) *Cohomology of finite groups of Lie type.* BRIAN J. PARSHALL, University of Virginia (798-20-17)
- 5:15– 5:45 Problem Session

New Orleans, Louisiana

Frank T. Birtel
Associate Secretary

CONTEMPORARY MATHEMATICS

**MARKOV RANDOM FIELDS AND
THEIR APPLICATIONS**

by *Ross Kinderman* and *J. Laurie Snell*

This book presents an introduction to Markov random fields and the related topic of infinite interacting particle systems. The principal concepts and theorems of the subject are illustrated in terms of models currently being studied. The Ising model is used to motivate the concept of a random field. The concept of a phase transition is discussed in terms of the breakdown of basic probability theorems such as the law of large numbers and the central limit theorem.

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The study of Markov random fields has brought exciting new problems to probability theory which are being developed in parallel with basic investigation in other disciplines, most notably physics. The mathematical and physical literature is often quite technical. This book aims at a more gentle introduction to these new areas of research.

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MATHEMATICAL SURVEYS

ESSENTIALS OF BROWNIAN MOTION AND DIFFUSION

by *Frank B. Knight*

This work was first-drafted five years ago at the invitation of the editors of the Encyclopedia of Mathematics and its Applications. However, it was found to contain insufficient physical applications for that series, hence it has finally come to rest at the doorstep of the American Mathematical Society. The first half of the work is little changed from the original, a fact which may partly explain both the allusions to applications and the elementary approach. It was written to be understood by a reader having minimal familiarity with continuous time stochastic processes. The most advanced prerequisite is a discrete parameter martingale convergence theorem.

General summary and outline:

0. Introduction. Some gratuitous generalities on scientific method as it relates to diffusion theory.

1. Brownian motion is defined by the characterization of P. Lévy. Then it is constructed in three basic ways and these are proved to be equivalent in the appropriate sense. Uniqueness theorem.

2. Projective invariance and the Brownian bridge presented. Probabilistic and absolute properties are distinguished. Among the former: the distribution of the maximum, first passage time distributions, and hitting probabilities. Among the latter: law of iterated logarithm, quadratic variation, Hölder continuity, non-recurrence for $r \geq 2$.

3. General methods of Markov processes adapted to diffusion. Analytic and probabilistic methods are distinguished. Among the former: transition functions, semigroups, generators, resolvents. Among the latter: Markov properties, stopping times, zero-or-one laws, Dynkin's formula, additive functionals.

4. Classical modifications of Brownian motion.

Absorption and the Dirichlet problem. Space-time process and the heat equation. Killed processes, Green functions, and the distributions of additive functionals. Time-change theorem (classical case), parabolic equations and their solution semigroups, some basic examples, distribution of passage times.

5. Local time: construction by random walk embedding. Local time processes. Trotter's theorem. The Brownian flow. Brownian excursions. The zero set and Lévy's equivalence theorem. Local times of classical diffusions. Sample path properties.

6. Boundary conditions for Brownian motion. The general boundary conditions. Construction of the processes using local time. Green functions and eigenfunction expansions (compact case).

7. This chapter is a "finale" on nonsingular diffusion. The generators $(d/dm)(d^+/dx^+)$ are characterized. The diffusions on open intervals are constructed. The conservative boundary conditions are obtained and their diffusions are constructed. The general additive functionals and nonconservative diffusions are developed and expressed in terms of Brownian motions.

The audience for this survey is anyone who desires an introduction to Markov processes with continuous paths which is both coherent and elementary. The approach is from the particular to the general. Each method is first explained in the simplest case and supported by examples. Therefore, the book should be readily understandable to anyone with a first course in measure-theoretic probability.

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East Lansing, November 12-13, 1982, Michigan State University

Second Announcement of the 799th Meeting

The seven hundred ninety-ninth meeting of the American Mathematical Society will be held at Michigan State University, East Lansing, on Friday and Saturday, November 12-13, 1982. Sessions will be held in the Kellogg Center for Continuing Education on the MSU campus.

Invited Addresses

By invitation of the 1982 Committee to Select Hour Speakers for Central Sectional Meetings, there will be four invited one-hour addresses. The speakers, their titles, and the scheduled times of presentation are as follows:

HAROLD G. DONNELLY, Purdue University, *L^2 cohomology of complete Riemannian manifolds*, 1:45 p.m. Saturday.

WILLIAM T. EATON, University of Texas, Austin, *Some uses of decomposition spaces in manifold theory*, 1:45 p.m. Friday.

SIMON HELLERSTEIN, University of Wisconsin, Madison, *Reality of the zeros of derivatives of entire and meromorphic functions*, 11:00 a.m. Friday.

JEFFREY B. RAUCH, University of Michigan, Ann Arbor, *Nonlinear interaction of waves: recent discoveries*, 11:00 a.m. Saturday.

All four talks will be given in the auditorium of the Kellogg Center.

Special Sessions

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

Geometric topology, SELMAN AKBULUT and MICHAEL HANDEL, Michigan State University. The tentative list of speakers includes Joan S. Birman, Steven A. Bleiler, William D. Dunbar, Jr., Allan L. Edmonds, William J. Floyd, Charles D. Frohman, David Gabai, Charles Livingston, Robert Meyerhoff, Ulrich Oertel, Peter Scott, John Smillie, and Laurence R. Taylor.

Interaction-diffusion systems, DONALD G. ARONSON, University of Minnesota, Minneapolis. The tentative list of speakers includes Maury D. Bramson, Vincenzo Capasso, Steven R. Dunbar, G. Bard Ermentrout, John A. Feroe, Robert Gardner, Stuart P. Hastings, C. Jones, Roger Y. Lui, Richard C. MacCamy, Hans G. Othmer, Joel A. Smoller, David Terman, William C. Troy, J. Vasquez, and Hans F. Weinberger.

Banach spaces of analytic functions, SHELDON AXLER, Michigan State University. The tentative list of speakers includes Leon Brown, Kevin F. Clancey, Carl C. Cowen, Jr., James J. Dudziak, Pamela B. Gorkin, James L. Hartman, S. V. Hruščev,

Daniel H. Luecking, Joel H. Shapiro, Allen L. Shields, and Carl Sundberg.

Semigroup theory, KARL E. BYLEEN and PETER R. JONES, Marquette University, and JOHN ZELEZNICKOW, Michigan State University. The tentative list of speakers includes G. T. Clarke, S. M. Goberstein, Robert P. Hunter, Peter R. Jones, Gérard J. Lallement, Donald R. LaTorre, Bernard L. Madison, Stuart W. Margolis, C. J. Maxson, Donald B. McAlister, Robert McFadden, John C. Meakin, Mohan S. Putcha, Norman Raymond Reilly, C. M. Reis, Motupalli Satyanarayana, Boris M. Schein, Howard Straubing, and Gabriel Thierrin.

Finite geometries and related topics, JONATHAN I. HALL, Michigan State University. The tentative list of speakers includes Michael G. Aschbacher, Eiichi Bannai, Aiden A. Bruen, A. Robert Calderbank, Marshall Hall, Jr., Donald G. Higman, William M. Kantor, Mark A. Ronan, Herbert J. Ryser, Ernest E. Shult, Stephen D. Smith, Alan P. Sprague, David B. Surowski, Joseph Adolphe Thas, Jacobus H. van Lint, and Richard M. Weiss.

Geometry of foliations, PHILIPPE M. TONDEUR, University of Illinois, Urbana-Champaign. The tentative list of speakers includes Robert A. Blumenthal, Lawrence W. Conlon, Thomas E. Duchamp, Richard H. Escobales, Jr., Herman R. Gluck, James L. Heitsch, Steven E. Hurder, David L. Johnson, Franz W. Kamber, Connor Lazarov, Albert Marden, Bruce L. Reinhart, and Jack Ucci.

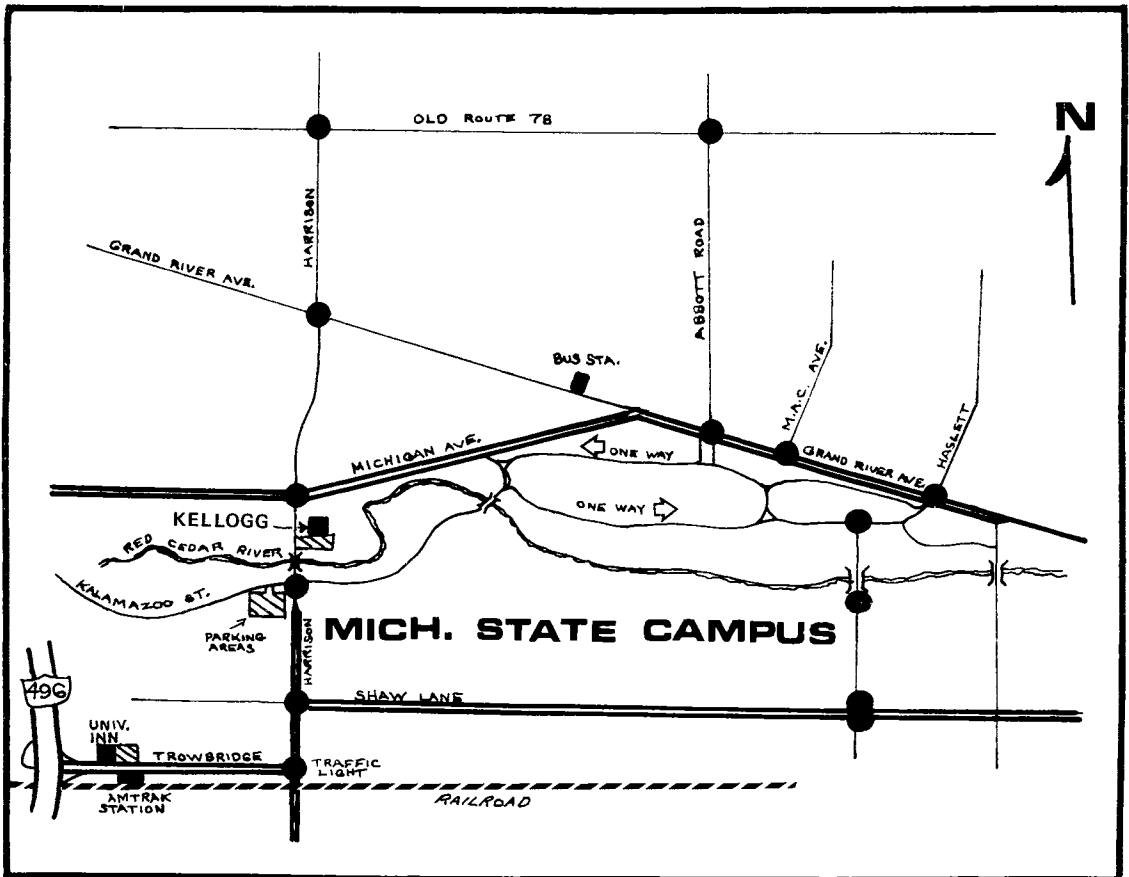
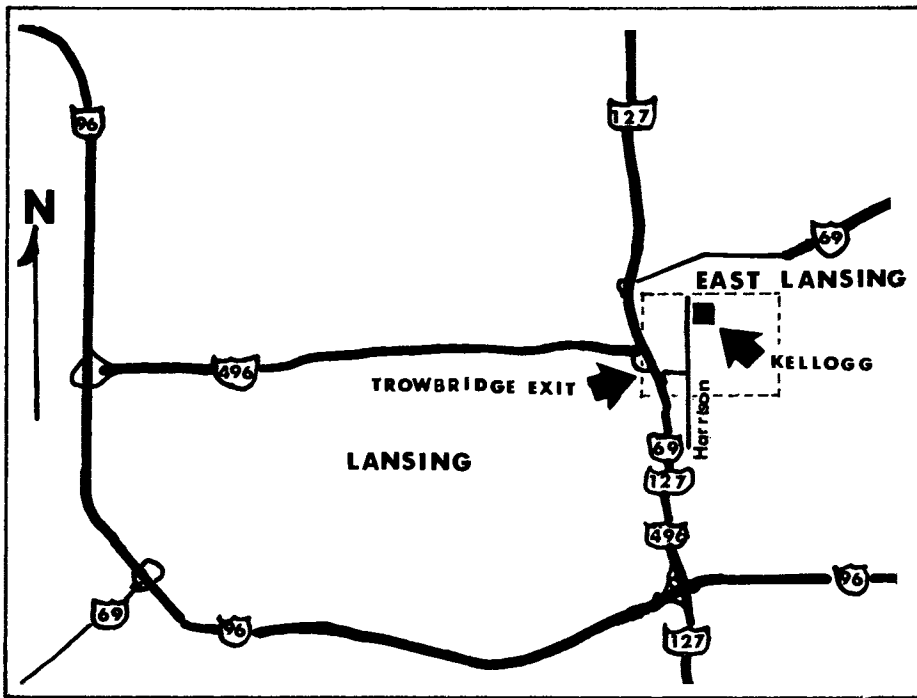
Classical complex analysis, ALLEN W. WEITSMAN, Purdue University. The tentative list of speakers includes Albert Baernstein II, James E. Brennan, Johnny E. Brown, David Drasin, Albert Edrei, Frederick W. Gehring, Robert P. Kaufman, Peter Lappan, John L. Lewis, Albert Marden, David Minda, Rao V. Nagisetty, George Piranian, Richard H. Rochberg, Lee A. Rubel, Daniel F. Shea, Kenneth Stephenson, Carl Sundberg, Donald J. Wright, and Jang-Mei Gloria Wu.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should have been sent to the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940, so as to arrive **prior to the deadline of September 13.**

Registration

The meeting registration desk will be located in the central lobby of the Kellogg Center and will be open from 8:00 a.m. until 5:00 p.m. on Friday, and from 8:00 a.m. until 10:00 a.m. on Saturday. The registration fees are \$10 for members, \$16 for nonmembers, and \$5 for students or unemployed mathematicians.



Accommodations

Rooms are available in the Kellogg Center at a cost of \$30 per night for single occupancy, or \$18 per person per night for a shared twin bedroom. A tax of 4 percent applies to these rates and is not included. Individuals should send their requests for reservations to the Kellogg Center for Continuing Education, Michigan State University, East Lansing, Michigan 48824 prior to the cut-off date of **October 28**. It is not necessary to prepay housing unless the reservation is to be guaranteed for late arrival, in which case a check payable to the Kellogg Center should be included. The telephone number for the Center is 517-332-6571.

The following area motels are within a short drive from the Center and, with the exception of the Red Roof Inn, are holding blocks of rooms for participants. Individuals should make reservations directly with the motel of their choice prior to the cut-off date of **October 28**. Rates quoted are as of March 1, 1982; they are subject to change and probably do not include the 4 percent tax.

Harley Hotel

3600 Dunckel, Lansing, MI 48910
Telephone: 800-321-2323

Single \$46.50 up Double \$53.50 up

Quality Inn (formerly Holiday Inn)

3121 E. Grand River, Lansing, MI 48912
Telephone: 517-351-1440

Single \$26.95 up Double \$32.95 up

Red Roof Inn

3615 Dunckel, Lansing, MI 48910
Telephone 517-332-2575

Single \$25.74 Double \$28.92 (1 bed)
Double \$31.04 (2 beds)

University Inn

1100 Trowbridge Road, East Lansing, MI 48823
Telephone: 517-351-5500

Single \$30 up Double \$36 up

The Life O'Riley Mobile Home Park is open for travel trailers at 6726 South Washington, Lansing, MI 48910, telephone 517-882-1331. The KOA Campground closes November 1.

Food Service

Food will be available at the Kellogg Center, and numerous restaurants are within easy walking distance.

Entertainment

A beer party with a cash bar will be held on Friday evening in the Centennial Room at the Kellogg Center.

Travel

East Lansing is located three miles east of Lansing, the capitol of Michigan, and is 85 miles west of Detroit. The airport in Lansing is served by Piedmont, Republic, and United Airlines, as well as Simmons (commuter) Airlines. Taxi fare from the airport to the Kellogg Center costs approximately \$8. Greyhound Bus Lines operates several buses each day from Detroit and Chicago. Amtrak's Blue Water Limited, operating between Chicago and Port Huron, passes through East Lansing; a connection to or from Detroit is possible by changing at Battle Creek.

Motorists traveling on I-96 or I-69 should take the Trowbridge exit and proceed east to Harrison Road, turn left, and proceed north about one mile to the Kellogg Center.

Parking

A gated parking lot is situated directly south of the Kellogg Center, where parking is 35 cents per hour, with a maximum of \$2 per day. Overnight guests at the Center may have their parking tickets validated at the hotel desk.

Paul T. Bateman

Associate Secretary

Urbana, Illinois

L^p Boundedness of Fourier Integral Operators

R. Michael Beals

Classical zero order pseudodifferential operators are bounded on L^p for $1 < p < \infty$, but for even the simplest Fourier integral operators (arising in the solution of the wave equation) this property may fail for $p \neq 2$. In this Memoir, the action of lower order Fourier integral operators on L^p spaces is considered. Under certain assumptions on the matrix of second derivatives of the phase function, it is shown that such operators are bounded, with the range of p depending on the order of the operator. That this range is essentially best possible is seen in the case of the wave equation. Applications are made to

solutions of strictly hyperbolic partial differential equations.

CONTENTS

1. Multipliers $e^{-i\varphi(\xi)}a(\xi)$
 2. An oscillating integral on \mathbb{R}
 3. An oscillating integral on \mathbb{R}^n
 4. Fourier integral operators
 5. Applications to strongly hyperbolic equations
- Bibliography

1980 *Mathematics Subject Classifications*. 42B20, 47G05

Memoirs of the American Mathematical Society
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List price \$4, institutional member \$3,
individual member \$2
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Monterey, November 19–20, 1982, Naval Postgraduate School

Second Announcement of the 800th Meeting

The eight hundredth meeting of the American Mathematical Society will be held at the Naval Postgraduate School in Monterey, California, on Friday and Saturday, November 19–20, 1982. This meeting will be held in conjunction with a meeting of the Society for Industrial and Applied Mathematics (SIAM). All sessions will take place in Ingersoll Hall.

Invited Addresses

By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there will be two invited one-hour addresses. The speakers are:

DAVID GIESEKER, University of California, Los Angeles, *Special divisors on Riemann surfaces*.

RICHARD SCHOEN, University of California, Berkeley, *Curvature and differential equations*.

Special Sessions

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

Mathematical biology, FRANK C. HOPPENSTEADT, University of Utah. The tentative list of speakers includes B. Ermentrout, James Keener, M. Mangel, G. Odell, and S. Tavaré.

Partial differential equations and differential geometry, PETER LI, Stanford University. The tentative list of speakers includes S. Y. Cheng, T. Frankel, R. E. Greene, A. Treibergs, and P. Yang.

Algebraic geometry, KENT MORRISON, California Polytechnic State University. The tentative list of speakers includes James A. Carlson, Richard Crew, Goro Kato, and Robert Varley.

Systems theory, CHEN-HAN SUNG, University of California, Santa Barbara. The tentative list of speakers includes L. O. Chua, J. Guckenheimer, J. W. Helton, T. Kailath, A. J. Krener, N. Levan, R. W. Kiu, E. Polak, R. Saeks, L. M. Silverman, C.-H. Sung, and F. F. Wu.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should have been sent to the American Mathematical Society so as to arrive by the deadline of **September 20, 1982**.

SIAM Program

PETER C. C. WANG of the Naval Postgraduate School will deliver an address entitled, *Engineering data handling systems and solid modeling*. ALFRED WEAVER of the University of Virginia will deliver an address entitled, *Mini-computers with applications in the CAD/CAM area*.

Registration

The meeting registration desk will be located outside of Room 122 Ingersoll Hall, and will be open

from 11:00 a.m. to 5:30 p.m. on Friday, and from 8:00 a.m. to 12:30 p.m. on Saturday. Registration fees will be \$6 for members of the AMS or SIAM, \$8 for nonmembers, and \$2 for students or unemployed mathematicians.

Accommodations

Although rooms **have not been blocked** at the following motels convenient to the campus, they are included here for information purposes and participants are advised to mention the mathematics meeting when making reservations. All are located in Monterey. The zip code is 93940. These rates are not firm, and are subject to possible change. Accommodations are **not** available at the Naval Postgraduate School.

Fairgrounds Travelodge

2030 Fremont Boulevard
Telephone: 408-373-3381 or 800-255-3050
Single \$33 Double \$40

Hilton Inn Resort

1000 Aquajito Road at Route 1
Telephone: 408-373-6141
All rooms \$60

Holiday Inn

2600 Sand Dunes Drive
Telephone: 408-394-1437 (Joelle Mazone)*
or 408-394-3321

Single \$65 Double \$75

* If 10 or more participants telephone Ms. Mazone for reservations, a special group rate will apply.

Hyatt Del Monte

1 Old Golf Course Road
Telephone: 408-372-7171 or 800-228-9000
All rooms \$65

Food Service

Food will be available at Herrmann Hall on Friday, but will **not** be available at that location on Saturday.

Social Events

The Friday luncheon announced in the August issue of the *Notices* has been cancelled. A social hour at 5:30 on Friday evening will precede a banquet at 7:00 p.m., at which JOSEPH B. KELLER of Stanford University will be the speaker. Participants who plan to attend the banquet, which will take place at Herrmann Hall, **must make reservations prior to October 20, 1982** by writing to Ms. Jackie Hadley, Department of Mathematics, University of Utah, Salt Lake City, Utah 84112. Please be sure to enclose a check for \$12 per person, payable to the American Mathematical Society. Seating for the banquet will be available only for those participants who make advance reservations. **Note that these arrangements differ from the previous announcement in the August issue of the *Notices*.**

Parking

Participants may park in A-2 and 'V' lots on the campus; permits can be obtained from the guard at the main gate. (A map indicating these areas will be included in the November issue of the *Notices*).

Travel and Local Information

Monterey is located 120 miles south of San Francisco and 350 miles north of Los Angeles. The weather is usually mild with daytime highs in the 50° F to 60° F range. There is rarely any rain in November.

The main entrance to the Naval Postgraduate School is at 3rd Street and Sloat Avenue, which can be reached by the following routes. From the north on Highway 1, take the Del Monte exit, proceed to the second traffic light and turn left. From the north on Highway 68, take the Fremont exit where

Highway 68 joins Highway 1, turn right at the first traffic light and then turn right again at the first stop sign. Drivers coming from the south will probably approach on Highway 68 and should follow the same instructions as above. If following the scenic route, traveling north on Highway 1 from Carmel, take the Aquajito exit (Monterey Peninsula College); turn left at the light, proceed across Fremont Street, turn right at the first stop sign, and continue to Sloat Avenue and the main gate.

Monterey is served by Golden West Airlines from San Francisco and Los Angeles, as well as United Airlines which also provides service to and from Los Angeles.

