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 #  DATE  PLACE  ABSTRACT DEADLINE  ISSUE
812  June 29–July 1, 1984  Plymouth, New Hampshire  APRIL 23, 1984  June
813  August 16–19, 1984  Eugene, Oregon  JUNE 5, 1984  August
(88th Summer Meeting)
814  November 2–3, 1984  Minneapolis, Minnesota
815  November 9–10, 1984  San Diego, California
816  January 9–13, 1985  Anaheim, California
(91st Annual Meeting)
April 12–13, 1985  Tucson, Arizona
January 7–11, 1986  New Orleans, Louisiana
(92nd Annual Meeting)
January 21–25, 1987  San Antonio, Texas
(93rd Annual Meeting)
January 6–10, 1988  Atlanta, Georgia
(94th Annual Meeting)
August 8–12, 1988  Providence, Rhode Island
(AMS Centennial Celebration)


Other Events Sponsored by the Society

June 10–August 18, 1984, Joint Summer Research Conferences in the Mathematical Sciences, Bowdoin College, Brunswick, Maine.
July 8–21, 1984, AMS-SIAM Summer Seminar on Nonlinear Systems of PDE in Applied Mathematics, College of Santa Fe, Santa Fe, New Mexico.
July 16–August 3, 1984, AMS Summer Research Institute on Geometric Measure Theory and the Calculus of Variations, Arcata, California.

Subscribers' changes of address should be reported well in advance to avoid disruption of service; address labels are prepared four to six weeks in advance of the date of mailing. Requests for a change of address should always include the member or subscriber code and preferably a copy of the entire mailing label. Members are reminded that U. S. Postal Service change-of-address forms are not adequate for this purpose, since they make no provision for several important items of information which are essential for the AMS records. Suitable forms are published from time to time in the Notices (e.g. June 1980, page 378). Send change of address notices to the Society at Post Office Box 6248, Providence, RI 02940.

Members are strongly urged to notify the Society themselves of address changes (in the manner described above), since (as explained above) reliance on the postal service change-of-address forms is liable to cause delays in processing such requests in the AMS office.
Notices
of the American Mathematical Society

Volume 31, Number 3, April 1984

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242 National Science Foundation Budget Request for FY 1985
260 New Goals for Mathematics Sciences Education
271 The Supply of Mathematical Researchers in the 1990s
278 News and Announcements
282 Queries
283 Letters to the Editor
286 NSF News & Reports
290 1984 AMS Elections (Nominations by Petition)
292 New Rules Concerning Abstracts
293 Future Meetings of the Society

Plymouth, June 29–July 1, 293; Symposium on Mathematical Biology, New York, May 28, 296; Eugene, August 16–19, 297; Synopses, Short Course on Environmental and Natural Resource Mathematics, 317; Call for Topics, 321; Invited Speakers and Special Sessions, 324

326 New AMS Publications
330 Miscellaneous
Personal Items, 330; Deaths, 330; New Doctorates (Supplement), 331

333 Special Meetings
339 AMS Reports & Communications
Recent Appointments, 339; Officers of the Society, 1983 and 1984, 340

341 Advertisements
356 Registration Forms
Summer List of Applicants, 356, 357; Eugene Preregistration and Housing Reservation Form, 359, 360
The Administration's budget request for the fiscal year 1985 was sent to Congress on February 1, 1984. This report examines the budget requests for the National Science Foundation.

As in recent years, the report concentrates on NSF support for research in the mathematical sciences and on the fate of support for science education within the Foundation. These reports have appeared annually for more than a decade—the most recent one was published in the April 1983 issue of the Notices, pages 280 to 289.

This year there are four components to the report:

First is the customary set of tables depicting the part of the entire NSF budget request allocated to support of the mathematical sciences (Table I), the fraction of the budget request for the Directorate of the Mathematical and Physical Sciences (MPS) which is devoted to the mathematical sciences (Table II), and the effects of inflation on the NSF budget over the past decade (Table III).

The other parts consist of excerpts from the submissions to Congress made by the three groups at the Foundation concerned with the Mathematical Sciences (not including computing), Computer Research, and Science and Engineering Education. These pieces, prepared by members of the Foundation's staff, serve to describe the projects for which Congressional funding is sought and to place in context the work supported by the Foundation.

Tables I and II, for the second year in a row, suggest that the prospects for support of mathematical research by the Foundation look better than they have for some time. Before 1982 less than 3% of the NSF budget was devoted to support of research in the mathematical sciences. The FY1985 budget request amounts to 3.75% of the total NSF budget request.

For most of the past decade, the Mathematical Sciences share of the MPS pie has been between 11% and 12%. In the FY1985 request, it has finally passed 12%. Because the increase in this fraction (half of a percent) is so much smaller than the expected increase for the mathematical sciences from FY1984 to FY1985 (which is over twenty percent), it follows that the other physical sciences may all expect to do about as well as mathematics next year, at least on the basis of percentage growth in NSF support for research.

Tables IIIa and IIIb suggest that support for research in the mathematical sciences has made

### Table I. National Science Foundation Budget (Millions of Dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Change</th>
<th>Actual</th>
<th>Change</th>
<th>Actual</th>
<th>Change</th>
<th>Plan</th>
<th>Change</th>
<th>Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>$28.3</td>
<td>7.8%</td>
<td>$30.5</td>
<td>14.1%</td>
<td>$34.8</td>
<td>19.3%</td>
<td>$41.5</td>
<td>21.7%</td>
<td>$50.5</td>
</tr>
<tr>
<td>1982</td>
<td>$32.3</td>
<td>14.1%</td>
<td>$35.8</td>
<td>17.3%</td>
<td>$42.5</td>
<td>20.3%</td>
<td>$50.5</td>
<td>3.75%</td>
<td>$50.5</td>
</tr>
</tbody>
</table>

**NOTE A.** Scientific research and facilities (excluding mathematics and science information). National and special research programs, and national research centers. Support for mathematics has been excluded, cf. items (1) and (3).

**NOTE B.** The programs in this group are ones in which there is some support for projects in every field, including mathematics. The foreign currency program involves both cooperative scientific research and the dissemination and translation of foreign scientific publications. Foreign currencies in excess of the normal requirements of the U.S. are used.

**NOTE C.** This heading covers the administrative expenses of operating the Foundation; the funds involved are not considered to constitute direct support for individual projects.
## TABLE II. DIVISION OF MATHEMATICAL AND PHYSICAL SCIENCES

(Millions of Dollars)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Sciences</td>
<td>$28.3 (11.0%)</td>
<td>$30.5 (11.2%)</td>
<td>$34.8 (11.5%)</td>
<td>$41.5 (11.6%)</td>
<td>$50.5 (12.1%)</td>
</tr>
<tr>
<td>Computer Research</td>
<td>22.3 (8.7%)</td>
<td>25.7 (9.4%)</td>
<td>29.3 (9.7%)</td>
<td>33.9 (9.4%)</td>
<td>39.4 (9.5%)</td>
</tr>
<tr>
<td>Physics</td>
<td>72.1 (28.1%)</td>
<td>75.3 (27.6%)</td>
<td>89.1 (29.5%)</td>
<td>105.9 (29.4%)</td>
<td>121.8 (29.2%)</td>
</tr>
<tr>
<td>Chemistry</td>
<td>57.6 (22.5%)</td>
<td>61.4 (22.3%)</td>
<td>67.6 (22.4%)</td>
<td>80.0 (22.3%)</td>
<td>92.1 (22.1%)</td>
</tr>
<tr>
<td>Materials Research</td>
<td>76.2 (29.7%)</td>
<td>79.9 (29.3%)</td>
<td>81.1 (26.9%)</td>
<td>97.5 (27.2%)</td>
<td>113.0 (27.1%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$256.5</strong></td>
<td><strong>$272.8</strong></td>
<td><strong>$301.9</strong></td>
<td><strong>$358.8</strong></td>
<td><strong>$416.7</strong></td>
</tr>
</tbody>
</table>

## TABLE IIIa. TEN-YEAR COMPILATION OF THE NSF BUDGET

(Millions of Dollars) Current dollars are converted to 1967 dollars using the wholesale/producer index

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Mathematical Sciences</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Support</td>
<td>$17.3</td>
<td>$20.1</td>
<td>$21.4</td>
<td>$22.8</td>
<td>$25.0</td>
<td>$28.3</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>9.4</td>
<td>10.4</td>
<td>10.6</td>
<td>9.7</td>
<td>9.3</td>
<td>9.6</td>
</tr>
<tr>
<td>(2) Other Research Support</td>
<td>502.1</td>
<td>642.9</td>
<td>702.8</td>
<td>761.0</td>
<td>817.7</td>
<td>873.7</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>83.9</td>
<td>88.0</td>
<td>93.9</td>
<td>98.7</td>
<td>103.2</td>
<td>109.9</td>
</tr>
<tr>
<td>(3) Education, Information, Foreign Currency Program</td>
<td>72.8</td>
<td>83.3</td>
<td>84.3</td>
<td>88.4</td>
<td>95.4</td>
<td>80.6</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>39.7</td>
<td>42.9</td>
<td>40.3</td>
<td>37.5</td>
<td>55.5</td>
<td>27.2</td>
</tr>
<tr>
<td>(4) Program Development and Management (&quot;Overhead&quot;)</td>
<td>42.2</td>
<td>45.5</td>
<td>48.7</td>
<td>54.7</td>
<td>58.2</td>
<td>59.2</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>22.0</td>
<td>24.6</td>
<td>23.9</td>
<td>23.9</td>
<td>21.7</td>
<td>20.0</td>
</tr>
<tr>
<td>(5) Totals</td>
<td>$724.4</td>
<td>$791.8</td>
<td>$857.2</td>
<td>$926.9</td>
<td>$996.3</td>
<td>$1041.8</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>585.5</td>
<td>407.8</td>
<td>409.7</td>
<td>598.0</td>
<td>870.6</td>
<td>852.1</td>
</tr>
</tbody>
</table>

## TABLE IIIb. TEN-YEAR COMPILATION (Continued)

(Millions of Dollars) Current dollars are converted to 1967 dollars using the wholesale/producer index

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Mathematical Sciences</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Support</td>
<td>$30.5</td>
<td>$34.8</td>
<td>$41.5</td>
<td>$50.5</td>
<td>101%</td>
<td>192%</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>10.2</td>
<td>11.3</td>
<td>11.5</td>
<td>11.3</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>(2) Other Research Support</td>
<td>875.7</td>
<td>960.6</td>
<td>1129.7</td>
<td>1295.3</td>
<td>62%</td>
<td>119%</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>292.5</td>
<td>317.0</td>
<td>317.0</td>
<td>317.0</td>
<td>-8%</td>
<td></td>
</tr>
<tr>
<td>(3) Education, Information, Foreign Currency Program</td>
<td>29.7</td>
<td>24.7</td>
<td>84.0</td>
<td>85.1</td>
<td>-66%</td>
<td>17%</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>9.9</td>
<td>8.2</td>
<td>8.2</td>
<td>8.2</td>
<td>-79%</td>
<td></td>
</tr>
<tr>
<td>(4) Program Development and Management (&quot;Overhead&quot;)</td>
<td>63.2</td>
<td>65.7</td>
<td>66.7</td>
<td>70.9</td>
<td>56%</td>
<td>68%</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>21.1</td>
<td>21.7</td>
<td>21.7</td>
<td>21.7</td>
<td>-6%</td>
<td></td>
</tr>
<tr>
<td>(5) Totals</td>
<td>$999.1</td>
<td>$1085.8</td>
<td>$1322.1</td>
<td>$1501.8</td>
<td>50%</td>
<td>107%</td>
</tr>
<tr>
<td>1967 dollars</td>
<td>533.7</td>
<td>538.3</td>
<td>538.3</td>
<td>538.3</td>
<td>-9%</td>
<td></td>
</tr>
</tbody>
</table>
The following report was prepared by the staff of the Mathematical Sciences Division of NSF and was submitted to Congress as a part of the material which accompanied the Administration's Budget Request for the Fiscal Year 1985.

Mathematical Sciences Subactivity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Actual FY1983</th>
<th>Plan FY1984</th>
<th>Request FY1985</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classical Analysis</td>
<td>$3.2</td>
<td>$3.9</td>
<td>$4.8</td>
</tr>
<tr>
<td>Modern Analysis</td>
<td>3.4</td>
<td>4.1</td>
<td>5.0</td>
</tr>
<tr>
<td>Geometric Analysis</td>
<td>3.1</td>
<td>3.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Topology &amp; Foundations</td>
<td>4.3</td>
<td>4.9</td>
<td>5.8</td>
</tr>
<tr>
<td>Algebra &amp; Number Theory</td>
<td>5.6</td>
<td>6.6</td>
<td>7.8</td>
</tr>
<tr>
<td>Applied Mathematics</td>
<td>4.1</td>
<td>5.3</td>
<td>6.7</td>
</tr>
<tr>
<td>Statistics &amp; Probability</td>
<td>3.7</td>
<td>4.7</td>
<td>6.0</td>
</tr>
<tr>
<td>Special Projects</td>
<td>7.3</td>
<td>8.3</td>
<td>9.6</td>
</tr>
<tr>
<td>Total</td>
<td>$34.8</td>
<td>$41.5</td>
<td>$50.5</td>
</tr>
</tbody>
</table>

Objectives and Description

The objectives of the Mathematical Sciences subactivity are to promote and foster significant American research in the mathematical sciences and to ensure the continuing vitality and long-range health of the discipline. Each subdiscipline of the mathematical sciences, from those with a sharp disciplinary focus to those that reach out to other disciplines, is supported to encourage their interaction and to provide a healthy balance among them. Various support mechanisms are used to foster the creation of new mathematical methods and techniques and to promote their use in research directed at improving our understanding of physical, biological, and social phenomena.

While traditionally driven by abstract internal goals, the modern trend in much of the mathematical sciences, certainly in applied mathematics and statistics but also in the other fields, is demonstrably dictated by the need to provide essential new modes of expression in the language of science and new technological tools. The demands of abstract elegance and applicability provide powerful forces which combine to further both the internal development and the external utility of mathematics. These forces contribute to the uniqueness of mathematics: it maintains the vitality and fecundity of its oldest branches (such as algebra and geometry) while enabling its newest branches (such as statistics and dynamical systems) to develop freely and rapidly on a strong theoretical base.

The staggering number and bewildering variety of applications of mathematics result from its intimate connections with science and technology. Some of these connections are predictable, others are not. The predictable connections make use of statistics, mathematical modeling, and computational mathematics. That overbooking on airlines leads only to relatively rare inconveniences is not a matter of blind luck, but of careful statistical analysis. Similarly, the design of efficient aircraft requires sophisticated mathematical modeling by partial differential equations of the flow of air over wings and the computation of approximate solutions on high speed digital computers. Unpredictable applications of mathematics are equally striking. The discovery and classification of a class of important solutions to the set of equations proposed by C. N. Yang and R. Mills to describe weak and strong interactions in particle physics.

Unlike research in scientific disciplines with an empirical background, mathematical research is focused on a variety of themes and problems. The mathematical sciences attack no central agreed-upon problem at any given time. Research proceeds on seemingly unrelated fronts; however, the concepts, methods, and techniques that result unify and illuminate broad areas of mathematics and science, despite their diverse origins.

During the recent past, a striking feature of research in all the sciences has been the convergence of investigations within different disciplines on problems that transcend individual sciences. Phenomena of phase transitions, for example, are studied by physicists, chemists, materials scientists, and mathematicians. This development in research is particularly evident in the mathematical sciences, where researchers from various subfields attack and solve problems from other areas of mathematics and science. Research in economics is tied to developments in algebra, geometry, and statistics; developments in mathematical biology cannot be separated from research in applied mathematics, probability, statistics, chemistry, and physics; in geological research and statistical methodology, numerical analysis, and physics are bound together.

Historically, the core of the Foundation's program of research support in the mathematical sciences has been the Scientific Research Project Support (SRPS) award. Recently there has been an emphasis on an extended program of special projects designed to develop and maintain the
infrastructure of the mathematical research community. These special projects, which include research institutes at the University of Minnesota and at Berkeley, California, postdoctoral and visitor support, postdoctoral fellowships, and research conferences and workshops, are important in furthering research interactions among mathematical subfields and mathematical scientists. These efforts were maintained in FY1984 while a significant investment to increase the base of postdoctoral and graduate student support was initiated in the SRPS programs. In addition, the Mathematical Sciences assumed some responsibilities in FY1984 for expanding research opportunities in undergraduate institutions, Presidential Young Investigators, certain aspects of international cooperative scientific projects, and some activities in support of mathematics education. These responsibilities will continue in FY1985 while the investments in postdoctoral and graduate student support will be enhanced as an item of high priority in recognition of the vitality brought to mathematical research by its younger practitioners.

A brief description of research areas supported under the Mathematical Sciences subactivity follows:

- **Classical Analysis** centers on properties of solutions of differential equations and the development of mathematical techniques to estimate these solutions. Equations of primary concern are those that model natural phenomena and, consequently, often display nonlinearities or discontinuities in their definition. The theories of special functions, several complex variables, and harmonic analysis form an interdependent network of research which provides a theoretical base for classical analysis.

- **Modern Analysis** is that part of mathematical analysis that has been developed in the 20th century by abstracting and refining the essential concepts from classical analysis and introducing new algebraic, geometric, and topological methods. A major goal is to provide unified approaches that explain both phenomena and results from analysis and have more general applicability. Recent thrusts are leading to new interactions with theoretical physics, engineering, and other sciences.

- **Geometric Analysis** encompasses the study of geometric objects such as curves and surfaces and the use of geometric models in the analysis of nonlinear phenomena such as those that arise in ordinary and partial differential equations, in functions of several complex variables, and in variational problems. Many of these mathematical phenomena have exciting connections to theoretical problems in physics and other sciences.

- **Topology and Foundations.** Topology studies in a formal and abstract manner those properties of geometric objects which persist after deformation by stretching, shrinking, and twisting without tearing or cutting. Numerous and varied problems have topological formulations, for example, the stability of orbits. Foundations research involves the study of the logical structure and basic concepts that undergird mathematics. It has intimate connections with the theory and application of computing.

- **Algebra and Number Theory** embraces such classical algebraic structures as the theory of integers and primes, polynomials and their sets of solutions, transformations between spaces, and combinatorial designs and enumeration. Further, it includes the evolution of these mathematical ideas to sophisticated algebraic structures labelled groups, rings, fields, algebras, lattices and categories, providing not only a generalization of these specific concepts, but an algebraic framework and descriptive theoretical context for questions throughout mathematics, science, and engineering.

- **Applied Mathematics** is the activity which brings mathematical methodology to bear on the needs of the empirical sciences for modeling and design. It is characterized by an attitude, an approach, or a way of thinking about problems and at its best involves the mathematical modeling and analysis (both theoretical and computational) of complex, real world phenomena rather than the development and study of mathematical structures in their own right. Current projects involve the whole spectrum of the biological, physical, social and engineering sciences. An important component of research in applied mathematics is the work on numerical analysis and scientific computation.

- **Statistics and Probability.** Statistics is the study of methods for the collection, organization, and analysis of data for the purpose of uncovering fundamental mathematical relationships among variables. There is a necessary creative tension between mathematical statistics and statistics viewed as a methodological science. The latter is receiving increased emphasis in the exploration of new computer-based methods of data analysis. Probability theory deals with phenomena that are random in the sense of combining long-term regularity with short-term unpredictability. Active areas such as ergodic theory, stochastic differential equations, and probability in abstract spaces lie on the border between probability and analysis.

- **Special Projects** fosters the increasingly fruitful interactions among researchers in different mathematical subfields and their areas of application. Research conferences and workshops encourage these interactions directly. The Mathematical Sciences Postdoctoral Research Fellowships and grants to the research institutes and other research centers...
provide such opportunities for junior investigators. Increasing requirements for special-purpose computer equipment for mathematical sciences research are addressed through awards for equipment.

**NSF Role**

The NSF is the only Federal agency with responsibility for support across the entire spectrum of the mathematical sciences. Research in the mathematical sciences is also funded by the Department of Defense (DOD), the Department of Energy (DOE), the National Institutes of Health (NIH), and the National Aeronautics and Space Administration (NASA). For the past decade, the research agencies of the DOD have focused their support on applied mathematics and statistics. Even in these areas, Foundation-supported research generally involves a broader range of topics than the more project-oriented research sponsored by the mission agencies.

The NSF role in support of academic basic research in the mathematical sciences is crucial. In FY1983, the Foundation provided 35 percent of the support in applied mathematics, 45 percent in statistics and probability, and 97 percent in the other mathematical sciences disciplines, for an overall total of 61 percent.

NSF coordinates its support of research in the mathematical sciences with its counterpart Federal agencies through the Interagency Committee for Extramural Mathematics Programs. This group meets regularly to share information on policies of support and to discuss areas of emphasis and of unusual scientific opportunity. Extensive day-to-day contact between program officers at the various Federal agencies is maintained by telephone and personal visits. Conferences and workshops are sometimes supported jointly by the Foundation and one or more of the other agencies. The Foundation also supports postdoctorals at the Mathematics Research Center at the University of Wisconsin, which has principal support from the Army Research Office (ARO), so NSF-ARO contact is continual and close.

**Major Programmatic Topics**

- Many phenomena, such as the distribution of heat in a nuclear reactor or weather conditions in the atmosphere, are accurately described by solutions of partial differential equations. The behavior of these solutions in any region is strongly dependent on their properties at the boundary of the region. Can solutions be reconstructed from knowledge of these boundary features in a coherent manner? To what extent does the geometry of the boundary affect this process?

- Operator theory on Hilbert space generalizes matrix theory on Euclidean space and is an important research area with innumerable applications. In recent years it has matured and split into several deep studies, one being approximation of operators. Is there an infinite dimensional approximate analog to the simple and useful Jordan decomposition for finite matrices? Researchers are close to characterizing all operators similar to or approximated by similarities of certain “nice” operators. How do matrix properties and especially approximations evolve as the dimension of the space tends to infinity?

- Traditional descriptive methods in statistics (bar graphs, histograms, etc.) have enabled practitioners to visualize simple data sets. With more complex data sets involving three- or higher-dimensional data, visual insight has not previously seemed plausible. Approaches involving complex methodology and graphics are being rapidly developed. They enable scientists to go to a work-station and, guided by a sophisticated data analyst-statistician, "see" high-dimensional data in order to pick out important features and clusters. How can reliable statistical assessments of these processes be provided? What limitations are present when the dimension of the data (the number of factors measured) and the number of observations are both large?

- Important connections have been discovered between the geometry and topology of a manifold, e.g., a surface, and the analytic properties of certain differential operators on the manifold. Classical dynamical systems, ergodic theory and group theory are brought into investigations in this area in a significant way. Understanding these connections has led to various deep results in mathematics and physics, from the classification of manifolds to geometric quantization in theoretical physics. Can these connections be explained fully to deepen our mathematical and physical understanding of the universe?

- A large variety of real world problems (e.g., optimal utilization of natural resources, most efficient routing schedules) can be mathematically modeled as constrained extreme problems, that is, finding the maximum or minimum of an “objective” function subject to constraints determined by physical or practical considerations. Such problems are subsumed under the heading “nonlinear programming” (NLP) problems. Can existence of solutions to NLP problems be established under conditions on the objective function and constraints often encountered in practical applications? How can such solutions be characterized? How does one design efficient algorithms for numerically solving NLP problems?

- Using concepts of distance based on divisibility of numbers by prime numbers, researchers in number theory developed a technique known as p-adic analysis which has proven its value in many situations. The technique is now seeing expanded use and is undergoing rapid
much of the statistical methodology and theory is now taking place and having a profound effect on the way statistics and research are done.

The pattern discovery faculties of the human visual system, which instantly perceives structures in three-space, in time, and in color, have led researchers at Harvard University under Peter Huber to construct advanced computer graphics systems for use in statistical data analysis to discover unanticipated data features. A sophisticated data analyst can now take a scientist to a work-station and improvise an analysis of the scientist's data following whims and hunches developed while sitting together in front of the screen. By rotating three-dimensional point clouds and using highlighting or "blinking" facilities, interesting data "clumps" can be detected. When detection is followed up by picking subsets of points, fitting smooth curves or surfaces and examining the smooth part and the "rough" part (the residuals), the implications of what is seen can be analyzed before moving on to further actions.

Combined with methods to reduce dimensionality, this revitalization of the descriptive aspects of statistics is engendering a variety of new and basic problems in statistical theory and has enormous promise for the study of multi-dimensional data.

The Uncertainty Principle for Partial Differential Equations. Charles Fefferman of Princeton University was the first recipient of the Foundation's Waterman Award. He has fulfilled the expectations of the award committee by becoming a leading researcher in differential equations and harmonic analysis. Fefferman's most recent work demonstrates the far-reaching consequences of the classical "uncertainty principle" for partial differential equations. He is able to apply these ideas to a number of broad scientific areas such as quantum mechanics, uncoupled harmonic oscillators, quantum gauge theory models, stability of matter, and atomic structure and chemical bonding.

The uncertainty principle relies on the fact that a function and its Fourier transform cannot both vanish on large subsets of the space of definition. A traditional rough estimate for computing eigenvalues of partial differential operators makes use of a volume counting procedure based on this principle. Much sharper estimates are obtained by Fefferman by packing distorted cubes instead of counting volumes from traditionally aligned cubes. This principle not only leads to sharper eigenvalue estimates but also gives new information regarding existence and regularity of solutions of partial differential equations.

Applications of this methodology also include the diagonalization of operators associated with variable coefficient differential equations. This is accomplished by cutting the phase space into suitably distorted boxes of unit volume in which the differential operator can be approximated by
multiplication by a scalar. It is hoped that this technique may make possible a unified treatment of variable coefficient differential equations. This, in turn, would make possible the construction of explicit approximate solutions to such equations.

The work is expected to have considerable influence on the direction of research in the modern theory of partial differential equations and will provide new bridges between the mathematical sciences and many users of mathematics.

Elliptic Curves and Arithmetic. Two remarkable breakthroughs of the past year were based on the link between the analysis and geometry of so-called elliptic curves and the theory of numbers. It has long been known that elliptic curves carried significant arithmetic information through the fact that the points on such a curve can be combined algebraically. Moreover, these curves are intimately related to problems arising from investigations into Fermat’s famous "Last Theorem." This conjecture states that for \( n \) greater than 2 the rational solutions to an equation of the form \( x^n + y^n = z^n \) are \( x = 1, y = 0; x = 0, y = 1 \); and (if \( n \) is even) \( x = -1, y = 0 \) and \( x = 0, y = -1 \).

In the 1920s, L. J. Mordell proved that elliptic curves, or their corresponding equations, have only a finite number of rational solutions. He theorized that this was the case for certain larger classes of curves, including those involved in Fermat’s conjecture. During the summer of 1983, G. Faltings, a young German mathematician, provided a solution to Mordell’s 60-year-old conjecture. His proof built on work of American, Russian, French, German, and Japanese mathematicians, a true demonstration of how independent international efforts on a common problem can culminate in the major results of a single, creative researcher. The result moves closer to Fermat’s conjecture as it is now known that the number of rational solutions is finite for each \( n \).

Also in 1983, Don Zagier of the University of Maryland and the Max Planck Institute in Bonn and Benedict Gross of Brown University provided a fundamental result linking the analysis of certain functions associated to elliptic curves with the class number problem for imaginary quadratic fields. The class number of a field describes in a certain sense how far that field is from having unique factorization of its elements into a product of prime numbers. What is particularly interesting here is that while the question is inherently one of arithmetic, sophisticated techniques of geometry and analysis were needed in its solution.

Dynamics of Collapsing Stars. A question of fundamental importance in the astrophysics of stars is determination of the behavior of a rotating cloud of gas collapsing under the influence of its own gravitation. Determining this behavior is necessary for a proper understanding of the formation of galaxies, stars, and planets. (S. Chandrasekhar of the University of Chicago received the 1983 Nobel Prize in Physics for his contributions to the understanding of white dwarfs and collapsing stars.) Early work of Poincaré, Lyapunov, and Jeans on such problems gave rise to the development of the powerful analytic techniques of bifurcation theory and perturbation series which lead to the solution of a simple scalar potential model. The assumptions underlying this model are now known to be oversimplified. In the last decade astrophysicists have used increasingly powerful computers to treat more complete models. Computations on these promising models produce, in some cases, conflicting results owing to inadequate numerical approximations and computing power.

Recently Norman Lebowitz, also of the University of Chicago, has formulated an iso-circulational model which expresses all the known conservation laws for the equations of fluid dynamics of such stars. This system has been shown to be solvable using finite dimensional polynomial spaces. This will allow efficient and precise solutions which avoid numerical approximations to enormous systems of equations. This work should ultimately lead to a better understanding of binary star formation and the development of planetary stars.

Changes Between FY 1984 Budget Request and FY 1984 Current Plan

The FY1984 Current Plan is $41.50 million, $0.67 million below the FY1984 Budget Request of $42.17 million. This represents a decrease of 1.7 percent. The distribution of the funds appropriated by the Congress for FY1984 results in a decrease of $0.4 million. The remaining reduction of $0.27 million consists of adjustments for funds transferred to the social sciences, Visiting Professorships for Women, Small Business Innovation Research, and the U.S.-India Joint Program. The decrease was distributed over all programs in accordance with perceived scientific opportunities and needs.

FY 1985 Budget Highlights and Explanation of Increases, Decreases, and Continuing Emphases

Obligations

<table>
<thead>
<tr>
<th>FY1983 Actual</th>
<th>$34,755,856</th>
</tr>
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<tbody>
<tr>
<td>FY1984 Current Plan</td>
<td>$41,500,000</td>
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<tr>
<td>FY1985 Request</td>
<td>$50,500,000</td>
</tr>
<tr>
<td>Difference FY1985/FY1984</td>
<td>$ 9,000,000</td>
</tr>
</tbody>
</table>

The FY1985 Budget Request of $50.5 million is $9.0 million or 21.7 percent above the FY1984 Current Plan. This represents a very significant increase in research support for the mathematical sciences.