Hugo Rossi

Associate Secretary

Salt Lake City, Utah

PROCEEDINGS OF SYMPOSIA IN APPLIED MATHEMATICS

MODERN STATISTICS: METHODS AND APPLICATIONS

edited by *Robert V. Hogg*

This volume contains the lecture notes prepared by the speakers for the AMS Short Course given in San Antonio on January 7-8, 1980.

The choice of topics from a field as large as Statistics is a difficult one. The organizers wanted to avoid any substantial overlap with the short course on statistics held three years earlier in St. Louis; therefore it seemed very natural to begin with one important topic that is sometimes overlooked in an introductory course, particularly one in mathematical statistics. This topic is one through which the general public most often hears about statistics, namely, survey sampling. Wayne Fuller spoke on *Samples and Surveys*, noting the operations necessary in conducting a survey of a human population. In his article, he explains the construction of a probability sample design and the corresponding optimal estimators.

The more general problem of the design and analysis of an experiment was covered by Peter John in his *Analysis of Variance*. These techniques have been extremely important in applications and have also motivated a large amount of statistical research. It is clear that even in an elementary design the experimenter must understand the importance of randomization.

Nonparametric statistical methods have played a major role in modern statistics. Two coordinated talks on that subject were given by Ronald Randles and Thomas Hettmansperger. Randles introduced distribution-free rank tests, such as one by Wilcoxon,

and some of their good asymptotic properties. Hettmansperger then explained how these rank tests could be used to obtain point and interval estimates for various parameters, including the regression situation. These resulting *R*-estimates are very robust because they are not highly sensitive to reasonable deviations from the underlying assumptions.

The important topic of regression was continued by considering isotonic regression and time series. F. T. Wright showed how to use the method of maximum likelihood to estimate ordered parameters. Then Douglas Martin considered a time sequence of data. After presenting a collection of interesting examples, he discussed appropriate models and their estimates, including robust ones.

This book provides an introduction to the statistical topics above. A background of good mathematics through advanced calculus with a little statistics is adequate preparation for enjoyment of the contents. The attentive reader will gain a fairly good understanding of the nature of survey sampling, design and analysis of experiments, nonparametric methods, isotonic regression, and time series. *Modern Statistics: Methods and Applications* is an excellent companion to *MAA's Studies in Statistics* also edited by Professor Hogg.

Volume 23, vi + 110 pages

List price \$13, institutional member \$13,

individual member \$7

ISBN 0-8218-0023-X; LC 80-16093

Publication date: July 1980

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Invited Speakers and Special Sessions

Invited Speakers at AMS Meetings

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

East Lansing, November 1982

Harold G. Donnelly	Simon Hellerstein
William T. Eaton	Jeffrey B. Rauch

Monterey, November 1982

David Gieseker	Richard Schoen
----------------	----------------

Denver, January 1983

Michael Aizenman	Benedict H. Gross
Bradley Efron	Roger E. Howe
Charles L. Fefferman	Samuel Karlin
(Colloquium Lecturer)	(Gibbs Lecturer)
Michael H. Freedman	Neil J. A. Sloane
David Gieseker	
Andrew M. Gleason (Retiring Presidential Address)	

Norman, March 1983

Boris Mityagin	Michael Starbird
Paul E. Schupp	Jeffrey D. Vaaler

New York, April 1983

W. Dale Brownawell	Oliver McBryan
Richard Hamilton	Wolfgang Ziller

Albany, August 1983

James Eells	Ira Herbst
Robert C. Gunning	J. H. B. Kemperman

Organizers and Topics of Special Sessions

The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of the *Notices* went to the printer.

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

November 1982 Meeting in East Lansing

Central Section

Deadline for consideration: Expired

Selman Akbulut and Michael Handel, *Geometric topology*
 Donald G. Aronson, *Interaction-diffusion systems*
 Sheldon Axler, *Banach spaces of analytic functions*
 Karl E. Byleen, Peter R. Jones, and John Zelezniokow, *Semigroup theory*
 Jonathan I. Hall, *Finite geometries and related topics*
 Philippe M. Tondeur, *Geometry of foliations*

Allen W. Weitsman, *Classical complex analysis*

November 1982 Meeting in Monterey

Far Western Section

Deadline for consideration: Expired

Frank C. Hoppensteadt, *Mathematical biology*
 Peter Li, *Partial differential equations and differential geometry*
 Kent Morrison, *Algebraic geometry*
 Chen-Han Sung, *Systems theory*

January 1983 Meeting in Denver

Associate Secretary: Paul T. Bateman

Deadline for consideration: Expired

Irving H. Anellis and G. E. Minc, *Proof theory*
 Woodrow W. Bledsoe, *Automatic theorem proving*
 Charles W. Curtis, *Representation theory of finite groups of Lie type*
 P. D. T. A. Elliott and Wolfgang M. Schmidt, *Dio-phantine problems and analytic number theory*
 John W. Gray, *Applied category theory*
 A. G. Kartsatos and Mary E. Parrott, *Monotonicity methods in differential equations*
 Sung J. Lee and M. Zuhair Nashed, *Abstract adjoints and boundary problems*
 Peter A. McCoy, *Function-theoretic methods in differential equations*
 Duong Hong Phong, *Pseudo-differential operators and applications*
 Carl B. Pomerance, *Number-theoretic algorithms*
 Norberto Salinas, *Operator algebras and operator theory*
 Arthur Schlissel, *History of mathematics*

March 1983 Meeting in Norman

Central Section

Deadline for organizers: Expired

Deadline for consideration: To be announced

Roger C. Alperin, *Homological and combinatorial methods in group theory*
 Dale E. Alspach, *Theory of Banach spaces*
 George Phillip Barker, *Linear algebra and matrix theory*
 Harold G. Diamond, *Analytic number theory*
 Benny D. Evans, *Geometric topology*
 Kevin A. Grasse and Luther W. White, *Control theory and applications*
 Joel K. Haack, *Rings and modules*
 Roger C. Lyndon, *The algebra of algorithms, automata, and languages*
 Andy R. Magid and Richard D. Resco, *Universal enveloping algebra and group algebras of infinite groups*
 William O. Ray, *Nonlinear functional analysis*
 Boris M. Schein, *Theory of semigroups*

April 1983 Meeting in New York

Eastern Section

Deadline for organizers: Expired

Deadline for consideration: To be announced

Marvin Knopf and Joel Lechner, *The mathematical legacy of Hans Rademacher*

April 1983 Meeting in Salt Lake City

Far Western Section

Deadline for organizers: Expired

Deadline for consideration: To be announced

August 1983 Meeting in Albany

Associate Secretary: Hugo Rossi

Deadline for organizers: January 11, 1983

Deadline for consideration: To be announced

Information for Organizers

Special Sessions at Annual and Summer meetings are held under the general supervision of the Program Committee. They are administered by the Associate Secretary in charge of the meeting with staff assistance from the Society office in Providence.

Send Proposals for Special Sessions to the Associate Secretaries

The Associate Secretary in charge of the AMS program at the Annual Meeting in Denver, January 1983, is Paul T. Bateman (address below); Special Sessions planned for this meeting had to be approved prior to June 9, 1982. The Associate Secretary in charge of the AMS program at the Summer Meeting in Albany, August 1983, is Hugo Rossi (address below); Special Sessions for this meeting must be approved before January 11, 1983. The programs of sectional meetings are arranged by the Associate Secretary for the section in question:

Far Western Section (Pacific and Mountain)

Hugo Rossi, Associate Secretary
Department of Mathematics
University of Utah
Salt Lake City, UT 84112
(Telephone 801-581-8159)

Central Section

Paul T. Bateman, Associate Secretary
Department of Mathematics
University of Illinois
Urbana, IL 61801
(Telephone 217-333-4996)

Eastern Section

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

Southeastern Section

Frank T. Birtel, Associate Secretary
Department of Mathematics
Tulane University
New Orleans, LA 70118
(Telephone 504-865-5646)

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.

Some Special Sessions arise from an invitation to a proposed organizer issued through the Associate Secretary. Others are spontaneously proposed by interested organizers or participants. Such proposals are welcomed by the Associate Secretaries.

The number of Special Sessions at a Summer or Annual Meeting is limited to twelve. Proposals, invited or offered, which are received at least nine months prior to the meeting are screened for suitability of the topic and of the proposed list of speakers, and for possible overlap or conflict with other proposals (specific deadlines for requesting approval for Special Sessions at national meetings are given above). If necessary, the numerical limitation is enforced.

Proposals for Special Sessions should be submitted directly to the Associate Secretary in charge of the meeting (at the address given in the accompanying box). If such proposals are sent to the Providence office, addressed to the *Notices*, or directed to anyone other than the Associate Secretary, they will have to be forwarded and may not be received before the quota is filled.

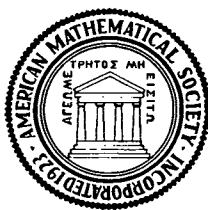
In accordance with an action of the Executive Committee of the Council, no Special Session may be arranged so late that it may not be announced in the *Notices* early enough to allow any member of the Society, who wishes to do so, to submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration.

Special Sessions are effective at sectional meetings and can usually be accommodated. They are arranged by the Associate Secretary under the supervision of the Committee to Select Hour Speakers for the section. The limitation on the number of sessions depends on the space and time available. The same restriction as for national meetings applies to the deadline for announcing Special Sessions at sectional meetings: no Special Session may be approved too late for its announcement to appear in time to allow a reasonable interval for members to prepare and submit their abstracts prior to the special early deadline set for consideration of papers for Special Sessions.

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.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Editorial Department, American Mathematical Society, Post Office 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.



REVIEWS IN RING THEORY

Compiled and Edited by Lance W. Small
Department of Mathematics, University of California, San Diego

These volumes collect 5,396 reviews from *Mathematical Reviews* of papers in noncommutative ring theory. All reviews of papers in ring theory from Volume 21 (1960) through Volume 58 (1979) appear here. Additionally, the editor has collected those papers from Volume 1 through Volume 20 which are necessary background. Papers on group rings, homological questions, and enveloping algebras with ring theoretic interest are also included.

Each review has an "appearance number" specifying the location of the review by chapter, section and number within the section. By and large, reviews within one section are arranged in "rough" chronological order (i.e., by appearance in *Mathematical Reviews*). The principal exceptions are papers in a series and very closely related papers. If a cited review occurs in these volumes, then its appearance number is listed after the review in which it is cited.

Cross-references are given at the beginning of some sections and chapters to inform the reader of closely related reviews appearing elsewhere. These cross-references may also be useful to the reader as a guide to finding reviews which do not appear where the reader thinks they should.

These volumes are a research tool. There are no other books containing the information herein except *Mathematical Reviews* itself.

The editor's previous work includes over 40 papers in ring theory. He has been a reviewer for *Mathematical Reviews* since 1968.

The work is divided into 31 chapters each subdivided into 3 to 21 sections. Chapter headings are:

- | | |
|---|---|
| 1. Primitive, prime and semi-prime rings | 16. Injective modules, self-injective rings and generalizations |
| 2. Theory of radicals | 17. Von Neumann regular rings and their generalizations |
| 3. Nil, nilpotent and radical rings | 18. Artin rings |
| 4. Simple and semi-simple Artin rings | 19. Quasi-Frobenius (QF) rings and their generalizations |
| 5. Division rings | 20. Perfect, semi-perfect rings and modules and their generalizations |
| 6. Matrices over commutative rings and fields and linear algebra (ring theoretic) | 21. Integral domains |
| 7. Classical orders, integral representation theory, arithmetic in algebras | 22. Goldie's theorem, rings of quotients |
| 8. Separable algebras, Azumaya algebras and their generalizations | 23. Noetherian rings |
| 9. Galois theory | 24. Group rings |
| 10. Hopf algebras — algebraic theory | 25. Homological and categorical methods in ring theory |
| 11. Rings satisfying a polynomial identity | 26. Torsion theories |
| 12. Rings with involution | 27. Automorphisms, endomorphisms and derivations on rings |
| 13. Lie and Jordan structures on rings | 28. Commutativity theorems. Generalizations of commutative rings |
| 14. Module theory (general) | 29. Topological rings and modules. Ordered rings |
| 15. Projective modules, flat modules and their generalizations | 30. Other rings and algebras. Miscellaneous topics and results |
| | 31. Books, conference proceedings and surveys |

Published in 2 volumes, xii + 1,114 pages (soft cover). List price \$160.00, institutional member \$120.00, individual member \$40.00, student \$20.00. ISBN 0-8218-0215-1; LC 81-10770. Publication date: August 1981. To order, please specify REVRING. Prepayment is required.

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Denver Meetings, January 3–9, 1983

First Announcement

The January 1983 Joint Mathematics Meetings, including the 89th Annual Meeting of the AMS, the 66th Annual Meeting of the Mathematical Association of America, and the 1983 Annual Meeting of the Association for Symbolic Logic, will be held January 5–9 (Wednesday–Sunday), 1983, in Denver, Colorado. Sessions of the MAA on Thursday, January 6, and Saturday–Sunday, January 8–9, will be held jointly with the National Council of Teachers of Mathematics. The meetings will be preceded by the AMS Short Course on January 3–4 (Monday–Tuesday), 1983. Sessions will take place in the Denver Convention Complex and the Executive Tower Inn.

The members of the Local Arrangements Committee are Nancy S. Angle, Paul T. Bateman (ex-officio), Jerrold W. Bebernes, William S. Dorn, John P. Gill, Jr., Gary W. Grefsrud, Raymond R. Gutzman, Zenos Hartvigson, Frieda K. Holley, William J. LeVeque (ex-officio), Arne Magnus, Richard Osborne, Arlan B. Ramsay (chairman), William N. Reinhardt, David P. Roselle (ex-officio) and Nancy Warren Townsend (publicity director).

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IMPORTANT DEADLINES

Abstracts,	
For consideration for special sessions	September 21
Of contributed papers	October 12
Employment Register	
(Applicants & Employers)	November 15
Preregistration and Housing	November 15
Preregistration cancellations (50% refund)	January 2
Dues credit for nonmembers/students	February 9

89TH ANNUAL MEETING OF THE AMS

January 5–8, 1983

Fifty-sixth Josiah Willard Gibbs Lecture

The 1983 Gibbs lecture will be presented at 8:30 p.m. on Wednesday, January 5, by SAMUEL KARLIN of Stanford University. Professor Karlin will speak on *Mathematical models and controversies in evolutionary theory*.

Colloquium Lectures

There will be a series of four Colloquium Lectures presented by CHARLES L. FEFERMAN of Princeton University. The title of this lecture series is *The uncertainty principle*. The lectures will be given at 1:00 p.m. daily, Wednesday through Saturday, January 5–8.

Retiring Presidential Address

ANDREW M. GLEASON of Harvard University will speak at 8:45 a.m. on Wednesday, January 5. Professor Gleason's title is *Nonexpansive maps*.

Birkhoff Prize

The 1983 George David Birkhoff Prize in Applied Mathematics will be awarded at 4:00 p.m. on Thursday, January 6.

Invited Addresses

By invitation of the Program Committee, there will be seven invited one-hour addresses. The names of the speakers, their affiliations, the titles of most of the talks, dates and times of presentation follow.

MICHAEL AIZENMAN, Princeton University, title to be announced, 2:15 p.m. Friday; BRADLEY EFRON, Stanford University, *Mathematics, statistics, and the modern computer*, 10:15 a.m. Thursday; MICHAEL H. FREEDMAN, University of California, San Diego, *The topology of four-dimensional manifolds*, 3:30 p.m. Wednesday; DAVID GIESEKER, University of California, Los Angeles, *Geometric invariant theory and module problems in algebraic geometry*, 3:30 p.m. Friday; BENEDICT H. GROSS, Brown University, *Rational points of infinite order on elliptic curves*, 8:45 a.m. Thursday; ROGER E. HOWE, Yale University, *Aspects of harmonic analysis on the Heisenberg group: dual pairs, theta functions, classical invariant theory*, 10:15 a.m. Wednesday; and NEIL J. A. SLOANE, Bell Laboratories, *The Leech lattice*, 2:15 p.m. Wednesday.

Special Sessions

By invitation of the same committee, there will be twelve special sessions of selected twenty-minute papers. The titles of these sessions and the names and affiliations of the mathematicians arranging them

Preregistration

Preregistration. Preregistration for these meetings must be completed by November 15, 1982. Those wishing to preregister must complete the form which appears at the back of this issue and submit it along with the appropriate preregistration fee(s) to the Mathematics Meetings Housing Bureau in Providence by November 15.

Preregistration fees do not represent an advance deposit for lodgings. One must, however, preregister for the meetings in order to obtain confirmed hotel accommodations through the Mathematics Meetings Housing Bureau, as outlined on the facing page.

Checks for preregistration fees should be made payable to the AMS. Canadian checks must be marked for payment in U.S. funds. Those who preregister for the AMS Short Course and/or Joint Mathematics Meetings pay fees which are 30 percent lower than those who register at the meetings. The preregistration fees are as follows:

AMS Short Course

Student/Unemployed	\$ 5
All Others	\$25

Joint Mathematics Meetings

Member of AMS, ASL, MAA, NCTM	\$38
Emeritus Member of AMS, MAA	\$ 9
Nonmember	\$58
Student/Unemployed	\$ 9
Employer, Employment Register	\$50
Applicant, Employment Register	no charge

MAA Minicourses

\$15 each

There will be no extra charge for members of the families of registered participants, except that all professional mathematicians who wish to attend sessions must register independently.

All full-time students currently working toward a degree or diploma qualify for the student registration fees, regardless of income.

The unemployed status refers to any person currently unemployed, actively seeking employment, and who is not a student. It is not intended to include persons who have voluntarily resigned or retired from his or her latest position.

The emeritus status refers to any person who has been a member of the AMS or MAA for twenty

years or more, and is retired on account of age from his or her latest position.

A \$4 charge will be imposed for all invoices prepared when preregistration forms are submitted without accompanying check(s) for the preregistration fee(s) or are accompanied by an amount insufficient to cover the total fee(s). Preregistration forms received well before the deadline of November 15 which are not accompanied by correct payment will be returned to the participant with a request for resubmission and full payment.

A 50 percent refund of the preregistration fee(s) will be made for all cancellations received in Providence no later than January 2, 1983. **No refunds will be granted for cancellations received after that date,** or to persons who do not attend the meetings.

The only exception to this rule is someone who preregisters for the Joint Mathematics Meetings only in order to attend an MAA Minicourse, and is too late to obtain a slot in the Minicourse. In this case, full refunds will be made of the Minicourse and Joint Mathematics Meetings preregistration fees, **provided the preregistrant has checked the box on the preregistration form that this was his or her intent.** Individuals who preregister for both the Joint Meetings and a Minicourse and who intend to attend the Joint Meetings, even if the Minicourse is not available, should, of course, **not** check the box on the preregistration form. In this case the Minicourse preregistration fee only will be refunded, and the Joint Meetings preregistration processed.

Those who wish to preregister for the Employment Register should read carefully the special article titled "Mathematical Sciences Employment Register" which follows this announcement of the Denver meetings. The attention of applicants is particularly directed to the box on the December issue of *Employment Information in the Mathematical Sciences*.

Please read the facing page titled **Housing** carefully before completing the preregistration/housing form.

Do not include payment for your housing with meeting preregistration fee(s).

N.B.: Place your AMS or MAA mailing label on the preregistration/housing form where indicated. If you do not have a label readily available, please supply complete name, address, and AMS or MAA member code.

Housing

Mathematics Meetings Housing Bureau. The preregistration/housing form for requesting hotel accommodations will be found at the back of this issue. Use of the services offered by the Mathematics Meetings Housing Bureau requires preregistration for the meetings. Persons desiring confirmed hotel accommodations should complete the form, or a reasonable facsimile, and send it to the Mathematics Meetings Housing Bureau, Post Office Box 6887, Providence, Rhode Island 02940, **so that it will arrive no later than November 15, 1982.**

Please read carefully the section on Hotel Accommodations before completing the form. Forms sent to the wrong address and thus incurring delay in delivery to the Housing Bureau until after the deadline cannot be accepted.

All reservation requests must be received in writing and be processed through the Housing Bureau in Providence. Telephone requests will not be accepted. Please do not contact the hotels directly. Blocks of rooms and special rates have been set aside for the Housing Bureau, and the hotel will either refer you back to the Housing Bureau, or give you a room outside of the block, which may be at a higher rate.

The number of rooms being held by the Denver hotels at each rate is limited. Housing assignments are made on a first-come, first-served basis, so participants desiring low-cost accommodations are urged to get their housing requests in as early as possible. Participants should also be aware that the special rates being offered in the section titled **Hotel Accommodations** may not be available after November 15. **Housing requests received after the deadline of November 15 most surely cannot be honored.**

Participants are strongly urged to rank every hotel on the housing form in the order of preference, and circle the type of room and the rate desired.

Reservations will be made in accordance with preferences indicated on the reservation form insofar as this is possible. Participants who rank only a few of the hotels may find themselves assigned to a hotel which is not satisfactory. If not all hotels are ranked, and all rooms have been filled at the ranked hotels, the assignment will be made at an unranked hotel with the next lowest rate. Deposit requirements vary from hotel to hotel, and participants will be informed of any such requirements directly by the hotels at the time of confirmation. **N.B.: Participants will receive no acknowledgement of their housing assignment until they receive a confirmation from the hotel.**

Participants who are able to do so are urged to share a room whenever possible. This procedure can be economically beneficial. The housing form should be fully completed to ensure proper assignment of rooms. Participants planning to share accommodations should provide the name(s) of the person(s) with whom they plan to occupy a room. Each participant should, however, complete a separate preregistration form. In order to avoid confusion or disappointment, parties planning to share rooms should send their forms together in the same envelope.

Please make all changes to or cancellations of hotel reservations with the Housing Bureau in Providence **before December 20, 1982, by calling 401-272-9500, extension 239.** After that date, changes or cancellations should be made with the Housing Office of the Denver and Colorado Convention and Visitors Bureau by telephoning 303-892-1112, extension 73.

Please read the facing page titled **Preregistration** carefully before completing the preregistration/housing form.

Do not include payment for your housing with meeting preregistration fee(s).

N.B.: Place your AMS or MAA mailing label on the preregistration/housing form where indicated. If you do not have a label readily available, please supply complete name, address, and AMS or MAA member code.

are as follows. The dates and times they will meet and lists of speakers will be announced later.

Proof theory, IRVING H. ANELLIS, McMaster University and G. E. MINC, Leningrad.

Automatic theorem proving, WOODROW W. BLEDSOE, University of Texas, Austin.

Representation theory of finite groups of Lie type, CHARLES W. CURTIS, University of Oregon.

Diophantine problems and analytic number theory, P. D. T. A. ELLIOTT, and WOLFGANG M. SCHMIDT, University of Colorado, Boulder.

Applied category theory, JOHN W. GRAY, University of Illinois, Urbana.

Monotonicity methods in differential equations, A. G. KARTSATOS, and MARY E. PARROTT, Center for Applied Mathematics, University of South Florida.

Abstract adjoints and boundary problems, SUNG J. LEE, University of South Florida, and M. ZUHAIR NASHED, University of Delaware.

Function-theoretic methods in differential equations, PETER A. MCCOY, U. S. Naval Academy.

Pseudo-differential operators and applications, DUONG HONG PHONG, Columbia University.

Number-theoretic algorithms, CARL B. POMERANCE, University of Georgia.

Operator algebras and operator theory, NORBERTO SALINAS, University of Kansas.

History of mathematics, ARTHUR SCHLISSEL, John Jay College of Criminal Justice.

September 21 was the deadline for submission of abstracts for consideration for inclusion in these special sessions.

Committee on the Agenda for Business Meetings

The Society has a Committee on the Agenda for Business Meetings. The purpose is to make Business Meetings orderly and effective. The committee does not have legal or administrative power. It is intended that the committee consider what may be called "quasi-political" motions. The committee has several possible courses of action on a proposed motion, including but not restricted to

- (a) doing nothing;
- (b) conferring with supporters and opponents to arrive at a mutually accepted amended version to be circulated in advance of the meeting;
- (c) recommending and planning a format for debate to suggest to a Business Meeting;
- (d) recommending referral to a committee;
- (e) recommending debate followed by referral to a committee.

There is no mechanism that requires automatic submission of a motion to the committee. However, if a motion has not been submitted through the committee, it may be thought reasonable by a Business Meeting to refer it rather than to act on it without benefit of the advice of the committee.

The committee consists of Everett Pitcher (chairman), Marian B. Pour-El, David A. Sanchez, and Guido L. Weiss.

In order that a motion for the Business Meeting of January 6, 1983 receive the service offered by the committee in the most effective manner, it should be in the hands of the secretary by December 6, 1982.

Everett Pitcher, Secretary

Contributed Papers

There will be sessions for contributed papers Wednesday morning and afternoon, Thursday morning and afternoon, Friday afternoon, and Saturday afternoon. The **deadline** for submission of abstracts of contributed papers is **October 12**. **Late papers will not be accepted.**

Audio-Visual Equipment

Rooms where special sessions and contributed paper sessions will be held will be equipped with an overhead projector and screen. Blackboards will **not** be available.

Other AMS Sessions

AMS Committee on Employment and Educational Policy

The Society's Committee on Employment and Educational Policy (CEEP) and the Mathematical Association of America (MAA) will sponsor a panel discussion at 4:30 p.m. on Friday, January 7, on *Freshman mathematics: Are there alternatives to calculus?* This panel is being organized by IRWIN KRA, SUNY Center at Stony Brook. The speakers are ANTHONY RALSTON, SUNY, Buffalo; PETER D. LAX, Courant Institute, New York University; R. O. WELLS, Rice University; and GAIL S. YOUNG, University of Wyoming.

Council Meeting

The Council of the Society will meet at 2:00 p.m. on Tuesday, January 4 in the Blue Room of the Executive Tower Inn.

Business Meeting

The Business Meeting of the Society will take place immediately following the award of the Birkhoff Prize at 4:00 p.m. on Thursday, January 6. The secretary notes the following resolution of the Council: Each person who attends a Business Meeting of the Society shall be willing and able to identify himself as a member of the Society. In further explanation, it is noted that *each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society.* For additional information on the Business Meeting, please refer to the box titled Committee on the Agenda for Business Meetings.

MATHFILE

An online demonstration of MATHFILE, the computerized version of *Mathematical Reviews*, can be seen in Booth 113 of the exhibit area in the Denver Convention Complex, during regular exhibit hours. Two printing terminals and a TV monitor will be connected to the computers of two commercial online vendors who offer MATHFILE.

You are invited to come to the booth, submit a literature search and see how quickly and easily the results are obtained with the help of the computer!

MATHFILE is available from vendors BRS (Bibliographic Retrieval Services) in Latham, NY and DIALOG Information Services in Palo Alto, CA.

Computer Communications

Denver, Colorado, January 3-4, 1983

The American Mathematical Society, in conjunction with its eighty-ninth annual meeting, will present a one and one-half day short course entitled "Computer Communications" on Monday and Tuesday, January 3 and 4, 1983, in the Symphony Ballroom of the Executive Tower Inn in Denver, Colorado.

Computer communication systems are expected to have a profound effect on human communications in the coming decades. Present day computer communications already span an extraordinary range: from the "low level" interaction of circuits on an integrated circuit chip in a typical computer to the "high level" conversations between computers at geographically distant locations.

The course is designed to acquaint the participant with mathematical ideas that pervade almost every level of computer communications. The mathematical methods used in this field include stochastic processes, combinatorics, analysis and logic, as well as various aspects of theoretical computer science.

Included in the course will be discussions of problems in data communication, complexity of VLSI (Very Large Scale integrated circuits) computations, modelling concurrent processes, probabilistic aspects of networks, and diffusion approximations. Opportunities will be available for participants to obtain first-hand experience working with the speakers in an interactive session on mathematical problems in computer communications.

Synopses of the talks and accompanying reading lists are printed following the announcements of the Denver Mathematics Meetings in this issue of the *Notices*. Participants will be presumed to have background knowledge corresponding to the content of a course in probability theory and introductions to logic and differential equations.

Those who hope to benefit the most from the course may wish to acquire a general background on networks, such as presented in the book *Computer networks*, by A. S. Tanenbaum, Prentice-Hall, New York, 1981.

The course will consist of five lectures and an "Overview" presented by the organizer; it will conclude with the interactive session mentioned above. The speakers are B. Gopinath (Bell Laboratories, Murray Hill), J. Michael Harrison (Stanford University), Pierre A. Humblet (Massachusetts Institute of Technology), Frank P. Kelly (Statistical Laboratory, University of Cambridge), Robert P. Kurshan (Bell Laboratories, Murray Hill) and Thomas Lengauer (University of Saarland).

The short course is open to all who wish to participate upon payment of the registration fee. There are reduced fees for students and unemployed individuals. Please refer to the sections entitled PREREGISTRATION, HOUSING and REGISTRATION AT THE MEETINGS for details.

The program is under the direction of B. Gopinath of the Bell Laboratories, Murray Hill. The short course was recommended by the Society's Committee on Employment and Educational Policy, whose members are Lida K. Barrett (chairman), Irwin Kra, Robert W. McKelvey, Donald C. Rung, Robert J. Thompson, and Barnet M. Weinstock. The short course series is under the direction of the CEEP Short Course Subcommittee, whose members are Stefan A. Burr, Ronald L. Graham (chairman), Robert W. McKelvey, Cathleen S. Morawetz, Barbara L. Osofsky, and Philip. D. Straffin, Jr.

The cost is \$36–\$55/hour on BRS and \$55/hour on DIALOG plus a \$6/hour telecommunications charge. Most searches can be completed with a few minutes of connect time.

The MATHFILE *User's Guide*, containing all the information necessary for searching, will be available at the booth for inspection and can be purchased at the AMS book sale.

66TH ANNUAL MEETING OF THE MAA

January 6–9, 1983

The **Mathematical Association of America** (MAA) will hold its 66th annual meeting on January 6 (Thursday) and on January 7–9 (Friday–Sunday). The Business Meeting of the MAA will take place at 9:30 a.m. on Saturday, January 8, at which the 1983 Award for Distinguished Service will be presented.

Sessions of the MAA on Thursday, January 6, and Saturday and Sunday, January 8–9, will be held jointly with NCTM.

The MAA Board of Governors will meet at 9:00 a.m. on Thursday, January 6.

The MAA is planning five Minicourses on *Placement testing*, *Computer programming*, *Computer software*, *Statistics*, and *Computer graphics*. The Minicourse on *Computer software*, will be given twice, if necessary. The Minicourses are open only to persons who have registered for the Joint Mathematics Meetings and paid both the Joint Meetings registration fee and the Minicourse registration fee. **If the only reason for registering for the Joint Meetings is to gain admission to a Minicourse, this should be indicated by checking the appropriate box on the preregistration form. Then, if the minicourse is full, full refunds can be made of the Minicourse and Joint Mathematics Meetings preregistration fees. Otherwise, the Joint Meetings preregistration will be processed, and then be subject to the 50 percent refund rule.**

The Minicourses have separate registration fees of \$15 each, and are limited to 30 participants each.

JOHN L. VAN IWAARDEN of Hope College will run a special session on *High level languages—why PASCAL?* at 7:00 p.m. on Friday, January 7.

For a more detailed listing of the activities of the MAA, see the Timetable.

The MAA will also schedule sessions for contributed papers. Detailed information on these sessions and procedures for submitting papers will appear in the November–December issue of *Focus*, the MAA newsletter.

The MAA Section Officers will hold an informal meeting at 4:00 p.m. on Friday, January 7.

The MAA Committee on Corporate Members will sponsor an evening session on *Mathematics publishing, copyright, and software*, at 7:00 p.m. on Friday, January 7.

At 7:00 p.m. on Thursday, January 6, there will be a panel discussion on *Interactions between schools and colleges*.

ACTIVITIES OF OTHER ORGANIZATIONS

The **Association for Symbolic Logic** (ASL) will hold its 1983 Annual Meeting on Saturday and Sunday, January 8–9. In addition to contributed papers, there will be several invited talks. A preliminary list of invited speakers is: T. CARLSON, D. A. MARTIN, and S. TODORČEVIĆ.

The **Association for Women in Mathematics** (AWM) will sponsor a Panel Discussion at 11:15 a.m. on Thursday, January 6, to be immediately followed by the AWM Business Meeting. The fourth annual AWM Emmy Noether Lecture will be given at 10:00 a.m. on Friday, January 7.

The **Rocky Mountain Mathematics Consortium** (RMMC) will sponsor a symposium on *Mathematics and seismic prospecting* at 2:15 p.m. on Friday, January 7. The symposium has been organized and will be moderated by DUANE PORTER of the University of Wyoming. Speakers are NORMAN BLEISTEIN, University of Denver; ROBERT BURRIDGE, Courant Institute of the Mathematical Sciences; and KEN LARNER, Western Geophysical, Houston.

The RMMC Board of Directors will meet at 2:00 p.m. on Thursday, January 6.

WILLIAM G. ROSEN, Head of the Mathematical Sciences Section of the **National Science Foundation** (NSF) will speak at 2:45 p.m. on Thursday, January 6, on *The budgetary outlook*.

The NSF will again be represented at a booth in the exhibit area. NSF staff members will be available to provide counsel and information on NSF programs of interest to mathematicians from 9:00 a.m. to 5:00 p.m., Thursday and Friday, January 6–7.

OTHER EVENTS OF INTEREST

Book Sales

Books published by the AMS and MAA will be sold for cash prices somewhat below the usual prices when these same books are sold by mail. These discounts will be available only to registered participants wearing the official meeting badge. VISA and MASTERCARD credit cards will be accepted for book sale purchases at the meeting. The book sales will be open the same days and hours as the Joint Mathematics Meetings registration desk (except on Saturday, January 8, when they will close at 2:00 p.m.) and are located in the Arena of the Denver Convention Complex.

Exhibits

The book and educational media exhibits are located in the Arena of the Denver Convention Complex and will be open Wednesday, January 5, through Saturday, January 8. The exhibits will be open from 1:00 p.m. to 5:00 p.m. on Wednesday; from 9:00 a.m. to 5:00 p.m. on Thursday and Friday; and from 9:00 a.m. to noon on Saturday. All participants are encouraged to visit the exhibits during the meeting. **Participants visiting the exhibits will be**

asked to display their meeting badge in order to enter the exhibit area.

INFORMATION FOR PARTICIPANTS

Hotel Accommodations

The rates listed below are subject to a 8.5 percent city hotel tax. The number after the name of the hotel is the number it carries on the map. The estimated walking distance from the hotel to the Denver Convention Complex is given in parentheses following the telephone number.

In all cases "single" refers to one person in one bed; "double" refers to two persons in one bed; "twin" refers to two persons in two single beds; and "twin double" refers to two persons in two double beds. A rollaway cot for an extra person can be added to double or twin rooms only; however, not all hotels are willing to do so.

Please make all changes to or cancellations of hotel reservations with the Housing Bureau in Providence before December 20, 1982. After that date, changes or cancellations should be made with the Housing Office of the Denver and Colorado Convention & Visitors Bureau by telephoning 303-892-1112 (extension 73).

Brown Palace Hotel (4)

321 17th Street
Denver, Colorado 80202

Telephone: 303-825-3111 (12 minutes)

Singles	\$70
Twin Doubles	\$80
Triples	\$90
Quads	\$90

Executive Tower Inn (2)

1405 Curtis Street
Denver, Colorado 80202

Telephone: 303-571-0300 (adjacent)

Singles	\$49
Doubles	\$59
Twin Doubles	\$59
Triples	\$64
Quads	\$69

Governors Court Hotel (8)

1776 Grant Street
Denver, Colorado 80203

Telephone: 303-861-2000 (20 minutes)

Singles	\$50, \$65
Doubles	\$60, \$75
Twin Doubles	\$60, \$75
Triples	\$70, \$85
Quads	\$80, \$95

The Denver Hilton (3)

(Employment Register Location)

Fifteen Fifty Court Place
Denver, Colorado 80202

Telephone: 303-893-3333 (11 minutes)

Singles	\$55
Doubles	\$65
Twin Doubles	\$65
Triples	\$75
Quads	\$85

Holiday Inn Denver Downtown (5)

15th and Glenarm Place

Denver, Colorado 80202

Telephone: 303-573-1450 (8 minutes)

Singles	\$50
Doubles	\$62
Twin Doubles	\$62
Triples	\$74
Quads	\$86

Denver Marriott-City Center (6)

1701 California Street

Denver, Colorado 80202

Telephone: 303-825-1300 (10 minutes)

Singles	\$55
Doubles	\$65
Twin Doubles	\$65
Triples	\$75
Quad	\$85

Plaza Cosmopolitan Hotel (7)

1780 Broadway

Denver, Colorado 80202

Telephone: 303-861-9000 (14 minutes)

Singles	\$48
Doubles	\$60

Quality Inn Central (9)

2601 Zuni Street I-25 at Speer Boulevard (Exit 212B)

Denver, Colorado 80211

Telephone: 303-433-6677 (*)

Singles	\$37
Doubles	\$42
Twin Doubles	\$42
Triples	\$47
Quads	\$52

*Not within walking distance, but shuttle service will be provided by the hotel at no charge.

Student/Unemployed Housing

We have been able to reserve a very limited number of rooms in the Standish Hotel, 1530 California Street, for use by students and unemployed participants. The Standish is about a seven-minute walk to the Convention Complex.

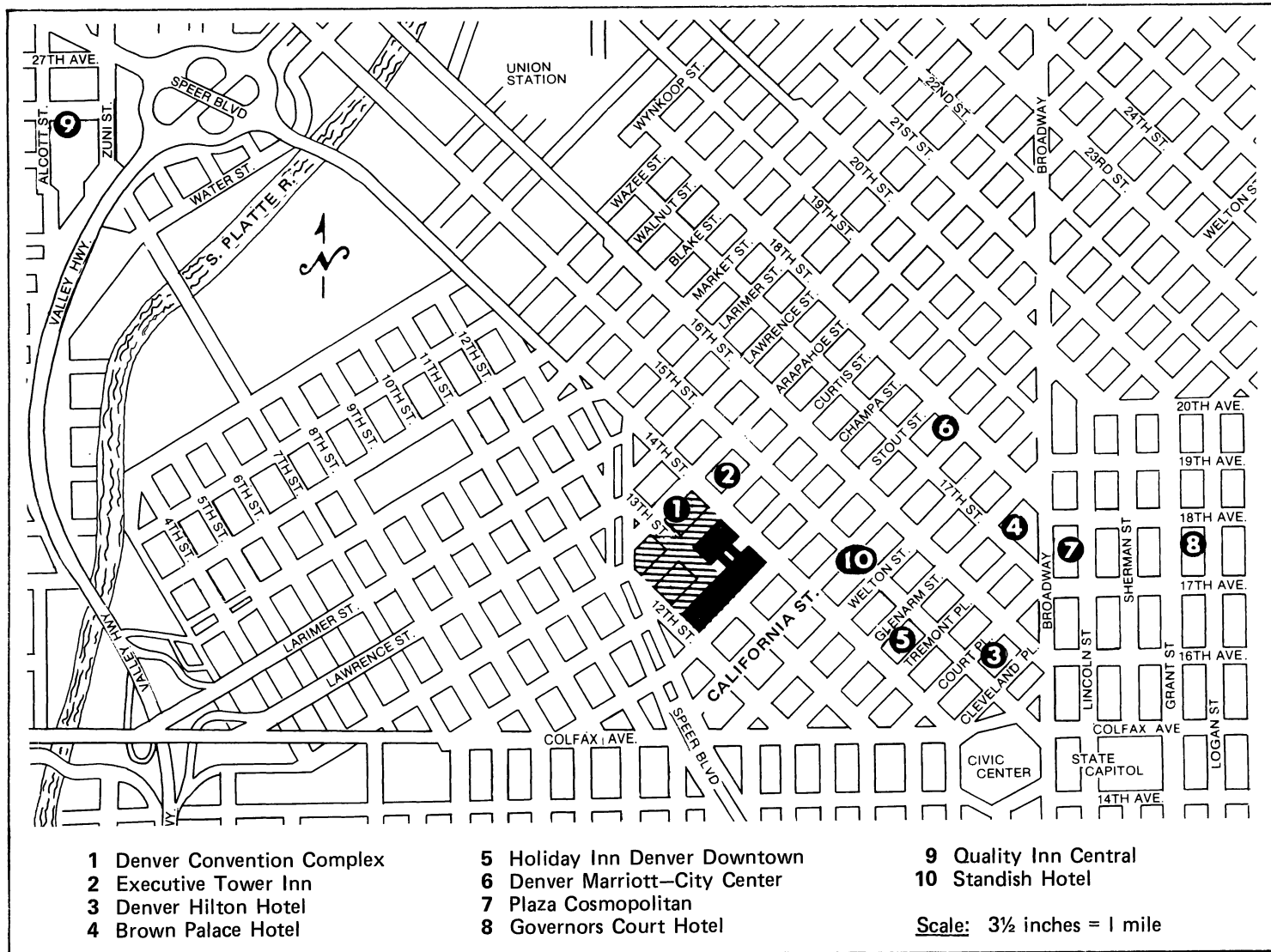
Since all rooms contain either twin beds or one or two double beds, it has been requested that two persons share a room for maximum occupancy, if possible. The rates for these rooms with private bath are as follows:

Singles	\$20
Doubles	\$24

In addition, a very limited number of rooms, each containing a sink, but with shared baths in the hall, are available at the single rate of \$14 per day.

In all cases, a deposit equivalent to one night's lodging will be required. **This deposit must be included with the preregistration fee(s).** Please note that, since the number of these low-cost accommodations is limited, it is likely that these rooms will be filled when your form is received in Providence, so please indicate at least five additional choices in the housing section of the preregistration/housing form to ensure that a confirmed hotel reservation will be made for you.

Downtown Denver



TIMETABLE

The purpose of this timetable is to provide assistance to registrants in the selection of arrival and departure dates. The program, as outlined below, is based on information available at press time.

AMERICAN MATHEMATICAL SOCIETY SHORT COURSE SERIES		
MONDAY, January 3	COMPUTER COMMUNICATIONS	
9:00 a.m. - 4:00 p.m.	REGISTRATION	
2:00 p.m. - 3:15 p.m.	Overview B. Gopinath	
3:30 p.m. - 4:45 p.m.	Introduction to data communication Pierre A. Humblet	
TUESDAY, January 4		
8:00 a.m. - 2:00 p.m.	REGISTRATION	
9:00 a.m. - 10:15 a.m.	The complexity of VLSI computations Thomas Lengauer	
10:30 a.m. - 11:45 a.m.	Modelling concurrent processes Robert P. Kurshan	
1:30 p.m. - 2:45 p.m.	Probabilistic aspects of networks Frank P. Kelly	
3:00 p.m. - 4:15 p.m.	Diffusion approximations for queuing networks J. Michael Harrison	
4:15 p.m. - 5:00 p.m.	Interactive session	
	JOINT MATHEMATICS MEETINGS	
TUESDAY, January 4	American Mathematical Society	
2:00 p.m. - 10:00 p.m.	COUNCIL MEETING	
4:00 p.m. - 8:00 p.m.		REGISTRATION
4:00 p.m. - 8:00 p.m.	AMS BOOK SALE	MAA BOOK SALE
WEDNESDAY, January 5	AMS	
8:00 a.m. - 5:00 p.m.	REGISTRATION	
8:00 a.m. - 5:00 p.m. morning	AMS BOOK SALE Special Sessions Sessions for Contributed Papers	MAA BOOK SALE
8:45 a.m. - 9:45 a.m.	RETIRING PRESIDENTIAL ADDRESS Nonexpansive maps Andrew M. Gleason	
10:15 a.m. - 11:15 a.m.	INVITED ADDRESS Aspects of harmonic analysis on the Heisenberg group: Dual pairs, theta functions, classical invariant theory Roger E. Howe	
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE I The uncertainty principle Charles L. Fefferman	
1:00 p.m. - 5:00 p.m. afternoon	EXHIBITS Special Sessions Sessions for Contributed Papers	
2:15 p.m. - 3:15 p.m.	INVITED ADDRESS The Leech lattice Neil J. A. Sloane	
3:30 p.m. - 4:30 p.m.	INVITED ADDRESS The topology of four-dimensional manifolds Michael H. Freedman	
8:30 p.m. - 9:30 p.m.	JOSIAH WILLARD GIBBS LECTURE Mathematical models and controversies in evolutionary theory Samuel Karlin	

N.B.: Only participants who qualify as students or unemployed as defined on the preregistration/housing form will be given these rooms.

Registration at the Meetings

Meeting preregistration and registration fees only partially cover expenses of holding meetings. All mathematicians who wish to attend sessions are expected to register, and should be prepared to show their meeting badge, if so requested. The fees for registration at the meeting (listed below) are 30 percent more than the preregistration fees.

Joint Mathematics Meetings

Member of AMS, MAA	\$49
Emeritus Member of AMS, MAA	\$12
Nonmember	\$75
Student/Unemployed	\$12

Employment Register

Employer	\$75
Applicant	No charge

AMS Short Course

Student/Unemployed	\$10
All Other Participants	\$30
One-day Fee (Second Day Only)	\$15

MAA Minicourse

All Participants	\$15
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Registration fees may be paid at the meetings in cash, by personal or travelers' checks, or by VISA or MASTERCARD credit cards. Canadian checks must be marked for payment in U.S. funds.

There is no extra charge for members of the families of registered participants, except that all professional mathematicians who wish to attend sessions must register independently.

All full-time students currently working toward a degree or diploma qualify for the student registration fees, regardless of income.

The unemployed status refers to any person currently unemployed, actively seeking employment, and who is not a student. It is not intended to include persons who have voluntarily resigned or retired from his or her position.