The significant increase in the Mathematical Sciences Subactivity budget in FY1984 provided the opportunity to continue the needed expansion of research support devoted to young investigators, to research visitors at major centers, and to graduate students; and to respond to important
scientific opportunities in computational mathematics and scientific computing. These initiatives resulted in a modest decrease in the number of senior researchers supported.

The FY1985 Budget Request permits a modest increase in the number of senior investigators supported and a continuation of the FY1984 initiatives, with emphasis on programs in support of graduate students and young investigators and on the provision of computational equipment necessary for the conduct of research. Increased support is also provided for research conducted at undergraduate institutions and for activities supportive of mathematics education, such as workshops and conferences including members of the research and educational communities.

- In the Special Projects program, the number of new 24-month Mathematical Sciences Postdoctoral Research Fellowships awarded annually is increased from 27 to 34; this requires a $0.4 million increase to a total of $2.0 million for support of this fellowship program. Other postdoctoral and visitor support provided by the Special Projects program is increased by 12 percent to $1.4 million. Funding for computational equipment in the Special Projects program is increased by $0.5 million to $1.4 million.

- The operation of the mathematical sciences research institutes at Berkeley and Minnesota is maintained at a constant level of effort of $3.1 million. The Berkeley institute will concentrate on Complexity Theory and Mathematical Economics; the Minnesota institute on Stochastic Differential Equations and their application in modeling of physical and engineering phenomena. Approximately 60 percent of the researchers supported at these institutes with Foundation funds are postdoctorals and young researchers.

- Total SRPS support increases $7.7 million to $40.9 million, and the number of senior researchers supported increases from 1,250 to 1,275, with emphasis on young faculty and researchers at undergraduate institutions.

- Of this increase, $4.4 million, distributed throughout all the subdisciplinary programs, emphasizes the provision of support for young researchers and graduate students: it is planned to increase by $1.6 million, to $3.0 million, research support for young investigators and postdoctoral research associates; and to provide an increase of $2.8 million, to $6.4 million, in the support of graduate research assistants funded on research grants to established senior investigators.

- In addition, continued emphasis is placed within SRPS, especially in the Applied Mathematics and Statistics and Probability programs, in the support of research activities and needed equipment in computational mathematics and in the mathematical aspects of large-scale scientific computing, considered an area of high scientific opportunity. This emphasis, initiated in FY1984, includes $1.7 million for the direct support of computational needs, an increase of $0.7 million or 70 percent above the FY1984 level. A total of $1.0 million of this amount is part of the Foundation-wide initiative on advanced scientific computing.

- An increase of $0.5 million to a total of $1.2 million is to be devoted to the support of international research activities and to the funding of research conducted at predominantly undergraduate institutions.

Percentage increases for the eight program elements of FY1985 over FY1984 Current Plan are:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Change, FY 1984 to FY 1985</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$Millions</td>
</tr>
<tr>
<td>Classical Analysis</td>
<td>$0.90</td>
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<tr>
<td>Modern Analysis</td>
<td>0.85</td>
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<tr>
<td>Geometric Analysis</td>
<td>0.90</td>
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<tr>
<td>Topology &amp; Foundations</td>
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<tr>
<td>Algebra &amp; Number Theory</td>
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<tr>
<td>Applied Mathematics</td>
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<tr>
<td>Statistics &amp; Probability</td>
<td>1.33</td>
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<tr>
<td>Special Projects</td>
<td>1.35</td>
</tr>
<tr>
<td>Total Mathematical Sciences</td>
<td>$9.00</td>
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The following report was prepared by the staff of the Computer Research Division of NSF and was submitted to Congress as a part of the material which accompanied the Administration’s Budget Request for the Fiscal Year 1985.

**Computer Research Subactivity**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Actual FY1983</th>
<th>Plan FY1984</th>
<th>Request FY1985</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical Computer Science</td>
<td>$3.4</td>
<td>$3.7</td>
<td>$4.3</td>
</tr>
<tr>
<td>Software Systems Science</td>
<td>3.2</td>
<td>3.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Software Engineering</td>
<td>3.1</td>
<td>3.4</td>
<td>3.7</td>
</tr>
<tr>
<td>Intelligent Systems</td>
<td>3.0</td>
<td>3.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Computer Systems Design</td>
<td>3.1</td>
<td>3.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Coordinated Experimental Research</td>
<td>11.2</td>
<td>13.7</td>
<td>16.7</td>
</tr>
<tr>
<td>Special Projects</td>
<td>1.2</td>
<td>1.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Computer Research Equipment</td>
<td>1.2</td>
<td>1.4</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$29.3</strong></td>
<td><strong>$33.9</strong></td>
<td><strong>$39.4</strong></td>
</tr>
</tbody>
</table>

**Objectives and Description**

The objectives of the Computer Research subactivity are to generate new fundamental knowledge about the structure and design of computer systems, both hardware and software, synthesize accumulated knowledge into coherent theories which point out new directions for exploration and testing, and train sophisticated research personnel essential to the continuing
Computer research is a young and developing discipline, dating from the early 1940s when the first modern electronic computer was conceived and built at a university with government support. Unlike mathematics, physics, and chemistry, which have had the benefit of centuries through which to develop and refine an intellectual tradition and a coherence of basic paradigms, computer research still displays the somewhat confusing but exciting vitality characteristic of an emerging intellectual discipline. The Foundation believes that computer research from its background in the mathematical sciences, electrical engineering, and logic has become a unique and vital academic discipline in its own right. The ubiquitous use of computers throughout all segments of life has given great impetus to computer research as a discipline; in turn, computer research is essential to the continued long-term development of the computer industry.

Computer research is the study of computers, information processing and computing. Its universe for study consists of strategies and algorithms for solving problems, methods of representing and transforming information, programs for carrying out computation procedures, and machines for executing programs. Its central unity arises from the concept of computational complexity as a measure of the feasibility of finding a solution to a given problem. It seeks to understand the irreducible limits of complexity in given problems and discover optimal ways of finding those solutions which are feasible. Unlike the physical sciences, which deal with the intrinsic properties of physical matter, computer research studies the intrinsic properties of problem-solving procedures and computing systems. It is therefore necessary to discover their underlying concepts and laws, to test their validity, and to examine their implications for design.

Basic computer research is carried out by a few of the largest computer companies, but most industrial activities emphasize applied research and technological development. The computer industry as a whole is technologically driven and intensely competitive. It is paced by the constant demand for new or improved products, which imposes short-term requirements on most research and development projects. Companies protect their innovation by secrecy. By contrast, universities encourage the study of new concepts even without any apparent market demand and insist upon open publication of research results. While industry is highly successful in exploiting and developing existing technology and making rapid incremental improvements, academic institutions provide a more conducive environment for long-range computer research.

Beginning in FY1981, Computer Research, in addition to providing support for research projects and research equipment, developed a coordinated program for establishing a modern experimental research capability in U.S. academic institutions. This Coordinated Experimental Research (CER) program consists of research facilities at selected universities together with a computer research network (CSNET), which is still under development. The purpose of the CER program is to provide academic institutions with the resources to undertake improved, long-range experimental research in this rapidly expanding field, and to provide the forefront academic research environment required to attract and retain the advanced students and faculty so urgently needed in computer research. By the end of FY1984 some 17 to 18 CER facilities will have been initiated. Approximately 80 academic, industrial and government research organizations are currently using CSNET on a regular basis.

In FY1984 Computer Research assumed additional responsibilities for research in undergraduate institutions, Presidential Young Investigators, and certain aspects of international cooperative scientific projects. These responsibilities will continue in FY1985.

The Foundation’s support of computer research is divided among eight programs. A brief description of each program follows:

- **Theoretical Computer Science** research is the study of the foundations of computation. It uses extensively tools from the mathematical disciplines of algebra, combinatorics, and logic. Questions concerning the inherent limitations and possibilities of computation are addressed.

- **Software Systems Science** research includes theoretical and experimental studies of the structure and semantics of programs and other software concepts such as the structure of programming languages, highly parallel processing systems and other systems for describing and controlling computation processes.

- **Software Engineering** includes studies of the processes of designing and creating useful software. Particular emphases are on design methodology, software testing, and tools for use by software engineers. The program also supports research in computational mathematics.

- **Intelligent Systems** research involves computer-based systems that can exhibit some of the characteristics of intelligence in assisting human problem solvers. Current areas of inquiry include knowledge engineering, automated theorem-proving, mechanical inferencing, problem-solving, computer vision, and language understanding systems.

- **Computer Systems Design** deals with the structure and measurement of computer systems and the principles and processes of design for highly complex computer systems. Sub-areas include Very Large Scale Integration
(VLSI) Design Methodology, Computer Architecture, Fault-Tolerant Computer Systems, Computer Systems Performance Measurement and Evaluation, and Computer Graphics. The major thrust concerns the impact of VLSI electronic technology on all of these areas.

- **Coordinated Experimental Research** projects in computer research involving multiple investigators are supported through the establishment and enhancement of experimental research facilities at academic institutions. Grants provide partial support for hardware, software, technical and professional support personnel, and necessary maintenance and operating costs to carry out projects of a magnitude and breadth too large for consideration under other research programs. The development of CSNET, the Computer Science Research Network, is one major activity.

- **Special Projects** is focused on subareas of computer science with special topical significance. They include privacy and security of computer systems and data bases, computer networks, and the management of very large data bases.

- **Computer Research Equipment** grants are for partial support of the purchase of research equipment to be shared by several researchers for conduct of experimental or theoretical computer research. Grants are for one year, and cover only equipment purchases and partial support for maintenance costs for the year of the grant.

**NSF Role**

Computer research is funded by several Federal agencies, but NSF is the agency with primary responsibility for the support of basic research in this area. Other Federal programs support computer research which is relevant to their respective missions; NSF responds to unsolicited proposals which are evaluated by peer review. As a result, NSF support plays a unique role in strengthening the academic base of computer research and developing the research discipline. The relative fraction of NSF support varies widely among subareas. Overall, in FY1983 the Foundation supported approximately 32 percent of the Nation’s university based computer research. Specifically, the relative fraction of computer research in the several subareas supported by NSF during FY1983 was:

- **In Theoretical Computer Science**, NSF provided approximately 90% of the Federal support. Other contributors were the Office of Naval Research and the National Security Agency.

- **In Software Systems Science**, NSF provided approximately 50 percent of the Federal support. The remainder was provided by DOD agencies, especially the Office of Naval Research and the Air Force Office of Scientific Research.

- **In Software Engineering**, NSF provided approximately 50 percent of the support for long range, fundamental research except in numerical analysis where NSF support was less than 20 percent. Other Federal agencies including DOD, DOE, and NASA have substantial applied research activities. In numerical analysis the major supporters are DOE and DOD but NSF plays a key role as the only source of support for non-mission directed research.

- **In Intelligent Systems**, the Defense Advanced Research Projects Agency (DARPA) of DOD was the principal source of Federal support. NSF coordinated its support, which was approximately 20 percent of the total, with DOD, NIH, and NASA to provide continuity for key areas of basic research which do not meet current program requirements of mission agencies.

- **In Computer Systems Design**, NSF provided seminal support for long range, fundamental research in the areas covered by the program. Other principal sources are NASA, DOE, and the various DOD agencies. These agencies also support construction and testing of experimental machines to test new architecture concepts, sometimes using staff and ideas which started with NSF support.

- **In Coordinated Experimental Research**, NSF support was planned in coordination with other agencies. DARPA provided substantial support to five universities, DOE to one. NSF, through its CER program, was the primary Federal source available for all other large scale academic experimental research.

- **In Computer Research Equipment**, the NSF was the major Federal source of support for research equipment with the exception of DARPA which provided the equipment needed for its own research. Other DOD agencies provided equipment support for a few of their researchers through the DOD equipment program but in most cases depended upon their researchers to find that support elsewhere.

Computer vendors and other companies that are interested in the information processing industry also support academic computer research. This support takes the form of discounts or gifts of equipment, faculty work or study contracts, visiting or consulting opportunities for faculty, a small number of graduate student fellowships or forgivable loans, and a small number of unrestricted departmental grants. The total investment by industry has been increasing in response to the critical situation in academic computer research and is now comparable to the total NSF support in this area.

The programs in Computer Research are coordinated closely with other Federal agencies and with industry. In Coordinated Experimental Research, the Foundation is coordinating its activities especially with DARPA and ONR. In several
cases, the enhancement of research facilities has been jointly sponsored with DARPA. In most cases the revitalized research capabilities at universities have attracted support from a variety of other agencies, as well as the Foundation, for expanded research efforts. The CSNET project has not only been coordinated through DARPA but has benefited from close technical collaboration between NSF and DARPA staff throughout the effort.

The Computer Science Advisory Subcommittee includes one or more representatives of industry on a rotating basis, and approximately 20 percent of mail reviewers solicited to evaluate proposals are industrial scientists. In addition, members of the NSF staff visit industrial laboratories to learn about industrial research activity. The CSNET, as it develops, will bring industrial and academic researchers into closer and more frequent interaction.

The Computer Engineering program of the Division of Electrical, Computer and Systems Engineering and the program of the Division of Information Science and Technology complement the Computer Research activities. There is continual coordination among the staff of all these units, and several projects are jointly evaluated and supported.

**Major Programmatic Topics**

- A topic of central importance is the distribution of computing tasks among several or many processors or specialized computing resources in order to benefit from concurrent processing of mutually independent program segments. This concept is motivating research in the architecture of parallel computers, software systems for controlling and optimizing the use of parallel computers, and problem strategies and algorithms which use parallel structures to enlarge the domain of feasible problems. Several of the Coordinated Experimental Research awards are devoted to one or more aspects of this study. Researchers working on the Crystal project at the University of Wisconsin, for example, are studying the design, construction, and use of a dynamically reconfigurable set of processing elements, each element containing substantial computing power.

- Conceptually, the design of complex systems of logical elements on a chip using Very Large Scale Integrated (VLSI) circuit technology and the design of complex software systems have much in common. Neither can be carried very far by humans without assistance in managing the complexity of detail required for successful completion of a task. One of the most important research topics in computer science is to understand how the computer, itself, can be used best to assist with the design of both hardware and software in computer systems.

- The development of VLSI technology makes it possible to design and build prototype models of computer architectures which are very different from any previously constructed. It also makes it possible for university research groups to carry out such design studies and be active participants in computer architecture research to a much greater degree than they have been since the earliest days of computer history. A central topic of research is how novel ideas in computer architecture may be implemented in VLSI technology and applied to improve greatly our ability to solve different classes of problems.

- Much has been learned about the classification of computation problems according to their degree of complexity, and it has been discovered that many common problems are too complex to allow the computation of a solution in all cases. Computer scientists have been able to show that even though mathematicians may be able to prove that solutions exist for a class of problems, it is impossible to devise an algorithm which will always compute the solution in a finite length of time using the fastest computers that are theoretically possible to construct. This makes it important to study algorithms which yield approximations of known accuracy to intractable computational problems.

- In many cases it is possible to devise probabilistic algorithms for computationally infeasible problems. Such algorithms depend upon random numbers and have a small probability of yielding an incorrect result. If the answer is correct, however, it is exactly, not only approximately, correct. Discovering fast probabilistic algorithms for important classes of computationally infeasible problems is another area of theoretical research that is of great current interest.

- One of the important activities of recent interest in Intelligent Systems is Expert Systems Research which is finding significant application in industry and defense. These systems require the capture of some area of human expertise, e.g. molecular structure, in a computer, and the definition and programming of search and reasoning rules to solve problems using that expertise. While there has been progress for many years in building expert systems, there are still major problems that require further research. The knowledge acquisition process is long, difficult and uncertain. The internal representation of human knowledge in a computer is poorly understood and leads to inefficient computer inference systems. The reasoning methods used in all systems are primitive and need refinement. Research in logic, programming tools, distributed problem solving, and automatic reasoning are contributing to progress in this field.

- Exchange of ideas and software among those doing computer related research is one of the
most difficult facets of research using computers. Lack of good exchange retards the rate of research progress. Methods to improve exchange would lend permanent archival value to the results of software research and are the subject of active inquiries in software engineering. For example, the symbolic and algebraic manipulation (SAM) research community does much of its research on medium size computers and uses the programming language LISP. The biggest potential user community for SAM systems, however, is those who do large-scale scientific computing. This group uses FORTRAN and tends to use very large computers. These two communities have built up different infrastructures and do not have much interaction. One important goal of software engineering research is to develop methods for making complex software systems such as SAM understandable and useful to other research communities.

**Significant Recent Achievements**

**Testbeds for Parallel Algorithms.** Increasing importance is being placed on the need for much more powerful computer resources, but the current supercomputers, outside of their arithmetic units, have very conventional architectures. Moreover, progress in developing new algorithms and programs which exploit parallelism has lagged behind hardware development. Two projects, the Crystal Project at the University of Wisconsin at Madison and the 2MOB project at the University of Maryland at College Park, are providing testbeds for developing and studying new algorithms for highly parallel computer architecture. The 2MOB machine, developed by Charles Reiger, of the University of Maryland, is a ring-connected set of 256 microprocessors which can be used to simulate a variety of computer architectures useful for image processing, artificial intelligence, and numerical analysis. Robert Cook, David DeWitt, Raphael Finkel, and Lawrence Landweber, of the University of Wisconsin, have developed Crystal as a software system which allows the user to partition and configure a ring network of many minicomputers into a configuration appropriate to a specific application, allowing, for example, array processor, back-end database machine, and distributed network configurations to operate in separate partitions simultaneously. Having these testbeds available for research in algorithms and software for parallel architectures will stimulate progress in the development of future supercomputers.

**Storage Management Policies for Computer Networks.** Each node in a computer network uses a finite amount of memory space for the traffic coming through it on all its incoming and outgoing links. Several policies for memory management have been proposed and analyzed. These policies include Complete Sharing, Complete Partitioning, Sharing with Maximum Allocation, and Sharing with Minimum Allocation. Complete Sharing allows memory to be allocated in an uncontrolled, first-come-first-served manner which results in unacceptable performance characteristics such as starvation. All other policies reserve some memory for each class of traffic, thereby alleviating the starvation problem. These policies block the traffic of a class even when some memory, reserved for some other class, is free.

Ashok K. Agrawala, University of Maryland, and a graduate student, studied memory management policies and formulated one which maximizes the throughput at a node. This policy, called Stacionary Delayed Resolution Policy, accepts traffic of any type as long as there is empty memory. It may, however, discard a message already in the memory in favor of a newly arrived message. The decision to take such action is based on the mix of messages in the memory at that instant. They have demonstrated that significant improvements in throughput at a node can be realized using the Delayed Resolution Policy compared to those proposed earlier. Use of this policy will increase the effective speed of computer networks.

**Applications of Computational Complexity to Secure Communication.** The discovery of public key cryptosystems by Martin Hellman and Whitfield Diffie of Stanford University in 1975 stimulated a great deal of research on non-military applications of cryptography. Over the last few years, this research has been concentrated on the study of protocols to be used in the exchange or protection of sensitive information over electronic networks. This research has suggested new applications such as the certification of electronic mail and the digital signing of legally binding contracts over networks.

One of the key concepts in the development of these protocols was the discovery of the notion of “oblivious transfer” by Michael Rabin of Harvard University. A protocol based on oblivious transfer of information involves the exchange of sensitive information between two parties without the need for a trusted intermediary. The protocol must ensure that neither party receives an advantage by gaining the sensitive information of the other party before releasing his information. The protocol operates through an initial exchange of seemingly “random” information between the parties. Then each party incrementally sends information that will allow the decoding of the “random” information. The choices of both the random information initially exchanged and the incrementally sent information are based upon deep results in complexity theory. It is possible to prove that the decoding task is initially computationally infeasible but as more and more decoding information is transmitted the task of decoding becomes equally easy for both parties. It is also possible to prove that, with high probability, neither party can cheat.

Manual Blum of the University of California, Berkeley, extended the oblivious transfer protocol
to show how electronic mail can be certified and to show how contracts can be signed over electronic networks. Mail certification requires the exchange of a message and a digitally signed copy of the message using oblivious transfer while contract signing requires the exchange of digitally signed contracts using the same techniques.

**Functional Programming.** In a functional programming language, a program is a collection of expressions and equations. Each expression is a collection of one or more subexpressions. Execution of a program consists of evaluating the expressions by replacing the subexpressions with known quantities or more elementary subexpressions until no more replacements are possible. Replacement of a subexpression is called a reduction. Reduction is constrained by a set of rewriting rules (function substitutions) which define the semantics of the language. Each conceivable sequence of reductions is called a derivation.

Functional programming languages are of interest for several reasons. The definition of such a language can be shown to be mathematically sound. Since the only executing process is reduction, multiple reductions might occur simultaneously, raising the possibility of effective use of computers having parallel architecture. Finally, functional languages have a potentially high expressiveness, meaning that programs might be more compact than in the usual programming languages.

Dana M. Latch of North Carolina State University has shown that normal mathematical set operations can be represented by sets of derivations or by sets of derivation pairs and, hence, can form the basis of a functional programming language. These representations of sets can be used to develop algorithms to check the consistency of the syntax and semantics of a language, to define a generator to produce a language interpreter, to check the consistency of the types of functions used in a program and to generate error messages during program execution in the event of invalid use of a language. This research will help define higher level programming languages that will be useful for the next generation of advanced computers.

**Changes Between FY 1984 Budget Request and FY 1984 Current Plan**

The FY1984 Current Plan of $33.90 million for Computer Research is $0.78 million, or 2.3 percent below the FY1984 Budget Request of $34.68 million. Of this decrease, $0.63 million results from the distribution of the funds appropriated by the Congress for FY1984. The remaining reduction of $0.15 million consists of adjustments for the social sciences, Visiting Professorships for Women, Small Business Innovation Research, and the U.S.-India Joint Program.

In making this reduction, highest priority has been given to the Coordinated Experimental Research program and the core Science Research Project programs. As a result, the largest percentage reduction, 24.1 percent, was made in the Special Projects program.

**FY 1985 Budget Highlights and Explanation of Increases, Decreases, and Continuing Emphases**

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<tbody>
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The FY1985 Budget Request for Computer Research is $39.35 million. This is an increase of $5.45 million or 16.2 percent above the FY1984 Current Plan and provides modest real growth, especially in experimental computer research. New coordinated experimental research facilities will be added following the plan established four years ago for strengthening academic research activity and research project support will be increased in both experimental and theoretical program elements. Research project support has been constrained for several years to allow the Foundation to initiate its program of Coordinated Experimental Research (CER) facilities grants. This program has helped prepare the way for greater participation by academic scientists in long range experimental research and it is now important for the Foundation to increase project support in response to new opportunities.

- Support for coordinated experimental research facilities will be increased by $3.4 million or 26.2 percent, to a total of $16.4 million. This will permit the addition of 4 or 5 new facilities bringing the estimated total to 22 to 24. Support for the Computer Science Network (CSNET), the other activity in the Coordinated Experimental Research program element, will be reduced by $0.4 million to $0.3 million, or by 57.1 percent, reflecting the continuing shift of that project toward self-supporting status.

- The research equipment program will be increased by $0.25 million, or 17.9 percent, to a total of $1.65 million. This increase will provide partial support for the first year maintenance costs for NSF supported equipment.

- Research project support will be increased by $2.2 million, or 11.7 percent, to a total of $21.0 million. This will allow support of new opportunities in experimental and theoretical computer research projects in areas such as algorithms for parallel architecture computers, probabilistic algorithms, software systems for parallel computers, and experimental studies of novel computer architectures.

Percentage increases for the eight program elements of FY1984 over FY1983 New Obligational Authority are:
The following report was prepared by the staff of the Science and Engineering Education Directorate of NSF and was submitted to Congress as a part of the material which accompanied the Administration’s Budget Request for the Fiscal Year 1985.

Science and Engineering Education Program Activity Summary

<table>
<thead>
<tr>
<th>Activity</th>
<th>Actual FY1983</th>
<th>Plan FY1984</th>
<th>Request FY1985</th>
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Goals and Description

The goal of the Science and Engineering Education (SEE) activity is to strengthen the quality of the Nation’s science and engineering education and help assure tomorrow’s citizens an adequate scientific knowledge base for more productive and socially and other sciences and to award graduate fellowships in these fields. NSF science and engineering education activities emanate from this basic authority.

NSF support for science and engineering education activities represents only a small fraction of the total national effort. Nevertheless, NSF programs are designed to gain maximum leverage from a relatively small investment that can lead to significant improvements in the nation’s science and engineering education activities.

NSF staff members are called upon frequently for their expertise in improvement of science and mathematics education by many national organizations. Governors’ offices, State legislatures, state and educational agencies, and universities have sought advice from the NSF on ways to improve their programs. In recent months the following countries have sent representatives to NSF to learn about United States support of precollege mathematics and science education: Zimbabwe, Nigeria, Brazil, France, Taiwan, Australia, China, and Holland.

The Foundation will continue to work with the Department of Education to ensure program coordination and complementary effort.

Changes Between FY 1984 Budget Request and FY 1984 Current Plan

The SEE activity received an appropriation of $75.0 million for its activities in FY1984. This amount represents an increase of $36.0 million from the FY1984 Budget Request of $39.0 million. The funds are allocated in the FY1984 Current Plan as follows:

- **Graduate Research Fellowships** ($20.3 million): This amount represents an increase of $1.3 million over the FY1984 Budget Request of $19.0 million, and will increase by 100 the number of new offers.

- **Precollege Science and Mathematics Education** ($68.6 million): This amount includes $54.7 million in FY1984 new obligatory authority (NOA) and $13.9 million carried over from FY1983. This represents an increase of $34.7 million in new obligatory authority over the FY1984 request of $20.0 million. As specified by the Congress, not less than $34.0 million of the FY1984 SEE appropriation is being made available for merit-based instructional materials development and demonstration activities. The Congress also provided authority for the transfer to research and related activities of up to $5.0 million for research in teaching and learning. To carry out this effort, a joint program has been established between SEE and the Foundation’s Directorate for Biological, Behavioral, and Social Sciences.

- The conference report accompanying the FY 1983 HUD-Independent Agencies Appropriation Act contained a provision directing the
approval of the Foundation’s FY1983 precollege science education plan by both Appropriations Committees prior to expenditure of any FY1983 funds. Approval for the FY1983 plan was secured in April 1983—nearly six months after the beginning of FY1983. Because of this, proposals were received late in the fiscal year, and, therefore, NSF was unable to obligate all of the appropriated funds in FY1983. As a result, $13,891,597 of FY1983 funds are carried over, providing a total of $68,591,597 in FY1984 obligatory authority for precollege activities.

**FY 1985 Budget Highlights and Explanation of Increases, Decreases, and Continuing Emphases**

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In FY1985, NSF will offer 550 new graduate fellowships. The total number of fellows supported in FY1985 will be about 1,550 as compared with an FY1984 estimate of 1,510. Yearly stipends for the fellows will increase from $8,100 to $9,000 or by 11.1 percent. The annual cost-of-education allowance to the institution attended by the fellow will remain at the FY1984 level of $4,900.

Support for Precollege Science and Mathematics Education will be the same as the FY1984 New Obligational Authority of $54.7 million. This will provide for a continuation of the programs initiated in FY1984, including informal science education, enhanced undergraduate education for teachers, and for broader in-service teacher activities through local and regional workshops.

**Changes in Budget Structure**

Input from a variety of sources, including the National Science Board, the National Science Board Commission on Precollege Education in Mathematics, Science and Technology and the Congress resulted in a number of changes in program focus and budget structure.

In FY1983 the Congress appropriated $15.0 million for precollege science and mathematics education. Furthermore, the FY1983 HUD-Independent Agencies Appropriations Conference Report directed that NSF gain approval from the Appropriations Committees of its FY1983 plan for support of precollege science education activities prior to obligating funds. The approved plan for FY1983 includes support for Presidential Awards for Excellence in Science and Mathematics Teaching, honors workshops for teachers, and instructional materials development.

In FY1984, funds for Science and Engineering Education (SEE) were requested under two subactivities: Graduate Research Fellowships and Precollege Teacher Improvement in Science and Mathematics. The FY1984 Current Plan differs from the FY1984 Budget Request in that the Current Plan redirects the focus of FY1984 precollege activities so that they are consistent with the Congressionally-approved plan for FY1983. In addition, two new efforts were added to the FY1984 Current Plan: local and regional teacher education, and informal science education for teachers and students.

In FY1985, the SEE activity will include two subactivities:
- Graduate Research Fellowships, the same as in previous years; and
- Precollege Science and Mathematics Education, which involves support for teacher development and incentives, new instructional materials, special studies to gain a better understanding of precollege science education in the United States, research in teaching and learning, informal science education, and activities to publicize and disseminate information about highly successful programs and outstanding research efforts.

**Graduate Research Fellowships Subactivity**

$21,000,000 for FY1985

**Objectives and Description**

The Graduate Research Fellowships subactivity promotes the future strength of the Nation’s scientific endeavors by recognizing and supporting the most promising graduate students. Highly talented U.S. citizens who are beginning graduate study are identified in a national competition. Awards for these portable fellowships are made on the basis of merit in all fields of science and engineering. Within this framework, the subactivity also supports graduate students who are members of ethnic minority groups underrepresented in science and technology through the award of Minority Graduate Fellowships.

This subactivity provides both stipends and cost-of-education allowances (institutional allowances in lieu of tuition and fees). Up to three years of support is offered to very capable graduate students for study at institutions of their choice. Full-time study support of this kind has historically accelerated Fellows’ progress toward active and distinguished science and engineering careers.

**NSF Role**

The role of NSF in this subactivity is to provide support through fellowship awards to highly talented graduate students for advanced study in the sciences and engineering. These awards are in recognition of the importance of science and engineering education in a nation
whose security and economic well-being depend crucially on science and technology.

Changes Between FY 1984 Budget Request and FY 1984 Current Plan

The FY1984 Current Plan is $1.3 million more than the FY1984 Budget Request of $19.0 million due to an increase in appropriation. This increase will be used to support up to 100 additional awards.