Persons who qualify for emeritus membership in either the Society or the Association may register at the emeritus member rate. The emeritus status refers to any person who has been a member of the AMS or MAA for twenty years or more, and is retired on account of age from his or her latest position.

Nonmembers who register at the meetings and pay the \$75 nonmember registration fee are entitled to a discount of the difference between the member registration fee of \$49 and the nonmember registration fee of \$75 as a \$26 credit against dues in either the AMS or MAA or both, provided they apply for membership before February 9, 1983.

Nonmember students who register at the meetings and pay the \$12 registration fee are entitled to a discount of the difference between the student preregistration fee of \$9 and the registration fee of

\$12 as a \$3 credit against dues in either the AMS or MAA or both, provided they apply for membership before February 9, 1983.

Nonmembers and nonmember students who thus qualify may apply for membership at the meetings, or by mail afterwards up to the deadline.

Registration Dates and Times

AMS Short Course

Promenade Foyer, Executive Tower Inn

Monday, January 3	9:00 a.m. to 4:00 p.m.
Tuesday, January 4	8:00 a.m. to 2:00 p.m.

Joint Mathematics Meetings

[and MAA Minicourse (until filled)]

Arena, Denver Convention Complex

Tuesday, January 4	4:00 p.m. to 8:00 p.m.
Wednesday, January 5	8:00 a.m. to 5:00 p.m.
Thursday, January 6,	
through	8:00 a.m. to 4:00 p.m.
Saturday, January 8	

Assistance and Information Desk

Outside Arena, Denver Convention Complex

Sunday, January 9	8:30 a.m. to 1:30 p.m.
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Please note that the Joint Mathematics Meetings registration desk will not be open on Sunday, January 9, and that the telephone message center will not be in operation. Other services provided during the meeting at the registration desk will also no longer be available (see section below on Registration Desk Services). There will, however, be a small desk set up outside the Arena in the Denver Convention Complex, where local information will be available and where a staff member will provide limited assistance to participants. No registration or cash transactions will be possible at this desk.

REGISTRATION DESK SERVICES

AMS/MAA Information

Information on the publications and activities of both organizations may be obtained at this section of the registration desk.

Assistance, Comments and Complaints

A log for registering participants' comments or complaints about the meeting is kept at the Transparencies section of the registration desk. All participants are encouraged to use this method of helping to improve future meetings. Comments on all phases of the meeting are welcome. If a written reply is desired, participants should furnish their name and address.

Participants with problems of an immediate nature requiring action at the meeting should see the meeting manager, who will try to assist them.

Audio-Visual Aid

A member of the AMS/MAA staff will be available to advise or consult with speakers on their audio-visual requirements.

Baggage and Coat Check

Information on checking facilities will appear in a later issue.

TIMETABLE

THURSDAY, January 6	American Mathematical Society	Other Organizations
8:00 a.m. - 4:00 p.m.	AMS BOOK SALE Special Sessions Sessions for Contributed Papers	REGISTRATION
8:00 a.m. - 4:00 p.m. morning		MAA BOOK SALE
8:30 a.m. - 1:00 p.m.		Mathematical Association of America Minicourse on Computer Programming
8:45 a.m. - 9:45 a.m.	INVITED ADDRESS Rational points of infinite order on elliptic curves Benedict H. Gross	
9:00 a.m. - 9:30 a.m.	EMPLOYMENT REGISTER ORIENTATION SESSION	
9:00 a.m. - 4:00 p.m.		MAA - BOARD OF GOVERNORS MEETING
9:00 a.m. - 5:00 p.m.	EXHIBITS	
9:30 a.m. - 4:00 p.m.	EMPLOYMENT REGISTER REGISTRATION	
10:15 a.m. - 11:15 a.m.	INVITED ADDRESS Mathematics, statistics, and the modern computer Bradley Efron	
11:15 a.m. - 12:15 p.m.		Association for Women in Mathematics Panel Discussion
12:15 p.m. - 12:55 p.m.		AWM - Business Meeting
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE II The uncertainty principle Charles L. Fefferman	
afternoon	Special Sessions Sessions for Contributed Papers	
2:00 p.m. - 4:00 p.m.		Rocky Mountain Mathematics Consortium Board of Directors Meeting
2:45 p.m. - 3:45 p.m.	The Budgetary Outlook William G. Rosen, NSF	
4:00 p.m. - 5:30 p.m.	PRIZE SESSION AND BUSINESS MEETING	
6:15 p.m.		AWM - Open Reception
7:00 p.m. - 9:00 p.m.		MAA - PANEL DISCUSSION Interactions between schools and colleges
7:00 p.m. - 10:00 p.m.		MAA - Minicourse on Placement Testing
FRIDAY, January 7	AMS	Other Organizations
8:00 a.m. - noon		MAA - Minicourse on Statistics
8:00 a.m. - 4:00 p.m.	AMS BOOK SALE	REGISTRATION
8:00 a.m. - 4:00 p.m.		MAA BOOK SALE
8:30 a.m. - 9:20 a.m.		MAA - INVITED ADDRESS Nonassociative algebras, the first 101 years Marvin L. Tomber
9:00 a.m. - 5:00 p.m.	EXHIBITS	
9:00 a.m.	EMPLOYMENT REGISTER DISTRIBUTION OF SCHEDULES	
9:30 a.m. - 10:20 a.m.		MAA - INVITED ADDRESS Speaker to be announced
9:30 a.m. - 5:30 p.m.	EMPLOYMENT REGISTER INTERVIEWS	
10:00 a.m. - 11:00 a.m.		AWM - Emmy Noether Lecture Speaker and title to be announced
10:30 a.m. - 11:20 a.m.		MAA - INVITED ADDRESS How to throw small matrices away, or, just what did Brown, Douglas, and Filmore do in 1973? Paul R. Halmos
11:30 a.m. - 12:20 p.m.		MAA - INVITED ADDRESS Nerve conduction and cardiac fibers: Some qualitative problems in differential equations Jane Cronin Scanlon
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE III The uncertainty principle Charles L. Fefferman	

Check Cashing

The meeting cashier will cash personal or travelers' checks up to \$50, upon presentation of the official meeting registration badge, provided there is enough cash on hand. Canadian checks must be marked for payment in U.S. funds.

Local Information

This section of the desk will be staffed by members of the Local Arrangements Committee and other volunteers from the Denver mathematical community.

Lost and Found

See the meeting cashier.

Mail

All mail and telegrams for persons attending the meetings should be addressed to the participant, Joint Mathematics Meetings, c/o Denver & Colorado Convention & Visitors Bureau, 225 West Colfax Avenue, Denver, Colorado 80202. Mail and telegrams so addressed may be picked up at the mailbox in the registration area during the hours the registration desk is open. U.S. mail not picked up will be forwarded after the meeting to the mailing address given on the participant's registration record.

Personal Messages

Participants wishing to exchange messages during the meeting should use the mailbox mentioned above. Message pads and pencils are provided. It is regretted that such messages left in the box cannot be forwarded to participants after the meeting is over.

Telephone Messages

A telephone message center is located in the registration area to receive incoming calls for participants. The center is open from January 5 through 8 only, during the hours that the Joint Mathematics Meetings registration desk is open. Messages will be taken and the name of any individual for whom a message has been received will be posted until the message has been picked up at the message center. The telephone number of the message center will be announced in the January issue of the *Notices*.

Transparencies

Speakers wishing to prepare transparencies in advance of their talk will find the necessary materials and copying machines at this section of the registration desk. A member of the staff will assist and advise speakers on the best procedures and methods for preparation of their material. There is a modest charge for these materials. Please note that this service will not be available on Sunday, January 9.

Visual Index

An alphabetical list of registered participants, including local addresses and arrival and departure dates, is maintained in the registration area.

MISCELLANEOUS INFORMATION

Child Care

Nanny's Hotel Babysitting, Inc., offers a professional babysitting service in the safety of your hotel

room. Many of the babysitters are older parents who have already raised a family of their own. Day or evening service is available. Please notify them as far in advance as possible. For more information, call 303-696-7855. The Brown Palace and the Hilton will arrange for babysitters if given enough prior notice.

Local Information

Taxis presently cost \$2.05 for the first mile and 90 cents each additional mile, one passenger. Each additional person is charged 40 cents extra, as long as they go from the same pickup point to the same destination. The Regional Transit District (RTD) operates buses throughout the area. Buses making local stops charge a flat fee of 70 cents during peak hours (6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 6:00 p.m., Monday through Friday), or 35 cents all other hours Monday through Friday, all day Saturday and Sunday. Express buses charge \$1-1.50 within town.

A section of 16th Street has been turned into a pedestrian mall, with free transportation up and down its length. Participants staying at the Hilton will find it convenient to utilize this transportation as far as Champa Street, which is only two blocks away from the Convention Complex.

Denver has an Art Museum, a Natural History Museum (including a Planetarium), an Arboretum, the State Capitol building (with a gold dome), the Denver Mint, and historical features such as the Molly Brown House. The nearest ski areas are over an hour away by automobile. Further information will be available at the Local Information section of the registration desk.

Parking

Those coming by car are advised to stay at either the Holiday Inn (which is within walking distance from the Convention Complex and provides free parking for registered guests), the Quality Inn (which has free parking for registered guests and a shuttle service to the Convention Complex), or the Executive Tower Inn (which is adjacent to the Convention Complex and has parking facilities for registered guests costing \$3 per day, either onsite or across the street, in and out privileges included). In addition the following hotels provide for parking for registered guests:

Marriott—\$10/day, including in/out.

Governors Court—\$3.50/day in area.

Plaza Cosmopolitan—\$4.50/24 hours, including in/out.

Hilton—\$8.50-\$10/day, underground.

Those driving in for the day may park in the garage adjacent to the Convention Complex at a cost of about \$5 per day.

All rates quoted above are subject to change.

Parking lots in the city range from 50 cents to \$1.75 per hour; 24 hour parking ranges from \$3.50 to \$16.

Social Events

The Local Arrangements Committee has arranged a no-host, cash-bar social at 6:30 p.m. on Friday,

TIMETABLE

FRIDAY, January 7	American Mathematical Society	Other Organizations
afternoon	Special Sessions Sessions for Contributed Papers	
1:00 p.m. - 6:00 p.m.		MAA - Minicourse on Computer Graphics
2:15 p.m. - 3:15 p.m.	INVITED ADDRESS Title to be announced Michael Aizenman	
2:15 p.m. - 5:15 p.m.		RMMC - Symposium on Mathematics and seismic prospecting Norman Bleistein Robert Burrige Ken Larner Duane Porter (moderator)
3:30 p.m. - 4:30 p.m.	INVITED ADDRESS Geometric invariant theory and module problems in algebraic geometry David Gieseker	
4:00 p.m. - 6:00 p.m.		MAA - Section Officers Meeting
4:30 p.m. - 6:00 p.m.	AMS CEEP/MAA PANEL DISCUSSION Freshman mathematics: Are there alternatives to calculus? Irwin Kra (organizer)	
6:30 p.m.	NO-HOST COCKTAIL PARTY	
7:00 p.m. - 9:00 p.m.		MAA - Committee on Corporate Members Session on Mathematics publishing, copy- right and software
7:00 p.m. - 9:30 p.m.		MAA - SPECIAL SESSION High level languages—why PASCAL? John L. Van Iwaarden
8:00 p.m. - 11:00 p.m.		Association for Symbolic Logic Council Meeting
SATURDAY, January 8	AMS	Other Organizations
8:00 a.m. - noon		MAA - Minicourse on Computer Software
8:00 a.m. - 4:00 p.m.		REGISTRATION
8:00 a.m. - 2:00 p.m.	AMS BOOK SALE	MAA BOOK SALE
8:30 a.m. - 9:20 a.m.		MAA - INVITED ADDRESS A systematic method for teaching mathematical proofs Daniel Solow
9:00 a.m.	EMPLOYMENT REGISTER DISTRIBUTION OF SCHEDULES	
9:00 a.m. - noon	EXHIBITS	
9:30 a.m. - 10:20 a.m.		MAA - BUSINESS MEETING
9:30 a.m. - 5:30 p.m.	EMPLOYMENT REGISTER INTERVIEWS	
10:30 a.m. - 11:20 a.m.		MAA - INVITED ADDRESS Mathematical modeling in petroleum reservoir simulation Richard E. Ewing
11:30 a.m. - 12:20 p.m.		MAA - INVITED ADDRESS Title to be announced Heinz-Otto Peitgen
morning		ASL - Sessions
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE IV The uncertainty principle Charles L. Fefferman	
afternoon	Special Sessions Sessions for Contributed Papers	
1:00 p.m. - 6:00 p.m.		MAA - Minicourse on Computer Software (tentative)
5:30 p.m. - 7:00 p.m.		ASL - Reception
7:00 p.m. - 10:00 p.m.		MAA - Minicourse on Placement Testing
7:00 p.m. - 10:00 p.m.		MAA - Film Program
8:00 p.m. - 11:00 p.m.		ASL - Council Meeting

The Denver Meetings Travel Hotline — Call 800-556-6882

In Rhode Island and outside the continental U.S. call 401-884-9500 or Telex 952165
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Another Member Service to Assist You if You're Attending the Denver Meetings and Use a Major Credit Card

One free call answers all your travel questions and supplies you with all your needs, including reduced-rate airline arrangements. Meeting preregistration can only be done through the Mathematics Meetings Housing Bureau, which can not be reached through this 800 number.

THE SUPERSERVICE:

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- Fare check: A special review 30 days prior to your trip and again 15 days prior to insure that you are getting the lowest available airline fare. You will be automatically re ticketed if fares drop below your original ticket cost.
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THE NECESSITIES:

- You must use VISA, MASTERCARD or AMERICAN EXPRESS to utilize the travel hotline. Please have your card number and expiration date ready when you call.

- Remember, you can use this convenient service to purchase your airline tickets and ground transfers.

THE GUARANTEE: The lowest fares, immediate confirmation and individualized personal service.

If you have any questions regarding this service, call
the Denver Meetings Travel Hotline — 800-556-6882

January 7. More details will be available in a later issue.

Travel

In January, Denver is on Mountain Standard Time. There is regular airline service to the Stapleton International Airport by several major airlines.

At the suggestion of the AMS Board of Trustees, the AMS/MAA Joint Meetings Committee authorized the experimental agreement with a travel service in an attempt to assist participants in obtaining the best airline fares possible to and from Denver. This travel service (which has an 800 number) is described in the box above. All participants are urged to consider this organization for their airline reservations. This experiment will be evaluated in order to determine whether it can provide a useful service for members.

The airport in Denver is approximately five miles from downtown, and the trip takes about fifteen minutes. The airport limousine stopping at the downtown hotels runs every 20 minutes from 6:30 a.m. until 10:30 p.m. daily. Present cost is \$4 per person. A taxi from the airport to a downtown hotel costs \$8.55 plus 40 cents for each additional passenger one way. There is good bus service provided by the Regional Transit District (RTD) on buses #28, #32, and #38 from the airport to downtown, with the fare varying between 35 cents and 70 cents, depending on the hour of day. Most major car rental agencies maintain desks at the airport.

AMTRAK's San Francisco Zephyr provides train service between Denver and Chicago and between Denver and the major west coast cities. The Denver Rio Grande Western Railroad operates a day train between Salt Lake City and Denver three days per week; in fact this is the only nonAMTRAK intercity train still running in the United States.

Denver can be reached by car via I-70 from the east and west, and via I-25 from the north and south.

Weather

Denver is located on the eastern slope of the Rocky Mountains and has a continental climate. The temperature can vary greatly at this time of year, and can easily drop below 0°F; however, the average high temperature in January is 52°F, and the average low is 23°F, with the median temperature in January being 31°F. The temperature drops rapidly at sundown, so the evening temperature is usually close to the overnight low (25°F to 28°F).

Paul T. Bateman
Associate Secretary

Urbana, Illinois

Important information on the Employment Register immediately follows.

TIMETABLE

SUNDAY, January 9	Other Organizations
8:30 a.m. - 1:30 p.m. morning and afternoon	ASSISTANCE & INFORMATION DESK
8:30 a.m. - 9:20 a.m.	ASL - Sessions MAA - INVITED ADDRESS VisiCalc and mathematical algorithms: Mathematical applications of an electronic spreadsheet Deane E. Arganbright
9:30 a.m. - 10:20 a.m.	MAA - INVITED ADDRESS Applications in the undergraduate curriculum Solomon A. Garfunkel
10:30 a.m. - 11:20 a.m.	MAA - INVITED ADDRESS Title to be announced Ruth Hoffman
11:30 a.m. - 12:20 p.m.	MAA - INVITED ADDRESS Progress report of the National Science Board Commission on Pre-College Prepara- tion in Mathematics Katherine P. Layton

SIAM-AMS PROCEEDINGS (ISSN 0080-5084)

MATHEMATICAL PSYCHOLOGY AND PSYCHOPHYSIOLOGY

edited by *Stephen Grossberg*

Understanding the mind and its neural substrates has long been one of the most challenging and important scientific problems confronting humanity. Experimental and theoretical progress in this area has recently accelerated to the point that our knowledge of brain processes is undergoing a revolutionary transformation. This volume contains articles by the invited speakers at a joint American Mathematical Society—Society for Industrial and Applied Mathematics Symposium on Mathematical Psychology and Psychophysiology in Philadelphia on April 15-16, 1980 at which several of the theoretical approaches to this area were reviewed.

The articles include contributions to a variety of topics and employ a variety of mathematical tools to explicate these topics. The topics include studies of development, perception, learning, cognition, information processing, psychophysiology, and measurement. The mathematical tools include algebraic, stochastic, and dynamical system models and theorems. Despite this diversity, the reader can discover an underlying coherence among the papers. Various concepts and formal laws reoccur in several different subjects. Distinct mathematical tools often probe different levels of the same underlying physical mechanisms.

Showing the conceptual and mathematical interconnectedness of several approaches to the fundamental scientific problem of understanding mind and brain is a significant contribution of this volume. Its interdisciplinary approach permits a deeper understanding of theoretical advances as it formally structures a broad overview of important data.

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- Norma Graham, *The visual system does a crude Fourier analysis of patterns*
 Geoffrey J. Iverson and Michael Pavel, *Invariant properties of masking phenomena in psychoacoustics and their theoretical consequences*
 Walter J. Freeman, *A neural mechanism for generalization over equivalent stimuli in the olfactory system*
 Ch. von der Malsburg and D. J. Willshaw, *Differential equations for the development of topological nerve fibre projections*
 Gail A. Carpenter, *Normal and abnormal signal patterns in nerve cells*
 Stuart Geman, *The law of large numbers in neural modelling*
 Stephen Grossberg, *Adaptive resonance in development, perception and cognition*
 Stephen Grossberg, *Psychophysiological substrates of schedule interactions and behavioral contrast*
 M. Frank Norman, *Sociobiological variations on a Mendelian theme*
 M. Frank Norman, *A "psychological" proof that certain Markov semigroups preserve differentiability*
 R. Duncan Luce and Louis Narens, *Axiomatic measurement theory*
 David L. Noreen, *Optimal decision rules for some common psychophysical paradigms*
 George Sperling, *Mathematical models of binocular vision*
 Dirk Vorberg, *Reaction time distributions predicted by serial self-terminating models of memory search*

1980 *Mathematics Subject Classifications* (Major headings):
06, 34, 35, 39, 60, 62, 92.

Volume 13, x + 318 pages

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Mathematical Sciences Employment Register

January Meeting in Denver

The Mathematical Sciences Employment Register, held annually at the Joint Mathematics Meetings in January, provides opportunities for mathematical scientists seeking professional employment to meet employers who have positions to be filled. Job listings (or descriptions) and résumés prepared by employers and applicants are displayed for the participants so that members of each group may determine which members of the other group they would like to have an opportunity to interview. A computer program assigns the appointments, matching requests to the extent possible, using an algorithm which maximizes the number of interviews which can be scheduled subject to constraints determined by the number of time periods available, the numbers of applicants and employers, and the pattern of requests. The report below outlines the operation of the register, indicating some of the procedures involved for the benefit of those not familiar with its operation.

The Mathematical Sciences Employment Register is apparently unique among employment services offered by professional organizations in the sciences, engineering and the humanities. The computer programs used are constructed around a matching program, devised by Donald R. Morrison and based on an algorithm described in his paper "Matching Algorithms" in *Journal of Combinatorial Theory*, volume 6 (1969), pages 20 to 32; see also "Matching Algorithms" (abstract) *Notices*, August 1967, page 630. The number of interviews arranged by the program is significantly greater than the number possible at the employment registers of other organizations, in many cases greater by an order of magnitude.

1983 Employment Register in Denver

The Employment Register at the Denver meeting will take place in the Ballroom Complex on the lobby level of the Denver Hilton Hotel on Thursday, Friday, and Saturday, January 6, 7, and 8, 1983. A short (optional) orientation session will be conducted by the AMS-MAA-SIAM Committee on Employment Opportunities at 9:00 a.m. on Thursday, January 6. The purpose of the orientation session is to familiarize participants with the operation of the Register and with the various forms involved. Interviews between applicants and employers will be scheduled for Friday and Saturday, January 7 and 8.

Fifteen-minute intervals are allowed for interviews, including two or three minutes between successive interviews. The interviews are scheduled in half-day sessions: Friday morning and afternoon, and Saturday morning and afternoon, amounting to four half-day sessions for interviews. There are ten periods in which interviews can be scheduled in the morning sessions and fourteen periods in the afternoon sessions. It is possible that an applicant or employer may be scheduled for the maximum number of interviews in a session, but the interview scheduling program can accommodate only six requests per session for each participant. The scheduling program does not have a provision allowing participants to specify particular times for interviews beyond the choice of session (day, and morning or afternoon). No interviews will be scheduled for the first of the three days, Thursday, January 6.

Requests for interviews to take place during the two sessions on Friday must be submitted on Thursday between 9:30 a.m. and 4:00 p.m. requests for interviews to take place during the Saturday sessions must be submitted on Friday before 4:00 p.m.

On Friday and Saturday mornings at 9 a.m. all schedules for applicants and employers for the day (both the morning and afternoon sessions) will be available for distribution in the Ballroom Complex.

The Saturday afternoon session is the annual "employers' choice" session. For this session interviews will be scheduled on the basis of requests made by employers. Applicants do not submit specific interview requests for this session; but, in order to participate they must indicate their availability for the session by filing the Interview Request Form for Saturday, indicating that they will attend the afternoon session that day. Request Forms for the "employers' choice" session must be submitted by 4:00 p.m. on Friday in order for the interviews to be scheduled for Saturday afternoon.

Applicants should be aware of the fact that interviews arranged by the Employment Register represent only an initial contact with employers, and that hiring decisions are not ordinarily made during or immediately following such interviews. **Applicants are advised to bring a number of copies of their vitae or résumés so that they may leave them with prospective employers.**

All participants in the Employment Register are required to register for the Joint Mathematics Meetings. For applicants there is no additional fee for participation in the Employment Register.

The preregistration deadline is November 15.

For employers, additional fees for participation in the Employment Register are \$50, if paid before the November 15 deadline for Joint Meetings preregistration, or \$75 if paid at the meeting.

Employers who wish to participate in the Register and who have neither preregistered nor paid the Employment Register fee must go to the Joint Mathematics Meetings registration desk in the Denver Convention Complex in order to complete their registration. (No provision will be made to handle cash transactions at the site of the Employment Register in the Denver Hilton.)

Employers who have completed registration for the Employment Register, and applicants who have preregistered, may pick up their MSER material after 9:30 a.m. on Thursday, January 6, in the Ballroom

December Issue of Employment Information in the Mathematical Sciences

For several years the periodical *Employment Information in the Mathematical Sciences* (EIMS) has published six issues per year listing open positions in academic, governmental and industrial organizations, primarily in North America, along with a few listings from countries in other parts of the world. EIMS is a joint project of the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. It is published by the Society.

The December issue of EIMS contains résumés of persons seeking professional positions in the mathematical sciences. Résumés of applicants taking part in the January 1983 Mathematical Sciences Employment Register at the Joint Mathematics Meetings in Denver will be included in the December 1982 issue provided both that they are received before the November 15 deadline specified below and are in satisfactory condition. Other mathematical scientists who wish to be included may have their résumés printed if the same deadline is observed and if the copy supplied meets the same technical requirements, described below.

Copies of the December issue of EIMS will be distributed both to subscribers and to the employers who participate in the Mathematical Sciences Employment Register at the Joint Mathematics Meetings in Denver in January 1983. Job applicants planning to participate in the Employment Register in Denver are therefore strongly urged to preregister so that their résumés can appear in the December issue.

Applicants who will participate in the Employment Register in Denver and wish to have their résumés included in the December issue of *Employment Information in the Mathematical Sciences* should complete both the special MSER Applicant Form and the Preregistration and Housing Form at the back of this issue of the *Notices*. Both Forms must be received in Providence by the November 15, 1982 deadline. Forms received after the November 15 deadline cannot be included in the printed booklet. For details on registration and preregistration for the Denver Joint Mathematics Meetings, please refer to the information on these subjects which may be found elsewhere in this issue of the *Notices*.

Applicants for professional positions in the mathematical sciences, who do not plan to attend the meeting in Denver and participate in the Employment Register there, may also submit résumés for publication in the December issue if they use the MSER Preregistration Form for

Applicants at the back of this issue of the *Notices* and observe the same deadline (November 15) as that for applicants who will be attending the meeting. (It is, of course, not necessary to preregister for the meeting if one is not going to attend the meeting.)

Preparation of Applicants' Résumés

The December issue of EIMS will be printed using photographic reproductions of Forms completed and submitted by applicants. For this reason, special care must be exercised by those who prepare the Forms in order to assure that the results are of good quality, and will be clear and legible after they have been photographed, reduced in size, and printed.

Because an employer's first impressions of an applicant are likely to be based on the appearance of the printed Form, applicants are strongly advised to study the suggestions given below very carefully before the forms are filled out, so that the original copy will be neither marred nor damaged.

The Forms should be carefully typed using a new black ribbon. The best results are obtained by using a modern typewriter with a carbon-coated polyethylene film ribbon, but satisfactory results may be obtained with a ribbon made of nylon or other woven fabric if suitable care is exercised. It is important that the keys be clean and make a sharp clear impression, which must be a uniform dark black; gray, blue, or other colors will not reproduce and should, therefore, not be used. Do not use an eraser, as it will cause smudges which reproduce when photographed. Use a correcting typewriter, or correction tape or fluid, if necessary.

Only an original copy of the Form should be submitted, a photocopy or xerographic reproduction will not reproduce as well and may not be accepted for publication. It is therefore important to exercise care in order to assure that the results are satisfactory. The timetable for production of the December issue will not permit poor copy received after the first week of November to be returned to applicants for correction or replacement.

Submission of copy of good quality is entirely the responsibility of the applicant. The Society (which will print this material) must be the final judge of what copy is capable of being reproduced adequately, and therefore of what is acceptable for inclusion in the printed booklet. The Society cannot undertake to correct or replace inadequate copy, and cannot entertain requests to prepare original copy. In the event the quality of a résumé, submitted by an applicant participating in the Employment Register, does not meet the necessary conditions for inclusion in the December issue, the résumé will nonetheless be posted at the Employment Register in Denver, along with those of the other participants.

Preregistration Information for Mathematical Sciences Employment Register

MSER PREREGISTRATION – Employers

Employers who plan to participate in the Employment Register are urged to preregister for it. The MSER Preregistration Form for Employers (which appears at the back of this issue of the *Notices*) should be submitted along with the Housing and Preregistration Form for the Joint Meetings. **Deadline** for receipt of both forms is **November 15, 1982**. Preregistration for the Employment Register, in addition to permitting inclusion in the printed lists, has the advantage of reduced fees and the services of the Mathematics Meetings Housing Bureau, and has the further advantage of helping to reduce waiting times at the meeting in Denver.

Employers are encouraged to provide more than one interviewer, when they are able to do so, in order to increase the number of interviews which may be scheduled. Please take care to indicate on the Form the number of interviewers for whom simultaneous interviews may be scheduled. (If all interviewers will be interviewing for the same position, or for the same set of positions, only one form should be submitted and only one employer code number will be assigned; therefore, each interviewer would then receive a separate computer schedule and separate table number.) More than one employer code will be required if some interviewers will not interview for all positions. Thus, if there are two disjoint sets of positions, two forms are required and two employer codes will be assigned.

A coded strip summarizes the information on each Form; it appears at the bottom of the Form. Employers' job listings will be posted at the meeting, so that applicants may study them when choosing which employers they wish to interview. All employers are required to complete the Summary Strip. The strip provides an abbreviated version of the information on the Form and is used to prepare a computer-printed list of preregistered employers for distribution to the applicants, called the Winter List of Employers.

Employers who have preregistered **must** pick up their MSER material in the Ballroom Complex of the lobby level of the Denver Hilton Hotel after 9:30 a.m. on Thursday, January 6, 1983, and **must** submit an interview request form by 4:00 p.m. in order to receive a computer printed schedule for the following day.

In order for interviews to be scheduled on one day, the Employer's Interview Request Form must be submitted by the 4:00 p.m. deadline on the

previous day; it will not be possible to assign any interviews to employers who do not submit the Request Forms in good time even if they choose not to identify particular applicants to be interviewed. Submission of the form is required in order to indicate availability for the session in question, whether or not any specific interviews are to be requested.

MSER PREREGISTRATION – Applicants

Applicants planning to participate in the Employment Register in Denver are urged to preregister for it. The special Applicants Preregistration Form for the Employment Register (which appears at the back of this issue of the *Notices*) should be completed and submitted with the Housing and Preregistration Form for the Joint Mathematics Meetings prior to the deadline of November 15.

Applicants' résumés will be made available to employers in printed form, so that they may be studied carefully at leisure. The December issue of *Employment Information in the Mathematical Sciences* which will be printed a few weeks before the Denver meeting will contain photographic reproductions of the résumés of applicants who have preregistered by **November 15**. Forms not received in time cannot be included in the issue. Applicants (as well as others planning to attend the Joint Meetings) should note that those who preregister well in advance of the final deadline have access to a wider selection of accommodations, including, in particular, those in the lower price range, which (being in limited supply) tend to be exhausted early in the preregistration process.

The **deadline** for receipt of applicant forms to be included in the December issue of EIMS is **November 15**. They must be accompanied by the Housing and Preregistration Form, since registration for the Joint Meetings is a prerequisite for registration for the Employment Register. The special forms for the Employment Register, as well as the Housing and Preregistration Form for the Joint Meetings, appear at the back of this issue of the *Notices*.

Applicants who preregister for the Employment Register may pick up their MSER material anytime after 9:30 a.m. on Thursday, January 6, 1983, in the Ballroom Complex of the lobby level of the Denver Hilton Hotel. **Interview Request Forms must be submitted the day before interviews are to be scheduled; applicants who fail to submit the Form before the 4:00 p.m. deadline on the previous day, cannot be included in the pool of participants available for interviews on the day in question.**

Complex where the Employment Register will be held. All who wish to have interviews scheduled for Friday or Saturday, **must submit their Interview Request Forms on the preceding day by 4:00 p.m.** Those who fail to do so cannot be included in the pool of available participants when the matching program which schedules the interviews is run on the computer that night. This applies both to preregistered employers and applicants, and to those registering at the meeting.

Employers who do not plan to attend the Employment Register, but wish to display literature, may do so (subject to approval) at no charge, provided all copies of the material to be displayed are received in the Providence Office (MSER, P. O. Box 6248, Providence, RI 02940) no later than November 15.

The MSER registration fee for employers covers the cost of a copy of the December Issue of *Employment Information in the Mathematical Sciences*. This publication contains printed copies of the résumés of applicants who preregistered prior to the November 15 deadline; it will also contain a copy of the summary Winter List of Applicants. The résumés themselves will be posted at the site of the Register. Additional copies of the December Issue of EIMS and both the summary Winter Lists (of Applicants and of Employers) will be available for sale at the AMS Book Sale at the meeting, as long as supplies last. Prices at the meeting are \$2 each for the summary lists and \$3 for the December issue. Any copies remaining after the meeting will be available from the Providence office of the Society for \$3 and \$6, respectively. (Attention is called to the fact that the December issue of EIMS will contain the Winter List of Applicants. It will not contain the Winter List of Employers.)

The Winter List of Employers consists of summaries of the position listings submitted by the employers who preregistered for the meeting; it will be distributed without charge to the applicants participating in the Register. Others may purchase the Winter List of Employers at the AMS Book Sale at the meeting or from the Providence office later, as long as the supply lasts. (See previous paragraph for prices.)

The Mathematical Sciences Employment Register is sponsored by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics; it is operated by members of the AMS staff under the general supervision of the joint AMS-MAA-SIAM Committee on Employment Opportunities.

Preregistration Information may be found in an accompanying article in this issue of the *Notices*. Information on the December Issue of *Employment Information in the Mathematical Sciences*, including specific suggestions for the proper preparation of material to be submitted for publication in the December Issue, will also be found in a separate article in this issue of the *Notices*.

1983 SUMMER SEMINAR IN APPLIED MATHEMATICS

Large-scale Computations in Fluid Mechanics

June 20-July 1, 1983
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, California

The fifteenth AMS-SIAM Summer Seminar in Applied Mathematics will be held June 20-July 1, 1983, and will take place at the Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California. The seminar will be sponsored jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics, and it is anticipated that it will be supported by a grant from a federal agency. The topic *Large-scale computations in fluid mechanics* was selected by the AMS-SIAM Committee on Applied Mathematics whose members at the time were John Dennis, Norman Lebovitz, Alan Newell, (chairman), and George C. Papanicolaou. The members of the organizing committee are Alexandre J. Chorin (University of California, Berkeley), Bjorn E. Engquist (University of California, Los Angeles), Stanley J. Osher (University of California, Los Angeles), and Richard C. J. Somerville, chairman (University of California, San Diego).

In the early spring a brochure will be available which will include a description of the scientific program, as well as information on the residence and dining hall facilities, with firm room and board rates, local information, and a reservation form to be used to obtain accommodations on campus. Each participant will pay a social fee to cover the cost of refreshments served at breaks and for social events. There will also be a meeting registration fee of \$30 (\$10 for students and/or unemployed).

Individuals may apply for admission to the seminar. Application blanks for admission and/or financial assistance can be obtained from the Meetings Department, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940. **The deadline for return of applications is March 4, 1983.** An applicant should have completed at least one year of graduate school and will be asked to indicate his or her scientific background and interest. A graduate student's application must be accompanied by a letter from his or her faculty advisor concerning the applicant's ability and promise. Those who wish to apply for a grant-in-aid should so indicate; however, funds available for the seminar are limited and individuals who can obtain support from other sources should do so.

Computer Communications

Synopses and Reading Lists

Introduction to Data Communication (Pierre A. Humblet). An essential element that allows computers to exchange digital data is the analog communication line, on which a signal is subject to noise and various kinds of distortions.

We present an overview of the techniques (modulation, detection, coding, and their theoretical foundations) used to transform a digital signal into an analog waveform, and to recover the signal from a corrupted version of the waveform.

In a computer communication environment, sources of data are typically bursty, so that it is economical to have many share the same transmission line. In that case the line is partially utilized to transmit addressing information that should be minimized. We present traditional techniques to that effect, along with recent results.

[1] A. S. Tanenbaum, *Computer networks*, Prentice Hall, 1981 (Chapters 3, 4, 6).

[2] R. G. Gallager, *Application of information theory to data communication networks*, New Concepts of Multi-User Communication, J. K. Skwirzynski (editor), NATO Advanced Study Institute Series, Series E No. 43, Sijthoff & Noordhoff, Rockville, MD, 1981.

[3] A. J. Viterbi and J. K. Omura, *Principles of digital communication and coding*, McGraw-Hill, 1979 (Chapters 2, 3, 4).

The Complexity of VLSI Computations (Thomas Lengauer). We give an overview of recent results on the complexity of computations in models recently proposed for Very Large Scale integrated circuits (VLSI).

The VLSI models are based on a synchronous boolean circuit model together with a planar embedding of the circuit. Another important part of the circuit specification is the input/output-convention, determining at what times and places in the circuit input bits are expected resp. output bits produced. Important complexity measures for VLSI circuits are the area of the circuit A , the number of synchronous steps (clock cycles) T needed for a computation and the switching energy E consumed by a computation.

Among the complexity measures formed by the combination of these primitive measures, most results have been obtained on the AT^2 -complexity of VLSI circuits. These include asymptotically optimal circuits for a large number of functions including such interesting functions as integer multiplication and Fourier transform. Furthermore, lower bounds on the switching energy are known for such functions

and the effect of the I/O-convention on the area requirement of the circuit has been analyzed.

The proof techniques used to establish these results are largely based on information transfer lower bound arguments. This means that the aspect of the computation dominating the complexity is the communication of intermediate results from one part of the circuit to another.

[1] T. Lengauer, K. Mehlhorn, *On the complexity of VLSI computations*, CMU Conference on VLSI Systems and Computations, Computer Science Press, 1981, 89–99.

[2] R. J. Lipton, R. Sedgewick, *Lower bounds for VLSI*, 13th ACM Symposium on Theory of Computing, 1981, 300–307.

[3] K. Mehlhorn, E. M. Schmidt, *Las Vegas is better than determinism for VLSI and distributed computing*, 14th ACM Symposium on Theory of Computing, 1982, 330–337.

[4] F. P. Preparata, J. E. Vuillemin, *Area-time optimal VLSI networks for computing integer multiplication and discrete Fourier transform*, 8th International Colloquium on Automata Theory and Programming, Lecture Notes in Computer Science, No. 115, Springer-Verlag 1981, 29–40.

[5] C. D. Thompson, *A complexity theory for VLSI*, Ph.D. Thesis, Department of Computer Science, Carnegie-Mellon University, Pittsburgh, PA, 1980.

[6] J. E. Vuillemin, *A combinatorial limit to the computing power of VLSI circuits*, 21st IEEE Symposium on the Foundations of Computer Science, 1980, 294–300.

Modelling Concurrent Processes (R. P. Kurshan). A “process” is an entity which can be described by a nondeterministic or probabilistic Turing machine. Several processes are “concurrent” if they mutually provide inputs to one another. The modelling problem is to interpret a set of concurrent processes in a way which is amenable to analysis of a particular type. Namely, the processes are to be analyzed to determine whether their collective behavior forces a given (desired) behavior upon a subset of the processes, or preserves certain generic properties (such as freedom from “deadlock”).

Examples of concurrent processes are: hardware components interacting on a VLSI chip, parallel programs, “structured” programming, distributed algorithms and computer networks (in particular, the “protocols” which govern the interactions among the distributed nodes). On a VLSI chip, one may wish to verify that a subset of the components maintains

synchronization. With parallel programs, one may wish to verify that they terminate with the correct answer. In computer networks, one may wish to show that the protocol insures that all data packets eventually reach their destinations if the physical line is eventually error-free.

Solutions to the modelling problem have evolved over several decades in the form of automata theory, temporal logic and their descendants, namely state-transition diagrams, petri nets, parallel programming languages and interaction paradigms such as "semaphores." So far, however, the abundance of solutions has yet to yield one without serious practical drawbacks. Automata generally suffer from "state explosion" in the sense that the total number of states grows exponentially with the number of concurrent processes, and in real-life problems the resulting number of states is often intractable. Temporal logic is generally unsuited to model interactions at process "interfaces" such as the contemporaneous transmission and receipt of a message.

We will describe a new model which is sometimes able to circumvent these drawbacks. Within the model one uses a technique of "reduction," wherein a subset of the processes is replaced by a simpler process. The simpler process is chosen to be such that for the purpose of verifying a given behavior, analysis of the original system is (provably) equivalent to analysis of the simpler system.

This lecture will be self-contained and no preparatory reading is necessary. However, the following reading list is provided to enable participants to acquaint themselves with the field.

[1] E. W. Dijkstra, *Cooperating sequential processes*, Programming languages, F. Genuys (editor), Academic Press, 1968.

[2] J. L. Peterson, *Petri nets*, Computing Surveys **9** (1977), 223–252.

[3] C. Hoare, *Communicating sequential processes*, Communications of the ACM **21** (1978), 666–677.

[4] P. Zafiropulo, *Protocol validation by duologue-matrix analysis*, IEEE Transactions on Communications **26** (1978), 1187–1194.

Probabilistic aspects of networks (Frank P. Kelly). In the last fifteen years developments in computer and communications systems have provided a major stimulus to work on probabilistic models of network flow and there has evolved what might now be termed a classical theory of queueing networks. Jackson networks, in particular, have proved successful in combining interesting theoretical properties with a wide range of applications. The first part of the talk will review results on sojourn times in open and closed Jackson networks.

To be useful, a model must concentrate on certain aspects of the real system, simplifying or ignoring others. Blocking is perhaps the most obvious feature of communication systems ignored in the classical theory of queueing networks. The second part of

the talk will describe a simple model of blocking for which some analytical progress is possible.

[1] R. L. Disney, *Queueing networks*, Proceedings of Symposia in Applied Mathematics **25** (1981), 53–83 (American Mathematical Society, Providence, RI).

[2] F. P. Kelly, *Reversibility and stochastic networks*, Wiley, New York, 1979 (Chapters 2, 3, 4).

[3] F. P. Kelly, *The throughput of a series of buffers*, Advances in Applied Probability **14** (September 1982).

[4] L. Kleinrock, *Queueing systems*, Computer Applications, Wiley, New York, 1976 (Volume II, Chapter 5).

[5] J. Walrand and P. Varaiya, *Sojourn times and the overtaking condition in Jacksonian networks*, Advances in Applied Probability **12** (1980), 1000–1018.

Diffusion Approximations for Queueing Networks (J. Michael Harrison). Queueing networks provide useful models for performance evaluation of computer communication systems. Unfortunately, exact analytical results for such models have been obtained only under very restrictive assumptions regarding service time distributions and/or queue disciplines. But if the network is heavily loaded, the vector queue length process can be well approximated by a certain multi-dimensional diffusion process, regardless of the underlying service time distributions. This diffusion process is multi-dimensional reflected Brownian motion (MRBM). Although MRBM is much more tractable than the queueing process it approximates, one still cannot obtain closed-form expressions for system performance measures except in special cases. With general system parameters, performance evaluation for MRBM requires solution of certain highly structured PDE problems. Efficient computational schemes that fully exploit the special structure are currently being investigated; there is much left to do.

[1] J. M. Harrison and M. I. Reiman, *Reflected Brownian motion on an orthant*, Annals of Probability **9** (1981), 302–308.

[2] J. M. Harrison, *The diffusion approximation for tandem queues in heavy traffic*, Journal of Applied Probability **10** (1978), 886–905.

[3] W. Whitt, *Heavy traffic limit theorems for queues: a survey*, Mathematical Methods in Queueing Theory, A. B. Clarke (editor), Lecture Notes in Economics and Mathematical Systems Number 98, Springer-Verlag, Berlin, 1974, 307–350.

[4] M. Reiser and H. Kobayashi, *Accuracy of the diffusion approximation for some queueing systems*, IBM Journal of Research and Development **18** (1974), 110–124.

[5] J. M. Harrison and M. Reiman, *On the distribution of multidimensional reflected Brownian motion*, SIAM Journal of Applied Mathematics **41** (1981), 345–361.

[6] A. J. Lemoine, *Networks of queues—a survey of weak convergence results*, Management Science **24** (1978), 1175–1193.

AMS Summer Research Conference Series

University of Colorado, Boulder, June 5 to August 13, 1983

The 1983 conferences in the AMS Summer Research Conference Series will be held at the University of Colorado, Boulder, between June 5 and August 13, 1983. It is anticipated that the series of week-long conferences will be supported by a grant from the National Science Foundation.

There will be ten one-week conferences in ten different areas of mathematics. Each week participants will arrive on Sunday and leave the following Saturday. The topics and organizers for the ten conferences were selected by the AMS Committee on Summer Research Conferences. The selections were based on suggestions made by the members of the committee, by members of the Council of the AMS and others. The committee considered it important that the conferences represent diverse areas of mathematical activity, with emphasis on areas currently especially active, and paid careful attention to subjects in which there is important interdisciplinary activity at present.

The conferences will be similar in structure to those held throughout the year at Oberwolfach. These conferences are intended to complement the Society's program of annual Summer Institutes and Summer Seminars, which have much larger attendance and are substantially broader in scope. The conferences are research conferences, and are not intended to provide an entree to a field in which a participant has not already worked.

It is expected that funding will be available for about thirty participants in each conference. Others, in addition to those funded, will be welcome, within the limitations of the facilities of the campus. Up to about seventy participants can be accommodated at each conference. Housing accommodations will be available on campus for those attending the conference, and daily meals will be served in a dining hall near the dormitories. A brochure describing the facilities available at the University of Colorado will be available from the AMS office in March 1983. The brochure will include information on firm room rates and the residence and dining hall facilities, as well as local information and a reservation form to be used for accommodations on campus. Each participant will pay a social fee to cover the cost of refreshments served at breaks and for social events.

Those interested in attending one of the conferences should request an application form from Carole Kohanski, AMS Summer Research Conference Coordinator, American Mathematical Society, Post Office Box 6248, Providence, RI 02940 (401-272-9500, extension 286), specifying which conference they wish to attend. Selection of the participants and approval of participant support will be made by the Organizing Committee for each conference. Women and members of minority groups are encouraged to apply and participate in these conferences. The deadline for receipt of applications is **February 1, 1983**. Those who wish to apply for a grant-in-aid should so indicate on the application form; however, funds available for these conferences are limited and so individuals who can obtain support from other sources should do so.

The AMS Summer Research Conference Series is under the direction of the AMS Committee on Summer Research Conferences which includes: James G. Glimm, Benedict Gross, Kenneth Kunen, Katsumi Nomizu, Donald S. Ornstein, Julius Shaneson, R. O. Wells, Jr. (chairman), and Shmuel Winograd.