In FY1984 600 new fellowships will be offered with approximately 1,510 graduate fellows receiving support from the program. The FY1984 annual stipend for all Graduate Fellows is $8,100, and the annual cost-of-education allowance for the universities is $4,900.

FY 1985 Budget Highlights and Explanation of Increases, Decreases and Continuing Emphases

In FY1985 this subactivity will offer 550 new fellowship awards and will support approximately 1,550 graduate fellows, as compared with an estimate of 1,510 in FY1984. The 12-month stipend for graduate fellows will be increased from $8,100 to $9,000 in FY1985 and the cost-of-education allowance will remain at $4,900.

Precollege Science and Mathematics Education Subactivity
$54,700,000 for FY 1985

Objectives and Description

The objective of the Precollege Science and Mathematics Education subactivity is to promote the development of quality programs of education in mathematics, science and technology for all the Nation’s youth. The elements supported under this subactivity address several of the recommendations contained in the final report of the National Science Board’s Commission on Precollege Education in Mathematics, Science and Technology, and several other national studies.

Support for this subactivity will result in the preparation of students for enhanced career options, as well as providing students with adequate training to pursue higher education opportunities in mathematics, science and technology. Programs will also help prepare students for productive living in a high-technology, information-intensive society.

This subactivity will consist of the three program elements: Precollege Materials Development and Research; Precollege Teacher Development and Incentives; and Special Activities. A brief description of each follows:

- **Precollege Materials Development and Research ($27,700,000 in FY1985)** supports activities that:
  - Enable the most capable scientists and science educators to develop new or improved science and mathematics instructional materials for students and the corresponding instructional materials for teachers;
  - Provide for research and development in the application of advanced technologies—particularly the computer—as educational and instructional tools for students and their teachers;
  - Permit the most capable scientists and science educators to conduct research and develop new materials and approaches for: (1) the instruction of undergraduate students who are training to become precollege science and mathematics teachers, and (2) the continuing improvement of precollege teachers who are currently teaching mathematics and science; and
  - Undertake basic and applied research on significant factors necessary for the effective teaching and learning of mathematics and science at the precollege level. These activities will be pursued in collaboration with the Biological, Behavioral, and Social Sciences Directorate.

- **Precollege Teacher Development and Incentives ($15,000,000 in FY1985)** involves activities that:
  - Support local and regional programs and projects of continuing education and professional development for precollege science and mathematics teachers. Such activities will be developed jointly with appropriate local educational agencies, and must meet the specific needs for teachers in the project area. Full-time, part-time, and summer activities will be encouraged. Cooperation with businesses, industries, universities and other appropriate entities will be encouraged;
  - Provide for annual recognition of outstanding secondary school teachers in science and mathematics through Presidential Awards for Excellence in Science and Mathematics Teaching. Increased professional status and awards to their schools will provide strong incentives for high quality teachers to enter and remain in their field; and
  - Select precollege science and mathematics teachers of proven high quality performance to participate in honors workshops. These workshops will provide specialized instruction, practical experience and leadership training to further develop the effectiveness of teachers in their home communities, school and professional associations. Attendees will be expected to assist in improving science and mathematics programs at their schools.

- **Special Activities ($12,000,000 in FY1985)** involves efforts that:
  - Support improved understanding and awareness of precollege students and their teachers through programs of informal science education using a variety of media, including radio, television and museums;

257
Support activities to publicize and disseminate information about highly successful programs and outstanding quality research in science and engineering education, including programs and research funded by federal, state, local or private entities;

- Study and analyze existing data bases to provide a systematic and continual understanding of the condition of precollege science education in the United States. Results will include the better understanding of science education as reflected in: (1) student and teacher achievements and participation; (2) course and materials selections; and (3) national and international comparisons for use by state and local educators and policy makers.

**NSF Role**

NSF's broad-based association will all elements of the nation's scientific and engineering research communities is well established. This relationship provides NSF with the opportunity to encourage the active participation of these communities in addressing the problems in precollege science and mathematics education. NSF provides support for precollege science and mathematics education activities based on the intrinsic scientific and educational merit of proposals received.

In addition, the National Science Board assumed leadership in establishing a Commission on Precollege Education in Mathematics, Science and Technology, which issued its final report in September 1983. The report provides recommended actions for all levels of government, industry, the private sector and others interested in addressing the problems of precollege science and mathematics education.

The NSF recognizes the distinct role of the Department of Education (ED) in supporting science and mathematics education. The particular contributions of ED to the federal science and mathematics initiatives include its national data collection capabilities and communication network among the Nation's state and local educational agencies and state boards of education. The Department of Education also administers programs that provide state and local educational agencies, and colleges and universities with an additional source of funding for precollege science and mathematics education activities primarily based on formula grants and categorical programs. The NSF will continue to work with ED to ensure coordination of effort.

**Some Significant Recent Achievements**

**Presidential Awards for Excellence.** This was the first year of a program to honor outstanding science and mathematics teachers from across the nation. The program was designed to identify two outstanding teachers from each state, the District of Columbia, and Puerto Rico, half in mathematics and half in science. NSF provided the school of each recipient with a $5,000 grant to be used for local instructional improvements. The teachers were honored and recognized by the President at a White House ceremony in October 1983. The U.S. business and industrial community made generous contributions amounting to approximately $700,000 in equipment and money to benefit the teachers' schools and for recognition activities. In addition, professional societies and mathematics and science teacher associations from across the nation donated extensively of their time and efforts to screen and nominate candidates.

**Computer Inequalities in Opportunities for Computer Literacy.** NSF's support of Wayne Welch and Ronald Anderson of the University of Minnesota resulted in a much publicized report, *Computer Inequalities in Opportunities for Computer Literacy*. This report, released in September 1983, was based on a nationwide random sample of 18,000 students and information obtained from school principals. Findings suggest that, while access to and use of computers is rapidly increasing in schools across the Nation, substantial instruction in computer programming is limited primarily to males attending large-city, computer-rich schools. The report further suggests that racial differences in school computer use are no longer large, though gender differences are, with boys using computers much more heavily than girls.

**National Assessment of Science, 1981-1982.** NSF supported the development of the National Assessment of Science, 1981-1982 report to ensure the continued inclusion of science as part of the National Assessment of Educational Progress (NAEP). This report provided essential information on trends in student attitudes and achievement in science in the U.S. from 1969 through 1982. NSF support also provided for analysis of the data on science and for the dissemination of the results. The results show a continued decline in the science achievement of 17-year-olds. No significant change in achievement for 13-year-olds was shown since the 1977 assessment. Attitudes of both age groups toward science declined significantly since the 1977 assessment. For 9-year-olds, achievement scores showed a slight increase, the first such increase for any age since data collection was begun in 1969. The significance of this project is that it presents data in a form that can be widely used by the scientific and educational communities.

**Data and Information.** The Office of Scientific and Engineering Education produced *Science and Engineering Education: Data and Information*. This is a compendium of information and data regarding resources, participation, achievement, attitudes and employment in science and engineering at all educational levels. This document updated and supplemented the *Science Education Databook*, first published in 1980. The new publication was intended specifically to assist the
National Science Board Commission with its work, but was of interest and utility to a wide range of policy and decisionmakers and the general public.

**Career-Oriented Science Topics for Elementary and Middle Schools (COMETS).** Two packages of grades 5–9 instructional materials, one for science and the other for science-centered language arts, were developed with NSF funds by the University of Kansas. Career-Oriented Science Topics for Elementary and Middle Schools (COMETS) focuses on the use of science role models, particularly women, to encourage students to consider careers in science. In addition, COMETS was designed to correct misperceptions held by adolescent women who question the importance of mathematics and science courses in career development. COMETS has undergone national testing and is presently being considered for adoption by the Department of Education's National Diffusion Network—a national information dissemination network.

**Changes Between the FY 1984 Budget Request and the FY 1984 Current Plan**

The FY1984 Current Plan in the Precollege Science and Mathematics Education subactivity differs from the FY1984 Budget Request due to an increased level of funding, a redirection of program focus consistent with the Congressionally-approved FY1983 precollege science and mathematics program plan, and the addition of two new activities: local and regional teacher education, and informal science education for teachers and students.

The FY1984 Budget Request, submitted to Congress in January 1983, requested $20.0 million for precollege science and mathematics. All of this amount was to support the Precollege Teacher Improvement in Science and Mathematics Program. The FY1984 Budget Request represented an expansion of the FY1983 Budget Request for this program.

In July 1983, Congress increased the level of funding for NSF's precollege science and mathematics education in the FY1984 appropriation to $54.7 million, an amount $34.7 million over the FY1984 Budget Request. With the increased FY 1984 appropriation, SEE will support not only the teacher improvement activity that was the sole focus of the FY1984 Budget Request, but other activities including precollege materials development and research and special activities, including informal science education and information in science and mathematics education.

**FY 1985 Budget Request**

The FY1985 Budget Request of $54.7 million is the same as the FY1984 New Obligational Authority. This support will continue the programs initiated in FY1984, and will provide for increased emphasis on informal science education, improved undergraduate education for teachers, and widespread teacher activities through local and regional teacher workshops. A total of $27.7 million will support Precollege Materials Development and Research, $15.0 million will support Precollege Teacher Development and Incentives, and $12.0 million will support Special Activities. All of these amounts are the same as in FY1984.

The FY1985 Precollege Science and Mathematics Education subactivity maintains the structure approved for FY1984 which includes three program elements: Precollege Materials Development and Research, Precollege Teacher Development and Incentives, and Special Activities.
New Goals for Mathematical Sciences Education

The Report of a Conference Sponsored by

The Conference Board of the Mathematical Sciences

Introduction

A flood of recent reports has thoroughly documented our nation's failure to provide sufficient numbers of its young people with a quality education in mathematics and science. These reports present a clear challenge to the mathematical sciences community to set specific, realizable goals for improving mathematical sciences education at all levels and, working in partnership with the existing educational system, to begin taking the steps necessary to achieve these goals.

The CBMS Conference

In response to this challenge, the Conference Board of the Mathematical Sciences (CBMS) organized a two-day conference of leaders of the various segments of the mathematical sciences community. Funding for the meeting was provided jointly by the Science and Engineering Education Directorate and the Division of Mathematical Sciences of the National Science Foundation. The meeting was held at Airlie House in Warrenton, Virginia, November 13-15, 1983.

Objectives. The objectives of the Conference were to:

• Seek consensus on the problems and obstacles which exist today to the achievement of quality mathematical sciences education in the schools and colleges.

• Set goals for the improvement of mathematical sciences education at the various levels, identify actions and activities which should be undertaken to achieve these goals, and set priorities among these goals and activities.

• Identify the governmental agencies, educational institutions, and professional societies through which these activities could be carried out.

• Make recommendations to CBMS and its member societies as to how they might act to improve mathematical sciences education both through their national and regional organizations and through the individual actions of their members.

• Establish an organizational mechanism with continuing responsibility for proceeding toward solutions of the problems identified and achievement of the goals set in this conference. The organization would be responsible for working to insure a flow of ideas between the mathematical sciences community and local, State, and Federal authorities concerned with mathematical sciences education.

Participants. Twenty-five individuals participated in the Conference. Among them were the President of the American Mathematical Association of Two-Year Colleges (AMATYC), President of the Institute of Mathematical Statistics (IMS), President of the National Council of Supervisors of Mathematics (NCSM), President and President-Elect of the National Council of Teachers of Mathematics (NCTM), Past-President of the Society for Industrial and Applied Mathematics (SIAM), and a member of the National Science Board (NSB) Commission on Precollege Education in Mathematics, Science and Technology. Also participating were representatives of the American Educational Research Association (AERA) [Special Interest Group in Mathematics], American Mathematical Society (AMS), American Statistical Association (ASA), Mathematical Association of America (MAA), Operations Research Society of America (ORSA), Society of Actuaries (SA), officers of CBMS, members of the Conference Steering Committee, and officials from private funding agencies.

The Conference. At the opening session on the evening of November 13, Dr. Cecily Selby, Co-Chair of the NSB Commission, set the stage for the Conference by summarizing the findings of the Commission and bringing the participants up-to-date on subsequent events.

The next morning, participants were divided into six working groups of 4-5 members. Each group was asked to consider three of the topics...
from a list of eighteen salient issues which had been identified by CBMS, and to:

- Identify the most important aspects of the stated problem.
- Identify prospects for action addressing each problem.
- Analyze the advantages and disadvantages of various conceivable actions.

Throughout the discussions, participants were asked to adopt the following as their guiding concern: To identify those contributions of advice or action from the community of mathematical science professionals that would improve the quality of mathematics education in elementary and secondary schools and colleges.

The list of topics was then reduced to six, comprising those areas seen by participants as holding the greatest potential for significant contributions from the mathematical sciences community. New working groups were then given the assignment of exploring these areas in considerably more depth, and of formulating recommendations for specific projects, activities, or studies to address the problem areas. These recommendations were incorporated into working papers that were then discussed and revised. After the close of the Conference, these papers were further revised by the Conference Steering Committee and, in their final form, constitute the bulk of this report (Sections I–VI).

In outlining possible projects and activities there was an effort by the Conference participants to distinguish between immediate short term needs and solutions, and long-term efforts, and to identify actions in both spheres.

Because of the limited time available at the Conference and the very broad scope of the issues under consideration, consensus on all details was not sought, only a general endorsement of principle. Despite this, there was a remarkable and reassuring degree of unanimity from all sides on major issues and recommendations.

The Conference was marked throughout by a spirit of rapport and friendly cooperation that united teachers, researchers, and administrators in their attempts to seek solutions to the complex and often frustrating task to which all were personally committed: improving education in the mathematical sciences.

The recommendations, by their nature, call for change in what is taught and how it is taught. However, there was and is a feeling of deep admiration and appreciation of teachers for the job they do under difficult and demanding circumstances.

Following the summary of recommendations below, the body of the report consists of separate sections which present the issues and recommendations of the Conference together with elaboration and discussion in the six main subject areas selected: Curriculum, Teacher Support Networks, Communication of Standards and Expectations, Mathematical Competence and Achievement, Remediation, and Faculty Renewal.

Summary of Topical Recommendations

I. Recommendations Concerning Curriculum

The fundamentals of mathematics desirable for students at elementary, secondary, and college levels have, in the view of many mathematics educators, changed radically, yet the changes are not reflected in core curricula.

The Conference recommends the establishment on a continuing basis of a Task Force broadly representing appropriate segments of the mathematical sciences community to deal with curricula.

The initial efforts of the Task Force should be:

- To gather information on current practices and alternatives both here and abroad regarding the scope and sequence of mathematical topics in the curriculum.
- To gather recommendations from scholarly groups, industry, and other interested parties on mathematical expectations for all (or some) students K–14.
- To formulate alternative high school programs for students not preparing to continue their mathematical studies at the college level, or intending to pursue college programs not requiring the traditional calculus sequence.

In the long term, the Task Force should provide a number of curricular components which may be assembled into viable curricula.

II. Recommendations Concerning Teacher Support Networks

With few exceptions there is little contact locally between elementary and secondary teachers in the schools and professional mathematical scientists on the faculties of colleges and universities and in industry.

The Conference recommends the establishment of a nationwide collection of local teacher support networks to link teachers with their colleagues at every level, and to provide ready access to information about all aspects of school mathematics.

III. Recommendations Concerning Communication of Standards and Expectations

There are two distinct issues here. The first concerns the need of secondary students, teachers, counselors, and parents to be kept informed of the standards and expectations of colleges and universities relating to mathematics achievement and the progress of individual students towards meeting these standards and expectations.

The second concerns the need of school systems, schools, and teachers for assistance in setting
standards, now and in the future, that will enable their students to meet the expectations of the colleges and universities and of future employers.

The Conference recommends, in response to the first issue, the use of "prognostic" tests designed to measure the progress of students toward fulfilling mathematical prerequisites for college programs, or for employment with or without postsecondary schooling, sufficiently early to allow for remedial and/or additional course work while still in secondary school.

In response to the second issue, the Conference recommends that a Writing Workshop be held to prepare a series of assistance pamphlets and course guides, based on current thinking and curricula, that would have the endorsement of the mathematical sciences community and provide timely assistance to school districts in their efforts to improve the quality of mathematics education.

IV. Recommendations Concerning Mathematical Competence and Achievement

Mathematical skills have become essential in many fields of business, industry, and government, not only in technical, but also in non-technical positions, blue collar as well as white collar jobs. As a consequence a much larger fraction of the population must learn more mathematics than ever before in order for society to function and for individuals to function in society.

The Conference recommends that strong efforts be made to increase public awareness of the importance of mathematics, and that more effort go into the identification and encouragement of the mathematically able and gifted, especially among women and minority groups. Care must be taken to ensure that all students, K–14, have equal and adequate access to technology.

V. Recommendations Concerning Remediation

Although there are reasons to hope that remediation may be a less serious educational problem in the future, it is currently a very serious problem facing secondary and post-secondary institutions in the United States. Current efforts and approaches are inadequate to solve the remediation problem.

The Conference recommends that (1) funding agencies support projects to improve current efforts in remedial education, and (2) a series of regional conferences be called to address the problems and needs of remedial education.

VI. Recommendations Concerning Faculty Renewal

The renewal of mathematics teachers' content knowledge, teaching skills, and enthusiasm for their work is clearly needed at all levels of education.

The Conference recommends new initiatives that address the special situation at each level: Elementary (K–4), Middle School (5–8), High School (9–12), Collegiate, and Two-Year Colleges and Technical Schools. It is recommended that the professional societies in the mathematical sciences, especially NCTM, MAA, and AMATYC seek support as soon as possible for projects to demonstrate effective models of the various faculty renewal activities recommended.

A Recommendation to CBMS

During the closing session of the Conference, the concern of the participants shifted from specific proposals to the question of how to insure appropriate follow-through from the mathematical sciences community. It was agreed that on-going oversight in some form by representatives of the mathematical sciences community will be essential (1) for the recommendations of this Conference to be further developed and implemented, (2) for the establishment of close, mutually rewarding and continuing ties between the research and educational communities as envisioned by the Conference, (3) for a continuing effort to develop a comprehensive view of the needs of mathematical sciences education.

The Conference strongly and unanimously recommends the establishment of a National Mathematical Sciences Education Board, or its equivalent, broadly representative of the mathematical sciences community, and that substantial funding should be sought for this Board to enable it to carry on all activities deemed appropriate.

The Findings of the Conference

I. Curriculum

The Issue

The fundamentals of mathematics desirable for students at elementary, secondary, and college levels have, in the view of many mathematics educators, changed radically, yet not reflected in core curricula.

The Response

The Conference recognizes the need for both a short-term and a long-term effort to deal with the question of curricula in the mathematical sciences, including the need for alternative high school programs. The Conference recommends the establishment on a continuing basis of a Task Force responsible for these activities. Members would be drawn from appropriate segments of the
mathematical sciences community and the publics served by the schools.

Elaboration and Discussion

Some assumptions underlying the recommendation of the Conference are:

• That the current organization of topics, courses, and course content needs to be reformulated for all students since they fail to reflect the "new basics" (e.g., CBMS Report The Mathematical Sciences Curriculum K–12: What is Still Fundamental and What is Not, 1982).

• That the "core" curriculum should include for all students experiences in mathematical modeling, use of statistics, and use of the computer as a tool to solve mathematical problems.

• That students should have the option of alternatives in mathematics and that, indeed, in K–12 alternatives should exist. However, no student except the severely handicapped should be able to choose courses in a way which, before grade 11 makes it impossible for him/her to move to a college-preparatory curriculum.

• That in each year, K–12, some mathematics should be taught to all students.

The Task Force. The initial efforts of the Task Force should be:

• To gather information on current practices and alternatives both here and abroad regarding the scope and sequence of mathematical topics in the curriculum.

• To gather recommendations from scholarly groups, industry, and other interested parties on mathematical expectations for all (or some) students K–14. It is noted, for example, that whereas it is commonly assumed that the mathematical skills required by business, industry, etc., are higher (or different) and will continue to change as a result of technological revolution, these requirements have not been assessed.

• To formulate from existing sources alternative high school programs for students not preparing to continue their mathematical studies at the college level, or intending to pursue college programs not requiring the traditional calculus sequence.

In the long term, the Task Force should provide a number of curricular components that reflect the changes needed, the advantages and disadvantages of which are identified, and which may be assembled into viable curricula by individual educational institutions or systems according to their perceived needs.

Alternative High School Programs. In An Agenda for Action (1980), NCTM recommends that more mathematics be required for all students, and that a flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the student population. More specifically, it recommends that at least three years of mathematics be required of all students in grades 9 to 12. Several reports of national commissions have already made this recommendation. However, it has also been noted that increased high school graduation requirements (which have already been defined in a number of states and in many local school districts) should not result in keeping all students longer in the same traditional tracks. These recommendations cannot be met with just two-track alternatives of either general mathematics courses or precalculus courses typical of many existing programs. It is not clear whether appropriate alternative programs have been defined or whether adequate curricular materials exist to service such alternatives.

The initial effort of the Task Force to survey existing materials should be directed at materials already produced by state and local school districts, publishers, and other sources that could be identified with the assistance of professional organizations such as the Association for State Supervisors of Mathematics (ASSM), NCTM, and others. The evaluation criteria and evaluations would be the responsibility of the Task Force.

Subsequently, the Task Force would act to define additional appropriate alternatives, and develop guidelines and prototypic materials.

II. Teacher Support Networks

The Issue

With few exceptions there is little contact locally between elementary and secondary teachers in the schools and professional mathematical scientists on the faculties of colleges and universities and in industry.

The Response

The Conference recommends the establishment of a nationwide collection of local teacher support networks to link teachers with their colleagues, teachers and non-teachers in the mathematical sciences at every level, and to provide easy access to information about all aspects of school mathematics.

Elaboration and Discussion

Support networks for teachers have been established in several locations, e.g., the Bay Area Mathematics Project (BAMP) and the Southern Illinois University Teachers' Center. The objectives of such networks, strongly endorsed by the Conference, are:
To extend the sense of professionalism among teachers by building a support system that links them to colleagues in the mathematical sciences, inside and outside of the schools.

To provide teachers at all levels with colleagues upon whom they can call for information concerning any aspect of school mathematics.

To enable teachers to enlarge their views of mathematics, their sources of examples, and their repertoire of classroom skills in communicating mathematics.

CBMS should seek funds to establish pilot state or regional projects sponsored by two or more of its affiliate societies for the purpose of supporting meetings, programs, and other activities designed to (1) enhance communication between teachers and other members of the mathematical sciences community, and (2) publicize the mathematical sciences and education.

Specifically, the Conference recommends that secondary school teachers be allowed time for professional activities, proper preparation of classes, especially where new topics are being introduced, and inservice training in classroom use of new technologies including computers, calculators, and communication devices.

The use of communication devices such as computer bulletin boards and mail systems between teachers and groups of teachers and other professional mathematical scientists should be encouraged.

The Conference recommends that funds be sought from agencies and foundations for the teacher support networks and other activities proposed above. In addition, grants to local groups should encourage local support in the form of state matching funds, endorsement from state science education task forces, contributions from local industries, and use of retired mathematical scientists, etc. It is expected that networks would build on school-university-industry-community projects where they now exist, and that projects, once established, would attract additional funding from local resources.

It is hoped that local networks will come to be established in many areas, and that linkings will take place between networks, so that benefits from regional efforts will gradually spread across the country.

III. Communication of Standards and Expectations

The Issues

There are two distinct issues here. The first concerns the need of secondary school students, teachers, counselors, and parents to be kept informed of the standards and expectations of colleges and universities, and of business and industry, relating to mathematics achievement. The second concerns the need of school systems, schools, and teachers for assistance in setting standards now and in the future that will enable their students to meet the expectations of the colleges and universities.

The Response

The Conference recommends in response to the first issue the use of "prognostic" tests designed to measure the progress of students toward fulfilling mathematical prerequisites for college programs, or for employment, with or without postsecondary schooling, sufficiently early to allow for remedial and/or additional course work while still in secondary school.

In response to the second issue, the Conference recommends that a Writing Workshop be held to prepare a series of assistance pamphlets and course guides, based on current thinking and curricula, that would have the endorsement of the mathematical sciences community and provide timely assistance to school districts in their efforts to improve the quality of mathematics education.

Elaboration and Discussion

Prognostic Testing. "Prognostic" tests in mathematics, by definition, are designed to serve as a predictor of the student's likelihood of future success in work or study that is dependent on mathematics.

These exams should test both skills and understanding, and seek to identify an optimal level of performance rather than minimal competency. They should be administered in the 9th and/or 10th grade in order to permit program changes based on the results.

There are several models and examples of such testing programs, including those of the state of Ohio and California, and of the MAA. Prognostic testing programs might best be undertaken at the state level, through cooperation among the mathematics faculties of high schools, colleges and universities, and local chapters of MAA and NCTM.

In addition to the obvious guidance and motivation such exams will provide for students, they can be expected to reduce the amount of remedial teaching done at the college level.

The Conference endorsed the use of prognostic testing on a broad scale. At the same time a number of concerns were voiced over possible abuses, including the following:

"Prognostic testing should be on a voluntary basis."

1 See article in Mathematics Teacher, November 1983.
"The result of tests should be made available only to the teacher, student and parents."

"Tests should not be used for teacher evaluation."

"Tests should not influence college admission."

"There already are too many paper-and-pencil/multiple choice tests administered in the schools, the distinctions between diagnostic tests and prognostic tests are not clear; classical testing procedures are archaic and need to be replaced by computer-administrated, tailor-made tests capable of analyzing errors, identifying strategies, etc."

**Writing Workshop.** The proposal of a Writing Workshop stems from the conviction that (1) there already exists a considerable body of knowledge and know-how available in the mathematical sciences community that could be *immediately* helpful in the national effort to improve the quality of mathematics education in elementary and secondary schools and colleges, and (2) that action should be taken to organize and communicate this information with a minimum of delay. However, this Workshop would only represent a first step in what must be a long-range enterprise.

It is proposed that the Workshop be convened for three weeks in the summer of 1984. Participants should represent a broad a spectrum of the professional mathematical sciences and related lay community as is possible and desirable.

The Workshop would have two major objectives:

a. The creation of a series of assistance pamphlets for the use of school systems and consultants, that set goals and address practical questions associated with education in mathematics and related subject areas. These include questions of teacher quality and training, text evaluation and selection, curriculum content, student testing and evaluation, computer literacy and usage, etc. Related areas of concern may include teacher certification requirements, teacher evaluation, promotions standards, high school graduation, and college entrance requirements.

Since there already exists a body of available materials (including those of NCTM, MAA, NCSM, and State Departments of Education) that bear on these matters, a careful assessment of these should be made to take care that the pamphlets prepared add to and extend available resources rather than duplicate them.

b. Outlining a series of teachers' guides directed at improving the teaching of mathematics by grades (not the teaching of specific texts). For example, a guide to teaching 9th grade algebra would, in addition to outlining what ought to be covered, create interest and motivate teacher and students by explaining the usefulness and relevance of the subject, giving significant but accessible examples and applications, historical and cultural references, computer-related activities, etc.

It must be stressed in setting curriculum standards and goals at this time (and we note that this is being done in almost every community nationwide with little guidance from the mathematical sciences community as a whole) that the curriculum is not static but undergoing reformulation, and that subsequent restatements would be required periodically.

As the materials prepared by this Workshop become available they should be widely distributed by CBMS and its member societies to state and local agencies.

**IV. Mathematical Competence and Achievement**

**The Issue**

Mathematical skills have become essential in many fields of business, industry, and government, not only in technical, but also in non-technical positions, blue collar as well as white collar jobs. As a consequence a much larger fraction of the population must learn more mathematics than ever before, in order for society to function, and for individuals to function in society. This is a problem that goes beyond the schools, a task that requires the support and participation of parents as well as teachers. It is a problem that requires that questions of equity for women and minorities be addressed in order to make maximum use of our human resources.

**The Response**

*The Conference recommends that strong efforts be made to increase public awareness of the importance of mathematics, that more effort go into the identification and encouragement of the mathematically able and gifted, especially among women and minority groups. Care must be taken to ensure that all students, K–14, have equal and adequate access to technology.*

**Elaboration and Discussion**

The Conference endorses the belief that most students are capable of completing a "standard" K–12 course of study in mathematics. A primary goal of mathematics education must be to encourage as many of the "capable" students as possible to complete their K–12 mathematics education. This requires that parents as well as students be informed of the critical importance of a mathematics education, and of the amount and type of high school mathematics needed to prepare each individual to perform meaningful work and to undertake college level studies. The lesson of the "new math" tells us that parents must be
encouraged and enabled to become partners in learning with children, especially young children.

New avenues for increasing public awareness must be conceived of and exploited. These must involve all segments of the mathematical sciences community: schools, colleges and universities, industry, the professional societies, and government agencies.

**The Able.** A subset of the mathematically "capable" are the mathematically "able": those who will fill technical jobs, become teachers, and carry out the bulk of the research and development essential to the continued health, economic well-being, and security of a technically advanced society. Special efforts must be made to identify and encourage the mathematically able to pursue careers in the mathematical sciences, engineering, the physical and biosciences, and especially teaching.

The Conference recommends that CBMS initiate a project whose objective is the collection, analysis, and dissemination of information on effective procedures to identify and educate mathematically able students. Again, special efforts need to be made within the population of women and minority groups.

**The Gifted.** Finally, within the ranks of the mathematically "able" there are the mathematically "gifted", those relatively rare individuals who, given educational incentives and opportunities, make significant contributions to the mathematical sciences and technology. It is imperative that special efforts be made to identify and encourage these individuals. The Conference recommends that some form of national scholarship be created to recognize merit in mathematics and recruit gifted students into the mathematical sciences. These awards should be based not on individual need, but on national need.

The Conference also recommends the creation of special incentive programs to encourage mathematics majors to enter the teaching profession.

**Equal Access to Technology.** We believe that all students, K-14, should have adequate access to computers and calculators to enhance their mathematical learning and to do their mathematical work. However, having access to calculators and computers is not of itself an education. There must be appropriately trained staff and adequate materials to integrate these tools into the educational program.