The material which follows describes each of the 1983 conferences, lists the chairmen and other members of the individual organizing committees, and outlines the subject matter to be considered in each of the one-week sessions.

June 5 to June 11

Combinatorics and algebra

RICHARD P. STANLEY (Massachusetts Institute of Technology), Chairman

The conference will be devoted to the interactions between combinatorics and algebra, especially commutative algebra, invariant theory, and representation theory. These branches of algebra have been intensely investigated in recent years, both by combinatorialists and algebraists. Important advances have been made both in combinatorics and algebra from the interaction between these two areas. Both areas should benefit greatly from continued interaction. The primary purpose of this conference is to further and to enhance this interaction between algebra and combinatorics. By gathering experts together from both fields, communication between them will be maintained.

The following are among the topics which should be covered during the meeting:

- (a) Applications of commutative algebra to the combinatorial and topological properties of simplicial complexes and partially ordered sets.
- (b) Algebras with straightening laws.
- (c) Representations of finite-dimensional semisimple Lie algebras.
- (d) Representations of infinite-dimensional semisimple Lie algebras.
- (e) Representations of finite groups.
- (f) Invariant theory.

Members of the Organizing Committee: Adriano M. Garsia (University of California, San Diego), Curtis Greene (Haverford College), Gian-Carlo Rota (M.I.T.), Richard P. Stanley (M.I.T.).

June 12 to June 18

Applications of algebraic K-theory to algebraic geometry and number theory

KEITH DENNIS (Cornell University), Chairman

Over the past several years there has been a rapid development in algebraic K -theory, and its influence on other parts of algebra and topology has grown steadily. This conference will focus on recent results

related to algebraic geometry and algebraic number theory. Major results that will be studied are those of Suslin and Merkurjev on the torsion in the Brauer group of a field, the local classfield theory of Kato and Parshin, the connections between regulators and values of L -functions with the sizes of K -groups given by Borel, Bloch and Beilinson, and work of Dwyer, Friedlander, Thomason, and Soule on the Lichtenbaum conjectures.

In particular, these results constitute major advances in understanding the geometry and arithmetic of algebraic varieties. The K -theoretic techniques involved have already yielded new insights into phenomena in codimensions greater than one heretofore considered to be inaccessible.

Members of the Organizing Committee: S. Bloch (University of Chicago), K. Dennis (Cornell University), E. Friedlander (Northwestern University), and M. Stein (Northwestern University).

June 19 to June 25

Axiomatic set theory

JAMES E. BAUMGARTNER (Dartmouth College), Chairman

Some of the most dramatic recent progress in axiomatic set theory has been made by combining techniques from areas once thought to be separate parts of set theory. These areas include the theory of constructibility and its generalizations, the theory of forcing, large cardinals, combinatorial set theory, and descriptive set theory, particularly the study of the Axiom of Determinateness (AD). Sample results are the use of forcing over models of AD to obtain consistency results for combinatorial properties of ideals, generalizations of constructibility to produce inner models for certain large cardinals, and the use of iterated forcing over models with large cardinals in obtaining consistency results for small cardinals. This conference will bring together leaders in all these areas, and emphasis will be placed on collaboration across area boundaries.

Members of the Organizing Committee: James E. Baumgartner (Dartmouth College), Donald A. Martin (UCLA), and Saharon Shelah (Hebrew University, Jerusalem).

June 26 to July 2

Group actions on manifolds

REINHARD SCHULTZ (Purdue University), Chairman

This subject has natural ties to the representation theory of finite groups, differential geometry, the geometry and analysis of Lie groups, and classical results on Riemann surfaces. Several decades ago, many basic observations about these "natural" group actions were shown to reflect deep relationships between the algebraic invariants of fairly general group actions. During the past two decades powerful techniques of algebraic and geometric topology such as surgery theory have expanded our knowledge of

group actions dramatically. Ideas and results from other branches of pure mathematics have also played decisive roles in the subject's development. The resulting advances have led to a greatly improved understanding of the ways in which the algebraic and geometric invariants of a group action fit together. Older results on an action's invariants can now be formulated in significantly more complete settings, and many unanticipated new results on the relations between invariants have been found. This conference will feature lectures on the evolution of the subject during the past two decades, its present state, and the prospects for its future.

Members of the Organizing Committee: Ted Petrie (Rutgers University), Frank Raymond (University of Michigan), and Reinhard Schultz (Purdue University).

July 3 to July 9

Ordered fields and real algebraic geometry

D. W. DUBOIS (University of New Mexico), Chairman

Jointly supported by NATO as NATO Advanced Research Workshop 58/83.

The exponentially rapid growth which has characterized research on real algebraic varieties over the past 15 years has taken a quantum leap as the result of two spectacular new developments. First there is the successful introduction of real algebro-geometric structure into most (not necessarily) smooth manifolds. The second involves discoveries of an incredible amount of feedback between real algebraic geometry and control theory. There have also been several recent, beautiful additions to the more "traditional" areas, in, for example, real quadratic forms, Abelian varieties, semi-algebraic geometry and topology, Nash rings, real spectra and places. Thus there are now three quite diverse aspects of the theory, each with specialized language and tools; there is a great need for communication among the three. It is intended that, in addition to presenting the exciting new results, this conference will contribute to the needed communication by means of interdisciplinary expository sessions, and also explore profitable avenues of applications and future research.

Members of the Organizing Committee: Gregory Brumfiel (Stanford University), D. W. Dubois (University of New Mexico), T. Y. Lam (University of California, Berkeley), and Albrecht Pfister (University of Mainz, West Germany).

July 10 to July 16

Microlocal analysis

LINDA PREISS ROTHSCILD (University of Wisconsin, Madison), Chairman

With the advent of Fourier integral operators and the techniques of microlocalization, linear PDE has undergone a dramatic change in the last decade. Recently, application of these methods has led to considerable progress in the following areas:

uniqueness in the Cauchy problem, smoothness and analyticity of solutions of linear PDE's spectral theory for differential and pseudodifferential operators, elliptic boundary value problems, and solutions of systems of complex vector fields. In addition, there has been stimulus from other areas of mathematics, especially from problems and techniques arising in several complex variables, and from applications of unitary representations of Lie groups.

A conference on this subject at this time would allow the participants to focus on these results and find new directions for linear PDE.

Members of the Organizing Committee: M. S. Baouendi (Purdue University), Richard Beals (Yale University), and Linda Preiss Rothschild (University of Wisconsin, Madison).

July 17 to July 23

Fluids and plasmas: geometry and dynamics

JERROLD E. MARSDEN (University of California, Berkeley), Chairman

Fluids and plasmas are governed by nonlinear PDE's that have a remarkably rich geometric and analytic structure. One aspect of this is their formulation as Hamiltonian systems with chaos described by their non-integrability or the breakdown of smooth solutions in a finite time. Recent work in dynamical systems such as Hopf bifurcation, invariant tori, strange attractors, sets of fractional Hausdorff dimension in both space and time, renormalization and Kolmogorov-Arnold Moser theory are all now believed to be relevant in understanding the dynamics of these and related systems.

There has been much work recently, theoretical and numerical, by both mathematicians and physicists in this area. This conference proposes to foster this growing interaction.

Members of the Organizing Committee: Philip Holmes (Cornell University), Andrew Majda (University of California, Berkeley), and Jerrold E. Marsden (University of California, Berkeley).

July 24 to July 30

Probability theory, partial differential equations and applications

DANIEL STROOCK (University of Colorado, Boulder), Chairman

For many years interesting results have been discovered by taking advantage of the interaction between stochastic analysis and partial differential equations. By now there are several examples which demonstrate the power of this line of research. This conference will be about such examples.

Although the central theme will be probability theory and partial differential equations, the organizers will be liberal when deciding what fits under that heading. Thus, topics in wave propagation, random media, statistical mechanics, stochastic differential geometry, filtering, and other cognate areas will be welcome.

It is intended by its organizers that this conference will provide an opportunity for practitioners of stochastic analysis to display their wares not only to one another but also to researchers in related areas. At the same time, it is hoped that people in related areas will contribute new problems and techniques from which future developments may arise.

Members of the Organizing Committee: Richard Holley (University of Colorado, Boulder), George Papanicolaou (Courant Institute, New York University), Mark A. Pinsky (Northwestern University), and Daniel Stroock (University of Colorado, Boulder).

July 31 to August 6

Geometrical analysis of singularities

JEFF CHEEGER (SUNY, Center at Stony Brook), Chairman

Recent developments have made it possible to study singular spaces from a viewpoint which emphasizes those respects in which they are similar to nonsingular spaces (manifolds). In particular, it has been recognized that homological statements about singular spaces tend to resemble closely statements about manifolds, when they are formulated in terms of a new homology theory. This theory can be defined in a number of ways among which are: special chains (intersection homology), L^2 -forms with respect to an appropriate metric (L^2 -cohomology), \mathcal{D} -modules (for algebraic varieties).

The theory has important connections with a number of areas, such as algebraic geometry, group representations, analysis and geometry of singular spaces, Morse theory of singular spaces, k -homology theory, and index theory. The conference will be concerned with such applications.

Members of the Organizing Committee: Jeff Cheeger (SUNY, Center at Stony Brook), Mark Goresky (University of British Columbia), and Robert MacPherson (Brown University).

August 7 to August 13

Kleinian groups

HOWARD MASUR (University of Illinois, Chicago), Chairman

The theory of Kleinian groups has deep and sometimes surprising connections with many other branches of mathematics including low dimensional topology, hyperbolic geometry, Lie groups, dynamical systems, and complex analysis. Many of these connections are newly discovered, and interest in the field is now large and growing. The major focus of this conference will be on the relationships between the theory of Kleinian groups and (1) deformation of complex (and hyperbolic) structures, (2) dynamical systems and ergodic theory, and (3) the iteration of rational mappings of the 2-sphere. It is expected that the conference will be of interest to a wide audience as well as to experts in these fields.

Members of the Organizing Committee: Bernard Maskit (SUNY, Center at Stony Brook), Howard Masur (University of Illinois, Chicago), and William P. Thurston (Princeton University).

AMS Book Orders—Toll Free Number For Users of VISA, MASTERCARD. Individuals in the continental United States may order books published by the Society by calling 800-556-7774 and using a charge card. The number will be attended from 8:00 a.m. to 4:15 p.m. Eastern Time, Monday through Friday except on holidays. When using a charge card for mail orders, please be sure to specify whether VISA or MasterCard and include the account number, expiration date, and signature.

AMS Catalogue of Publications

The 1982–1983 *AMS Catalogue of Publications*, a catalogue of AMS books and journals, is ready for distribution. In addition to a complete listing of the Society's publications and an author/title index to them, this catalogue has a subject index of the books included in the catalogue, as well as descriptive paragraphs about publications new in the past year.

Copies have been sent to libraries and book agents throughout the world and will be sent to new members starting with those accepted in August. Others interested in receiving a copy may obtain one by requesting it from the Providence office of the Society, P. O. Box 6248, Providence, RI 02940, Attn. E. Nordman.

CONTEMPORARY MATHEMATICS (ISSN 0271-4132)

Plane Ellipticity and Related Problems

Robert P. Gilbert, Editor

In this collection of papers concepts associated with plane-ellipticity are extended in several ways. For example, the investigations of Begehr and Gilbert, Begehr and Hsiao, Hile and Snyder treat systems of elliptic partial differential equations in the plane which resemble in some sense the Cauchy-Riemann equations. Their point of view is to seek general representation formulas and to use these in some cases to solve boundary value problems. Continuing with the theme of generalizing the Cauchy-Riemann equations, Buchanan treats the Bers-Vekua type systems in two complex variables, while Delanghe and Sommen, Brackx and Pincket, and Lounesto investigate hypercomplex function theory in \mathbb{R}^n , that is the class of homogenous functions having values in a Clifford algebra.

The remaining talks comprising this special meeting cannot be categorized as falling into a general group, but rather explore isolated, albeit important, topics associated with ellipticity.

CONTENTS

- A. K. Aziz, M. R. Dorr and R. B. Kellogg, *The finite element method and non-local boundary conditions for scattering problems*
H. Begehr and R. P. Gilbert, *Boundary value problems associated with first order elliptic systems in the plane*

John C. Bruch, Jr., and James M. Sloss, *Coupled variational inequalities for flow from a non-symmetric ditch*

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Gerald N. Hile, *Function theory for generalized Beltrami systems*

Robert A. Hummel, *On a variational inequality for the hodograph method*

Heinrich Begehr and George C. Hsiao, *Nonlinear boundary value problems of Riemann-Hilbert type*

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Peter A. McCoy, *Approximate solutions of an elliptic equation on select domains*

M. H. Protter, *Gradient bounds for a class of second order elliptic equations*

Herbert H. Snyder, *Elliptic systems in the plane associated with certain partial differential equations of deformable media*

F. Treves, *A homogeneous linear PDE in the plane, with smooth real coefficients, whose only solution is the zero function*

F. Brackx and W. Pincket, *The Newtonian potential for a generalized Cauchy-Riemann operator in Euclidean space*

1980 *Mathematics Subject Classifications*: 35J55, 35A92, 30A97.

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Symposium on Algebraic Topology in Honor of José Adem

Samuel Gitler, Editor

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Samuel Gitler, *José Adem's contribution to algebraic topology*

J. F. Adams, *Graeme Segal's Burnside ring conjecture*
Enrique Antoniano, *Sections for bundles over projective spaces*

Luis Astey, *An integrality theorem for K-theory Chern classes*

- José L. Arraut and Duane Randall, *Index of tangent fields on compact manifolds*
M. G. Barratt and W. R. Miller, *On the antiautomorphism of the Steenrod algebra*
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Edgar H. Brown, *Smooth n -manifolds immerse in $\mathbb{R}^{2n-\alpha(n)}$*
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Albrecht Dold, *Fixed point theory and homotopy theory*
Mauricio Gutierrez, *On crossed modules*
A. Haefliger and K. Sithanantan, *A proof that Br_1^c is 2-connected*
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S. Y. Hussein, *Zeros of equivariant S^3 -maps*
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Emilio Lluís-Puebla, *On K_3 of the dual numbers*
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R. James Milgram, *A survey of the compact space form problem*
Luis Montejano, *β -homotopy equivalences*
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Victor Snaith and Jorgen Tornehave, *On $\Pi^{*S}(BO)$ and the Arf invariant of framed manifolds*
E. Spanier, *Cohomology isomorphisms*
Oscar Valdivia G., *S -productos vectoriales: Teoría algebraica y topológica*
Alberto Verjovsky, *Cobordism of three dimensional spheres*
Stephen Wilson, *Towards BP_*X*
A. Zabrodsky, *Homotopy actions of nilpotent groups*
1980 Mathematics Subject Classifications: 55-06, 57Rxx

Contemporary Mathematics
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Homology and Dynamical Systems

John M. Franks

This book is an exposition of a number of results dealing with the connections between algebraic topology and dynamical systems. For the most part proofs are included; where they are omitted a reference is given. The topics covered include: Morse gradients, symbolic dynamics and subshifts of finite type, Smale and Morse-Smale diffeomorphisms and flows, and the zeta function and homology zeta function of a diffeomorphism.

The book is intended for graduate students or researchers interested in the relationship between topology and dynamical systems. It is especially appropriate for persons with a background in topology who want to learn about dynamical systems. This book would be appropriate for a graduate level course. Except for an assumed background in algebraic topology the material is largely self-contained.

There are numerous books on algebraic topology and many on dynamical systems. This is the only book devoted to the inter-relationships of these two fields.

1980 Mathematics Subject Classifications: 58F09; 57R50

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MEMOIRS OF THE AMS

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Induction Theorems for Groups of Homotopy Manifold Structures

Andrew J. Nicas

The work of Sullivan and Wall, as extended by Kirby and Siebenmann, showed the existence of an exact sequence of pointed sets for the surgery theory of a compact oriented manifold with boundary $(M^m, \partial M)$, $m \geq 6$:

$$\mathcal{S}_{\text{TOP}}(M, \partial M) \longrightarrow \mathcal{N}_{\text{TOP}}(M, \partial M) \longrightarrow L_m(\pi_1(M)).$$

In this Memoir it is shown how to make this sequence and its extension to the left an exact sequence of abelian groups which is natural with respect to induction and restriction for a covering projection of finite index

(and more generally for fibrations with compact manifold fiber). Dress induction and localization are applied to obtain induction theorems for $S_{\text{TOP}}(M, \partial M)$.

1980 *Mathematics Subject Classifications*: 57R67, 57R65, 18F25, 20C99.

Memoirs of the American Mathematical Society
 Memoir Number 267, vi + 108 pages (soft cover)
 List price \$6, institutional member \$4,
 individual member \$3
 ISBN 0-8218-2267-5; LC 82-11546
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The Cohomology of Chevalley Groups of Exceptional Lie Type

Samuel N. Kleinerman

ABSTRACT

The group cohomology of the discrete groups G , given by Chevalley groups of exceptional Lie type over the finite field F_q , and the cohomology of $\text{Spin}_{10}(F_q)$ is computed. The classifying spaces of these groups are constructed as pull-backs of a diagram whose corners are spaces that are cohomologically equivalent to one or two copies of the corresponding classifying space of the continuous Lie group. The cohomology of the corners of the diagram are therefore known. Using Eilenberg-Moore and Serre spectral sequences, the cohomology of G as a module and often as an algebra is determined for \mathbb{Z}/l coefficients, for almost all primes l when $(l, q) = 1$. The l -primary cohomology is also determined.

As an application, in certain cases $\Omega(BG(F_q)^+)$ is shown to be the homotopy theoretic fiber of a self map, with degree a power of l , of some sphere that is localized at l . The “+” is Quillen’s “+ construction”.

1980 *Mathematics Subject Classifications*: 20G40, 20J06, 55R40, 57T35.

Memoirs of the American Mathematical Society
 Memoir Number 268, viii + 82 pages (soft cover)
 List price \$5, institutional member \$4,
 individual member \$3
 ISBN 0-8218-2268-3; LC 82-11545
 Publication date: September 1982
 To order, please specify MEMO/268N

C*-Bundles and Compact Transformation Groups

Bruce D. Evans

This paper is concerned with the structure of the C^* -algebras associated with smooth actions of compact Lie groups. The author represents such an algebra as sections of a (C^*) bundle, and studies the bundle from a geometric viewpoint. The bundle usually cannot be locally trivial, but it can be chosen to be locally a “cone” over simpler bundle(s) of the same type.

Such locally conical bundles can be classified in terms of homotopy classes of bundle maps.

1980 *Mathematics Subject Classifications*: 46L05; 55R05, 55R10, 57N80, 57S15.

Memoirs of the American Mathematical Society
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 List price \$4, institutional member \$3,
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PROCEEDINGS OF THE STEKLOV INSTITUTE (ISSN 0081-5438)

Moduli of Families of Curves and Quadratic Differentials

G. V. Kuz'mina

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Foreword

Introduction. The method of extremal metrics

0. On an extremal metric for a general modulus problem
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4. The method of symmetrization in geometric problems involving capacity
5. The problem of the maximal conformal modulus in families of doubly connected domains
6. Problems on the maximum of the product of the conformal radii of nonoverlapping domains

Bibliography

1980 *Mathematics Subject Classifications*: 30-02

Proceedings of the Steklov Institute
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Special Meetings

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

AN ANNOUNCEMENT will be published in the *Notices* if it contains a call for papers, and specifies the place, date, subject (when applicable), and the speakers; a second 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.

IN GENERAL, announcements of meetings held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadline dates for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. All communications on special meetings should be sent to the Editor of the *Notices*, care of the American Mathematical Society in Providence.

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

1982-1983. **Special Year in Lie Group Representations**, University of Maryland, College Park, Maryland. (June 1982, p. 373)

July 1, 1982-September 1, 1983. **Special Year in Mathematics Related to Energy**, University of Wyoming, Laramie, Wyoming

Program: The program for the year will involve cooperation between mathematicians in academia and in industry, as well as researchers in other areas of science and engineering. Major areas to be covered include the following: mathematical modeling especially related to oil recovery, flow in porous media, and chemical reactors; mathematical analysis of coupled systems of nonlinear partial differential equations; numerical analysis of transport dominated flow in two and three dimensions; computational algorithm development for large, sparse, nonlinear, nonsymmetric systems of equations; and inverse problems in reflective seismology, geophysical prospecting, and oceanography. There will also be lecture series given by prominent scholars and people from industry.

Support: Funding has been provided by the University of Wyoming, Mobil Oil Corporation, and the National Science Foundation.

Information: Kenneth I. Gross, Department Head, Mathematics Department, University of Wyoming, Laramie, Wyoming 82071.

September 1, 1982-August 31, 1983. **Statistical and Continuum Approaches to Phase Transition**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, Minnesota. (January 1982, p. 74)

OCTOBER 1982

October-November 1982. **Workshop on Teaching of Graduate and Undergraduate Mathematics**, Chiangmai, Thailand. (January 1982, p. 77)

13-15. **1982 Department of Energy Statistical Symposium**, Idaho Falls, Idaho. (August 1982, p. 471)

15-16. **Fourth Annual Midwest Probability Colloquium**, Leverone Hall, Northwestern University, Evanston, Illinois.

Invited Speakers: T. Harris (University of Southern California), N. Etemadi (University of Illinois at Chicago Circle), and M. Steele (Carnegie-Mellon University).

Information: Midwest Probability Colloquium, c/o Mathematics Department, Northwestern University, Evanston, Illinois 60201, (312) 492-3298.

17-21. **International Conference on Mathematics**, University of Riyadh, Riyadh, Saudi Arabia. (February 1982, p. 200)

18-20. **American Society for Cybernetics Annual Meeting**, Columbus, Ohio. (June 1982, p. 375)

18-20. **Symposium on Waves on Fluid Interfaces**, Mathematics Research Center, University of Wisconsin, Madison, Wisconsin. (June 1982, p. 376)

18-29. **Modeling and Analysis in Biomedicine**, Trapani, Italy. (August 1982, p. 471)

20-29. **Regional Training Course on the Teaching of Undergraduate Mathematics**, Chiangmai, Thailand. (June 1982, p. 376)

25-27. **Sparse Matrix Symposium**, Fairfield Glade, Tennessee. (February 1982, p. 200)

26-28. **Symposium on Medical Image and Pattern Analysis**, Berlin, Germany.

Information: Medical Image and Pattern Analysis, P.O. Box 639, Silver Spring, Maryland 20901, (301) 589-3386.

26-28. **IEEE Computer Society International Symposium on Medical Imaging and Image Interpretation**, Berlin, Federal Republic of Germany. (August 1982, p. 471)

27-28. **Fifth IEEE Symposium on Mass Storage Systems**, Boulder, Colorado.

Information: Bernard T. O'Lear, NCAR, P.O. Box 3000, Boulder, Colorado 80307, (303) 494-5151, ext. 293.

27-29. **Nineteenth Annual Meeting of the Society of Engineering Science**, Ralo, Missouri. (August 1982, p. 471.)

27-30. **Symposium on Inequalities in Statistics and Probability**, University of Nebraska-Lincoln, Lincoln, Nebraska. (August 1982, p. 471)

30-November 2. **Sixth Annual Symposium on Computer Applications in Medical Care**, Washington, D.C.

Information: Office of Continuing Medical Education, George Washington University, 2300 K Street N.W., Washington, D.C. 20037.

- 2-4. **Second International Conference on Reactive Processing of Polymers**, Pittsburgh Hilton Hotel, Pittsburgh, Pennsylvania. (August 1982, p. 471)
- 2-4. **SIAM Conference on Numerical Simulation of VLSI Devices**, Boston, Massachusetts. (April 1982, p. 296)
- 3-5. **Second International Symposium on Real Time Data '82**, Versailles, France.
Chairman: E. G. Kingham.
Information: INRIA, Service des Relations Extérieures, Domaine de Voluceau-Roquencourt, B. P. 105, F-78153 Le Chesnay, Cedex, France.
- 3-5. **Twenty-third Annual IEEE Symposium on Foundations of Computer Science**, Chicago, Illinois. (February 1982, p. 201)
- 6-16. **Relational Representations of Biological and Environmental Systems**, University of Khartoum, Khartoum, Sudan. (August 1982, p. 471)
- 11-14. **American Mathematical Association of Two-Year Colleges Annual Convention**, Las Vegas, Nevada. (June 1982, p. 376)
- 16-December 10. **Autumn Course on Mathematical Ecology**, International Centre for Theoretical Physics, Trieste, Italy. (April 1982, p. 297)
- 17-19. **Congrès "Architecture des Machines et Systèmes Informatiques"**, Lille, France. (August 1982, p. 472)
- 21-30. **Deterministic Models in Population Biology**, University of Khartoum, Khartoum, Sudan. (August 1982, p. 472)

DECEMBER 1982

- 14-17. **International Seminar on Combinatorics and Applications (in Honor of S. S. Shrikhande)**, Indian Statistical Institute, Calcutta, India.
Information: K. S. Vijayan, Indian Statistical Institute, 203 B. T. Road, Calcutta, 700 035, India.
- 28-January 4. **Conference on Abelian Group Theory**, University of Hawaii at Manoa, Honolulu, Hawaii. (August 1982, p. 472)

JANUARY 1983

- 8-9. **Association for Symbolic Logic Annual Meeting**, Denver, Colorado. (June 1982, p. 376)
- 10-14. **Fourth International Symposium on Approximation Theory**, Texas A & M University, College Station, Texas.
Program: Invited and contributed papers covering all branches of approximation theory.
Information: C. K. Chui, L. L. Schumaker, or J. D. Ward, Department of Mathematics, Texas A & M University, College Station, Texas 77843.

MARCH 1983

- 21-23. **Second ACM SIGACT-SIGMON Symposium on Principles of Database Systems**, Atlanta, Georgia.
Topics: Topics to be covered include concurrency control; database design; database security; data models; data structures; dependency theory; distributed database; error control; file organization; query languages; schema design; and performance evaluation.
Deadline for Abstracts: October 15, 1982.
Information: Philip A. Bernstein, Aiken Computation Laboratory, 33 Oxford Street, Harvard University, Cambridge, Massachusetts 02138.
- 21-26. **UAB International Conference on Differential Equations**, University of Alabama in Birmingham, Birmingham, Alabama.
Speakers: Invited speakers include: T. Kato (University of California, Berkeley), P. Lax (Courant Institute), L. Nirenberg (Courant Institute), M. Schechter (Yeshiva University), and B. Simon (California Institute of Technology).
Program: The conference is devoted to recent research in ordinary and partial differential equations. Contributed papers will be welcome.
Information: Ian W. Knowles or Roger T. Lewis, Department of Mathematics, University of Alabama in Birmingham, Birmingham, Alabama 35294.

- 5-9. **Thirty-fifth British Mathematical Colloquium**, University of Aberdeen, Scotland, United Kingdom.
Program: There will be three one-hour lectures and eighteen forty-minute lectures by invited speakers. There will also be splinter group sessions at which participants may contribute short talks.
Principal Speakers: Louis Nirenberg (Courant Institute), Daniel G. Quillen (Massachusetts Institute of Technology), Dennis P. Sullivan (I.H.E.S. and City University of New York).
Information: R. J. Archbold, Department of Mathematics, The Edward Wright Building, Dunbar Street, Aberdeen AB9 2TY, Scotland, United Kingdom.
- 19-21. **IEEE Infocom 83: Second Annual Joint Conference of the IEEE Computer and Communications Societies**, San Diego, California.
Information: John Spragins, Program Chairman, IEEE Infocom 83, P.O. Box 639, Silver Spring, Maryland 20901, (803) 656-3190.
- 21-22. **Fourteenth Annual Modeling and Simulation Conference**, University of Pittsburgh, Pittsburgh, Pennsylvania.
Call for Papers: Contributed papers are being sought, with emphasis on microprocessors and their applications as well as energy, social, economic, and global modeling and simulation and traditional areas of modeling and simulation.
Deadline for Abstracts: January 31, 1983.
Information: William G. Vogt or Marlin H. Mickel, Modeling and Simulation Conference, 348 Benedum Engineering Hall, University of Pittsburgh, Pittsburgh, Pennsylvania 15261.

- 25-27. **Fifteenth ACM Symposium on Theory of Computing**, Boston, Massachusetts.
Topics: Topics to be covered will include algorithms and data structures, automata and formal languages, computability and complexity theory, models of computation, semantics and logics of programs, theory of data bases, theory of logical design and layout, theory of parallel and asynchronous computation.
Deadline for Abstracts: November 19, 1982.
Program Committee: Ronald Fagin, Michael L. Fredman, David Harel, David S. Johnson, Richard M. Karp, Nancy Lynch, Christos H. Papadimitriou, Ronald L. Rivest, Walter L. Ruzzo, and Joel Seiferas.
Information: Albert Meyer, MIT Laboratory for Computer Science, NE43-801, 545 Technology Square, Cambridge, Massachusetts 02139.

MAY 1983

- 11-13. **Optimisation Days 1983**, École Polytechnique, Montréal, Canada.
Organizers: École Polytechnique, McGill University, Concordia University, Université de Montréal, École des Hautes Études Commerciales, Université du Québec à Montréal.
Program: Sessions will consist of invited and contributed talks. Papers presenting original developments as well as those of expository nature will be considered.
Deadline for Abstracts: January 31, 1983.
Information: Michael P. Polis or Richard Hurteau, Department of Electrical Engineering, École Polytechnique, Campus de l'Université de Montréal, Case postale 6079, succursale "A", Montréal, Québec, H3C 3A7 Canada.
- 23-25. **Eighteenth New Zealand Mathematics Colloquium**, Massey University, Palmerstown North, New Zealand.
Program: There will be invited speakers and parallel sessions of presented papers on all aspects of mathematics and their applications.
Information: Secretary, Eighteenth New Zealand Mathematics Colloquium, Department of Mathematics and Statistics, Massey University, Palmerstown North, New Zealand.

13-16. Tenth International Symposium on Computer Architecture, Stockholm, Sweden.

Sponsors: IEEE, ACM, EUROMICRO, and the National Swedish Board for Technical Development.

Call for Papers: Papers are solicited in any areas of computer architecture. Deadline for papers is October 15, 1982.

Information: Jean Loup Baer, University of Washington, Computer Science Group, Seattle, Washington 98105.

20-24. 1983 International Symposium on the Mathematical Theory of Networks and Systems, Ben Gurion University of the Negev, Beer Sheva, Israel.

Topics: General system theory; algebraic system theory; differential- and algebro-geometric methods in system theory; operator theoretic methods; infinite dimensional systems and networks; systems in Hilbert resolution spaces; stochastic system theory; stability theory; systems over rings.

Deadline for Papers: January 15, 1983.

Information: P. A. Fuhrmann, Department of Mathematics, Ben Gurion University of the Negev, Beer Sheva 84120, Israel.

27-29. ACM IEEE Twentieth Design Automation Conference, Miami Beach, Florida.

Purpose: The conference will cover all aspects of the use of computers as aids to the design process. The purpose of the conference is to bring together practitioners and theoreticians from industry, government and academia who are interested in all problems related to the underlying concepts and the use of CAD/CAM tools and systems.

Program: There will be sessions for contributed papers of both 20- and 10-minute lengths. There will also be panel and mini-workshop sessions.

Deadline for Contributed Papers: November 19, 1982.

Information: Hillel Ofek, IBM Corporation (B22/951), P.O. Box 390, Columbia Street, Poughkeepsie, New York 12602, (914) 485-7763.

27-29. SIAM Symposium on the Applications of Discrete Mathematics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Program: There will be invited speakers from industry and academia, as well as contributed papers and poster presentations.

Deadline for Abstracts: December 1, 1982.

Information: Society for Industrial and Applied Mathematics, 1405 Architects Building, 117 South 17th Street, Philadelphia, Pennsylvania 19103, (215) 564-2929.

28-30. Thirteenth International Symposium on Fault-Tolerant Computing, Milan, Italy.

Sponsor: IEEE Computer Society.

Program: Contributed papers will be given in the area of fault-tolerant computing.

Information: Michele Morganti, Telettra S.p.A., Via Mattei 20, I-20064 Gorgonzola MI, Italy.

JULY 1983

4-9. Tenth International Conference on General Relativity and Gravitation, Fondazione Cini, Isola di San Giorgio, Venice, Italy.

Sponsor: International Society of General Relativity and Gravitation.

Organizers: Institutes of Physics, Universities of Padua and Pavia.

Information: GR 10 Secretariat, Istituto di Fisica "G. Galilei", Via Marzolo, 8, I 35100 Padova, Italy.

11-15. Ninth British Combinatorial Conference, University of Southampton, England.

Invited Speakers: (To date) J. C. Bermond (Orsay), J. M. Hammersley (Oxford), J. W. P. Hirschfeld (Sussex), C. C. Lindner (Auburn), A. Schrijver (Amsterdam), J. Sheehan (Aberdeen), E. E. Shult (Kansas), V. T. Sós (Budapest), R. P. Stanley (MIT).

Information: E. K. Lloyd, Faculty of Mathematical Studies, The University, Southampton, SO9 5NH, England.

11-16. Seventh International Congress of Logic, Methodology and Philosophy of Science, Salzburg, Austria.

Topics: Proof theory and foundations of mathematics; model theory and applications; recursion theory and theory of computation; axiomatic set theory; philosophical logic; general methodology of science; foundations of probability and induction; foundations and philosophy of the physical sciences, biology, psychology, the social sciences, and linguistics; history of logic, methodology and philosophy of science; and fundamental principles of the ethics of science (invited addresses only).

Deadline for Papers: January 20, 1983.

Information: Paul Weingartner or Georg Dorn, Institut fuer Philosophie, Universitaet Salzburg, Franziskanergasse 1/1, A-5020 Salzburg, Austria.

11-22. L.M.S./S.E.R.C. Durham Symposium in Potential Theory, University of Durham and Grey College, Durham, United Kingdom.

Support: Science and Engineering Research Council and London Mathematical Society.

Organising Committee: J. G. Clunie, W. K. Hayman, D. A. Brannan, A. Baernstein, P. J. Rippon, C. Pommerenke.

Program: Invited talks by A. Baernstein, A. Dahlberg, F. W. Gehring, P. Jones, P. J. Rippon, H. S. Shapiro, B. Fuglede, L. A. E. Carleson. There will also be contributed talks and discussion sessions.

Information: D. A. Brannan or J. G. Clunie, (Ref. PT/83), Faculty of Mathematics, The Open University, Walton Hall, Milton Keynes MK7 6AA, United Kingdom.

12-15. International Conference on the Teaching of Mathematical Modelling, Exeter University, Exeter, England.

Program: The conference will bring together people interested in the use of applications of mathematics in teaching and emphasis will be placed on: how applications can be used most effectively in the teaching of standard mathematical topics; and how to design, teach and examine mathematical modelling courses.

Information: Mrs. S. Williams, Conference Secretary, University of Exeter, St. Lukes, Exeter, EX1 2LU, England.

18-22. International Conference on Mathematics in Biology and Medicine, Bari, Italy.

Purpose: To bring together scientists in pure and applied mathematics and scientists in biology and medicine in order to discuss the common problems encountered in the formulation, analysis and numerical solution of mathematical models (deterministic and stochastic) in the biomedical sciences. Simulation methods and problems of validation of models vs. experimental data will also be treated. Surveys on recent mathematical results motivated by biological questions will be given.

Program: There will be invited talks and contributed talks.

Call for Papers: 200-word abstracts should be sent to the address below no later than February 1, 1983. The Conference language is English.

Information: V. Capasso, Istituto di Analisi Matematica, Università di Bari, Palazzo Ateneo, 70121 Bari, Italy.

25-29. Sixth International Symposium on Multivariate Analysis, University of Pittsburgh, Pittsburgh, Pennsylvania.

Topics: Topics will include applications, mathematical statistics, probability theory, and statistical computations.

Deadline for Abstracts: March 15, 1983.

Information: P. R. Krishnaiah, Center for Multivariate Analysis, Ninth Floor, Schenley Hall, University of Pittsburgh, Pittsburgh, Pennsylvania 15260.

15-17. Fourth International Conference on Mathematical Modelling, Zurich, Switzerland.

Call for Papers: Contributed papers are sought in 20-minute, 10-minute and poster-session lengths.

Deadline for Abstracts: October 31, 1982.

Information: X. J. R. Avula, Co-Chairman, Fourth International Conference on Mathematical Modelling, School of Engineering, University of Missouri-Rolla, Rolla, Missouri 65401, (314) 341-4581.

22-26. Seventh International Conference on Structural Mechanics in Reactor Technology, Marriott Hotel, Chicago, Illinois.

Call for Papers: Primary themes of the meeting will be making fission power plants safer and more reliable and developing fusion power plants for the 21st century.

Topics: Topics will include structural mechanics, core loading conditions, materials behavior, effects of earthquakes on plants, fluid mechanics, operating experience, accident sequences and calculational procedures. Papers may deal with theory, applications or both.

Information: Stanley Fistedis, Reactor Analysis and Safety Division, Argonne National Laboratory, Argonne, Illinois 60439.

22-26. Universal Algebra, József Attila University, Szeged, Hungary.

Organizer: János Bolyai Mathematical Society.

Program Committee: B. Csákány, E. Fried, E. T. Schmidt, Á. Szendrei, R. Wiegandt.

Program: There will be one-hour invited lectures and 20-minute contributed papers on various topics of universal algebra. A problem session will also be held.

Call for Papers: Papers relating to the theme are welcome. A one-page abstract should be sent to the address below no later than May 31, 1983.

Information and Abstracts: L. Szabó, or Á. Szendrei, Bolyai Institute, Aradi vértanúk tere 1, 6720 Szeged, Hungary.

22-27. Tenth International Congress on Cybernetics, Namur, Belgium.

Program: There will be symposia on the following subjects: principles of cybernetics and general theory of systems; cybernetics in social systems; cybernetics in the engineering sciences; and cybernetics in biology and medicine.

Call for Papers: Papers are invited on specific subjects with the symposia topics listed.

Deadline for Abstracts: December 31, 1982.

Information: Association Internationale de Cybernétique, Palais des Expositions, Place André Ryckmans, B-5000 Namur, Belgium.

AUGUST 1984

August 1984. **Fifth International Congress on Mathematics Education**, University of Adelaide, Australia. (June 1982, pp. 331, 376)



LECTURES IN APPLIED MATHEMATICS

ALGEBRAIC AND GEOMETRIC METHODS
IN LINEAR SYSTEMS THEORY

edited by Christopher I. Byrnes and Clyde F. Martin

The papers contained in this volume were presented as research papers at the AMS-NASA-NATO Summer Seminar on Algebraic and Geometric Methods in Linear Systems Theory, held at Harvard University in June 1979. They represent cross-sections of four broad methodological areas of mathematical systems theory—algebraic geometric and topological techniques, Lie algebraic techniques, algebraic techniques, and real and complex analytic techniques—and complemented the tutorial lectures of the Advanced Study Institute. This workshop was jointly supported by a grant from Ames Research Center-NASA and a grant from the Advanced Study Institute Program of NATO.

Contributors to the book are:

Roger Brockett	Michiel Hazewinkel
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Diederich Hinrichsen and	Leiba Rodman
Dieter Prätzel-Wolters	

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TAUBERIAN THEORY AND ITS APPLICATIONS

by A. G. Postnikov

This monograph is devoted to the classical version of Tauberian theory. The principal role is played by Tauberian theorems with remainder terms for power series. Some applications of the theory are presented. The book is divided into 29 sections and progresses from the Laplace-Stieltjes transform through theorems

of Tauber, Littlewood, Hardy, Fatou, Subhankulov, Onishi, and Ikehara.

1980, Issue 2, Number 144, v + 138 pages (soft cover)

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Personal Items

Thomas L. Drucker of the University of Wisconsin has been appointed to an assistant professorship at the University of Wisconsin-Extension.

Stanley P. Hughart of California State University, Sacramento, retired on July 1, 1982. He was a member of the faculty for 28 years.

William I. Layton of Newberry College has been appointed Chairman of the Department of Mathematics and Physics at that university.

D. Ramachandran of the University of North Carolina, Chapel Hill, will be visiting the Department of Statistics and Computer Science at the University of Georgia, beginning September 1982.

Richard Summerhill of Kansas State University has been appointed Head of the Mathematics Department at that university.

Deaths

Stewart S. Cairns, Professor Emeritus of the University of Illinois, died on June 28, 1982 at the age of 78. He was a member of the Society for 52 years.

Haskell B. Curry, Professor Emeritus of Pennsylvania State University, died on September 1, 1982 at the age of 81. He was a member of the Society for 57 years.

H. C. Griffith, Professor Emeritus of Florida State University, died on December 2, 1982 at the age of 64. He was a member of the Society for 32 years.

H. T. Karnes, Professor Emeritus of Louisiana State University, died on March 7, 1980 at the age of 74. He was a member of the Society for 39 years.

Dora E. Kearney of Seattle, Washington died on June 26, 1982 at the age of 85. She was a member of the Society for 58 years.

Gerald S. Silberman of California State University, Sacramento, died on July 31, 1982 at the age of 51. He was a member of the Society for 29 years.

Helen M. Titus of Wichita State University died on December 18, 1981 at the age of 59. She was a member of the Society for three years.

Raymond L. Wilder of Santa Barbara, California, died on July 7, 1982 at the age of 85. He was a member of the Society for 55 years. (See page 521.)

Visiting Mathematicians (*Supplementary List*)

The following lists of visiting mathematicians include both foreign mathematicians coming to the United States and Canada, and Americans going abroad. The original lists appeared on pages 382-384 of the June 1982 *Notices*; supplementary lists appeared on pages 474-476 of the August 1982 issue.

American Mathematicians Visiting Abroad

Name and Home	Host Institution	Field of Special Interest	Period of Visit
Brockwell, Peter J. (U.S.A.)	University of Kuwait	Probability and Stochastic Processes	8/82 - 8/83
Bullen, Peter (Canada)	University of Melbourne, Australia	Inequalities, Non-absolute Integrals, Mathematical Education	7/82 - 6/83
Curjel, Caspar (U. S. A.)	E.T.H., Zurich, Switzerland	Algebraic Topology	9/82 - 6/83
Iyer, Hariharan K. (U.S.A.)	CSIRO, Australia	Statistics	8/82 - 8/83
Marshall, Donald E. (U.S.A.)	Academy of Sciences, Sweden	Complex Analysis, Functional Analysis	9/82 - 6/83
Mysak, Lawrence (Canada)	E.T.H., Zurich, Switzerland	Dynamical Oceanography, Wave Motions	9/82 - 8/83
Reiner, Irving (U.S.A.)	University of London, Kings College, United Kingdom	Representation Theory of Groups	1/83 - 6/83
Warner, Seth (U.S.A.)	University of Oslo, Norway	Topological Algebra	9/82 - 6/83
Zidek, James V. (Canada)	Imperial College, England	Decision Theory	10/82 - 6/83

Visiting Foreign Mathematicians

Bagley, Jonathan (England)	Colorado State University		8/82 - 5/83
Boehm, Michael (Germany)	Brown University	Fluid Dynamics, Partial Differential Equations, Non-linear Evolution Equations	9/82 - 2/83
Börger, Reinhard (West Germany)	University of Toledo	Category Theory	9/82 - 6/83
Campanello, Julio (Italy)	Suny at Albany	Commutative Algebra	9/82 - 4/83
Chalambakis, Nicolas (Greece)	Brown University	Partial Differential Equations and Application of Solid Mechanics	9/82 - 8/83
Chen, Fengsu (People's Republic of China)	Brown University	Computational Fluid Mechanics	1/81 - 12/82

Constantin, Peter (Israel)	Indiana University, Bloomington	Functional Analysis	8/82 - 5/83
Dalenius, Tore (Sweden)	Brown University	Probability and Statistics	9/82 - 5/83
Drygas, Hilmar (West Germany)	University of Pittsburgh	Statistics	9/82 - 4/83
Duncan, John (Scotland)	Indiana University, Bloomington	Functional Analysis	8/82 - 5/83
Dydak, Jerzy (Poland)	University of Washington	Topology	9/82 - 6/83
Flury, Bernhard (Switzerland)	Purdue University	Multivariate Analysis	6/82 - 6/83
Ganter, Bernhard (West Germany)	Emory University	Combinatorics, Universal Algebra	9/82 - 12/83
Gao Ren (People's Republic of China)	Suny at Albany	Functional Analysis	6/82 - 6/84
Haagerup, Pia (Denmark)	University of Pennsylvania	Mathematics/Physics	1/83 - 6/83
Haagerup, Uffe (Denmark)	University of Pennsylvania	Analysis	1/83 - 6/83
Hu, Mingzhi (People's Republic of China)	Brown University	Fracture of Fiber Reinforced Material	10/82 - 9/83
Huang, Wen-Tao (Taiwan)	Purdue University	Selection and Ranking Procedures	6/82 - 8/82
Ichikawa, Akira (Japan)	University of British Columbia	Stability and Control of Stochastic Systems	9/82 - 8/83
Ishikawa, Hirofumi (Japan)	University of Washington	Number Theory	9/82 - 6/83
Jianzhong, Jhang (People's Republic of China)	University of Washington	Nonlinear Programming	9/82 - 6/83
Kleinschmidt, Peter (West Germany)	University of Washington	Convex Geometry, Combinatorics	9/82 - 6/83
Klement, Peter (Austria)	University of Cincinnati	Fuzzy Sets	1/83 - 6/83
Kunisch, Karl (Austria)	Brown University	Functional Analysis, Differential Equations, Approximation and Control Theory	8/82 - 8/83
Michael, James H. (Australia)	Indiana University, Bloomington	Partial Differential Equations	9/82 - 12/82
Ng, Vee-Ming (Malaysia)	Purdue University	Structural Inference	5/82 - 12/82
Przymusińska, Halina (Poland)	University of Pittsburgh	Mathematical Logic	7/82 - 6/83
Przymusiński, Teodor (Poland)	University of Pittsburgh	Topology	7/82 - 6/83
Rao, R. Sita Rama Chandra (India)	University of Toledo	Number Theory	9/82 - 4/83
Read, T. R. C. (Australia)	Colorado State University	Statistics	8/82 - 5/83
Ruitenbun, Wim (The Netherlands)	New Mexico State University	Constructive Mathematics	8/82 - 5/83
Rybakowsky, Krzysztof (Poland)	Brown University	Differential Equations	9/82 - 5/83
Saunders, Ian (Australia)	Colorado State University	Probability and Stochastic Processes	8/82 - 5/83
Scheurle, Jürgen (West Germany)	Brown University	Functional Analysis, Partial Differential Equations	12/82 - 7/83
Sheu, Shuenn-jiy (Taiwan)	Brown University	Probability Theory and Stochastic Control	6/82 - 5/83
Sitaram, Alladi (India)	University of Washington	Harmonic Analysis	9/82 - 6/83
Somolinas, Alfredo (Spain)	Brown University	Biostatistics and Differential Equations	9/81 - 5/83
Stavroulakis, Ioannis (Greece)	Brown University	Functional Differential Equations	1/82 - 1/83
Tai, Hsin-sheng (People's Republic of China)	Institute for Advanced Study	Differential Geometry	9/82 - 4/83
Tuckwell, Henry C. (Australia)	University of British Columbia	Mathematical Neurobiology	1/83 - 6/83
Wang, Mingshu (People's Republic of China)	Brown University	Differential Equations	7/82 - 12/82
Wang, Min-zhong (People's Republic of China)	Brown University	Mathematical Analysis and Theory of Elasticity	9/82 - 9/83
Wiegandt, Richard (Hungary)	University of British Columbia	Algebra	8/82 - 12/82
Wood, Graham (New Zealand)	University of Washington	Functional Analysis	9/82 - 6/83
Yan, Ji Yi (China)	Cornell University	Mathematical Programming	8/82 - 8/84
Yang, Shao-qing (People's Republic of China)	Brown University	Dynamical Systems Theory	9/81 - 8/83
Ye, Biquan (People's Republic of China)	Brown University	Continuum Mechanics and Applied Mathematics	1/81 - 10/83
Yun, Tian-quan (People's Republic of China)	University of British Columbia	Elasticity, Integral Equations, Optimization	7/82 - 12/82
Zhao, Shu Yu (People's Republic of China)	University of Pennsylvania	Boolean Space Geometry and Boolean Algebra	7/82 - 6/83

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.