**V. Remediation**

**The Issue**

Although there are reasons to hope that remediation may be a less serious educational problem in the future, it is currently a very serious problem facing secondary and post-secondary institutions in the United States. Current efforts and approaches are inadequate to solve the remediation problem.

**The Response**

The Conference recommends that (1) funding agencies support projects to improve current efforts in remedial education and (2) a series of regional conferences be called to address the problems and needs of remedial education.

**Elaboration and Discussion**

The reasons for the current problems in remediation are many. The following list of contributing factors is meant to be illustrative rather than exhaustive:

- The common practice during the past decade of "social promotion" of students in elementary and secondary schools.
- Open admissions policies in public higher education.
- The increased mathematical sophistication of work in many disciplines and professional training programs, leading to a rapid escalation of mathematics course requirements in high school and college.
- Lack of societal support for mathematics education.
- Lack of interest, motivation, and commitment on the part of students and faculty.

Although we believe that the current trends away from "social promotion" and toward increased mathematics course-taking requirements, increased societal expectations for mathematics learning, and increased communication of standards and expectations for mathematics achievement, may over time reduce the need for remedial mathematics courses at the college level, it is clear that these same trends will take several years before their effects are felt and may, at least in the short run, increase the need for remediation at the elementary and secondary levels.

Moreover, the current approaches to remedial education are often inadequate due to a lack of appropriate curricular materials for the remedial population, limitations in the diagnostic capability of currently available tests, and limitations in the capability of institutions to respond specifically to the information obtained from these diagnostic tests.

Because remedial education will be a continuing need at all educational levels for some time into the future, because public school systems and universities are finding it increasingly difficult to fund remedial programs, and because alternatives to the current approaches to remedial education are desperately needed at the present time, it is urgent that prompt action be taken.

In light of the situation described, the Conference recommends that:
VI. Faculty Renewal

The Issue

The renewal of mathematics teachers’ content knowledge, teaching skills, and enthusiasm for their work is clearly needed at all levels of education.

The Response

Teacher needs and appropriate renewal strategies are quite different for elementary school generalists, middle school and secondary school specialists, and two-year college or four-year college faculty. Recommendations are made for new initiatives that address the special situation at each level. A common thread that runs through the recommendations at all levels is the need for a continuing commitment from all parties participating in renewal programs—the school systems, the teachers, the universities, and the professional societies.

Elaboration and Discussion

Elementary Level (K–4). Mathematics at this level is commonly taught by generalists who have responsibility for all subjects, too often without the leadership of mathematics resource specialists. We believe appropriate teacher renewal programs should be concentrated on a small fraction of all teachers, with the view to transforming them into (at least partial) specialists. Programs should have the following characteristics:

1. Format. The program should be based in a local school system, optimally including a summer program and released time for participants to develop innovations and to study during the following academic year, and a follow-up in the succeeding summer. The crucial factor is linking study with the teachers’ regular teaching experiences, and sustaining the renewal spirit by engaging these teachers in a network of mathematics educators, such as that proposed earlier in this report.

2. Institutional Base. Normally, programs would be based in a college or university, but each project would be co-directed by a team including three active members: a mathematician, a specialist in mathematics education, and a teacher or administrator who is regularly in the classrooms of the proposed participants. The instructional staff serving under the co-directors should be largely recruited from among outstanding teachers.

3. Commitment. Programs do not work without commitment. School systems do not work without commitment. School systems should show their commitment by providing released time for participants and by agreeing to utilize their newly developed talents. Universities should commit themselves to long-term involvement with the schools and teachers. Participants should commit themselves to remain in the classroom at the same level for several years, and to share their new knowledge, skills, and enthusiasm with other teachers. Professional societies should demonstrate their commitment by helping to formulate suitable programs and disseminate the program plans and results. Financial support for direct program costs should come entirely from external funding agencies.

4. Participants. Elementary teachers with special interest and aptitude in mathematics are the most promising participants for such programs, to prepare leaders for mathematics instruction in grades K–4.

5. Subject Matter. Guidelines for appropriate program content are well described by several recent reports: the NCTM Guide for the Preparation of Teachers of Mathematics, and the MAA Recommendations on the Mathematical Preparation of Teachers. As a general principle, it is recommended that participants be taught mathematical ideas appropriate for the participants’ students, and that these be taught to the participants so as to illustrate, by example, appropriate teaching methods. Mathematics and methods will thus be fused.

Middle School (5–8). At this level mathematics should be taught by people who have special training in the subject and who spend all or much of their time teaching mathematics. Unfortunately, at the present time there is a severe shortage of qualified mathematics teachers for such positions. Thus renewal is specially critical.
The appropriate format, institutional base, and commitment for teacher renewal at the middle school level are very similar to those for grades K–4. Further the aforementioned content guides describe proper subject matter for this level also, as well as appropriate pedagogy.

The participants for middle school renewal programs should be chosen with care. In particular, it seems inadvisable to use scarce resources to provide minimal certification for teachers “excessed” from other subjects. Successful middle school mathematics teaching demands a blend of content knowledge, teaching skill, and desire to work with young people of that age. Renewal programs should be focused on current mathematics teachers and selected prospective mathematics teachers who have ability and interest in the subject.

High School (9–12). In the high schools today mathematics is taught by several kinds of people, each having different needs for renewal:

1) Teachers underqualified to teach the current traditional curriculum need programs which provide the depth and breadth of mathematical knowledge needed to make intelligent curricular decisions and to teach with confidence. Programs that will be effective for this goal should follow the general principles mentioned above: content and pedagogical coursework closely linked to teaching experience, with committed support from the participants’ school and the university faculty involved.

2) For teachers well qualified to teach the traditional school program, the changing nature of mathematics makes advanced study essential. For those who will lead schools and students in adopting curricula of the future, it is important to begin careful study of topics such as discrete mathematics, algorithmic linear algebra, mathematical modeling, probability and statistics, and the best examples of using computers as tools in mathematical problem solving and instruction.

The most urgent area for teacher education is to get teachers to teach problem-solving. The NSB Commission called for courses in technology, that is, courses applying science and mathematics to the solution of real-world problems. Much of the responsibility for this curricular initiative will, properly, lie with mathematics teachers. There is some text material available now and some teachers will be comfortable using it. However, greater efforts in the development of materials and in teacher retraining will be needed. To stimulate and support this work, institutions could profitably exploit models such as the Woodrow Wilson Foundation Institutes that draw together high school teachers, curriculum developers, and university/industry specialists for a program of content and pedagogy study targeted on curriculum development and implementation in a particular topic area. It will be hard to find capable university people, either mathematicians or engineers, who are ready to lead this activity, but efforts should be made.

The demands made on high school teachers by renewal programs such as those described above, as well as the need for active participation in the teaching profession described earlier in this report, are inconsistent with the heavy teaching loads currently borne by these teachers. If teachers’ content knowledge, teaching skills, and enthusiasm for their work is to be renewed, clearly reduced teaching loads are essential at the high school level, a recommendation strongly endorsed by the Conference.

Collegiate. Faculty in colleges and universities are generally well-qualified to teach traditional subject matter. However, they too face the challenge of mastering new topic areas and teaching tools of great importance for the future. Moreover, if recommended changes take place in precollege education, college faculty may be ill-prepared to meet their students.

The challenges and opportunities arising from computing will have a significant impact on mathematical sciences education. Students will come from high school with increasing experience in the use of computers to solve mathematical problems. The content of traditional courses such as linear algebra and calculus will be affected by computing. Computers will make several new mathematical science courses such as discrete mathematics and mathematical modeling of great importance, and new faculty will routinely use computing in their research and teaching. Thus it is critical for efforts in renewal of collegiate mathematical science to develop awareness of computers and the mathematical methods they imply.

Collegiate faculty will also need programs to increase their knowledge of mathematical modeling and problem-solving of the ill-posed, real-world sort, discrete algorithmic mathematics, the mathematics of technology studies, and the many new examples of applications relevant to service courses for students in areas just beginning to use mathematics as an important tool.

Whereas college faculty commonly have the mathematical ability and flexible time constraints that make self-education feasible, there are strategies that have proven effective and should be supported. The Chautauqua short courses and a variety of stipends for summer or academic year self-study and course development are examples. There is not often an incentive for collegiate faculty to improve their knowledge of and skill in teaching. Support for creative proposals in this crucial area of faculty responsibility should be supported.

Two-Year Colleges and Technical Schools. The teaching responsibilities of two-year-college and technical school faculty touch most of the courses in grades 9–14, with vocational subjects as well.
Their need for up-dated content knowledge and teaching methods, such as use of computers, is at least as great as high school and university teachers. At the same time, they have heavy teaching loads and little incentive for innovation. The mechanisms and support provided for renewal of faculty at other institutions should also be made available and modified suitably for two-year-college and technical college faculty.

Implementation of Renewal Strategies. The National Science Foundation and various state or local government agencies are already supporting some programs to meet the need for faculty renewal. We strongly support those beginning efforts and urge more. The professional societies in the mathematical sciences, especially NCTM, MAA, and AMATYC, should seek support as soon as possible for projects to demonstrate effective models of the various faculty renewal activities recommended above.

Unfinished Business

In general, the Conference confined itself to consideration of issues on which the professional mathematical sciences community is especially well-qualified to comment. As a result, such issues as merit pay for teachers, length of school day, etc., were not considered. However, there were several important issues which quite appropriately came before the Conference but which received only limited attention, in part because of the unavoidable absence of representatives from organizations best qualified to speak on these issues, and in part because of time limitations.

Matters of unfinished business included (1) consideration of a wide range of issues relating to the teaching of computer science, including the shortage of computer science teachers at all levels, and (2) issues relating to access for women and minorities to both mathematics and computing. Although cognizance of both of these concerns was taken in the recommendations, it was strongly felt that these issues are both sufficiently important and sufficiently complex to warrant explicit attention on the part of the mathematical sciences community on other occasions.

Appendix

Conference Participants

Steering Committee

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<th>Name</th>
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<td>Conference Board of the Mathematical Sciences</td>
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Keynote Speaker

Cecily Selby
New York, New York
National Science Board
Commission on Precollege Education in Mathematics, Science and Technology, Co-Chair

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American Statistical Association
Conference Board of the Mathematical Sciences, Executive Committee
Society of Actuaries, Director of Education
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269
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Mathematical Association of America, President-Elect
American Mathematical Association of Two-Year Colleges, President
National Council of Teachers of Mathematics, President

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National Science Foundation, Division of Mathematical Sciences, Director
Ford Foundation
National Science Foundation, Division of Mathematical Sciences, Acting Deputy Director
The Supply of Mathematical Researchers in the 1990s

Lida K. Barrett, Moderator. The Council of the American Mathematical Society has asked the Committee on Employment and Educational Policy to address the issue of the supply of mathematical scientists in the 1990s. Mel Hochster and Alex Rosenberg had written the Council expressing their concerns about this issue. Hochster pointed out the declining number of graduate students, the continued syphoning of talent at all levels into computer science, engineering and industry, and the need for a program to locate mathematically talented youngsters. Alex Rosenberg pointed to the number of retirements expected in the Mathematics Department at Cornell during the period from 1993 to 1998 and raised the question as to whether there will be a sufficient supply of talented mathematicians to replace them. This panel discussion is one result of the Council's request.

Let me begin by quoting from an article entitled Mathematics Today—Sprucing Up the Old Queen by Hirsh Cohen which appeared in the December 1983 issue of the Communications of the ACM.

Mathematics, queen or handmaiden, has had a long romance with science. In the past there have been periods of intimacy and then times of moving away. These cycles have something to do with the vitality of mathematics and the sciences; mathematics draws challenges and concepts from nature and experiments, clarifies and refines them into precise statements, and then moves on toward abstracting the relations and concepts. In the best circumstances, there is a return to nature again after the abstractions have been worked through. Where is the mathematics today in this cyclic partnership with science and, in particular, with computer sciences?

There are three movements of change in mathematics today: a turning once again toward applications, active participation in science and public policy, and a growing emphasis on computation.

The speech Toward Renewing a Threatened Resource by E. E. David, Jr., President of Exxon Research and Engineering Company, given earlier in this meeting (and printed in the February 1984 Notices, pages 141 to 145), reflects the three movements of change noted by Professor Cohen. In his speech David presented an overview of the report of the National Research Council's Ad Hoc Committee on Resources for the Mathematical Sciences, a committee he chaired. I would like to quote two passages from this report. First:

As an outsider, but very interested observer of the mathematics community, I am here to consider with you today an astonishing and an alarming state of affairs in mathematics research in the United States. It is astonishing because, while no field associated with science and engineering has advanced further, no major field has lost as large a fraction of its federal research support in the last decade and a half. It is alarming because, at present funding levels, the community is losing its very ability to renew itself, let alone to maintain the quality of its research. And this is happening despite record crowding in the mathematics classrooms at many universities.

Later in the report David states:

The importance of mathematics goes beyond its relationship to technology. In itself, mathematics ranks as one of the supreme uses of the human intellect. And of course it has become an essential tool of progress in many sciences.

To put the Council's concerns and the remarks of Cohen and David into perspective let us consider the changing nature of the supply of mathematicians over the past fourteen years. At the winter Annual Meetings in San Antonio in January of 1970 there were two speeches entitled Are There Too Many Ph.D.'s?, one given by Duren and the other by Anderson. Duren spoke of the need for mathematicians and their growing role in applied areas. Anderson quoted statistics on the rising number of Ph.D.'s and the declining number of academic positions. In the fourteen years since January 1970 we have gone through a period, where there were too many mathematicians seeking too few academic positions. A number of mathematics Ph.D.'s either accepted teaching
jobs that failed to provide time for research, took a sequence of short-term positions or left the academic world of mathematics. Some of these individuals found nonacademic jobs with meaningful mathematical content; others were not as fortunate. At this meeting there is an indication that the employment situation has changed. At the employment register the number of individuals seeking employment and the number of employers seeking mathematicians is about equal.

What is the relation of current Ph.D. production to the number of academic openings and where will it be in the 1990s? What is happening with mathematics in other countries? What is happening to the number of graduate students entering mathematics? Where can we find able mathematical talent? The panel will address these issues as follows: GAIL YOUNG will present data about the supply of mathematicians in the future. JIM STASHEFF will give information about what is being done in Germany and England. WILSON ZARING, using his own institution as an example, will discuss the number of graduate students enrolled at various times over the past twenty years and currently. MAUREEN MCKEOUGH will discuss a source for contact with talented young people who might be future mathematicians.

Gail S. Young

The question of the supply and demand for mathematicians throughout the 1990s is remarkably difficult. From 1950 to 1980, rather little had to be considered but probable academic positions and the probable reaction of prospective graduate students to these. There are now many more variables. But we must begin with the present.

I will talk about mathematics proper, the traditional areas of pure and applied mathematics, not such mathematical sciences as operations research, statistics or computer science.

1. The present state. In round figures, last year mathematics departments hired 1150 people. Only 250 of these were Ph.D.'s. Of the other 900, employers said that for nearly 600 positions they would have preferred Ph.D.'s. One is reminded of the early '60s. However, the new Ph.D.'s do not feel the way graduates did then. In the '60s, new Ph.D.'s all believed that they would have low teaching loads, they would get research grants, and they would get early tenure. None of these is true now. Nevertheless jobs are there in great number.

The supply of new Ph.D.'s. in pure and applied mathematics has been slowly declining, from 541 in 1978-1979 to 462 in 1982-1983, but that is only a 15% drop. The distribution into various types of employment has also been remarkably stable. In round figures, out of 475 Ph.D.'s., about 250 go into university and college mathematics departments, 10 into one-year colleges or high schools, 25 into other academic departments or into research institutes, 80 into government or industry, and 90 take positions outside the United States.

The percentage of Ph.D.'s. awarded to non-citizens has risen sharply from 26% in 1978-1979 to 39% or 180, last year. Certainly one reason for the increase has been the inability of mathematics graduate departments to get enough U.S. graduate students to fill their teaching assistant needs. Of the 180 non-citizens, 90 left the country; how many of the others are permanent residents or instead are staying here for a 2-year training period, I do not know.

2. The demand. Kuh and Radner [1] have made a competent extrapolation to predict the academic demand for mathematicians from 1975 to 2000. Briefly, they predicted a sharp rise in positions (more than has occurred) to about 1984, a rather level period from now to 1990, a sharp drop to 1997, then a quite rapid gain to the year 2000. The principal reason for the predicted drop in faculty size is demographic; the kids just will not be there. However, I distrust all such extrapolations, with good historical reasons. Some of my concerns will be covered later.

I turn now to industrial demand, that is, all non-academic demand. At this meeting Edward E. David, reporting on the work of the Committee on Resources for the Mathematical Sciences, discussed the nature of industrial work, and predicted a large demand for Ph.D. mathematicians. I concur, and believe that we are already seeing a rapid rise in such employment at the bachelor's and master's degree levels; this rise being a major factor in the increase of majors. I know of no reliable predictions on non-academic employment. The predictions in [2] are badly flawed; in the bachelor's class of 1978, twice as many mathematicians found professional jobs in industry as were predicted for the whole next decade.

3. Uncertainties in our situation.

(i) This is a highly unstable period in the world economy. Whether we are facing unprecedented prosperity or unprecedented calamity is debated, and outside my competency. But the outcome affects our position more than any other consideration.

(ii) In 1980, courses of the level of calculus and below formed 88% of our undergraduate enrollment; precalculus courses formed 53%, and remedial mathematics was 6%. Most college students are now in programs requiring some mathematics; at Wyoming, 95% of our students need mathematics, if only college algebra. The need for remedial and precalculus courses is usually blamed on the secondary schools; that is only part of the problem. The fact is that 20 years ago mathematics was taken only by students going into fields such as engineering where some mathematical talent was to be expected. Now
students who never dreamed that social work or nursing would require statistics, or that political science would need matrix theory, are having to face the facts as freshmen.

Sharp improvement in the secondary schools will lead to a reduction in our elementary load. Despite all the reports on education recently published, there is as yet little evidence of the sort of action and funding required to change the situation. When or if it does materialize, as fast as we lose remedial teaching, we gain teacher training and retraining programs. In the '50s and '60s, a third of our majors were prospective teachers.

(iii) On the other hand, the increased usefulness of mathematics in other fields may increase the demand for more years of mathematics, particularly if the mathematics departments broaden their offerings; cf. papers in [3].

(iv) I have been writing as though all mathematics teaching were done in mathematics departments. That is certainly not so at universities with strong programs in quantitative fields. At the University of Wyoming, which is not a hi-tech school, I counted over 50 courses whose content was primarily mathematical. About 15 of these on closer examination turned out to be courses we could well cross-list, taught by faculty who could well have joint appointments. That would nearly double our junior-senior offerings.

In addition, I have data to support a crude estimate that each year in this country there must be 100 to 150 Ph.D. theses outside mathematics sciences departments that could well be theses in mathematics. These students often end up in academia, but rarely in mathematics departments. They typically are not found in the Combined Membership List, and have little or no contact with the local mathematics department. Cooperation with such people will, I believe, increase the demand for mathematics courses; failure to cooperate will mean that the department is increasingly seen as a source of elementary training only.

(v) Symbol-manipulating systems such as MACSYMA or SCRATCHPAD have reached a high state of development, and, as the cost of computing and computer memory drop, become more feasible. To predict the effect on our teaching requires more expertise than I possess. One possible effect is a great reduction in time required to teach our elementary courses, which are primarily filled with teaching and drilling algorithms that can be done easily and rapidly on the computer.

Another possible consequence is this. All readers of this have one thing in common; they are good at manipulation and like it. If they were not, they could not have stood the first couple of years of mathematics to become majors. Remove the need for that skill, and mathematics will become accessible to many more people. Our enrollments will rise. The long term effect should be analogous to the introduction of Arabic numerals or of the Calculus.

My guess is that all this will begin in the '90s, with unpredictable effects on enrollment and on our future.

(vi) Tenure is increasingly blocking the way for young faculty. Kuh and Radner estimate that by 1994, 82.3% of the total mathematics faculty will be tenured, and 68% of these will be over 50; I rather accept that estimate, which is their most favorable of three alternatives. That state of affairs should make universities unattractive to good young people.

(vii) Retirements will be insignificant. The '90s will see the retirement of the Ph.D. classes of the '50s. The total number of our Ph.D.'s in the '50s was 2326, and according to a study by the Committee on Human Resources, in 1980 there were only 1510 in academia (Table in [1]). In my own Ph.D. class, 35 years after their degrees, only half were still in teaching. However, if all the 1510 were still in teaching in 1990, that would mean only 150 retirements a year in the decade.

My own guess is that we will see a slow increase of enrollments in courses with high mathematical content until around 1990, and then a quite steady increase. I hope that the mathematics departments will share in this.

I think industrial employment will rise as sharply as the supply permits, and that industrial groups will offer the research mathematician a viable alternative to academia. There will be more Murray Hills and more Yorktown Heights. But quite possibly this will mean a greater fragmentation of the mathematical world. Most industrial mathematicians will work in project teams, not as part of a group of mathematicians, and this will certainly cause fragmentation.

The supply of mathematics Ph.D.'s can be increased rather rapidly if the demand and the support is there. In 1960 there were 303 Ph.D.'s; in 1965, there were 688 [4]. But then a third of the graduate students had federal support, and everyone believed that there were limitless jobs. The David Committee is calling for 1000 fellowships a year, nothing like the support of the '60s, but probably more than we will get in the near future.

4. The effect on research. My first thought was that we would certainly maintain great strength in research, almost despite whatever happened to jobs and supplies. After all, the '30s were years in which Ph.D. classes averaged about 75, and when the employment situation was desperate. Yet a glance at the journals of the time convinces one that there were many brilliant young mathematicians starting their careers then. But I remembered later the environment of the time, the small AMS-MAA meetings, when 300 was huge, the presence and accessibility of all the leaders, the quick recognition of young talent, and I changed my view.
I think that fragmentation, the probable decline of academic departments, the increased number of departments and companies where mathematics is done, may end the present mathematical structure, where universities are the centers of research and the AMS is the leading society. Whether this is necessarily bad, I cannot say. But it seems to me very likely unless strong efforts are made to change events.

I am very glad to see the AMS responding to these problems.

References


Wilson M. Zaring

We are here to discuss the problem of the expected shortage of Ph.D.'s in the 1990s. It is interesting that this problem has to be dealt with by mathematicians, and mathematicians, I think, have a conflict of interest in the solution of this problem. I hope that as we deal with this problem we can avoid the boom-and-bust phenomena that occurred in the 1960s. My job today, however, is to talk about the graduate program at Illinois and our experiences there and what light, if any, this sheds upon the general problem.

Graduate enrollment at the University of Illinois hit its peak in the mid 1960s when we enrolled about 400 graduate students in mathematics and graduated 30 or so Ph.D.'s per year. Starting in 1967 our graduate enrollment began a steep and steady decline that did not bottom out until 1980 when we enrolled about 150 students. Our lowest graduating group was in the calendar year 1983 when we awarded only six Ph.D.'s in mathematics. That is a drop in graduate enrollment of about 60% and about an 80% drop in graduations. The extra drop in graduates is largely explained by the fact that in 1980 between 30 and 40 percent of our students were masters candidates only.

In 1980 things began to turn around on our campus. Graduate enrollment has risen from 7 to 10 percent each year since. This past fall we enrolled almost 200 students and of these about 75% were declared Ph.D. candidates (about 36% of whom were foreign students). Will this trend continue? I do not know. It may be in part a result of the economic recession. Traditionally during difficult economic times people go to school in larger numbers. I have noted however, with interest, that our recent applicants contain a larger pool of better prepared and more able students than we received during the period of declining enrollment and that makes me cautiously optimistic that there is a growing interest in mathematics among good students.

I am sure that it comes as no surprise that our declining graduate enrollment very closely paralleled the national drop in undergraduate degrees awarded in mathematics and statistics according to figures compiled by the National Center for Educational Statistics. This is just a way of saying that today's Ph.D. is drawn from yesterday's mathematics major. Thus, if we are to produce more Ph.D.'s in mathematics, we must pay more attention to our own undergraduate programs and we must strive to make those programs more interesting and more attractive.

On our own campus we have about six different curricula in mathematics including statistics, actuarial mathematics, mathematics education, etc. Over the past three years total enrollment in those curricula has more than doubled, from about 500 students to about 1100 students. But there is a catch. The increase has been almost entirely in one program and that is our mathematics/computer science curriculum which has grown four-fold in three years. All across our land students of all ages are intrigued by computers. Computers are interesting, they are fun, they are useful, and they are highly profitable. Those who go into computer science will earn far more than they could expect of a career in mathematics. So if we need more mathematicians the best thing we could do would be to unplug all of the computers in the land. That, however, is neither a realistic nor a desirable solution. Nevertheless, the future growth of mathematics is closely tied to the field of computer science. If the job market for computer scientists should begin to close down, then I think we will see a resurgence of interest in mathematics and mathematics enrollments will increase. In the meantime, we must make extra efforts to make our undergraduate programs in mathematics interesting and attractive. Although I dislike clichés, I think we must attempt to increase the visibility of our mathematics programs and we must try to make mathematics the prestige subject to study. Mathematics majors must be targeted as a special national resource to be nurtured and developed.

I have been asked to talk about our faculty and what the expectations there are. Our faculty pretty well fits into the pattern that was just described. Our staff underwent a very large expansion in the mid 1950s, and those people will be coming up for retirement before long. We will start retiring people at a small rate fairly soon— we have had very few retirements in the last few years. During the 1990s, however, we expect to be retiring three, four or five people each year.
Another question is whether there will be students to teach. Our experience on our campus is that enrollment in lower division courses is mushrooming, and the same thing goes for more advanced courses such as advanced calculus, linear algebra, differential equations and statistics. These courses are largely service courses for people from other departments; we are seeing students to teach. Over the past eight years we have had about a 30% increase in body count, and we have had to deal with that with about a 3% increase in faculty. You can guess what has happened: our classes are getting bigger. At one time we thought of a small class as one with an enrollment of 25, today our small classes have about 35 students.

James D. Stasheff

The situation at Illinois is a magnified version of what is happening at North Carolina. We are seeing a tremendous bulge in service courses at the junior level, where you cannot go out and hire TA's who are graduate students and you cannot hire engineers or adjunct professors to handle that kind of course. We have not had to face that problem previously at North Carolina.

The problem I am supposed to address is what do we do between now and 1997, when it has suddenly become clear, that we are going to need a lot more mathematicians even without increased industrial positions for them.

The problem of maintaining our research vitality until demographics return us to a shortage of Ph.D.'s in academia is international.

West Germany: In 1978, the West German government initiated the Heisenberg program of five-year stipends for young researchers in science, 150 to be awarded each year through 1983, tenable at the location of choice of the awardee, including approximately fifty universities. It is hoped that ordinary academic positions will be available at the end of the five-year stipend. But two things seem to be happening. There are indications that some of those in the program opt out in favor of more secure positions before the five years are up while, on the other hand, some administrators consider those on the stipends as being "taken care of", and do not consider them for a regular position.

Great Britain: In 1983, the government began a "new blood" program, having previously slashed university budgets and faculties very seriously. This consists of creating new regular academic positions, primarily research in the early years but reverting to ordinary positions later: 200 in science and technology and 30 in "arts" (=humanities and social studies). The (approximately fifty) universities submit proposals of research projects for individual researchers, apparently rated primarily as research proposals though the positions are intended to become regular academic positions. (See Higher Education Supplement of The Times of London, March 1983.)

Both of these foreign programs are intended as holding actions, to keep active young researchers around until positions begin to open up.

Another idea which has been discussed is the prospect of "mortgaging" individual positions: coming up with money to hire somebody before the retirement takes place, significantly before. Apparently there are some individual liberal arts colleges in this country that are already doing this on a very minor scale; they will hire somebody a year ahead. In some state universities it is exactly the opposite: you wait until a person retires and then you take a year off before you hire somebody else. I know of only two specific examples of schools hiring someone in advance.1 I would like to learn of other examples, especially any hiring more than a year in advance. The latter would be the kind that could really make an impression on the problem.

What the United States government is doing at the present time amounts to something close to the German system, at least in mathematics. There is an infusion of money now for graduate students and young researchers immediately after the Ph.D. But nothing is being done to hold on to them until 1997. The present action admittedly represents a temporary solution, even from Washington's point of view: for the next two or three years, this is the operating mode. So we can hope that we will be able to hold onto this cohort. Whether in 1990 (when we are basically in the trough of undergraduate enrollment) something can be done to hold on to them yet a little longer, is really a significant issue. We need to think about doing something about it.

The situation in Washington is flexible at the present time. We need to get in there and influence things so that an adequate solution is attempted.

I think that many of us, especially those like myself at state institutions, might think about what ought to be done at the state level. The experience with the Federal government is that they are willing to be educated but they will not do it on their own. That's like telling your students they can go home and read the textbook and after all they can learn it that way on their own. We know better when we are teaching calculus—apparently we need to apply the same lesson to teaching about the teaching of calculus.

Administrators and legislators must be educated to plan ahead and hire before the pool of research talent becomes inadequate for anticipated needs.

1In response to this plea, one major example was brought to my attention.

275
Maureen McKeough

The American Mathematical Society is a rather intimidating group for a non-mathematician to address. It reminds me of John Kennedy’s often quoted comment to an assemblage of Nobel Laureates at the White House, “This is perhaps the most distinguished group to ever dine at the White House—save for when Thomas Jefferson dined alone”.

I’m here to talk about mathematics, about which I know little and you know much. My purpose, rather, is to acquaint you with sources of information about highly talented students in mathematics and the possibilities this information presents for addressing the problem that is the topic of this panel—“The Supply of Mathematical Researchers in the 1990s”.

The entire United States and part of Canada are currently served by one of several academic Talent Searches. You may be familiar with the Talent Search concept which was developed by Julian Stanley of Johns Hopkins University. The process involves identifying, through schools or parents, students of approximately 7th grade age who have scored at the 95th percentile or better on a standardized achievement test. These students are invited to take the Scholastic Aptitude Test (SAT) and a significant percentage of them achieve SAT scores indicative of very unusual mathematical and/or verbal ability. The searches now conducted in various parts of the country are modeled on the system developed by Stanley.

I am not going to defend or critique the talent search idea here. Much has been written and said on both sides of that issue.

Instead, I want to tell you about the demonstrated ability of these students, possibilities for your involvement with them and the institutions sponsoring talent searches.

SAT scores range from 200 to 800. The average score for college bound seniors graduating in 1983 was 425 on the verbal portion and 468 on mathematics. Anywhere from 12% to 40% of the seventh graders taking the SAT have scored above the mean for college bound seniors in the verbal or mathematical area. In 1982-1983, the first year in which all fifty states were served by a talent search, approximately 70,000 junior high age students took the SAT; approximately 17,000 of them scored better than the average college bound seniors who also took the test.

Before turning to very high scoring students, let us focus on the large number of seventh graders doing as well or better than their high school peers bound for college. As they enter 8th grade and high school, what education in mathematics is offered them? They are already doing as well as those who have been in school four years longer, how will they be expected to spend a comparable four years? I ask you to concern yourself with these questions in a meaningful way.

A score higher than the mean for college bound seniors is used to qualify students for special opportunities offered in connection with the talent searches. Cut-off scores of 500 or above in mathematics and 430 and above on the verbal portion are the more common ones required to be eligible for the classes. Thousands of seventh grade students meet these criteria. Indeed, some of them score 700 or above and a few have even scored an astonishing 800 on the mathematics portion of the SAT. Indeed, certainly a single score is not a predictor of high mathematical ability. For this reason, it is common to require several indicators to qualify students for the services offered in connection with the talent searches. For the purposes of this panel discussion, however, I want to impress upon you this observation: throughout the country each year a successful, organized effort is being made to search out students who demonstrate unusual ability at a stage when educational intervention may be most desirable. These students represent a resource for you in your concern for future mathematical researchers. Perhaps even more important, you represent resources for them. Moreover, the task of linking you with them may be uncommonly easy if you are interested in doing so.

At the end of this article, you will find a list of Talent Search institutions and contact people. An explanation is in order concerning the Illinois situation. An annual talent search in Illinois is conducted by nine state-funded regional service centers as part of their larger responsibility for gifted students and the school districts serving them. Since Illinois is also considered part of the target area for Northwestern University’s Midwest Talent Search, you have been supplied with information for both.

How might you use this information? How might you help these students? I think there are a number of possibilities. I would like to suggest a variety of them, ranging from some which are specific and immediate, to others which require more planning and cooperation. I offer these few, trusting that your own creativity will improve on my suggestions and tailor them to your circumstances.

• Make a commitment (perhaps at a department level) to annually secure the names of high scoring students in your state and review them to determine if offering special opportunities, arranging mentorships, or some other efforts seem advisable. Most of the searches have policies and practices (and sign-offs from participants) allowing for the release of names of students to educational institutions. In most instances, you can specify want names from certain geographic areas, score ranges, etc., and you will be asked to pay a modest fee to cover the cost of reproducing the information for your use.

• Contact the talent search office and introduce yourself as a resource person. You might serve as
an advisor, mentor, teacher, consultant or even a speaker. The chair of this panel, Lida Barrett, was a guest speaker at three awards cremonies in Illinois (she did not contact us, however, we found her).

- Organize, through professional groups, departments, or institutions, challenging intellectual experiences for these students which can be offered regularly in the summer or on Saturdays during the school year. Recruit students directly or by listing your offering with the talent search. In some of these experiences, pay particular attention to career issues. Most of these students probably do not know what a mathematical researcher does. You probably won't want to try to articulate that to seventh graders, but if it takes you two years to organize a program, the students identified last year will be sophomores in high school.

- Organize a summer residential experience to acquaint highly gifted students with mathematics research as a career. I know of a New Jersey offering of this kind which encourages women of junior high school age to consider engineering as a career.

- Notify individual students and parents, identified through the search, that you are interested in their progress. Perhaps you might tell them of your own educational background.

- Identify any of the able students in schools near you. Offer your services to the schools or teachers as they examine and plan their able students' curricula.

Mathematically talented students identified through the talent search have demonstrated that they can master algebra through contact with a teacher for 15 hours or less plus independent study. It is not unreasonable to suppose that they find the pace and depth of the conventional mathematics curriculum boring or frustrating if some adjustment isn't made for their ability. They may be "turned off" before they ever experience the beauty and excitement you have found in your discipline.

I think there are two characteristics of gifted students which make them a likely reservoir from which to draw future mathematical researchers. They have diverse talents and multiple interests; they will need, as adults, to have an integrated life in which one's work is consistent with one's values and an important part of one's life, not just a job. The flexibility and diversity of universities offer unusual opportunities for people of this sort. For example, I am fortunate to have as a teacher, in one of my regional Latin classes, a professor of mathematics.

I hope individually and collectively you will seek to acquaint these talented students with university life, serve as resources for them, and involve yourselves in their education.

Lida Barrett: These concluding remarks include not only those presented by the chair at the panel session but also reflections on the issues. First, the panel has addressed mathematics in the 1990s in terms of the number of positions available and possible sources of talent. It would appear from these presentations that concern for employment for mathematicians in this country differs from the concerns expressed in England or Germany. However, the concern here is not simply for the availability of positions for new Ph.D.'s in pure mathematics but for positions where there will be adequate time to pursue research and to develop research talent. The speech by David presents the National Research Council's recommendations to remedy this situation. The availability of appropriate postdoctoral experiences for young mathematicians seems crucial to the future of the field.

Second, it is my assessment that needs presented in the report entitled The Mathematical Sciences published by the Committee on Support of Research in the Mathematical Sciences of the National Research Council in 1968 are still crucial. Namely, these are the need for mathematicians in core mathematics and also the need for those trained in applied mathematical sciences and for mathematicians to interact with other fields on the needs that are currently present as described in our society. The dilemma for the mathematics community today is whether or not we can both train the creative pure mathematicians needed to support mathematics in its continued growth and also supply mathematicians trained in applied mathematics and mathematicians interested in and capable of interacting with the broader academic community. Is our current mode of undergraduate/graduate education the appropriate one for the future needs of the mathematics community and for the society at large? Will we have sufficient young people with mathematical talent interested in using that talent? The mathematics community needs to reflect on these matters and respond to the challenge.

[Editor's Note: The Talent Search institutions referred to by Maureen McKeough and their contact people are Arizona State University (Debbie Lawyer, Department of Special Education); Duke University (Gordon Stanley, West Duke Building); Johns Hopkins University (Bill Durden, Latrobe 305); University of Denver (Holly Hultgren); and Northwestern University (Joyce Van Tassel-Baska, School of Education).]
Massera Released

In a memorandum from the Canadian Committee of Scientists and Scholars, Israel Halperin has announced the José Luis Massera was released from prison on March 3, 1984. He is now in his own home in Montevideo, Uruguay. Information available is that he is in reasonably good health, is permitted to leave and to re-enter Uruguay but there are some conditions on his freedom (not yet known to the Committee). Honorary doctorate degrees are to be awarded to Massera in Brazil (Rio de Janeiro) and Italy (Pisa) in the next few months. (See the Letters to the Editor in this issue for more on Professor Massera.)

Washington Presence for Mathematics

The Joint Projects Board for Mathematics has announced the appointment of Kenneth M. Hoffman of the Massachusetts Institute of Technology as its Executive Secretary for National Affairs. The Joint Projects Board consists of (including the presidents and executive officers) of the AMS, MAA & SIAM. The position of Executive Secretary is a new, part time, position created by the three organizations in an effort to facilitate the exchange of information between the mathematical community and government agencies.

Hoffman will be responsible for collecting and disseminating information and data on research and education in the mathematical sciences, coordinating relations between the mathematical community and State and Federal agencies, and monitoring legislation affecting the mathematical sciences. He will continue to serve in his position as professor of mathematics at the Massachusetts Institute of Technology, but will maintain an office in Washington at the MAA headquarters.

For the past two or three years, Hoffman was the executive director of the National Research Council’s Ad Hoc Committee on Resources for the Mathematical Sciences, whose chairman was Edward E. David, Jr. (see the February, 1984 Notices, pages 141 to 145). He was chairman of the mathematics department at MIT, 1971 to 1979, and more recently was chairman of a committee on relations between MIT and intelligence agencies of the Federal government. He has been a member of the AMS council and the council of the AAAS and was chairman of the Society’s Committee on Science Policy until he resigned to accept his new position.

Sloan Fellowships Awarded

Sloan Research Fellowships for 1984-1985 have been awarded to ninety young scientists and economists of extraordinary promise, including twenty mathematicians.

The fellowships, granted by the Alfred P. Sloan Foundation, run two years and are in the amount of $25,000.

Selection under this program follows a well-developed procedure designed to identify scholars who show the greatest promise of doing original work in their fields. Aside from the dollar value of the fellowships, which has become increasingly important in recent years, less tangible benefits are often cited by the fellows themselves. The early recognition of distinguished performance which the fellowships confer, after years of arduous preparation, is a strong stimulus to personal and career development.

S S. Chern of the University of California, Berkeley, Peter D. Lax of Courant Institute of Mathematical Sciences, New York University, and David Mumford of Harvard University are the mathematicians on the fifteen-member selection committee.

The mathematicians awarded Sloan Fellowships for 1984, with their affiliations are: STEVEN R. BELL (Princeton University), ROBERT W. BROOKS (University of Maryland, College Park), TIMOTHY CARLSON (Ohio State University), G. BARD ERMENTROUT (University of Pittsburgh, Pittsburgh), IGOR B. FRENKEL (Rutgers University), MICHAEL HANDEL (Michigan State University), DAVID HARBAKER (University of Pennsylvania), JEFFRY N. KAHN (Rutgers University), STEVEN P. KERCKHOFF (Stanford University), ROBERT V. KOHN (Courant Institute of Mathematical Sciences, New York University), ROBERT K. LAZARSFELD (Harvard University), NGAIMING MOK (Princeton University), JOHN C. NEU (University of California, Berkeley), DALE H. PETERSON (University of Michigan, Ann Arbor), RODOLFO R. ROSALES (Massachusetts Institute of Technology), MICHAEL TABOR (Columbia University), JERROLD B. TUNNELL (Rutgers University), GUNTER A. UHLMANN (Massachusetts Institute of Technology), THOMAS WOLFF (California Institute of Technology), and PIT MANN WONG (University of Notre Dame).

Request for Photos

In conjunction with the Centennial of the American Mathematical Society which is to be celebrated in Providence in 1988, the AMS would like to set up an exhibit of group photos from meetings and similar items of interest.

If anyone has memorabilia of this kind which they would like to give or loan to the AMS, please write to Dr. William J. LeVeque, Executive Director, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.
New Director of Courant Institute

The Courant Institute of Mathematical Sciences has appointed Cathleen S. Morawetz as its new director. According to Institute officials this is the first time a woman has been named to head a mathematical institute in the United States.

Morawetz received her B.S. degree from the University of Toronto (1945), an M.S. from the Massachusetts Institute of Technology (1946), and a Ph.D. from New York University (1951). She began at Courant as a research assistant in 1951 and has been there since that time, serving as associate director since 1979. She has held two Guggenheim Fellowships (1966–1967 and 1978–1979) and has been a visiting professor at the University of Rome, the Tata Institute, the University of Paris and the Mittag-Leffler Institute. Morawetz has been very active in the Society, having served on numerous committees, on the Council and on the Board of Trustees, of which she is currently the chairman. Her research interest lies mainly in the application of partial differential equations to fluid dynamics and wave propagation.

AMS Receives Short-Term Enrichment Grant

The Institute of International Education has announced a grant under the Short-Term Enrichment Program (STEP) of the U.S. Information Agency to the Society. This grant of $2,500 has been made to the AMS to assist non-U.S.-government-sponsored foreign students to participate in the Joint Summer Research Conferences in the Mathematical Sciences, June 10–August 18, 1984, Brunswick, Maine (6 grants to be awarded); the AMS-SIAM Summer Seminar, July 8–21, 1984, Sante Fe, New Mexico (1 grant to be awarded); and the AMS Summer Research Institute, Arcata, California, July 16–August 3, 1984 (3 grants to be awarded). For topics, please refer to announcements of these conferences in previous issues of the Notices. Awards to individual students may be made up to a maximum of $250.

To be eligible for these grants the foreign student must be enrolled in full-time graduate studies at a U.S. institution of higher learning. One is ineligible if he/she is receiving any U.S. Government funds for either academic or travel expenses or if one is on refugee, immigrant or
News for the Institute for Mathematics and its Applications

Minneapolis

The Institute for Mathematics and its Applications (IMA) and its participating Institutions (Indiana University, Iowa State University, Michigan State University, Northern Illinois University, Northwestern University, Ohio State University, Purdue University, University of Chicago, University of Illinois (Urbana), University of Iowa, University of Michigan, University of Minnesota, Wayne State University) are jointly sponsoring a one-week conference on the Classifying Spaces of Groups. This conference will be held at the University of Minnesota from July 22 to 27, 1984. The conference is being organized by Mark Feshbach, Henry Glover, and Stewart Priddy. A tentative list of speakers are J. F. Adams, W. Browder, G. Carlsson, W. G. Dwyer, L. Evans, H. Glover, J. P. May, J. McClure, R. J. Milgram, H. Miller, G. Mislin, S. Mitchell, S. Priddy, Victor Snaith, R. Swan and C. Wilkerson. This is an experimental conference which is an attempt to cover areas of Mathematics which are not directly related to the yearly IMA programs. More information can be obtained by writing to the IMA.

Ayner Friedman and Robert Jensen will be in residence at the IMA for a week of concentration on Differential Games from May 7 to 11, 1984.

The IMA is also planning a Workshop on Financial Intermediation from May 17 to 19, 1984. This will be jointly sponsored with the University of Minnesota department of Finance. Tentative speakers are J. Boyd, E. Prescott, R. Townsend, N. Wallace, B. Smith, S. Battacharia, and E. Green. The organizers for the conference are: John Kerakan and Neil Wallace.

Visitors are welcome at all IMA activities.

tourist visa status. Previous recipients of STEP awards are ineligible for a second grant.

Interested applicants should send all necessary information, including the conference for which the grant is requested, to William J. LeVeque, Executive Director, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940 prior to the deadline of May 1, 1984.

Russian-English Dictionary to be Revised

Under the joint auspices of the National Academy of Sciences of the USA, the Academy of Sciences of the USSR, and the American Mathematical Society, a Russian-English dictionary of the mathematical sciences was published by AMS in 1961. In time it has been recognized that a new edition would be desirable, and indeed A. J. Lohwater, the original author, was working on a revision until his death in 1982.

Now the project has been taken up by the Translations Department at AMS headquarters. To maximize the value of this undertaking the Russian-reading mathematical public is hereby solicited to submit contributions to the word list. These may be of two kinds: 1) new meanings for terms already in the dictionary (for example, “support” for “нодгатель”); 2) new entries (for example, “слонение”). It would be helpful if contributors can cite a specific occurrence of the new word or meaning in the Russian literature, together with one or more occurrences of the corresponding term in a primary English language context (not a translation).

Responses should be addressed to the Translations Department, American Mathematical Society, Post Office Box 6248, Providence, RI 02940.

MAA Honors Women

The Board of Governors of the Mathematical Association of America (MAA) has issued a special citation honoring all those who have contributed to mathematics by working to enhance the status of women. The citation, approved by the board in January and read publicly on January 26 at the Annual Business Meeting of the Association in Louisville, Kentucky, begins:

“History will record the 1970s as the decade of Women’s Rights, a time when a liberating movement captured the imagination and stirred the conscience of the Western World... The Women’s Movement in mathematics has been especially strong.”

The citation states that, “Many women—and more than a few men—have worked hard and effectively to convince women that they have potential for excellence in mathematics and that they should receive recognition and rewards commensurate with their achievements.”

The contributions of women to mathematics are described and honored in the concluding passage of the Citation:

“Women have achieved prominence in research, teaching, writing, and editorial responsibilities, and have risen to the highest levels of leadership in mathematical organizations. Public recognition for these achievements has inspired other women to make full use of their capabilities, in mathematics as in all affairs, with pride and confidence. The Board of Governors of the Mathematical Association of America recognizes and honors their many contributions.”

Following the reading of the Citation, Julia Robinson, President of the American Mathematical Society, and Linda P. Rothschild, President of the Association for Women in Mathematics, accepted the Citation on behalf of those honored.

As...

Geert C. E. Prins Prize Fund

Professor Geert C. E. Prins of Wayne State University died on February 25 in Amsterdam.
He was a member of the Society for over thirty years. The Department of Mathematics at Wayne State has announced a memorial Prize in Professor Prins' memory to be awarded each year to an outstanding student of mathematics. Contributions for this prize should be made to the Wayne State Fund for the Department of Mathematics in Professor Prins' name and sent to Professor Togo Nishiura, Chairman, Department of Mathematics, Wayne State University, Detroit, Michigan 48202.

Fulbright Scholars Available for Lectures

Since the Council for International Exchange of Scholars (CIES), published Volume I of the 1983-1984 Directory of Visiting Fulbright Scholars (see February 1984 issue of Notices, page 158), 262 more scholars have been awarded grants or have submitted occasional lecture topics. These scholars are listed by discipline in Volume II of this directory.

Of these 262 scholars two are in the field of Computer Science and four are in Mathematics and Statistics. Limited funds are available to facilitate visits to interested institutions, especially those that have had little opportunity to participate in educational exchange programs.


Fulbright Scholar Awards 1985-1986

The Council for International Exchange of Scholars (CIES) announces that applications are now being accepted for Fulbright Scholar Awards abroad during 1985-1986. This year’s offerings include over 250 awards for postdoctoral research, about a third of the total. The remainder are for college and university lecturing or for consultative or teaching positions with governmental bodies or other professional institutions.

Application deadlines for 1985-1986 are June 15, 1984 for Australasia, India, Latin America and the Caribbean, and September 15, 1984 for Africa, Asia (except India), Europe, and the Middle East. All applications are reviewed by recognized specialists both in the applicant’s professional and academic discipline and in the chosen geographic area. The Presidentially appointed Board of Foreign Scholarships makes final selections, with the agreement of agencies in the host country abroad.

Information and applications may be obtained from CIES, 11 Dupont Circle, Washington, D.C. 20036; 202-833-4841. --CIES News Release

Call for Manuscripts

Mathematical Surveys and Monographs

The Mathematical Surveys series, published by the AMS, has been significantly expanded in scope in the last two years, as reflected by the change of title to Mathematical Surveys and Monographs. The editors of the series now seek to publish scholarly and research monographs as well as surveys of a particular field, and are seriously searching for appropriate manuscripts.

The AMS pays royalties to authors on this series of 15% of the LIST PRICE of the book (with division of that amount among multiple authors), even if the book is sold at a discount. Each author is entitled to ten free copies of the book. Books are heavily promoted by direct mail, in space advertising in the NOTICES and other journals, and at exhibits at AMS meetings and those of other organizations. In keeping with the longstanding AMS policy, all volumes are kept in print permanently. In addition, AMS books are printed on acid-free paper.

Prospective authors for the Mathematical Surveys and Monographs Series are invited to communicate with one of the members of the Mathematical Surveys Editorial Committee: Donald W. Anderson (chairman), M. Susan Montgomery, Gian-Carlo Rota, or R. O. Wells, Jr.
301. Bertram Ross (Mathematics Department, University of New Haven, West Haven, CT 06516). Can anyone provide me with the title and source of any publications dealing with the subject of Fractional Calculus (differentiation and integration to an arbitrary order) published in the last 10 years?

302. S. Ruijsenaars (Department of Mathematics, Tübingen University, Tübingen, Federal Republic of Germany). Does literature exist concerning functional equations of the form
\[ F(z + 1) + 2F(z) + F(z - 1) = M(z)F(z), \]
where \( z \in \mathbb{C} \) and \( M \) is a given meromorphic function? More specifically, are any nontrivial meromorphic solutions known in case \( M(z) \) equals \( \alpha \tan^2 \beta z \) or \( \alpha/(\beta + z \cot \pi z) \), where \( \alpha, \beta \in \mathbb{R} \)?

303. Pavel G. Todorov (Department of Mathematics, Paisii Hilendarsici University, 4000 Plovdiv, Bulgaria). It is well known that for \( n = 3, 4, \ldots \) the equation
\[(x^n - 1)/(x - 1) = x^{n-1} + x^{n-2} + \cdots + x + 1 = 0 \]
is solvable by radicals. Is it known whether the derivative equation of the formula
\[(n - 1)x^{n-2} + (n - 2)x^{n-3} + \cdots + 2x + 1 = 0 \]
is solvable for \( n = 7, 8, \ldots \)?

Responses

The editor would like to thank all those who sent in replies.

288. (vol. 30, p. 759, November 1983, Seymour Kass) Generalizations of the Bohr inequality \( |a + b|^2 \leq |a|^2 + b| \), with \( a, b \) complex numbers, \( \alpha, \beta > 0 \), \( 1/\alpha + 1/\beta = 1 \). Reply: Since \( f(z) = |z|^p \) is convex for \( p \geq 1 \) on \( \mathbb{R} \) or \( \mathbb{C} \), one has, for \( \lambda_1, \ldots, \lambda_n > 0 \) with \( \sum \lambda_i = 1 \) and all \( x_1, \ldots, x_n \in \mathbb{C} \); the inequality
\[ |\sum \lambda_i x_i|^p \leq \sum \lambda_i |x_i|^p. \]
So for \( y_i = \lambda_i x_i \), one has
\[ |\sum y_i|^p \leq \sum \lambda_i^{-p} |y_i|^p. \]
(Contributed by A. Dress: also T. Rassias and J. Peetre)
Letters to the Editor

Massera Released

Professor J. L. Massera was released from prison in Uruguay on March 3, 1984. Efforts of scientists and scientific societies all over the world (one was the visit to Montevideo by a delegation which included Mary Gray) to obtain this release, date back to 1975 when Massera was first seized and tortured.

Among these efforts was the initiation by the Canadian Committee of Scientists and Scholars of an International Campaign-Massera, in 1981, directed by Professor Henri Cartan and myself. This Campaign was supported by the AAAS, SIAM, the AMS, the national mathematical societies of most of the major countries, more than 250 FRS, more than 60 Nobel Laureates, more than 50 Members of the Parliament of Canada, more than 1000 mathematicians in Japan, more than 700 scientists in Switzerland, and many others.

Bulletins were published three times a year and translated into French, German, Spanish and other languages.

In July, 1983 this Campaign arranged for a message from 51 Nobel Laureates to go to each member-country of the Human Rights Commission of the United Nations insisting that this Commission had a duty to press effectively for the release of Massera. In January and February, 1984, at the request of this Campaign, a flood of letters from many countries reached Geneva, where that Commission was in session. These letters said simply that they supported strongly the message from the Nobel Laureates.

Now that Massera is free, the Canadian Committee of Scientists and Scholars has initiated a second International Campaign, this time for Yuri Orlov (physicist) and Anatoly Shcharansky (mathematician), both persecuted in the USSR, both adopted by Amnesty International as prisoners of conscience. Dr. Orlov, after 7 years of cruel imprisonment, is now banished to Siberia. Dr. Shcharansky is in his 5th year of imprisonment. Both are in weakened health, caused by prison conditions.

International Campaign-Orlov and Shcharansky will publish Bulletins every 3 or 4 months and turn a spotlight on the way prisoners of conscience are treated in the USSR, escalating the Campaign until the two victims are given freedom.

You can help by sending a message to the Secretary of the Communist Party of the USSR in Moscow, Konstantin Chernenko, simply saying that you will give your support to International Campaign-Orlov and Shcharansky, directed by Professors Cartan and Halperin.

Our first Bulletin will be printed to appear in April–May, 1984 (English version 1/2 million copies). If you volunteer to distribute copies, please say how many copies to send to you. If you can contribute to the cost of printing and postage, please do (cheque payable to ICOS).

Israel Halperin
University of Toronto
(Received March 23, 1984)

EDITOR'S NOTE: See News and Announcements in this issue about Professor Massera.

José Luis Massera

The accompanying message of support for the cause of Professor Massera was signed in Argentina last December by A. P. Calderón, L. A. Santaló, M. Balanzat, and sixty others.

I call your attention to this letter since it is the first to be signed by mathematicians living in my country, so close geographically, politically and culturally to Uruguay. It comes in the immediate aftermath of the restoration of democratic government in Argentina. The influence of this event on the Uruguayan situation gives us renewed hope for the success of the international campaign for the liberation of Massera.

Cora Sadosky
The Institute for Advanced Study
(Received February 6, 1984)

From the Argentine Mathematical Community to the President of Uruguay, General Gregorio Alvarez.

The signing members of the Argentine Mathematical Community manifest our solidarity with the eminent Uruguayan mathematician Ing. José Luis Massera, Jailed for ideological reasons, to whom we are united not only by a love for science but by the traditional fraternal ties of the Río de la Plata.

Therefore we add our voice to the numerous petitions for his immediate release.

What a Book Review Is and Is Not

I am concerned with book reviews that do not review books, an ill policy in my opinion. Years ago, some mathematicians called my attention to this question at the time Paul Halmos was the book review editor of the Bulletin of the American Mathematical Society, and to a sheet of instructions sent to reviewers by the Bulletin editorial committee. In 1983, my attention was once again struck by a book review of that sort in the American Mathematical Monthly; the reviewer clearly did not even skim over the book, and in the few lines about the book, in between many lines on his dreams or nightmares in the field, he even asserted that the author included material that is not at all in the book. I felt that misinforming
the USA and international readership was being carried too far, and decided to write Halmos, now the Monthly's Editor. In his very kind reply of 4 November 1983, Halmos told me "You should keep in mind that at least in the Bulletin and in the American Mathematical Monthly a book review is not really meant to be a detailed review of the contents and accomplishments of the book. It is meant instead to be an essay on the subject of the book putting the book into a context. The discussion of the book itself might be as much as 50 percent of the review or as little as 10." Shortly afterwards, a mathematician who had just written a book review for the Bulletin criticized (to me) the sheet of instructions he received from the editorial committee; he wrote his review paying no attention to it, as he felt that a review in the Bulletin has to aim at a mixed audience who should be informed about the book's content and its relevance to the field. I then turned to Meyer Jerison, the present Bulletin book review editor, asking for a copy of that sheet of instructions, which Jerison very kindly sent me. On its top, one reads "P. R. Halmos, Bulletin Editorial Committee" as well as "What a book review is and is not" (and, at the end, there is a short P.S. by Jerison, which is appropriate, but not pertinent to my criticism). Among other (fit or not, in my opinion) things, one reads "A good review is a chatty expository essay on a currently interesting subject", and also "A book is an excuse for a review." I have known Halmos personally and closely for over 35 years, and feel grateful to him for all his many services to mathematics and mathematicians, myself included, and therefore believe that if his good intentions in the matter of book reviewing are to be realized, a new review of policy is needed now.

Leopoldo Nachbin
University of Rochester
(Received December 12, 1983)

Axion of Choice

Questions of priority are notoriously difficult. With regard to the Axiom of Choice, I prefer not to enter further into a controversy, except to point out that in his letter (Notices, January 1984, page 17) Irving H. Anellis has misrepresented my position, apparently due to a misreading of a footnote on page 80 of Gregory H. Moore's Zermelo's Axiom of Choice. There Moore correctly states that I have "pressed a claim for Peano."

I do agree with Professor Anellis that historically there has been a "denigration of the contributions of Peano," but his suggestion that this was due to anti-Semitism cannot be correct: Peano was not Jewish, and I know of no evidence that anyone who knew him thought he was. (I suspect that Professor Anellis's unnamed Milanese colleague confused Peano with his friend, the logician Alessandro Padoa, who was Jewish.)

The causes of the neglect of Peano are rather more complicated. I discussed some of them in my biography of Peano; my views have been confirmed in part by a grandniece of Peano in her Presentazione to the Italian translation of my book (Peano: Storia di un Matematico, Turin: Editore Boringhieri, 1983).

Hubert Kennedy
Providence College
(Received January 19, 1984)

Definitions

It is a great convenience to mathematicians that the meanings of technical words and other symbols are generally agreed on. Since we have no equivalent of the French Academy, this requires that sometimes we be willing to use definitions we do not like.

I believe there is almost universal support for what I have said so far, but I want to go farther and argue for some specific definitions. The natural numbers used to be the positive integers. Now when one finds the expression, he does not know whether zero is included unless he is told. Why not accept the earlier meaning? (To a less sophisticated audience I might even argue that zero is less natural than the positive integers.) Next, I have never known a mathematician who was willing to give up the convenience of being able to distinguish between "a ≤ b" and "a < b," but there are many who write "<" for "is a subset of." Finally, does every ring have a unity? There is much to be said for using a definition general enough to include all the similar algebras commonly studied, e.g. the even integers. What is at present not acceptable is to use either definition without telling the reader of the other.

John Dyer-Bennet
Carleton College
(Received November 21, 1983)

Policy on Letters to the Editor

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.
Position Open

Associate Executive Director

American Mathematical Society

Providence, Rhode Island

With the impending retirement of Dr. Lincoln K. Durst, the Society's Deputy Executive Director since 1970, the position of Associate Executive Director of the American Mathematical Society will become open in 1984.

Qualifications: the ideal candidate would

- have received a Ph.D. in one of the mathematical sciences within the past 10 or 15 years, so as to be familiar with the language and trends of contemporary American research mathematics,
- have a good command of the English language and be capable of writing well and easily
- have both an interest and previous experience (at least at the departmental committee level) in administration
- have an equable temperament and be able to work harmoniously with mathematicians and nonmathematicians alike.

Some previous experience with computers (as text or data processors), printing, publishing, government relations, or business management would be welcome but is of secondary importance.

Responsibility: About 125 people work in the Society's Providence office, and about half of them are concerned with publishing (editorial processing, translation, computer composition, printing/binding, promotion). In addition there are departments concerned with meetings, member services, order fulfillment, fiscal records, and computer programming and operations. The editorial offices for Mathematical Reviews, in Ann Arbor, employ another 70 persons. The two offices share some facilities, including the use of two DEC-2060 mainframes, but management is largely separate.