Lloyd R. Welch (1984) has been appointed by President Andrew M. Gleason to the *Proceedings of Symposia in Applied Mathematics Editorial Committee*. Continuing members of the committee are Stephen Childress (1983) and Stephen Crandall (1982).

H. Jerome Keisler (1985) and Yiannis N. Moschovakis (1985) have been appointed by President Andrew M. Gleason to the *Committee to Select the Winner of the Steele Prize*. Other members of the committee are Stuart Antman (1983), M. D. Kruskal (1983), Louis Nirenberg (1983), Alex Rosenberg, chairman (1983), Max M. Schiffer (1983), Edwin H. Spanier (1984), and Gail S. Young (1983). Terms on this committee expire on June 30.

Benedict H. Gross (1986) and Katsumi Nomizu (1986) have been appointed by President Andrew M. Gleason to the *Committee on Summer Research Conferences*. Other members of the committee are James G. Glimm (1985), Kenneth Kunen (1983), Donald S. Ornstein (1983), Julius Shaneson (1984), R. O. Wells, Jr., chairman (1985), and Shmuel Winograd (1984). Terms on this committee expire on June 30.

Michael Artin (1985) and Thomas H. Brylawski (1985) have been appointed by President Andrew M. Gleason to the *Committee on Summer Institutes*. Other members of the committee are Robert Osserman, chairman (1984), George C. Papanicolaou (1983), Harold M. Stark (1984), and Stephen Wainger (1983). Terms on this committee expire on February 28.

A joint *AMS-MAA Committee on Arrangements for the Albany Meeting* (August 8-12, 1983) has been appointed by Presidents Andrew M. Gleason (AMS) and Richard D. Anderson (MAA). The committee members are Lindsay N. Childs, William W. Fairchild, Richard Z. Goldstein, chairman, Timothy L. Lance, Violet Larney, William J. LeVeque (ex officio), David P. Roselle (ex officio), Hugo Rossi (ex officio), B. David Saunders, Edward C. Turner, Nura D. Turner, and Edward S. Thomas.

Presidents Andrew M. Gleason (AMS) and Seymour V. Parter (SIAM) have appointed Stuart S. Antman, David Gilbarg and Werner C. Rheinboldt to the joint *AMS-SIAM Committee to Select the Winner of the Birkhoff Prize for 1983*. Professor Gilbarg will serve as chairman. This committee replaces the one

announced in the June *Notices*, page 339, whose members have resigned.

Reports of Past Meetings

The June Meeting in Bellingham

The seven hundred ninety-fifth meeting of the American Mathematical Society was held at Western Washington University, Bellingham, Washington, on Friday and Saturday, June 18-19, 1982. There were 122 registrants, including 59 members of the Society. This meeting was held in conjunction with a meeting of the Pacific Northwest Section of the Mathematical Association of America (MAA). Richard Levin served as the local organizer of the meeting.

Invited Addresses. By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there were two invited one-hour addresses:

MICHAEL FREEDMAN, University of California, San Diego, spoke on *Bing topology, infinite procedures, and the Poincaré conjecture in dimension four*. He was introduced by Richard Schori.

MARINA RATNER, University of California, Berkeley, spoke on *Ergodic theory in hyperbolic space*. She was introduced by Hugo Rossi.

Special Sessions. By invitation of the same committee, there were two special sessions of selected twenty-minute papers. The topics of these special sessions, the names of the organizers and the lists of speakers are as follows:

Continuum theory, LEWIS E. WARD, JR., University of Oregon. The speakers were W. D. Collins, Andrzej Gutek, Charles L. Hagopian, Kenneth R. Kellum, Marcus M. Marsh, Lee Mohler, R. E. Smithson, E. D. Tymchatyn, Eldon J. Vought, and L. E. Ward, Jr.

Several complex variables, JOHN SCHERK, University of Alberta. The speakers were James A. Carlson, J. B. Carrell, Linda A. Ness, and J. Leahy.

Contributed Papers. There were two sessions of contributed ten-minute papers of six and three speakers each. They were chaired by R. Levin and J. F. Sallee.

MAA Program. The MAA program included an hour address by J. A. COCHRAN of Washington State University entitled *A potpourri of eigenvalue results—the exploitation of analogies*. There were also two MAA special sessions: *Different methods of teaching mathematics*, organized by B. Hogan of Highline Community College; and *Topics in mathematics*, organized by E. Newell of Highline Community College. In addition there were two MAA panel discussions: *Mathematics and computer science*, moderated by P. C. Gilmore of

the University of British Columbia; and *Trends in graduate programs*, moderated by R. Kauffman of Western Washington University.

The featured speaker at the Friday evening banquet was E. Hewitt of the University of Washington. His talk was *Even mathematicians are odd*. The speaker at the Saturday afternoon luncheon was M. P. Sward, Associate Director of the MAA. Her talk was *Like 55, mathematics saves lives*.

Salt Lake City, Utah

Hugo Rossi
Associate Secretary

1982 Summer Research Institute

Recursion Theory

The thirtieth Summer Research Institute sponsored by the Society took place on the campus at Cornell University, Ithaca, New York, from June 28 to July 16.

The purpose of the Institute was to present, unify, and broaden worldwide research in recursion theory and allied disciplines. Major topics encompassed were the lattice of R.E. sets (structure theory, automorphisms), the R.E. degrees, the upper semilattice of Turing degrees (embeddings, theories, automorphisms, pseudo-jump), the priority method ($0', 0'', 0'''$), higher recursion theory (continuous functionals, recursive functionals of higher type, E -recursion, inductive definitions, admissible sets, hierarchy theory), recursive and constructive mathematics (recursive algebra, recursive analysis, recursive functional analysis, constructive presentations), recursive model theory (Ehrenfeucht theories, Lindenbaum algebras with additional structure), descriptive set theory (determinacy, Π^1_2 -singletons, scales in $L(R)$, homogeneous trees), the fine structure of Gödel's constructible universe (morasses, box principles, applications to higher recursion theory, recursion-theoretic methods), and finally theoretical computer science and computational complexity.

There were seven short courses which included a total of 27 one-hour lectures summarizing main directions of current research. In addition, there were 28 invited one-hour addresses, 37 contributed half-hour addresses, and several informal seminars.

A total of 144 mathematicians registered for the institute, 30 of whom were accompanied by one or more family members for at least part of the time. Seventeen countries not in North America were represented by the following numbers of participants: Australia (1), Bulgaria (1), China (4), Czechoslovakia (1), Egypt (1), England (9), France (4), Greece (1), Israel (1), Italy (1), Japan (4), Norway (1), Singapore (1), Sweden (2), Venezuela (1), West Germany (6), and Yugoslavia (1).

As with previous summer research institutes, the Society will publish formal proceedings in the series *Proceedings of Symposia in Pure Mathematics*, which will include papers by most of the hour speakers. The topic of this institute was selected by

the AMS Committee on Summer Institutes which, at the time, consisted of Robert Gilmer, Morris W. Hirsch, Robert Osserman (chairman), George C. Papanicolaou, Wilfried Schmid, and Stephen Wainger. The Organizing Committee for the Institute included Solomon Feferman, Yiannis Moschovakis, Anil Nerode (co-chairman), Hilary Putnam, Gerald Sacks, Joseph Shoenfield, Richard A. Shore (co-chairman), and Robert I. Soare. The institute was supported by a grant from the National Science Foundation.

The Summer Meeting in Toronto

The report of the mathematical portion of this meeting will appear in a later issue of the *Notices*.

Council Meeting. The Council met in the Governing Council Chamber of Simcoe Hall on the campus of the University of Toronto at 5:00 p.m. on August 22, 1982. There were 32 members present. President Gleason was in the chair.

The Council accepted in principle a proposal that the eligible group for AMS Postdoctoral Fellowships be changed to persons several years (perhaps four to seven) past the Ph.D. Details are to be left to the *Committee on Postdoctoral Fellowships*. The change does not affect the competition of January 1983, for which the eligible group continues to be persons with recent Ph.D. degrees.

The Council has acted to establish a *Committee on Professional Ethics*. The scope and access to the Committee are to be developed.

The Council elected Joel A. Smoller to the *Editorial Committee of the Transactions and Memoirs* and to the Council, replacing Paul H. Rabinowitz, who had resigned.

The Council repealed a standing rule that an individual should not accept more than one invitation to speak in a special session at one meeting.

The following bit of history is given in background for the next action of the Council to be described. Professor Chandler Davis, who took his Ph.D. at Harvard in 1950 and went to the University of Michigan, was called before the Unamerican Activities Committee of the U.S. House of Representatives in 1954. He was asked questions, among them 26 questions about such matters as whether he was acquainted with certain persons, whether he was aware of actions of certain groups, particularly of Communist Party activities, and whether he was involved in the preparation and printing of certain documents. He refused to answer, basing his refusal on the position that the questions were improper in that they contravened both his rights and those of others to freedom of speech and freedom of the press as guaranteed by the First Amendment to the Constitution. He was offered the opportunity to decline to answer by virtue of the Fifth Amendment, which protects one from self-incrimination, and did not do so because of his stated belief that the questions themselves were improper. He was indicted

for contempt of Congress. At about the same time he was dismissed from his position at the University of Michigan. He was convicted in Federal Court. With the unsolicited financial assistance of members of the academic community, mathematicians in particular, he was able to appeal but the appeal lost in the Circuit Court and the Supreme Court. He then served a prison sentence of six months, with time off for good behavior.

The Council passed a motion which "urge[s] the President of the United States to pardon Professor Chandler Davis." Moreover, "the Council requests the President of the United States to take all steps permitted by law to clear Professor Davis's record of any stain of criminality arising from this episode."

The Council named additional candidates for the position of member-at-large of the Council in response to petitions. These are

A. T. Bharucha-Reid William H. Ruckle
Bernard L. Madison Michael Shub

(Candidates for various offices previously named by the Council were reported in the *Notices* for June, page 391.)

The Council had recessed for dinner from 6:30 p.m. to 8:00 p.m. and adjourned at 10:00 p.m.

Business Meeting. The Business Meeting followed the session for the award of Steele Prizes on 25

August 1982 in the Auditorium of the Medical Sciences Building on the campus of the University of Toronto. President Gleason presided.

The Secretary reported on items of Council business, which have been published above and in the February issue of the *Notices*, pages 212-213. He reported that President Gleason had selected eight candidates for four positions on the Nominating Committee of 1983 and 1984, namely

James A. Donaldson Robert R. Phelps
Linda Keen Bruce Rothschild
O. Carruth McGehee Wolfgang M. Schmidt
Robert M. Miura James Stasheff

The Chairman will be Ralph S. Phillips.

The new Assistant Executive Director, Jill P. Mesirov, was introduced to the membership.

Professor Leonard Gillman introduced a resolution thanking the University of Toronto for its hospitality and the members of the *Committee on Arrangements* for their work in facilitating the meeting. Moreover, he included in his motion special words of gratitude to the members of the Providence staff in attendance.

The meeting adjourned at 5:30 p.m.

Bethlehem, Pennsylvania **Everett Pitcher**
Secretary

CONTEMPORARY MATHEMATICS (ISSN 0271-4132)

PAPERS IN ALGEBRA, ANALYSIS AND STATISTICS edited by Rudolf Lidl

The papers collected in this volume are modified versions of invited lectures and some contributed specialist session papers presented at the 21st Summer Research Institute of the Australian Mathematical Society held at the University of Tasmania from 12th January until 6th February 1981.

The 21st Summer Research Institute covered a wide range of topics in pure and applied algebra, analysis and statistics. Most of the invited lectures were of a survey nature and each week of the Institute was devoted to different subject areas. Invited lectures reproduced in this volume are:

- C. W. Curtis and G. I. Lehrer, *Homology representations of finite groups of Lie type*
- R. Delbourgo, *Matrix correlation functions*
- D. Elliott, *Some aspects of singular integral equations—A numerical analyst's viewpoint*
- F. Hirzebruch, *Some examples of algebraic surfaces*
- I. G. Macdonald, *Lie groups and combinatorics*
- M. Mendès-France, *Paper folding, space-filling curves and Rudin-Shapiro sequences*
- G. Pilz, *Near-rings: What they are and what they are good for*

- T. J. Rivlin, *The optimal recovery of functions*
- N. J. A. Sloane, *Recent bounds for codes, sphere packings and related problems obtained by linear programming and other methods*
- G. S. Watson, *Three aspects of the statistics of directions*
- E. C. Zeeman, *Bifurcation and catastrophe theory*

Twenty-two of the contributed papers are also included in this volume on specialist topics in algebra, analysis and statistics.

One of the main strengths of this book is the introductory and survey nature of some papers, especially Hirzebruch, Pilz, Rivlin, Sloane, Watson, Zeeman. Articles of high research value are Curtis and Lehrer, Macdonald, Sloane. The papers by Delbourgo, Elliott, Mendès-France concentrate on a narrower topic than the other invited papers. Some papers contain expository work (e.g. Pilz, Rivlin, Zeeman), but the main emphasis is on surveying a given topic.

Individuals might gain an insight into a new field due to the introductory nature of some of the papers. They will also get to know the frontiers of current research in some topics.

1980 *Mathematics Subject Classifications*: 00A10; 05-06, 14-06, 16-06, 41-06, 62-06, 94-06

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SITUATION WANTED advertisements are accepted under terms spelled out on page A-355 of the April 1979 *Notices*. (Deadlines are the same as for other classified advertisements.)

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POSITIONS AVAILABLE

East Carolina University
Mathematics Department, Greenville NC 27834

Applications are invited for two tenure-track positions (rank and salary commensurate with credentials) beginning Fall, 1983. One position is in the area of Computer Science and the other in the area of either Mathematics or Statistics. Candidates for each position must have a Ph.D. Degree in a Mathematical Science; in addition, candidates for the Computer Science position should have the equivalent of a Master's Degree in Computer Science. Applicants must have a strong commitment to both research and teaching. Send resume and three recent letters of reference to Gary Richardson. EO/AAE.

EAST CAROLINA UNIVERSITY CHAIRPERSON DEPARTMENT OF MATHEMATICS

The search has been reopened for the position of Chairperson of the Department of Mathematics. Nominations and applications must be received by December 1, 1982, to be assured of consideration. Applicants should submit dossier with three letters of reference. Candidates must have Ph.D. in mathematics/mathematical sciences and should furnish evidence of effectiveness in teaching, of ability to lead and administer a multifaceted department, and of scholarly achievement involving research, creative activity, publications, etc. Rank and salary commensurate with qualifications. The Mathematics Department has 34 full-time members in mathematics, mathematics education, computer science, and statistics, and offers B.A. in mathematics, B.A. in computer science, and B.S. in mathematics for preparation of teachers, and the master's degree, as well as service courses for all university students. Send application to Professor Eugene E. Ryan, Chair, Search Committee, Department of Mathematics, East Carolina University, Greenville, NC 27834; 919-757-6121. An AA/EO Employer

DEPARTMENT OF STATISTICS, PRINCETON UNIVERSITY

We have openings for an Assistant Professor and for Visiting Faculty, beginning September 1983. Candidates should have teaching experience and evidence of research ability. Junior faculty at Princeton are encouraged to work on sponsored research projects or on their own research in lieu of some teaching. Among candidates of equal quality, preference will be given to those with experience or interest in two or more of: theoretical questions; applications of statistics and data analysis; innovative statistical use of computers. The Department has its own Digital Equipment Corporation VAX-11/750.

The Department encourages applications from women and members of minority groups. Apply to: G. S. Watson, Acting Chairman, Department of Statistics, Princeton University, Fine Hall, P.O. Box 37, Princeton, NJ 08544.

THE UNIVERSITY OF MELBOURNE CHAIR OF STATISTICS

The University of Melbourne invites applications for the Chair of Statistics which will become vacant on 1 January, 1983 on the retirement of Professor E. J. Williams. The appointee will be a distinguished scholar in any area of statistics or probability and will be expected to promote teaching and research and engage in consulting with other University departments and outside organizations.

SALARY: \$A43,904 per annum.

Further information about the position, application procedure, superannuation, travel and removal expenses, housing assistance and conditions of appointment is available from the Registrar. All correspondence (marked "Confidential") should be addressed to the Registrar, The University of Melbourne, Parkville, Victoria, 3052, Australia.

Applications close on 1 November, 1982.

Applied Mathematics University of Alabama in Birmingham

A tenure-track position for teaching and research in applied mathematics. Assistant or Associate Professorship according to qualifications. Any area of applied mathematics will be considered. Departmental members are currently active in nonlinear wave dynamics, mathematical modeling and operations research. UAB is a young and growing urban university with 14,000 students and 7,000 faculty and staff. Birmingham is a major commercial and industrial center located in central Alabama having warm summers and mild winters. Summer teaching is optional and is normally available at 1/3 of academic salary. Send letter of application, résumé, and three letters of reference to Dr. J. Buckley, Mathematics Department, University of Alabama in Birmingham, Birmingham, AL 35294. Application deadline is January 31, 1983. UAB is an Affirmative Action/Equal Opportunity Employer.

Applications are invited for an assistant professor position in the general areas of nonlinear differential equations and global analysis. The successful candidate must have outstanding research potential and have demonstrated excellence in teaching. Exceptionally well-qualified persons, whose background and experience warrant a tenure-level appointment are also encouraged to apply. The research focus of the candidate should be among the following areas: dynamical systems, global or qualitative theory of nonlinear partial differential equations, or modern mathematical physics. Résumés and 3 letters of recommendation should be sent prior to January 15, 1983 to James B. Robertson, Chairperson, Department of Mathematics, Santa Barbara, CA 93106.

The University of California, Santa Barbara, is an equal opportunity/affirmative action employer.

POSITIONS AVAILABLE

Assistant/Associate Professor, Biomathematics Program, North Carolina State University. Teaching, research, consulting in field of stochastic modeling/model validation. Résumé, research interests, transcripts (recent graduates), three reference letters to: Dr. H. R. van der Vaart, Statistics Department, NCSU, Raleigh, NC 27650-5457. January 31, 1983 or until position is filled. AA/EOE.

ASSISTANT PROFESSOR IN MATHEMATICS

The Department of Mathematics at Oregon State University invites applications for a possible Assistant Professor (tenure-track) position in Mathematics beginning September 1983. All areas in mathematics will be considered.

A Ph.D. or the equivalent is required. Duties include research activity, teaching six to eight class hours per week. Salary \$21,000–22,500, depending on qualifications. The closing date for applications is January 15, 1983.

For further information, write to:

Dr. Richard M. Schori, Chairman
Department of Mathematics
Oregon State University
Corvallis, OR 97331

Attn: Staff Selection Committee

Oregon State University is an Affirmative Action/Equal Opportunity Employer and complies with Section 504 of the Rehabilitation Act of 1973.

It is anticipated that the Department of Mathematics will have openings for visiting and tenure-track appointees for the academic year 1982–1983. Special attention will be given to persons in numerical analysis or p.d.e. Applicants are asked to send a vita and three letters of recommendation to Robert H. Oehmke, Department of Mathematics, University of Iowa, Iowa City, Iowa, 52242. The process of evaluating applications will begin on January 24, 1983. The University of Iowa is an Affirmative Action and Equal Opportunity Employer and specifically encourages applications from women and minorities.

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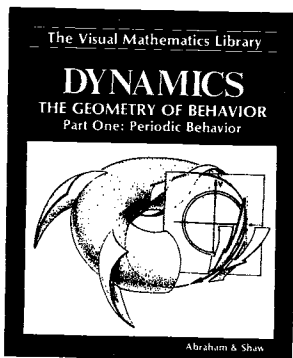
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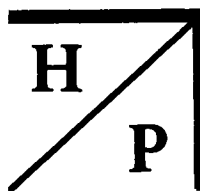
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Address inquiries and applications to *Calvin C. Moore, Mathematical Sciences Research Institute, 2223 Fulton Street, Room 603, Berkeley, California, 94720*. Applicants' files should be complete by January 10, 1983.

One of the two programs for the 1984-85 academic year has been selected already; it is to be Low Dimension Topology. The program committee consists of Robert Edwards (Chairman), Robion Kirby, and William Thurston. The Institute eagerly welcomes suggestions from the mathematical community of programs for future years. These should be sent to Calvin C. Moore at the above address.

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