The person filling the open position will work with the Executive Director and the continuing Associate Executive Director, Dr. Jill P. Mesirov, in administering the work of this staff, and in executing the decisions of the Board of Trustees and of the Council. Sensitivity for the concerns of the mathematical research community is essential, since an important part of the job is to facilitate communication between members of the staff and the Trustees, the Council, editorial and other AMS committees, government agencies, and American and foreign mathematicians. Some travel will be involved.

Term of Appointment: Preferably this will be a three-year initial appointment, with a good possibility of reappointment on a term or continuing basis. Alternatively, the Society may consider the temporary appointment for one or two years of a mathematician on leave from a college or university.

Applications and nominations should be sent to

Dr. W. J. LeVeque, Executive Director
American Mathematical Society
P. O. Box 6248
Providence, R.I. 02940

Completed applications received by 1 June 1984 will be assured of consideration. Appropriate letters of reference should also be received by that date.

The Society is an equal opportunity employer, and has a generous fringe-benefit program, including TIAA/CREF. Salary for this position will be commensurate with the background of the appointee.
NSF Announces Mathematical Sciences Postdoctoral Research Fellowships

Thirty recent recipients of doctoral degrees in the mathematical sciences have been offered fellowship awards under the National Science Foundation's (NSF) Mathematical Sciences Postdoctoral Research Fellowship program, now in its sixth year. These awards will permit recipients to choose research environments that will have maximal benefit to their scientific development.

The awards are made to U.S. citizens or nationals. Selections are made on the basis of ability of the applicant and the likely improvement on his or her future in science. A panel of mathematical scientists, chosen by the American Mathematical Society (AMS), the Institute for Mathematical Statistics (IMS), and the Society for Industrial and Applied Mathematics (SIAM), evaluated 112 applications; final selections were made by the NSF.

The format of these Postdoctoral Fellowships has been changed significantly from those of former years to provide increased flexibility for the recipients. The stipend of $55,200 provides support for two nine-month academic years and three two-month summers, with the awardee's having two options for receiving the academic-year support: as full-time support for any eighteen academic-year months in a three-year period, in intervals not shorter than three consecutive months (the Research Fellowship option), or as a combination of full-time and half-time support over a period of three academic years, usually one academic year full-time and two academic years half-time (the Research Instructorship option).

The recipients in the mathematical sciences are listed below (institutions in parentheses are the current institution, those outside the parentheses are those at which the fellowship will be held): Michael T. Anderson (Rice University), University of California, Berkeley; D. Wallace Andreoli (Florida International University), University of California, Berkeley; David L. Banks (Virginia Polytechnic Institute and State University), University of California, Berkeley; Mutia Buys (University of New Mexico), University of Arizona; Jennifer Tour Chayes (Harvard University), Harvard University; Lincoln Chayes (Harvard University), Harvard University; Donna Crystal (Cornell University), Rheinische Friedrich-Wilhelms-Universität, Bonn, West Germany; Steven Paul Diaz (University of Pennsylvania), Brandeis University; Nicholas M. Ercolani (Ohio State University), University of Arizona; John Froelich (University of Iowa), University of California, Berkeley; Kenneth M. Golden (Courant Institute of Mathematical Sciences, New York University), Rutgers University; Robert E. Gompf (University of California, Berkeley), Mathematical Sciences Research Institute, Berkeley; Dhananjay Najela (Ohio State University), California Institute of Technology; Joel Hass (University of Michigan), Mathematical Sciences Research Institute, Berkeley; Michael L. Hogan (Stanford University), Columbia University; Michael J. Hopkins (Lehigh University), Princeton University; William David Joyner (University of Maryland), University of California, San Diego and Massachusetts Institute of Technology; Daniel MacRae Keenan (Carnegie-Mellon University), Brown University; Robert Krasny (University of California, Berkeley), Courant Institute of Mathematical Sciences, New York University; Robert S. Lubarsky (Massachusetts Institute of Technology), University of California, Berkeley; Diane M. Meuser (Boston University), Harvard University; Allen Moy (Yale University), Yale University; Robert A. Proctor (University of California, Los Angeles), Massachusetts Institute of Technology; Niles D. Rutten (Massachusetts Institute of Technology), Courant Institute of Mathematical Sciences, New York University; Steven H. Schochet (Courant Institute of Mathematical Sciences, New York University), Princeton University; Brad Shelton (University of California, San Diego), University of California, San Diego; Alice Silverberg (Princeton University), Harvard University; David Steinberg (Mathematical Research Center, Madison, Wisconsin), Stanford University and Tel Aviv University; Paul A. Voight (Yale University), Yale University; Virginia R. Young (University of Virginia), Institute for Advanced Study.

—NSF News Release

First Presidential Young Investigators

The White House Office of Science and Technology Policy has announced the selection of 200 engineers and scientists to receive the first Presidential Young Investigator Awards. The awards, which fund research by faculty near the beginning of their academic careers, are intended to help universities attract and retain outstanding young Ph.D.'s who might otherwise pursue nonteaching careers. The program is administered by the National Science Foundation (NSF). The awards carry an annual base grant from NSF of $25,000. In addition, NSF will provide up to $37,500 per year to match contributions from industrial sources, bringing the possible total support to $100,000 per year. The individual
universities are responsible for raising the non-federal funds. It is expected that 200 new investigators will be named each year, resulting after five years in a projected level of 1,000 active awards.

These awards address the growing faculty shortages in highly competitive fields of engineering and science. This problem has become acute in fields like engineering and computer sciences, but extends throughout scientific and technical disciplines.

Names of Presidential Young Investigators in the mathematical sciences, their institutions and fields of research follow: JOHN J. BARTHOLOLDI (Georgia Institute of Technology), Operations Research; ROBERT L. BRYANT (Rice University), Partial Differential Equations; RALPH L. COHEN (Stanford University), Topology; STUART A. GEMAN (Brown University), Probability and Statistics; KLAUS HOLLIG (Texas A&M University), Numerical Analysis; PETER W. JONES (University of Chicago), Fourier and Complex Analysis; and MITCHELL B. LUSKIN (University of Minnesota), Numerical Analysis.

NATO Postdoctoral Fellowships Awarded

The National Science Foundation (NSF) and the Department of State have announced the award of fifty North Atlantic Treaty Organization (NATO) Postdoctoral Fellowships in Science. These fellowships are awarded to young scientists for full-time postgraduate study abroad at institutions and laboratories in NATO countries or in countries that cooperate with NATO.

Of these fifty awards, although nineteen are in the general area of the physical sciences, mathematics and engineering, none have been awarded in the mathematical sciences.

Women and Minorities Continue Gains in Science, Engineering Employment

Women and minorities continue to make substantial gains in science and engineering employment and training but are still underrepresented in those fields, according to a new NSF report. Employment of women scientists and engineers increased more than 200 percent between 1972 and 1982, compared with about 40 percent for men. As a result, women accounted for 13 percent of the science-engineering work force in 1982. During the same period, the employment of black scientists and engineers almost tripled—to 86,000—while the employment of whites was up 40 percent.

The study also shows that the rates of participation of women and minorities in precollege science and mathematics courses and in receipt of science and engineering degrees are still lower than those of men and the majority.

One of the most dramatic features of the last decade, according to the report, has been the trend for more women to select education programs leading to science or engineering degrees. Women received 37 percent of the science-engineering bachelor's degrees granted in 1981, up from 27 percent in 1971. Women also earned 23 percent of all doctoral degrees in science and engineering granted in 1982, compared with 11 percent 10 years earlier.

Copies of the report, Women and Minorities in Science and Engineering (NSF 84-300), are available from the Division of Science Resources Studies, National Science Foundation, 1800 G Street, N.W., Washington, DC 20550; 202-634-4691.

Precollege Science and Mathematics Education

The National Science Foundation Directorate for Science and Engineering Education has issued an announcement concerning precollege science and mathematics education. This booklet contains information about precollege activities, including materials development and research, teacher development and incentives and special activities. General information for the preparation and submission of proposals is given. Proposals may be submitted at any time but applicants should allow six to nine months for review and processing. Copies of this announcement are available from the Directorate for Science and Engineering Education, National Science Foundation, Washington, DC 20550.

New Deadline for U.S.-United Kingdom Cooperative Science Program

The next deadline for submission of proposals from U.S. scientists for cooperative research, seminars, or long-term research visits under the U.S.-United Kingdom program has been changed to September 1, 1984 for 1985 funding. For further information about the program, contact Marilyn Rurak, Division of International Programs; 202-357-7554.

Cooperative Research with Eastern Europe

NSF's Eastern Europe Cooperative Science programs seek to foster and support scientific and technological cooperation between the U.S. and Bulgaria, Hungary, and Romania.

The programs offer financial support for three types of activities: cooperative research projects, seminars and workshops, and scientific visits for planning purposes. Proposals must be submitted to NSF by American institutions, and to the appropriate foreign agency by foreign institutions. Proposals should be prepared according to standard NSF guidelines, but must also contain a
section on “International Cooperation,” which describes the cooperative aspects of the work plan and the mutual benefits to be obtained. Proposals for joint research should be submitted at least nine months before the requested starting dates; for seminars, 12 months; and for short-term visits, six months.

For further information, contact Deborah Wince, Division of International Programs; 202-357-9516. —NSF Bulletin

Cooperative Science Program with Latin America and the Caribbean

Through its Division of International Programs, NSF supports U.S. investigators in cooperative scientific activities with colleagues in Latin America and the Caribbean. Collaborative research project support is ordinarily on a supplemental basis. Seminars/workshops on a specific topic and scientific visits of short duration are also supported. Cooperating foreign scientists must obtain support from other sources, and must submit a matching proposal to their own national science council.

Copies of the program guidelines, Cooperative Science Programs with Latin America and the Caribbean (NSF 80-52), are available. The semiannual deadline dates for submission of proposals are May 1 and November 1.

For additional program information, write or phone the U.S.-Latin America Cooperative Science programs, Division of International Programs; 202-357-9563. —NSF Bulletin

New Deadline Established for U.S.-Italy and U.S.-Switzerland Cooperative Science Programs

A new annual deadline of June 1, 1984, has been established for submission of proposals for fiscal year 1985 funding under the U.S.-Italy and U.S.-Switzerland Cooperative Science programs. Programs include cooperative research projects, workshops, and long-term research visits. The deadline for the U.S.-Switzerland International Postdoctoral Fellowship applications remains unchanged, i.e., October 1, 1984.

For further information, write or phone Henryk Uznanski, Division of International Programs; 202-357-7754. —NSF Bulletin

NSF Awards for Small Business Innovation Research

One hundred awards totaling $3.5 million have been made by the National Science Foundation (NSF) to small science- and technology-based firms in a program designed to increase the public return on investment from Federal funded research.

The awards, administered through the NSF’s Small Business Innovation Research (SBIR) program, were made to firms in 24 states and the District of Columbia. A total of 1,186 proposals were received in this year’s program from 48 states and the District of Columbia. Firms receiving awards ranged from a one-person company to one with 300 employees.

Objectives of the SBIR program are to increase the opportunity for small science and high technology firms to participate in NSF-funded research and to support high quality and cutting-edge research of interest to the NSF in areas that have potential industrial applications.


Positions Open in NSF

Applicants for the following positions should submit résumés including current salary to NSF, Personnel Administration Branch, Room 212, 1800 G Street, N.W., Washington, DC 20550; Attn: Timothy Connelly, 202-357-7840. Hearing impaired individuals should use TDD 202-357-7492. NSF is an Equal Opportunity Employer.

Specific years of successful scientific research experience beyond the Ph.D. are required for the following positions in all fields: Program Director, six to eight years; Associate Director, four to six years; Assistant Program Director, three to four years.

NSF’s Division of Mathematical Sciences, Division of Computer Research, and Directorate for Science and Engineering Education are seeking qualified applicants for the positions of assistant program director, associate program director, and program director for their respective activities in NSF. The positions will be filled on a one- or two-year rotational basis and are excepted from the competitive civil service. Salaries range from $30,000 to $45,000 for assistant program director; $35,000 to $55,000 for associate program director; and $40,000 to $65,000 for program director.

Applicants should have a Ph.D. or equivalent experience and training in an appropriate field and the required years of successful scientific research experience beyond the Ph.D. A broad, general knowledge of the field and some administrative experience are also required. For the Science and Engineering Education Directorate positions, expertise in materials development, research or teacher development for precollege science and mathematics education is also required.

—NSF Bulletin
The AMS is pleased to announce that it is publishing a major new reference work, *Reviews in Number Theory 1973–83*, edited by Richard K. Guy.

The format and classification system follow essentially the plan established in the earlier volumes, with refinements thought to be desirable by a panel of specialists after ten years of experience with the original. As before, each entry is provided with an “appearance number” in this work, as well as its original MR number. In addition to appearance numbers for all MR numbers cited in the text of reviews, appearance numbers have been given for forward references originally identified by phrases such as “to appear”. Also, appearance numbers are given at the bottom of each entry for all later entries which cite the present one, so that the reader can learn of more recent results. For occasional papers which have not been reviewed in MR, reviews from Zentral­blatt für Mathematik or “guest reviews” have been included. Cross referencing has been enhanced and simplified by bringing together batches of related papers into subsections of sections of chapters. Wherever a review consists largely of the table of contents of the proceedings of a conference, the MR and appearance numbers of the individual papers have been added. A scan has been made of all of MR in order to pick up papers not originally included but that now, with hindsight to see the directions that number theory has been taking in the last ten years, seem to have significant number-theoretic content. This has resulted in adding about 400 reviews prior to 1973.

1980 Mathematics Subject Classification: 10—XX

Six volumes, approximately 3,600 pages (soft cover)

Prepublication prices: List $625, institutional member $500

Publication date: November 1984

To order, please specify REVNUM/83
1984 AMS Elections

Nominations by Petition

Vice-President or Member-at-Large

One position of vice-president and member of the Council ex officio for a term of two years is to be filled in the election of 1984. The Council intends to nominate two candidates, whose names may be expected to appear in the June issue of the Notices, which is scheduled to be mailed by the printer on May 25. Nominations by petition as described in the box are acceptable.

Five positions of member-at-large of the Council for a term of three years are to be filled in the same election. The Council intends to nominate seven candidates, whose names may be expected to appear in the June Notices. Nominations by petition in the manner described in the box are acceptable. The Council has stated its intent to have at least ten candidates and will bring the number up to ten if the nominations by petition do not do so.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions.

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

The Nominating Committee for 1985

Four places on the Nominating Committee will be filled by election. There will be four continuing members of the Nominating Committee, namely

Heini Halberstam
Robert P. Langlands
Barry Simon
Harold M. Stark

The new members will be elected in a preferential ballot. The President will name six candidates for these four places. The names may be expected to appear in the June issue of the Notices. Nominations by petition, in the manner described in the box, will be accepted. Should the final number of candidates be less than eight, the President will bring it up to eight.

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

Rules and Procedures

Use separate copies of the form for each candidate for vice-president, member-at-large, or member of the Nominating Committee.

1. To be considered, petitions must be addressed to Everett Pitcher, Secretary, P.O. Box 6248, Providence, Rhode Island 02940, and must arrive by July 9, 1984.

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

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

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

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

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

7. When a petition meeting these various requirements appears, the Secretary will ask the candidate whether he is willing to have his name on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.
NOMINATION PETITION FOR 1984 ELECTION

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

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

- [ ] Vice-President
- [ ] Member-at-Large of the Council
- [ ] Member of the Nominating Committee


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291
New Rules Concerning Abstracts
of Papers Submitted to the Society

Two changes have recently been ordered in the procedure for processing abstracts. These changes in procedure were made by the Executive Committee, the Council and the Board of Trustees.

A fifteen dollar fee for each abstract (except for abstracts of invited hour addresses) has been instituted to cover a portion of the expenses of preparing the abstract for publication in the journal Abstracts of papers presented to the American Mathematical Society. Abstracts should be accompanied by the payment of $15: send a check or money order, or use VISA or MASTERCARD, but do not send cash. If an abstract is received in Providence without payment, an invoice will be sent and the abstract will be set aside until payment is received. If payment is not received before the issue of the Notices containing the program of the meeting is typeset, the paper will not be listed in the program of the sessions.

Each person who is not a member of the Society but who wishes to present a paper at a meeting or by title, must henceforth be sponsored by a member, whose signature must appear on the abstract form. The only exceptions to this rule are invited hour speakers and invited speakers in Special Sessions; in the latter case such speakers will be considered to be sponsored by the organizer of the Special Session. Abstracts of papers, none of whose authors is a member of the Society, which are received in Providence without the signature of a sponsoring member will be returned to the submitter, who must bear the responsibility for locating a suitable sponsor.

New abstract forms have been prepared for use by mathematicians who present papers at AMS meetings or who submit abstracts for presentation “by title” in Abstracts. The new forms contain instructions covering these new procedures. They are being distributed to departments of mathematics in universities and colleges in the United States and Canada and are available on request from the Society’s office in Providence. The new forms should be used as soon as possible, in order to avoid confusion and distress.

The new rules will be enforced beginning with by title abstracts to appear in the October 1984 issue and papers to be presented at the fall 1984 sectional meetings of the Society.

For copies of the new abstract forms, write to the Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, U.S.A.
The eight hundred and twelfth meeting of the American Mathematical Society will be held at Plymouth State College in Plymouth, New Hampshire, on Friday, Saturday and Sunday, June 29, 30 and July 1, 1984. The Society will meet jointly with the Northeast Section of the Mathematical Association of America (MAA).

All scientific sessions will be held in Hyde Hall.

**Invited Addresses**

By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there will be three invited one-hour addresses. The speakers, their affiliations, the titles of their talks, and the days on which their talks are tentatively scheduled, are as follows:

DAVID CATALIN, Princeton University and Purdue University, *Boundary behavior of holomorphic maps and the ∇-problem*, 9:00 a.m. Saturday.

AMITAI REGEV, The Weizmann Institute, Israel and Pennsylvania State University, *P. I. algebras and representations of classical groups*, 3:00 p.m. Friday.

JONATHAN ROSENBERG, University of Maryland, College Park, *Recent applications of C*-algebras to the topology and geometry of manifolds*, 9:00 a.m. Sunday.

**Special Sessions**

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


*C*-algebras and topology/geometry, JONATHAN ROSENBERG, Friday afternoon and Sunday. Paul Baum, Peter Haskell, Richard Herman, Jerome Kaminker, James Mingo, Robert Powers, Marc Rieffel, Jonathan Rosenberg, Claude Schochet, Antony Wassermann, and Dana Williams.

**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 prior to the deadline of April 23, 1984.

**MAA Banquet**

This traditional and popular event will be held on Friday evening. The after-dinner speaker is RICHARD D. ANDERSON of Louisiana State University, a Past President of the Association. All meeting participants are invited to attend the banquet. Advance reservations are requested, and a preregistration form on which this can be indicated follows on page 294. The cost for the banquet, including a wine and cheese social, is $10 per person. Check or money order should be made payable to Plymouth State College and mailed with the form to Paul L. Estes, Department of Mathematics, Plymouth State College, Plymouth, New Hampshire 03264.

**Other MAA Activities**

Events scheduled by the MAA include the following:

On Saturday morning SOLOMON GARFUNKEL, Executive Director of COMAP, will conduct a workshop on Applicable mathematics; ALICE T. SCHAFER, Wellesley College, will speak on Mathematics in management courses: Prerequisites, topics, expectations. That same afternoon JOHN F. DALPHIN, Indiana-Purdue University at Fort Wayne, will speak on Accreditation and certification of mathematics and computer science programs; FERNAND J. PREVOST of the New Hampshire State Department of Education will chair a panel discussion on The crisis in mathematics teaching training. In the evening STEPHANIE F. TROYER, University of Hartford, will speak on The fourth dimension.

Additional information concerning the MAA activities will be included in the June issue of the Notices and the April Newsletter issued by the Northeast Section of the MAA to its members.

**Registration**

The meeting registration desk will be located in the lobby of Mary Lyon Hall in the center of the Plymouth State College campus. The desk will be open from 1:00 p.m. until 6:00 p.m. on Friday, and from 8:00 a.m. until 10:00 a.m. on Saturday. The registration fees are $5 for students or unemployed mathematicians and $10 for all others.

Although it will be possible to register at the meeting, the Local Arrangements Committee prefers and requests preregistration. A form suitable for that purpose is on page 294.

**Petition Table**

A petition table will be set up in the registration area. Additional information can be found in a box in the Eugene meeting announcement on page 305 in this issue of the Notices.

**Accommodations**

On campus. Dormitory rooms will be available in Mary Lyon Hall, a two-minute walk from Hyde Hall. The daily rates are $17 per person for singles and $11 per person for double or triple occupancy. Rooms may be reserved when preregistering (see above).

Off campus. Rooms may also be obtained at the following hotels. Interested participants should make their own arrangements directly, citing
Preregistration, Meals and Lodging

Plymouth, New Hampshire Mathematics Meeting
June 29–July 1, 1984

AMS Eastern Section/MAA Northeast Section

Please complete the form below and return it with your check (made payable to Plymouth State College) to:

Professor Paul L. Estes
Department of Mathematics
Plymouth State College
Plymouth, New Hampshire 03264

Name ___________________________ Last __________ First __________ Middle Initial __________

Affiliation ____________________________

Mailing Address ____________________________

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Name(s) of sharer(s):* ____________________________________________________________

TOTAL ENCLOSED $________

*Each person sharing should submit a separate form with payment.

Check membership:

AMS [ ] MAA [ ] Nonmember [ ]
their association with the Plymouth State College meetings. Prices are subject to change.

Plymouth Inn (0.5 miles)
52 South Main Street, Plymouth 03264
Telephone: 603-536-1129
Single $20–$25 Double $25–$30

Deep River Motor Inn (1 mile)
Highland Street, Plymouth 03264
Telephone: 603-536-2155
Single $34.95 Double $39.95

Knoll Motel (1 mile)
Route 3, Plymouth 03264
Telephone: 603-536-1245
Single $25–$26 Double $25–$30

Pilgrim Motel and Cottages (1 mile)
Route 3, Plymouth 03264
Telephone: 603-536-1319
All rooms $26–$36

Circle House Bed & Breakfast (3 miles)
Route 25, Plymouth 03264
Telephone: 603-536-2471
$15 per person

Holiday Inn (4 miles)
Route 3, Campton 03264
Telephone: 603-536-3520
Single $42 Double $50

Travel

Participants who can conveniently travel by car are encouraged to do so. Plymouth is about 2.5 hours north of Boston on Interstate 93.

Commercial airline service is available to Boston, to Manchester, New Hampshire, and to Laconia, New Hampshire. Car rentals are available at Boston airport (Logan) and in downtown Manchester and Laconia. From Logan airport, two Concord Trailways buses serve Plymouth daily.

Parking

There is ample free parking in lots located liberally and conveniently about the campus.

Middletown, Connecticut

W. Wistar Comfort

Associate Secretary
On Some Mathematical Questions in Biology
DNA Sequence Analysis


The eighteenth annual Symposium on Some Mathematical Questions in Biology will be held on Monday, May 28, 1984, in the Beekman Room of the New York Hilton Hotel, New York, New York, in conjunction with the annual meeting of the American Association for the Advancement of Science. The symposium is sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics, and Section A (Mathematics) of the American Association for the Advancement of Science. Cosponsors: Section G (Biological Sciences) and U (Statistics).

The program has been arranged by an organizing committee consisting of H. Thomas Banks (Brown University); Gail A. Carpenter, (Northeastern University); Joel E. Cohen (Rockefeller University); Joseph B. Keller (Stanford University); Robert M. Miura (University of British Columbia), chairman; Garrett M. Odell (Rensselaer Polytechnic Institute); Charles S. Peskin (Courant Institute, New York University); and John Rinzel (National Institutes of Health).

The theme of the symposium is DNA Sequence Analysis. There will be two half-day sessions, each including three one-hour lectures.

PROGRAM

Chairman: Robert M. Miura

9:00 a.m. Some Mathematical Questions in Biology—DNA Sequence Analysis
Presiding: DAVID LIPMAN, National Institutes of Health

Unresolved problems in DNA Sequence Analysis. WALTER FITCH, University of Wisconsin Medical School

Mutation pressure, fixation probability and rates of evolution. ALLAN C. WILSON, University of California, Berkeley

Pattern recognition in DNA. PETER H. SELLERS, Rockefeller University

2:30 p.m. Some Mathematical Questions in Biology—DNA Sequence Analysis
Presiding: WALTER FITCH, University of Wisconsin Medical School

Probability distributions for DNA Sequence Comparisons. MICHAEL S. WATERMAN, University of Southern California

Some probabilistic and statistical problems in the analysis of DNA sequences. SIMON TAVARE, Colorado State University

RNA folding prediction: The continued need for interaction between biologists and mathematicians. MICHAEL ZUKER, National Research Council of Canada
88th Summer Meeting of the AMS
August 16–19, 1984

Colloquium Lectures
There will be a series of four Colloquium Lectures presented by Paul H. Rabinowitz of the University of Wisconsin, Madison. The title of this lecture series is Minimaz methods in critical point theory and applications to differential equations. The lectures will be given at 1:00 p.m. daily, Thursday through Sunday, August 16–19.

Steele Prizes
The 1984 Leroy P. Steele Prizes will be awarded at a session at 4:30 p.m. on Saturday, August 18.

Invited Addresses
By invitation of the Program Committee, there will be seven invited one-hour addresses. The list of speakers, their affiliations, the dates and times of their talks, and the titles follow:

Ralph Cohen, Stanford University, Applications of homotopy theory to analytic and geometric problems, 3:20 p.m. Friday; Ralph Greenberg, University of Washington, Seattle, Elliptic curves and L-functions, 3:20 p.m. Sunday; Yianis N. Moschovakis, University of California, Los Angeles, Foundations of the theory of algorithms, 2:05 p.m. Sunday; Paul Seymour, Bell Communications Research, Inc., A Kuratowski theorem for general surfaces, 11:05 a.m. Thursday; Clifford H. Taubes, University of California, Berkeley, Gauge theories and the calculus of variations, 3:20 p.m. Thursday; Chiu-Lian Terng, Northeastern University, A natural variational problem in Riemannian geometry, 8:40 a.m. Saturday; David A. Vogan, Jr., Massachusetts Institute of Technology, Unitary representations of simple Lie groups, 8:35 a.m. Thursday.

Special Sessions
By invitation of the same committee, there will be six special sessions of selected twenty-minute papers. The topics of these special sessions, the names and affiliations of the mathematicians arranging them, and tentative dates and times are as follows:

Variational methods in nonlinear problems, Felix E. Browder, University of Chicago, 8:00 a.m. Sunday.

Algebraic topology, Ralph Cohen, 8:00 a.m. Saturday.

Geometry of configurations, Jacob E. Goodman, CUNY, City College and Richard Pollack, Courant Institute of the Mathematical Sciences, New York University, 8:00 a.m. Friday.

Computational complexity, Eugene M. Luks, University of Oregon, Eugene, 8:00 a.m. Sunday.
Preregistration and Housing

Preregistration. Preregistration for these meetings must be completed by July 1, 1984. All 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 July 1.

Preregistration for the meeting and full payment of room/board charges is a requirement in order to obtain confirmed residence hall accommodations at Eugene through the Mathematics Meetings Housing Bureau. Checks for preregistration fee(s), housing payments and fees for social events 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, MAA, IIME $47
Emeritus Member of AMS, MAA $12
Nonmember $12
Student/Unemployed $12

MAA Minicourses #1 through #8 $20 each

Do not submit minicourse fee(s) with preregistration form.

A $5 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 payments due. Preregistration forms received well before the deadline of July 1 which are not accompanied by correct payment will be returned to the participant with a request for resubmission with full payment.

A 50 percent refund of the preregistration fee(s) will be made for all cancellations received in Providence no later than August 13, 1984. 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 refund will be made of the Joint Mathematics Meetings preregistration fee, 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 Joint Meetings preregistration will be processed.

Housing. The use of the services offered by the Mathematics Meetings Housing Bureau requires preregistration for the meetings. Persons desiring confirmed residence hall accommodations should complete the preregistration/housing form, or a reasonable facsimile, and send it with payment in full to the Mathematics Meetings Housing Bureau, Post Office Box 6887, Providence, Rhode Island 02940-6887, so that it will arrive no later than July 1, 1984. (See Housing section of preregistration/housing form.)

Please read carefully the section on University Housing 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 residence halls reservations with full prepayment for room/board will be confirmed by the Housing Bureau. All reservation requests must be received in writing and be processed through the Housing Bureau in Providence. Please do not contact the university directly. Telephone requests will not be accepted. Housing assignments are made on a first-come, first-served basis, so participants desiring specific types of accommodations are urged to get their housing requests in as early as possible. Housing requests received after the deadline of July 1 most surely cannot be honored.

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/housing form. Parties planning to share rooms should send their forms together in the same envelope, if possible.

Changes/Cancellations

Please make all changes to or cancellations of residence hall reservations with the Housing Bureau in Providence before July 15, 1984 in order to receive full refund of housing payment. After that date, cancellations should be made with the Housing Bureau in Providence up until August 10, 1984, at which time a partial refund (amount paid minus one night’s room/board) will be made. No cancellations can be made between 5:00 p.m. on Friday, August 10, and 4:00 p.m. on Wednesday, August 15, after which changes or cancellations may be called in to Mary Coccoli at the Telephone Message Center number in Eugene. Changes in reservations may be made at any time by notifying the Housing Bureau in Providence.

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 and address.
Structures of graphs and matroids, Paul Seymour, 8:00 a.m. Thursday.

Gauge theories and applications, Clifford H. Taubes, 8:00 a.m. Friday.

Most of the papers to be presented at these special sessions will be by invitation; however, anyone contributing an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these sessions should indicate this clearly on the abstract, and should submit it by May 15, 1984, three weeks earlier than the normal deadline for contributed papers, in order that it may be considered for inclusion.

Contributed Papers
There will be sessions for contributed papers on Thursday, Friday, Saturday and Sunday mornings and afternoons as needed. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics, and should be sent to the American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, so as to arrive by the abstract deadline of June 5, 1984. Members are reminded that a charge of $12 is imposed for retyping abstracts that are not in camera-ready form.

Late papers will not be accepted.

Other AMS Sessions
Council Meeting
The Council of the Society will meet at 5:00 p.m. on Wednesday, August 15.

Business Meeting
The Business Meeting of the Society will take place immediately following the Steele Prize Session on Saturday, August 18. 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.

64th Summer Meeting of the MAA
August 16–19, 1984

Hedrick Lectures
The 33rd Earle Raymond Hedrick Lectures will be given by Neil J. A. Sloane of AT&T Bell Laboratories. The title of this series of three lectures is Lattices, sphere packings and applications. These lectures will be given at 11:00 a.m. on Friday, Saturday, and Sunday, August 17–19.

Invited Addresses
There will be seven invited fifty-minute addresses. The list of speakers, their affiliations, dates and times of their talks, and the titles follow:

Peter J. Hilton, SUNY, Center at Binghamton, How to fold polygons and do number theory, Part II, 10:00 a.m. Sunday.

Robert L. Jewett, Western Washington State University, Applications of geometry to the social sciences, 1:00 p.m. Sunday.

Jean J. Pedersen, University of Santa Clara, How to fold polygons and do number theory, Part I, 9:00 a.m. Sunday.

Carl Pomerance, University of Georgia, Athens, How to factor an integer, 1:00 p.m. Saturday.

Constance Reid, San Francisco, Mathematicians without mathematics, 2:15 p.m. Friday.

David P. Roselle, Virginia Polytechnic Institute and State University, Combinatorial problems with surprising solutions, 2:15 p.m. Thursday.

Ronald J. Stern, University of Utah, Instantons and the topology of 4-manifolds, 8:40 a.m. Friday.

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 August 18, 1984, receive the service offered by the committee in the most effective manner, it should be in the hands of the secretary by July 18, 1984.

Everett Pitcher, Secretary
American Mathematical Society Short Course Series

Introductory Survey Lectures on
Environmental and Natural Resource Mathematics

Eugene, Oregon, August 14–15, 1984

The American Mathematical Society, in conjunction with its eighty-eighth summer meeting, will present a two day short course on Environmental and Natural Resource Mathematics on Tuesday and Wednesday, August 14 and 15, at the University of Oregon in Eugene. The program is being coordinated by Robert McKelvey of the University of Montana.

The field of environmental and resource management is a highly interdisciplinary one, where mathematical modeling analyses have proved to be extremely effective. From the beginnings of the subject, mathematical scientists have been able to play major, sometimes decisive, roles in its development. At the same time, the requirements of resource modeling applications have stimulated new initiatives in mathematical theory.

The purpose of the course is to provide participants with an overview of natural resource modeling and the kind of mathematical ideas which enter. In addition the course will provide an entrée to the literature of the subject, for those who might wish to learn more, or even become actively involved in research.

Synopses of the talks and accompanying reading lists appear in this issue of the Notices. The course will consist of six 75 minute survey lectures, and a final discussion session with audience participation. Richard Plant, a mathematician from the University of California, Davis, will lead off, discussing the role of mathematical models in integrated management of insect pests. Maureen Cropper, an economist from the University of Maryland, will describe recent theoretical work on decentralized management of environmental systems. Geoffrey Heal, resource economist from Columbia University, will introduce some of the classical issues, of equity and economic efficiency, in the management of an exhaustible resource such as oil. Colin Clark of the Applied Mathematics Institute of the University of British Columbia, will examine models of renewable resources, especially marine fisheries, and will discuss the effect of fluctuating environments and incomplete information. Frank Clarke, of the University of British Columbia, an authority on convex analysis and control theory, will explore some perspectives on optimal control theory that are particularly relevant to applications to natural resource modeling. Finally Graciela Chichilnisky, of Columbia University, will examine some macroeconomic aspects of trade in resources, a subject that relies heavily on game theory and topological methods. Dr. Chichilnisky holds doctorates in both mathematics and economics.

Environmental and natural resource modeling can draw on a wide variety of mathematical disciplines, such as optimization theory, differential equations (stability, qualitative theory, etc.), stochastic processes, variational calculus and control theory, game theory (including differential games), decision theory and risk analysis, etc., and can utilize some of the most sophisticated techniques that bear upon these disciplines (e.g. non-linear functional analysis, topological degree theory, non-smooth analysis, Ito calculus, etc.). Resource modeling also draws on much of modern economic theory, and on theoretical concepts from biology, physics and chemistry. It provides fascinating opportunities for the applied mathematician to expand his intellectual horizons.

The lectures in the short course should be accessible to advanced graduate students and professional mathematicians. No previous experience in resource modeling, nor familiarity with economic theory, will be assumed. It would be helpful to know a little about non-linear optimization (e.g. the Kuhn-Tucker conditions), and to be familiar with the simplest ideas from optimal control theory (such as can be obtained quickly by reading about the maximum principle, e.g. in Colin Clark's book, Mathematical Bioeconomics). More detailed and specific references are listed by the lecturers in their synopses.

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 titled Preregistration and Housing and Registration at the Meetings for details.

The short course was recommended by the Society's Committee on Employment and Educational Policy, whose members were Lida K. Barrett, Stefan A. Burr, Lisel Novak Gaal, Irwin Kra and Donald C. Rung (chairman). The short course series is under the direction of the CEEP Short Course Subcommittee, whose members were Stefan A. Burr (chairman), Lisel Novak Gaal, Cathleen S. Morawetz, Barbara L. Osofsky, and Philip D. Straffin, Jr.
Minicourses

Eight Minicourses are being offered by MAA. The names and affiliations of the organizers, the topics, the dates and times of their meetings, and the enrollment limitations of each are as follows:

Minicourse #1: *The intersection of mathematics and statistics* is being organized by THOMAS R. KNAPP, University of Rochester, and will be given from 8:00 a.m. to 10:50 a.m. on Friday and Saturday, August 17 and 18. Total enrollment for this Minicourse is limited to 30 persons. This course will focus on the incorporation of crucial statistical concepts into the mathematics curriculum, with particular emphasis on the last two years of secondary school and the first two years of college. There will be two three-hour sessions featuring small-group exercises and discussions of issues such as how much descriptive statistics to include, where you stop with probability, estimation vs. hypothesis testing, and the proper roles for computers and derivations.

Minicourse #2: *Applications of probability theory to the analysis and design of computer systems* is being organized by ROBERT GEIST, Clemson University, and KISHOR TRIVEDI, Duke University, and will be given from 8:40 a.m. to 10:40 a.m. on Saturday and Sunday, August 18 and 19. Total enrollment for this Minicourse is limited to 30 persons. The course is designed to provide the professional mathematician, who has a knowledge of elementary probability theory, with the fundamental tools necessary to independently investigate the configuration design of computer systems. Most examples will be suitable for use in the senior undergraduate curriculum, but extensions to current questions will also be explored. The material will be presented in four fifty-minute lecture sessions titled *Fundamental concepts, performance evaluation, reliability evaluation, and optimization.*

Minicourse #3: *Introductory computer science* is being organized by J. ARTHUR SEEBACH, St. Olaf College, and will be given from 2:15 p.m. to 4:15 p.m. on Friday and Saturday, August 17 and 18. Total enrollment for this Minicourse is limited to 30 persons. This Minicourse will present a number of the most central concepts of the conceptual core of the 1978 Association for Computing Machinery recommended courses in machine organization and data structures. The key structural or logical issues will be presented for mathematicians, starting with the use of binary arithmetic to represent the actual state of a computer. Next the course will introduce the representation and manipulation of data. The latter part of the Minicourse will discuss what is involved in more complex and higher-level organization of data and instructions. This will include several important data structures and the concepts of assemblers and operating systems. In addition, if time and the interest of the audience permit, the course might close with a brief foray into programming languages or input/output techniques. This is not a programming course nor is a programming background expected. Binary modular arithmetic, intuitive logic, and curiosity about what all the fuss and fancy jargon are about are the appropriate tools for this course.

Minicourse #4: *(A COMET Minicourse) Teacher in-service programs* is being organized by EUGENE A. MAIER, Mathematics Learning Center and Portland State University, and will be given from 8:00 a.m. to 10:50 a.m. and from 2:15 p.m. to 4:15 p.m. on Friday, August 17. Total enrollment for this Minicourse is limited to 80 persons. Mathematicians are becoming more aware of the responsibility of the mathematics community for developing programs to improve mathematics teaching at all levels in the schools. The CUPM Panel on Continuing Mathematical Education of Teachers (COMET) is sponsoring this minicourse for mathematicians who are interested in designing quality in-service programs. Mathematicians with no prior involvement in “math education” are especially welcome. The course will investigate strategies and procedures for offering continuing education that serves to increase teachers’ competence and confidence in teaching mathematics. Topics discussed will include: types of programs, funding, judging needs and interests of teachers, program design and selection of content, instructional approaches, examples of exemplary programs, and reflections of a mathematician as a mathematics educator.

Minicourse #5: *Pascal for mathematicians* is being organized by HARLEY FLANDERS, Florida Atlantic University, and will be given from 5:00 p.m. to 7:00 p.m. on Thursday, August 16, and from 6:15 p.m. to 8:15 p.m. on Saturday, August 18. Total enrollment for this Minicourse is limited to 40 persons. This is a four-hour, self-contained introduction to computer programming in the programming language Pascal. No previous programming experience is expected. The language will be presented through a sequence of graded examples. As far as possible, the examples will solve the kinds of problems that interest scientists and mathematicians rather than data organizers. Some program listings and other material will be handed out, and many programs will be run on a demonstration computer. However, the course will be hands-off rather than hands-on, since the main purpose is to teach Pascal, not how to communicate with a particular machine. (References: 1. K. Jensen & N. Wirth, Pascal User Manual and Report, Springer-Verlag, 1978; and 2. H. Flanders, *Scientific Pascal*, Reston Publishing Co., 1984.)

Minicourse #6: *Introduction to computer graphics* is being organized by JOAN WYZKOWSKI, Bradley University, and will be given from 8:40 a.m. to 10:40 a.m. and 2:15 p.m. to 4:15 p.m. on Sunday, August 19. Total enrollment for this Minicourse is limited to 30 persons. Graphs and illustrations of geometrical objects are useful tools in the teaching of mathematics. Computer graphics simplifies the production of these teaching aids. This Minicourse will present some of the mathematical techniques used to produce realistic pictures on graphics terminals. Emphasis will be on the use of these techniques to complement mathematics instruction. Some of the topics to be discussed are curve and surface sketching, 2D and 3D transformations, perspective drawing, and hidden line removal. Since personal computers will be available for demonstrations and in-class implementations, programming experience is necessary.

Minicourse #7: *Discrete algorithmic mathematics* is being organized by STEPHEN B. MAURER, Swarthmore College and Alfred P. Sloan Foundation, and will be given from 9:00 a.m. to 11:30 a.m. and from 7:30 p.m. to 9:30 p.m. on Thursday, August 16. Total enrollment for this Minicourse is limited to 80 persons. The organizer will present
his ideas on how to give a freshman-sophomore mainstream discrete mathematics course which is neither “finite math” nor “discrete structures” and which highlights the algorithmic point of view. He will discuss how to glue the course together using induction/iteration/recursion; how to avoid the Scylla of dull play with definitions and the Charybdis of too many subtle proofs; how to make the course valuable to all students, not just computer science students; and how you don’t have to be an expert in combinatorics or computer science to teach it, because it is based on ideas all mathematicians are familiar with in other contexts.

Minicourse #8: Microcomputer software in mathematics instruction is being organized by ROY E. MYERS, Pennsylvania State University, New Kensington, and will be given from 10:00 a.m. to noon and 2:15 p.m. to 4:15 p.m. on Thursday, August 16. Total enrollment for this Minicourse is limited to 30 persons. A wide variety of instructional software is becoming available for use with microcomputers. It varies in nature, including drill and practice, tutorial, and materials for use as lecture aids. Software is available for use in courses from introductory algebra through calculus, statistics, differential equations, and linear algebra. In this Minicourse, various types of software will be demonstrated, and issues relating to their uses will be discussed. It is planned that a large variety of software will be available and that Minicourse participants will have the opportunity to work with the software on microcomputers.

The Minicourses are open only to persons who have registered for the Joint Mathematics Meetings and paid the Joint Meetings registration fee.

The Minicourses have separate registration fees of $20 each. This fee entitles the registrant to attend all sessions of the Minicourse for which he/she has registered. Please note in the descriptions above the dates and times when these Minicourses meet. Participants are limited to two Minicourses each. It is advised that alternate choices be given in the event the first and/or second choice Minicourses are full. Payment of the fee(s) must be made to the Minicourse Cashier at the meeting registration desk in Eugene two working hours prior to the beginning of the Minicourse or the reservation will be relinquished to someone on the waiting list. When making payment, the participant should present the confirmation to the Minicourse Cashier. “Standby” reservation confirmations will be issued to participants whose preregistration was received after the Minicourse was filled. These individuals should check with the Minicourse Cashier one working hour prior to the Minicourse to see if any openings have occurred.

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 refund can be made of the Joint Mathematics Meetings preregistration fee(s). Otherwise, the Joint Meetings preregistration will be processed, and then be subject to the 50 percent refund rule.

Contributed Papers

Papers are being accepted on four topics in collegiate mathematics for presentation in contributed paper sessions at the MAA Summer Meeting in Eugene. These sessions will be held on Thursday morning and afternoon and Friday morning. The topics are:

- Precalculus, college, and remedial instruction—common concerns (Anneli Lax, Courant Institute of the Mathematical Sciences, New York University, Session Leader)
- Visual mathematics in the undergraduate curriculum (Martin E. Flashman, Humboldt State University, Session Leader)
- Motivating teaching ideas that do not compromise mathematics: Presentations, examples, or applications (Larry Runyan, Shoreline Community College, Session Leader)
- Use of computers in upper division mathematics courses (Ronald H. Wenger, University of Delaware, Session Leader)

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes.

Individuals wishing to submit papers for any of these sessions in Eugene should send the following information to the MAA Washington office (1529 Eighteenth Street, NW, Washington, DC 20036) before May 15, 1984.

1. Title
2. Intended session
3. A one-paragraph abstract (for distribution at the meeting)
4. A one-page outline of the presentation
5. A list of special equipment required for the presentation (e.g., computer, film projector, videotape player).

Late papers will not be accepted.

This information will be sent to session leaders who will arrange for refereeing. Selection of papers will be announced by July 1, 1984.

Other MAA Sessions

The Panel on Curriculum at Two-Year Colleges will hold a session from 2:10 p.m. to 4:20 p.m. on Saturday, August 18. The first hour will be devoted to a presentation of the panel’s investigations and the second hour will be an open forum during which reactions and suggestions from the audience will be encouraged. The moderator is RONALD M. DAVIS, Northern Virginia Community College.

The MAA Film Program will be held at 7:00 p.m. on Thursday, August 16.

Business Meeting

The Business Meeting of the MAA will take place at 4:35 p.m. on Friday, August 17 at which the 1984 Carl B. Allendoerfer, Lester R. Ford, and George Pólya Awards for expository writing will be presented. Awards of Certificates for Meritorious Service will be announced. This meeting is open to all members of the Association.
Board of Governors

The MAA Board of Governors will meet at 9:00 a.m. on Wednesday, August 15. This meeting is open to all members of the Association.

Section Officers

The Section Officers' Annual Meeting will take place at 3:30 p.m. on Thursday, August 16.

Banquet for 25-year Members

The MAA is planning its ninth annual banquet for individuals who have been members of the Association for twenty-five years or more. The banquet will take place at 6:15 p.m. on Saturday evening, August 18, in Gerlinger Lounge. Part of the program will be a special tribute to G. Baley Price. Dinner will be served at 7:00 p.m.; the menu is as follows: soup, stuffed beef tenderloin, asparagus with Hollandaise sauce, herbed rice, marinated vegetable salad, Devonshire cream with raspberries, rolls and coffee. Dinner will be preceded by a reception.

Please note that all tickets for this banquet must be purchased through preregistration, since a guarantee must be given to the caterer. Tickets are $16 each and interested participants should complete the appropriate section of the preregistration form.

Joint AMS-MAA Sessions

By invitation of the AMS-MAA Joint Program Committee (Jeanne L. Agnew, Melvin Hochster, Robion C. Kirby (chairman), Roy W. Ryden), the following speakers will address the joint meeting of the AMS and MAA on the history and development of mathematics. The names of the speakers, their affiliations, the dates and times of their talks, and the area of the subject they will address follow:

RAOUL H. BOTT, Harvard University, Topology, 9:45 a.m. Saturday; PHILIP J. DAVIS, Brown University, Mathematics and rhetoric, 9:45 a.m. Thursday; and JUDITH V. GRABINER, California State University, Dominguez Hills, Controversies in artificial intelligence: A historian's perspective, 9:45 a.m. Friday.

ACTIVITIES OF OTHER ORGANIZATIONS

The Association for Women in Mathematics (AWM) will be arranging a program for presentation at 9:00 a.m. on Friday, August 17. The AWM Membership Meeting will follow at 10:20 a.m. At 8:30 p.m. on Friday, August 17, the AWM will sponsor a party.

Pi Mu Epsilon (TME) will hold its annual meeting on Friday and Saturday, August 17 and 18. The J. Sutherland Frame Lecture will be given at 8:30 p.m., on Saturday, August 18. The name of the speaker and the title of the talk will be announced later.

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 exhibits.

Exhibits

The book and educational media exhibits will be open from 1:00 to 5:00 p.m. on Thursday, August 16 and from 8:30 a.m. to 4:30 p.m. on Friday and Saturday, August 17 and 18. All participants are encouraged to visit the exhibits during the meeting.

MATHFILE

The online MR database MATHFILE will be shown in the exhibit area during regular exhibit hours. Information published in Mathematical Reviews since 1973 can be located by the computer in seconds. A printout of results is ready in minutes.

MATHFILE can now be accessed on two inexpensive evening systems especially designed for users of personal computers. BRS/After Dark and now DIALOG's Knowledge Index are offering MATHFILE in addition to many other databases. Knowledge Index requires no monthly minimum and includes 2 hours of free introductory search time with the initial fee of $35. Both systems use simplified command languages, but differ in price and in the software used. BRS/After Dark is menu-driven, Knowledge Index is not.

Although the evening services are designed for personal users, an academic department can also subscribe at the same low prices. Both systems will be demonstrated during exhibit hours.

MATHFILE is searched in libraries on the main systems of DIALOG and BRS, and is also available from the European Space Agency—Information Retrieval Service (ESA—IRS).

The MATHFILE User's Guide will be available for inspection at the booth and can be purchased at the AMS book sale.

For those interested in obtaining more information on the vendors’ services, the toll-free numbers are:

BRS: 800-833-4707; in New York 518-783-1161.
DIALOG: 800-227-1927; in California 800-982-3810.

Summer List of Applicants

At the direction of the AMS-MAA-SIAM Committee on Employment Opportunities, which is charged with operation of the Employment Register and with the publication of Employment Information in the Mathematical Sciences, the Society will publish a Summer List of mathematical scientists seeking employment for distribution at the Eugene meeting.

Copies of the 1984 summer list will be available at the Transparencies section of the registration desk for $3. Following the meeting, they may be purchased from the AMS office in Providence for $5. This list should prove useful to employers who have last-minute openings in the latter part of the summer or in the fall.
1 Bean Complex
Gaswell
DeBusk
Ganoe
Henderson Hall (check-in)
2 Hamilton Complex (cafeteria)
Dunn
Robbins
Spiller
3 Walton Complex
Caswell
DeCou
Dyment
Hawthorne
4 Bean Complex Parking
5 Erb Memorial Union
6 Fenton
Mathematics Library
7 Deady
8 Geology
9 Gilbert
10 Geisinger
11 Science Library
12 Outdoor Tennis Courts
13 Covered Tennis Courts
14 Leighton Pool
15 City Center Lodge
16 Continental Motel
17 New Oregon Motel
18 Greentree Motel
19 Angus Inn
20 Sixty-Six Motel
Petition Table
At the request of the AMS Committee on Human Rights of Mathematicians, a table will be made available in the meeting registration area at which petitions on behalf of named individual mathematicians suffering from human rights violations may be displayed and signed by meeting participants acting in their individual capacities.

Signs of moderate size may be displayed at the table, but must not represent that the case of the individual in question is backed by the Committee on Human Rights unless it has, in fact, so voted. Volunteers may be present at the table to provide information on individual cases, but notice must be sent at least seven (7) days in advance of the meeting to the Meetings Department in Providence (telephone 401-272-9500). Since space is limited, it may also be necessary to limit the number of volunteers present at the table at any one time. The Committee on Human Rights may delegate a person to be present at the table at any or all times, taking precedence over other volunteers.

Any material which is not a petition (e.g., advertisements, résumés) will be removed by the staff. When registration closes, any material on the table will be discarded, so individuals placing petitions on the table should be sure to remove them prior to the close of registration.

The deadline for receipt of applicant forms to appear in this summer list is July 1, 1984. The applicant preregistration résumé and instructions on its completion can be found at the back of this issue.

Instead of an Employment Register at the Summer Meeting in Eugene, there will be an opportunity for posting of both applicant résumé forms and employers' announcements of open positions in or near the main meeting registration area. There will be no special room set aside for interviews. No provisions will be made by the Society for interviews: arrangements will be the responsibility of each employer and applicant. Messages may be left in the message box located in the registration area.

Special applicant and employer forms will be available at the Transparencies section of the registration desk both for applicants to post résumés and for employers to post forms announcing positions.

Applicants who submit an applicant form, but do not plan to attend the meeting, will appear on the printed list only. There is no provision made for posting résumés for participants who do not attend the meeting.

ACCOMMODATIONS

University Housing

Participants desiring confirmed reservations for on-campus housing must preregister and send payment in full for housing to the Mathematics Meetings Housing Bureau prior to the July 1, 1984 deadline.

Participants in the Joint Mathematics Meetings may occupy residence hall rooms at the University of Oregon during the period of August 13 through 19 only. A very limited number of rooms will be available for those who do not preregister.

Participants requesting housing on the University of Oregon campus during the meetings will be assigned to the Bean, Hamilton and Walton Complexes. (Please refer to the section below titled Room and Board Rates.)

Families with children under the age of two will not be allowed to stay in the dormitories. Children between the ages of two and four may stay in the dormitories but must occupy a bed at the adult rate. Meals for children in this category are free. Only two persons will be allowed in each room. The university neither provides cots nor allows sleeping bags. Because the university residence hall facilities are not suitable for children under the age of two, participants with very young children are advised to consider the various motels in the area. (See section on Motel Accommodations below.)

Dormitories at the University of Oregon are not air-conditioned and have no elevators. The buildings have either two or four floors; porters will be on hand to assist participants with their luggage during peak hours. Room assignments will be made on ground or lower floors for those who request this in writing on the housing form. Each dormitory room contains two beds, desks with lamps and chairs, bookcases, and closets with approximately five hangers. Each bed will be prepared in advance with sheets, a blanket, pillow, and pillowcase for the duration of the conference, and one towel and washcloth will be supplied daily, as well as soap and drinking glasses. Bathrooms (one on each floor) will be appropriately identified by gender. For this reason, it may be necessary for one sex or the other to use the rest rooms on either the floor above or below the one on which their rooms are located. There is limited privacy in the bathrooms since the shower stalls are separated only by shower curtains. The dressing rooms are in a recessed area; however, there are no doors. Participants may wish to bring dressing gowns to ensure privacy in going from the dressing area to the showers.

No pets are allowed in the residence halls. Alcoholic beverages are allowed provided the 21 year age limit is observed. There will be no telephone service in any of the university accommodations; however, there are pay telephones and campus phones in the public areas.

Check-In Location and Times

The check-in desk for all residence halls is located on the ground floor of Henderson Hall in the Bean Complex on 15th Street between Agate and Moss Streets. Those arriving via I-5 should exit onto Franklin Boulevard, follow signs to the university onto Agate Street (south), cross 13th Street, and continue to 15th Street where a left turn will take them to Henderson Hall. Participants may use the unloading area next to Henderson Hall on Agate
Street while checking in and then move their vehicles to the campus parking lot at 15th and Moss Streets. There are no parking fees and no stickers are required for cars.

Participants should ensure that they arrive at the university during the hours the check-in desk is open. Anyone arriving after these hours may not be able to obtain keys to his or her room and may have to seek accommodations elsewhere for the night. The check-in desk will be in operation daily from 8:00 a.m. to 5:00 p.m. on August 14, 17, 18, and 19. On August 15 and 16 the desk will be in operation from 8:00 a.m. to 9:00 p.m.

At time of check-in, participants will receive two keys which will open doors to their rooms as well as the outside and basement doors. **Although there is no deposit required for keys, a $13 charge will be imposed for keys that are lost or not returned.**

Room and Board Rates
The following rates apply for residence hall accommodations at the University of Oregon. Please note there is no room or food tax applicable.

Adults (16 years of age and up) includes breakfast and lunch
- Singles $23.50
- Doubles (per person) $18.50

Children (5 years of age through 15) includes breakfast and lunch
- Singles $20.50
- Doubles (per person) $15.50

Children (over 2 years of age and under 5) bed only—meals free $11.50

**Food Services**
Breakfast and lunch for those participants staying in the residence halls will be served in Hamilton Cafeteria located in the block bordered by 13th, 15th, Agate, and Columbia Streets. Meal tickets will be issued to each preregistered individual (and family members, if applicable) at time of check-in. Dining hours are:
- **Breakfast** 6:45 a.m. to 10:00 a.m.
- **Lunch** 10:30 a.m. to 1:30 p.m.
- **Dinner** 4:00 p.m. to 6:30 p.m.

Meals in the cafeteria are generous. A typical breakfast would be fruit juices, canned or fresh fruit, cold or hot cereals, scrambled or fried eggs, waffles, cottage cheese, assorted condiments, and assorted hot and cold beverages. Lunch would typically be soup, seafood casserole, grilled sandwiches and a meatless sandwich or plate, tossed green salad with assorted dressings, cookies or coffee cake and various hot and cold drinks. It will be possible for a limited number of those staying in the residence halls to purchase dinner in the Hamilton Cafeteria on a cash basis.

Fountain Court Cafe in Erb Memorial Union will be open from 7:00 a.m. to 4:00 p.m. daily. Food, offered cafeteria-style, may be purchased on a cash basis. Hours of operation are:
- 7:00 a.m. to 10:30 a.m. Breakfast
- 10:30 a.m. to 2:00 p.m. Soups, salads, hamburgers, etc.
- 2:00 p.m. to 4:00 p.m. Soft drinks, snacks

For those participants who wish to eat off-campus, there is a variety of restaurants within walking distance of the university. Other restaurants in the area may be reached by using public or private transportation. A detailed restaurant list will be available at the meeting.

**Motel Accommodations**
Blocks of rooms have been set aside for use by participants at the motels listed below. All are located within walking distance, on East Broadway and Franklin Boulevard. East Broadway merges with Franklin Boulevard; this main area borders the campus on the north side. **These motels would be ideal accommodations for families, since there are no restrictions regarding children.**

The rates listed below are subject to a 6 percent tax. The following codes apply: **AC = Air Conditioned; CL = Cocktail Lounge; FP = Free Parking; RT = Restaurant; SP = Swimming Pool; TV = Television. 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 beds. A rollaway cot for an extra person can be added to double or twin rooms only in some of the motels. The age limit for children below which there is no charge, providing a cot is not required and they are in the same room as a parent, is shown in parenthesis on the same line as the charge for an extra person in the room.**

Participants should make their own reservations early, directly with the motels, and should identify themselves as participants in the Joint Mathematics Meetings. Participants making motel reservations should be prepared to remit a one night’s deposit to the motel in order to guarantee their room reservation.

**Angus Inn Motel** (F on campus map)
2121 Franklin Boulevard—4 blocks from campus
Telephone: 503-342-1243

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<thead>
<tr>
<th>Meal Type</th>
<th>Days</th>
<th>Rates</th>
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<tbody>
<tr>
<td>Singles</td>
<td></td>
<td>$24</td>
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<tr>
<td>Doubles</td>
<td></td>
<td>$28</td>
</tr>
<tr>
<td>Twin Queens</td>
<td>2</td>
<td>$28 (2 persons)</td>
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<td></td>
<td>3</td>
<td>$32 (3 persons)</td>
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<td></td>
<td>4</td>
<td>$36 (4 persons)</td>
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<tr>
<td>Cots</td>
<td></td>
<td>$4</td>
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<tr>
<td>Cribs</td>
<td></td>
<td>Free</td>
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<tr>
<td>Suites</td>
<td>(accommodating 6-8)</td>
<td>$38-$50</td>
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No charge for children using cribs.

AC, FP, SP, TV, sauna, jacuzzi, limited kitchenettes are available (no utensils provided)

Deposit and balance due may be paid by personal check (Canadian checks must be marked “Payable in U.S. funds”), travelers’ check, or American Express, Carte Blanche, Diners Club, MasterCard, or Visa.
City Center Lodge (B on campus map)
476 East Broadway–8 blocks from campus
Telephone: 503-344-5233

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<tr>
<th>Room Type</th>
<th>Rate</th>
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<tr>
<td>Singles</td>
<td>$22</td>
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<tr>
<td>Doubles</td>
<td>$24</td>
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<tr>
<td>Twin Doubles</td>
<td>$26</td>
</tr>
<tr>
<td>Triples</td>
<td>$30  (2 beds)</td>
</tr>
<tr>
<td>Quads</td>
<td>$34  (2 beds)</td>
</tr>
<tr>
<td>Cots</td>
<td>$4   (complete)</td>
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</tbody>
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Children must occupy a crib or bed. Maximum number of beds in room: 2
AC, FP, TV, SP (heated)
Deposit may be paid by personal check (Canadian checks must be marked “Payable in U.S. Funds”), American Express, Diners Club, MasterCard, Visa. Balance due must be paid by credit card.

Continental Motel (C on campus map)
390 East Broadway–8 blocks from campus
Telephone: 503-343-3376

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<tr>
<th>Room Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singles</td>
<td>$20</td>
</tr>
<tr>
<td>Doubles</td>
<td>$26 (also queen and king-sized beds)</td>
</tr>
<tr>
<td>Triples</td>
<td>$30 (2 or 3 beds; 3 persons)</td>
</tr>
<tr>
<td>Quads</td>
<td>$34 (2 or 3 beds; 4 persons)</td>
</tr>
<tr>
<td>Cots</td>
<td>$6</td>
</tr>
<tr>
<td>Port-a-cribs</td>
<td>$3 (complete)</td>
</tr>
</tbody>
</table>

No charge for children under two years of age.
AC, FP, SP, TV
Deposit may be paid by personal check (Canadian checks must be marked “Payable in U.S. funds”) or travelers' check or American Express, Diners Club, MasterCard, Visa. Personal checks will be accepted for payment of balance due with credit card identification.

Greentree Motel (E on campus map)
1759 Franklin Boulevard–1 block from campus
Telephone: 503-485-2727

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singles</td>
<td>$36.50</td>
</tr>
<tr>
<td>Doubles</td>
<td>$44.50 (1 queen)</td>
</tr>
<tr>
<td>Twin doubles</td>
<td>$46.50 (2 queens)</td>
</tr>
<tr>
<td>Triples</td>
<td>$50.50 (2 queens)</td>
</tr>
<tr>
<td>Quads</td>
<td>$53.50 (2 queens + cot, 3 persons)</td>
</tr>
<tr>
<td>Cots</td>
<td>$54.50 (2 queens; 4 persons)</td>
</tr>
<tr>
<td>Cribs (2)</td>
<td>$7.00</td>
</tr>
</tbody>
</table>

No charge for children using cribs. Maximum number of beds in room: 3
AC, SP, FP, CL, TV, RT, coffee shop, kitchenettes (must provide own utensils)
Deposit may be paid by personal check (Canadian checks must be marked “Payable in U.S. funds”), or travelers' check or American Express, Amoco, Carte Blanche, Diners Club, MasterCard or Visa. Balance due must be paid by credit card.

New Oregon Motel (D on campus map)
1655 Franklin Boulevard–1 block from campus
Telephone: 503 683-3669

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singles</td>
<td>$40.50</td>
</tr>
<tr>
<td>Doubles/Twin doubles</td>
<td>$44.50</td>
</tr>
<tr>
<td>Triples</td>
<td>$48.50 (2 beds, 3 persons)</td>
</tr>
<tr>
<td></td>
<td>$51.50 (3 beds, 3 persons)</td>
</tr>
</tbody>
</table>

Quads $53.50 (2 beds, 4 persons)
Cots (10) $7.00
Cribs (limited) Free (no linen provided)

No charge for children using cribs.
Maximum number of beds in room: 3
Family units: 765.50 (2 bedrooms each with 1 or 2 queen-sized beds and connecting bath); maximum occupancy 6 or 7. AC, FP, SP (indoor), TV, saunas, jacuzzi, racquetball court, handicapped facilities
Deposit may be paid by personal check (Canadian checks must be marked “Payable in U.S. funds”), travelers' check or American Express, Amoco, Carte Blanche, Diners Club, MasterCard or Visa. Balance due must be paid by credit card.

Sixty-Six Motel (A on campus map)
755 East Broadway–4 blocks from campus
Telephone: 503-342-5041

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singles</td>
<td>$17.95</td>
</tr>
<tr>
<td>Doubles</td>
<td>$19.95</td>
</tr>
<tr>
<td>Twin doubles</td>
<td>$21.95 (2 beds, 2 persons)</td>
</tr>
<tr>
<td>Triples</td>
<td>$23.95 (2 beds, 3 persons)</td>
</tr>
<tr>
<td>Quads</td>
<td>$24.95 (2 beds, 4 persons)</td>
</tr>
</tbody>
</table>

There are no cots or cribs. No charge for children using sleeping bags; towel charge only. NOTE: One sleeping bag allowed per room.
AC, FP, TV
Deposit may be paid by personal check (Canadian checks must be marked “Payable in U.S. funds”) or travelers' check or American Express, MasterCard or Visa. Balance due must be paid by credit card only.

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 Joint Meetings registration at the meeting (listed below) are 30 percent more than the preregistration fees.

Joint Mathematics Meetings

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member of AMS, MAA, IMAE</td>
<td>$61</td>
</tr>
<tr>
<td>Emeritus Member of AMS, MAA</td>
<td>$15</td>
</tr>
<tr>
<td>Nonmember</td>
<td>$93</td>
</tr>
<tr>
<td>Student/Unemployed Student</td>
<td>$15</td>
</tr>
<tr>
<td>Student/Unemployed All Others</td>
<td>$10</td>
</tr>
<tr>
<td>One-day Fee (Second Day Only)</td>
<td>$15</td>
</tr>
</tbody>
</table>

AMS Short Course

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student/Unemployed All Others</td>
<td>$10</td>
</tr>
<tr>
<td>All Other Participants</td>
<td>$30</td>
</tr>
<tr>
<td>One-day Fee (Second Day Only)</td>
<td>$15</td>
</tr>
</tbody>
</table>

MAA Minicourses #1 through #8

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Participants</td>
<td>$20</td>
</tr>
</tbody>
</table>

Registration fees may be paid at the meetings in cash, by personal or traveler's checks, or by Visa or MasterCard credit card. 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 any person who has voluntarily resigned or retired from his or her latest position.

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

Nonmembers who register at the meetings and pay the $93 nonmember registration fee are entitled to a discount of the difference between the member registration fee of $61 and the nonmember registration fee of $93 as a $32 credit against dues in either the AMS or MAA or both, provided they apply for membership before September 19, 1984.

Nonmember students who register at the meetings and pay the $15 registration fee are entitled to a discount of the difference between the student preregistration fee of $12 and the registration fee of $15 as a $3 credit against dues in either the AMS or MAA or both, provided they apply for membership before September 19, 1984.

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

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 meetings director, who will try to assist them.

Audio-Visual Assistance

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

Rooms where special sessions and contributed paper sessions will be held will be equipped with an overhead projector, screen, and blackboard. Presenters of ten- or twenty-minute papers are strongly urged to use the overhead projector rather than the blackboard for their presentation in order to obtain maximum visibility by all members of the audience of the material being presented.

Baggage and Coat Check

Provision will be made for participants checking out of the residence halls or motels early to leave baggage in the registration area until leaving the campus.

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. Due to the increased use of credit cards, cash availability may be lower than at other meetings. It is strongly advised that participants bring travelers' checks which are honored by banks and most restaurants. 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 Eugene 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, c/o Joint Mathematics Meetings, Department of Mathematics, University of Oregon, Eugene, Oregon 97403. Mail and telegrams so addressed may be
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.

### TUESDAY, August 14

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 a.m. - 4:00 p.m.</td>
<td><strong>REGISTRATION</strong></td>
</tr>
<tr>
<td>10:30 a.m. - 10:45 a.m.</td>
<td>Introduction</td>
</tr>
<tr>
<td>10:45 a.m. - noon</td>
<td>Economic incentives for pollution control Maureen Cropper</td>
</tr>
<tr>
<td>2:00 p.m. - 3:15 p.m.</td>
<td>Applications of mathematics in insect pest management Richard Plant</td>
</tr>
<tr>
<td>3:15 p.m. - 3:45 p.m.</td>
<td>Break</td>
</tr>
<tr>
<td>3:45 p.m. - 5:00 p.m.</td>
<td>Classical issues in exhaustible resource management Geoffrey Heal</td>
</tr>
</tbody>
</table>

### WEDNESDAY, August 15

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m. - 2:00 p.m.</td>
<td><strong>REGISTRATION</strong></td>
</tr>
<tr>
<td>9:00 a.m. - 10:15 a.m.</td>
<td>Renewable resource management Colin Clark</td>
</tr>
<tr>
<td>10:15 a.m. - 10:45 a.m.</td>
<td>Break</td>
</tr>
<tr>
<td>10:45 a.m. - noon</td>
<td>Applying abstract control theory to concrete models Frank Clarke</td>
</tr>
<tr>
<td>2:00 p.m. - 3:15 p.m.</td>
<td>General equilibrium theory and the international trade in extractive resources Graciela Chichilnisky</td>
</tr>
<tr>
<td>3:15 p.m. - 3:45 p.m.</td>
<td>Break</td>
</tr>
<tr>
<td>3:45 p.m. - 4:45 p.m.</td>
<td>Panel Discussion: Mathematicians and natural resource modeling Robert McKelvey</td>
</tr>
</tbody>
</table>

### AMERICAN MATHEMATICAL SOCIETY SHORT COURSE SERIES

#### ENVIRONMENTAL AND NATURAL RESOURCE MATHEMATICS

- **REGISTRATION**
- **Introduction**
- Economic incentives for pollution control Maureen Cropper
- Applications of mathematics in insect pest management Richard Plant
- Break
- Classical issues in exhaustible resource management Geoffrey Heal

### JOINT MATHEMATICS MEETINGS

#### American Mathematical Society

- **REGISTRATION**
- **Board of Governors Meeting**
- **Council Meeting**

#### Mathematical Association of America

- **REGISTRATION**

### THURSDAY, August 16

#### AMM

- **REGISTRATION**
- **Welcome Address** Paul Olum, President University of Oregon

#### MAA and Other Organizations

- **Invited Address** Unitary representations of simple Lie groups David A. Vogan, Jr.
- **MAA - Contributed Paper Sessions**
  - Visual mathematics in the undergraduate curriculum Martin E. Flashman
  - Precalculus, college, and remedial instruction—common concerns Anneli Lax
- **MAA - Minicourse #7 (Part A)** Discrete algorithmic mathematics Stephen B. Maurer
- **MAA - Minicourse #8 (Part A)** Microcomputer software in mathematics instruction Roy E. Myers

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309
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 will be located in the registration area to receive incoming calls for participants. The center will be open from August 15 through 18 only, during the hours that the Joint Mathematics Meetings registration desk is open. Messages will be taken and the name of any individual 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 available at the meeting. Just prior to the start of the meeting, participants can obtain the number by calling 503-555-1212 and asking for the telephone number of the "Mathematics Meetings" at Erb Memorial Union on the University of Oregon campus.

**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 be not be available on Sunday, August 19.

**Visual Index**

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

**MISCELLANEOUS INFORMATION**

**Athletic Facilities**

Participants may use the swimming pool on campus for a daily fee of $1. The pool is available from 7:00 a.m. to 8:00 a.m. and from noon to 1:30 p.m., Monday through Friday; from 6:00 p.m. to 7:30 p.m., Monday through Thursday; and from 2:00 p.m. to 4:00 p.m. on Saturday and Sunday. The Esslinger gym, which includes indoor handball, tennis, and racquetball courts, and weight room is open from 7:00 a.m. to 9:00 p.m., Monday through Friday. There is a nominal charge for the use of these facilities. Reservations are required for use of the indoor tennis courts. There is no charge for the use of the outdoor tennis courts; however, reservations for these courts cannot be made.

**Book Store**

The University Book Store is located at 13th and Kincaid at the west edge of campus. It will be open 8:15 a.m. to 5:30 p.m., Monday through Friday.

**Camping and RV Facilities**

- **Chalet Village**, 7 miles west of Eugene. RV hook up. Blacktop with trees, Laundromat. $8/night. 503-747-8311. 205 South 54th, Springfield, Oregon 97478.
- **Diamond Hill RV Park**, 15 miles north. Pool, store. $9 full hook up. 503-995-8050. 32917 Diamond Hill Drive, Harrisburg, Oregon 97446.
- **Fern Ridge Shores Campground & Marina**, 12 miles west of Eugene on Fern Ridge Lake. 300 unimproved tent sites. 20 hook ups with lights and water. Swim, water ski, sail, fish. Restrooms, food concession. 503-935-2030. 29652 Jeans Road, Veneta, Oregon 97487.
- **Sherwood Forest KOA**, 8 miles south of Eugene. Shade trees, pool, jacuzzi. Tents, full hook ups. $8 and up. 503-895-4110. 298 East Oregon Avenue, Creswell, Oregon 97426.

**Child Care**

The EMU Child Care Center may be able to accommodate the needs of a few participants, provided they are contacted well in advance of the meeting. For more information, write to the University of Oregon Child Care and Development Center, 1511 Moss Street, Eugene, Oregon 97403, or call 503-686-4384. In addition, there will be a list of babysitters at the Local Information section of the registration desk.

**Crib Rental**

Cribs and rollaway beds can usually be arranged directly with one's hotel or motel. (Cribs and cots are not allowed in the university residence halls.) A limited number of cribs are available for rent at Franklin Boulevard Rent All, 4340 Franklin Boulevard (503-726-6517).

**Handicapped**

Some, but not all, of the residence halls and other facilities are accessible for the handicapped. Those handicapped persons with special requirements for on campus housing should make this clear in writing when submitting the preregistration/housing form. Persons with special needs with regard to the scheduling of the sessions should write Kenneth A. Ross at the University of Oregon or telephone 503-686-4721 as soon as possible.

**Libraries**

Library facilities are excellent. In addition to the main library which houses most mathematics education journals and a computer search service, branch libraries of interest include the following:

- Mathematics library, 210 Fenton, 686-3023
- Science library, Science Library Building, 686-3075
**TIMETABLE**

**THURSDAY, August 16**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
</table>
| 11:05 a.m. - 12:05 p.m. | INVITED ADDRESS  
A Kuratowski theorem for general surfaces  
Paul Seymour |
| 1:00 p.m. - 2:00 p.m.  | COLLOQUIUM LECTURE I  
Minimax methods in critical point theory and applications to differential equations  
Paul H. Rabinowitz |
| 1:00 p.m. - 5:00 p.m.  | AMS BOOK SALE |
| 1:00 p.m. - 5:00 p.m.  | EXHIBITS  
MAA - Contributed Paper Session  
Motivating teaching ideas that do not compromise mathematics: Presentations, examples, or applications  
Larry Runyan |
| 2:10 p.m. - 5:10 p.m.  |  
MAA - INVITED ADDRESS  
Combinatorial problems with surprising solutions  
David P. Roselle |
| 2:15 p.m. - 4:15 p.m.  |  
MAA - Minicourse #8 (Part B)  
Microcomputer software in mathematics instruction  
Roy E. Myers |
| 3:20 p.m. - 4:20 p.m.  | INVITED ADDRESS  
Gauge theories in the calculus of variations  
Clifford H. Taubes |
| 3:30 p.m. - 5:30 p.m.  |  
MAA - Section Officers Meeting |
| 5:00 p.m. - 7:00 p.m.  |  
MAA - Minicourse #5 (Part A)  
Pascal for mathematicians  
Harley Flanders |
| 7:00 p.m.                          | MAA - FILM PROGRAM |
| 7:00 p.m. - 10:00 p.m.            | Pi Mu Epsilon - Reception |
| 7:30 p.m. - 9:30 p.m.             | MAA - Minicourse #7 (Part B)  
Discrete algorithmic mathematics  
Stephen B. Maurer |
| 8:00 p.m. - 10:00 p.m.            | WINE TASTING |

**FRIDAY, August 17**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>morning</td>
<td>Sessions for Contributed Papers</td>
</tr>
<tr>
<td>SPECIAL SESSIONS</td>
<td></td>
</tr>
</tbody>
</table>
Geometry of configurations |
| 8:00 a.m. - (Tentative) |  
Gauge theories and applications |
| 8:00 a.m. - 10:50 a.m.  |  
MAA - Minicourse #1 (Part A)  
The intersection of mathematics and statistics  
Thomas R. Knapp |
| 8:00 a.m. - 10:50 a.m.  |  
MAA - Minicourse #4 (Part A)  
A COMET Minicourse  
Teacher in-service programs  
Eugene A. Maier |
| 8:30 a.m. - 10:50 a.m.  |  
MAA - Contributed Paper Session  
Use of computers in upper division mathematics courses  
Ronald R. Wenger |
| 8:30 a.m. - 4:30 p.m.  | REGISTRATION |
| 8:30 a.m. - 4:30 p.m.  | AMS BOOK SALE |
| 8:30 a.m. - 4:30 p.m.  | EXHIBITS  
MAA - INVITED ADDRESS  
Instantons and the topology of 4-manifolds  
Ronald J. Stern |
| 8:40 a.m. - 9:30 a.m.  |  
Association for Women in Mathematics Program |
| 9:00 a.m. - 10:20 a.m.  |  
MAA BOOK SALE |
Documents Room, 205 Computer Center, 686-4406, (houses computing journals, manuals, etc.)
Law library, 240 Law Center, 686-3088
Architecture & Allied Arts, 277 Lawrence, 686-3637
Bureau of Governmental Research & Service, Hendricks Hall, 686-3048

Local Information

Four city parks are recommended. Amazon Park, at 26th and Hilyard, is a typical recreational park and includes a public swimming pool. Hendricks Park is a woody scenic park and ideal for picnicking and hiking; to get to it, drive or walk east on 19th to Fairmount, go one block south to Summit, and then proceed eastward and upward into the park. Skinner’s Butte Park is north of Skinner’s Butte on Cheshire Avenue; it is reached by going north on High Street as far as possible and then turning left onto Cheshire. This is a recreational park bordering the Willamette River. There is also Alton Baker Park; to reach it drive over the Ferry Street Bridge and bear right. Alton Baker Park is a nice park for sun-bathing or wading in the Willamette.

A fine night or day view of Eugene can be obtained by walking or driving to the top of Skinner’s Butte; take High Street north to behind the butte and follow signs to the top. The more substantial butte at the south end of town is Spencer’s Butte. There are nice trails to the top, from which a spectacular view is available. The trails begin at Spencer’s Butte Park out South Willamette Street about five miles south of downtown Eugene.

There are many miles of attractive running trails (including the famous “Pre’s Trail”) readily accessible from campus. Maps will be available at the Local Information section of the registration desk. During these meetings on the University’s Hayward Field, there will be the 1984 National Master’s Track and Field Championships. Those interested in competing can obtain further information from Oregon Track Club Masters, 1587 Agate, Eugene, Oregon 97403.

For the day tripper or overnight camper a variety of trails, including The Pacific Crest Trail through the Three Sisters Wilderness, are within easy driving distance of Eugene.

Some excellent walking trails are to be found at the Mountain Pisgah Arboretum. This 118 acre facility is about six miles from campus. More detailed information and directions to the arboretum will be available at the Local Information section of the registration desk.

Bicycles can be rented from Pedal Power Bicycles at Fifth Street. There are numerous bike paths; maps will be available at the Local Information section of the registration desk. Bikers and joggers are advised to travel in pairs and to watch out for roller skaters. Roller skates can be rented from the Outdoor Skate and Skateboard Shop, 1283 Lincoln Street (approximately 300 West 13th).

Canoes can be rented at the Canoe House on the Millrace and bike path. It is located across Franklin Boulevard from the big Science Building on campus with address approximately 1200 Franklin Boulevard.

Sailboats can be rented at Dorena Lake, approximately 30 miles south of Eugene.

Several public golf courses are with a few miles of campus.

The Lane County Golf will take place August 14–19 at the fairgrounds, 13th and Monroe.

The Weirheuser Lumber Company in Eugene’s sister city, Springfield, has tours from 2:00 to 5:00 p.m. on Mondays, Wednesdays, and Fridays.

A fish hatchery open to the public is located at the EWEB Power Plant in Leaburg, approximately 18 miles east of Eugene. There are abundant opportunities for fishing within less than a one hour drive from Eugene; guides are available for those wishing to try the McKenzie River.

The new Hult Center for the Performing Arts opened in September 1982 and has made Eugene one of the most important cultural centers in the Northwest. Performances range from Bach to rock.

The University of Oregon Museum of Art offers continuous changing exhibitions, outstanding permanent collections devoted to oriental, Russian, and African, as well as contemporary Northwest and American art, and photography. The museum is open noon to 5:00 p.m. Wednesday through Sunday. Closed holidays. No admission charge.

Maude Kerns Art Center at 15th and Villard Streets offers local and traveling art shows and includes a gift shop. The Lane County Historical Museum has exhibits showing how western pioneers lived, dressed, traveled and cooked. To reach it, drive west on 11th to Monroe, left on Monroe to 13th to fairgrounds entrance, then left on 13th one block to the museum.

Willamette Science and Technology Center (WISTEC) features hands-on exhibits and weekend planetarium shows. Open noon to 5:00 p.m. Tuesday through Sunday; planetarium shows at: 1:00 and 3:00 p.m. Saturday and Sunday; $2/adults, $1/senior citizens, $0.75/children, under six years free; 2300 Centennial Boulevard, next to Autzen Stadium.

For shopping there is Eugene’s Downtown Mall and the 101-store Valley River Center, a large indoor shopping mall. There is also the Fifth Street Public Market (at Fifth Street and High) with delicious food and unique items including crafts by Oregon artists. On Saturdays, hand-made and home-grown bargains can be found in the open air Saturday Market at 8th and Oak.

For further information about the area, call the Eugene-Springfield Convention and Visitors Bureau at 1-800-547-5445; inside Oregon call 1-800-452-3670.

Medical Services

Sacred Heart General Hospital is located one block west of campus at 1255 Hilyard. The emergency room is located at 705 East 13th. The emergency phone number is 503-686-6931. The campus emergency number is extension 3333.
### TIMETABLE

**FRIDAY, August 17**  

<table>
<thead>
<tr>
<th>Time</th>
<th>American Mathematical Society Activities</th>
<th>Mathematical Association of America and Other Organizations Activities</th>
</tr>
</thead>
</table>
| 9:45 a.m. - 10:45 a.m. | AMS-MAA INVITED ADDRESS  
Controversies in artificial intelligence:  
A historian’s perspective  
Judith V. Grabiner | AWM - Membership Meeting  
MAA – HEDRICK LECTURE I  
Lattices, sphere packings and applications  
Neil J. A. Sloane  
IIIE - Council Luncheon |
| 10:20 a.m. - 11:05 a.m. |  
11:00 a.m. - noon |  
noon - 1:00 p.m.  
1:00 p.m. - 2:00 p.m. |  
COLLOQUIUM LECTURE II  
Minimax methods in critical point theory and applications to differential equations  
Paul H. Rabinowitz |
| 2:15 p.m. - 3:05 p.m. |  
2:15 p.m. - 4:15 p.m. |  
MAA - INVITED ADDRESS  
Mathematicians without mathematics  
Constance Reid  
IIIE - Contributed Paper Session |
| 3:20 p.m. - 4:20 p.m. |  
4:35 p.m. - 5:35 p.m. |  
5:45 p.m. |  
8:30 p.m. - 10:30 p.m. |  
SALMON BAKE  
AWM - Party |

**SATURDAY, August 18**  

<table>
<thead>
<tr>
<th>Time</th>
<th>AMS Activities</th>
<th>MAA and Other Organizations Activities</th>
</tr>
</thead>
</table>
| morning       | Sessions for Contributed Papers  
SPECIAL SESSION |  
8:00 a.m. - (Tentative)  
Algebraic topology  
8:00 a.m. - 9:00 a.m.  
8:00 a.m. - 10:50 a.m. |  
IIIE - Dutch Treat Breakfast  
MAA - Minicourse #1 (Part B)  
The intersection of mathematics and statistics  
Thomas R. Knapp  
REGISTRATION  
MAA BOOK SALE  
EXHIBITS |
| 8:30 a.m. - 4:30 p.m. |  
8:30 a.m. - 4:30 p.m. |  
3:20 a.m. - 4:30 p.m. |  
AMS BOOK SALE  
8:40 a.m. - 9:40 a.m.  
INVITED ADDRESS  
A natural variational problem in Riemannian geometry  
Chuu-Lian Terng  
8:40 a.m. - 10:40 a.m. |  
MAA - Minicourse #2 (Part A)  
Applications of probability theory to the analysis and design of computer systems  
Robert Geist  
Kishor Trivedi  
IIIE - Contributed Paper Session |
| 9:00 a.m. |  
9:45 a.m. - 10:45 a.m. |  
AMS-MAA INVITED ADDRESS  
Topology  
Rudol H. Bott  
MAA – HEDRICK LECTURE II  
Lattices, sphere packings and applications  
Neil J. A. Sloane  
MAA - INVITED ADDRESS  
Factorization of large integers (tentative)  
Carl Pomerance |
Eugene Meetings SuperPhone Exclusive
800-556-6882

UNITED AIRLINES

FLY TO EUGENE WITH UNITED AND SAVE

United, the major carrier to Eugene, is making special round trip air fares available to the Joint Mathematics Meetings in Eugene, Oregon, August 14-19, 1984. United is offering a 35 percent discount on full round trip coach fares. This special fare requires departure between August 13 and 20. Reservations and ticketing must be done at least fourteen days in advance.

Other fares will, of course, still be available after the fourteen-day limitation.

These special offers are available ONLY through the Eugene Meetings SuperPhone Exclusive.

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Hours of Operation: 9:00 a.m. to 7:00 p.m. EST, Monday through Thursday, Friday until 6:00 p.m.

Where discounts exceed 35 percent, they will be provided automatically through SuperPhone’s FARE CHECK system.

Parking
Bean Complex parking lot is located at 15th and Moss Streets near Henderson Hall. There are no parking fees or stickers required.

Social Events
Salmon Bake
A salmon bake is being planned for Friday, August 17, from 5:45 to 7:30 p.m. in the Bean picnic area adjacent to the Bean Complex. The menu will consist of baked salmon, scalloped potatoes, corn-on-the-cob, green beans, cole slaw, relishes, French bread, fresh fruit, bar cookies, beer, soft drinks and coffee. Tickets are $12 for adults and $6.50 for children ages 6 through 15. There is no charge for children five years of age and under. Tickets will be available only through preregistration as the university requires an early deadline in order to plan for the bake.

Wine Tasting
There will be a wine tasting on Thursday, August 16, from 8:00 p.m. to 10:00 p.m. in Gerlinger Lounge. The finest northwest wines will be featured together with California wines. Cheese and meat trays, bread and punch will also be served. Due to space limitations, the number of participants will be restricted. Tickets, priced at $7.50 per person, will be sold only through preregistration.

Tours
The Local Arrangements Committee has arranged for Great Western Travel Adventures, Inc. of Eugene, Oregon, to offer the following trips and tours before, during, and after the Joint Mathematics Meetings. Interested parties should contact Great Western directly; please note the June 15 deadline for reservations. The following text was supplied by GWTA:

"Passengers, by accepting the booking confirmation and the terms set forth thereon, agree that GWTA and any affiliate or subsidiary shall not be nor become liable or responsible for any injury or damage to person or property in connection with any transportation, accommodations or other services, or from any causes beyond the control of GWTA or any affiliate or subsidiary for any act or error caused by the owners or contractors providing such services. GWTA or any affiliate or subsidiary shall not be liable for any additional expenses sustained by the passenger as a result of the foregoing causes. GWTA reserves the right at all times to cancel the tour or portions thereof, on refund of the appropriate value paid by the passenger for the cancelled portion, without further liability.

The Eugene/Springfield Convention and Visitors Bureau and Great Western Travel Adventures welcome you to Oregon. The Eugene/Springfield metropolitan area offers a convenient hub for enjoying the diverse cultural and recreational opportunities found in the Pacific Northwest. While here, take time from your equations, theories and fractals to see the real natural wonders of the Oregon Coast and Crater Lake, among marvelous others. Custom travel arrangements for families and groups wanting a more "inside" view of Oregon are our specialty. Please inquire for details on wilderness treks, rent-a-cars, trout and salmon fishing, bed and breakfast, motorhomes or guest ranches before and after the meetings.

Oregon Coast/August 15

The nearby Oregon Coast is loved by millions—a few at a time! Your escorted luxury motorcoach tour begins on the University of Oregon campus, crosses the rugged Coast Range for Florence, then heads north along sand dunes, beaches and fresh water lakes, up and around massive headlands and through unique animal habitats to Newport. Exciting scenery all the way with numerous stops for photography, a lighthouse or two and marine interpretive centers.
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Organizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00 p.m.</td>
<td>COLLOQUIUM LECTURE III Minimax methods in critical point theory and applications to differential equations</td>
<td>American Mathematical Society</td>
</tr>
<tr>
<td>2:15 p.m.</td>
<td>MAA - Minicourse #3 (Part B) Introductory computer science</td>
<td>J. Arthur Seebach</td>
</tr>
<tr>
<td>2:10 p.m.</td>
<td>MAA - PANEL DISCUSSION Curriculum at Two-Year Colleges</td>
<td>Ronald M. Davis (moderator)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>PRIZE SESSION AND BUSINESS MEETING</td>
<td>Mathematical Association of America and Other Organizations</td>
</tr>
<tr>
<td>6:15 p.m.</td>
<td>MAA - Banquet for 25-Year Members</td>
<td></td>
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<tr>
<td>6:30 p.m.</td>
<td>MAA - Invited Address: Foundations of the theory of algorithms</td>
<td>Yiannis N. Moschovakis</td>
</tr>
<tr>
<td>8:30 p.m.</td>
<td>MAA - Invited Address: How to fold polygons and do number theory Part II</td>
<td>Jean J. Pedersen</td>
</tr>
<tr>
<td>1:00 p.m.</td>
<td>COLLOQUIUM LECTURE IV Minimax methods in critical point theory and applications to differential equations</td>
<td>American Mathematical Society</td>
</tr>
<tr>
<td>1:00 p.m.</td>
<td>MAA - Invited Address: Applications of geometry to the social sciences</td>
<td>Robert I. Jewett</td>
</tr>
<tr>
<td>2:05 p.m.</td>
<td>INVITED ADDRESS: Foundations of the theory of algorithms</td>
<td>Yiannis N. Moschovakis</td>
</tr>
<tr>
<td>2:15 p.m.</td>
<td>MAA - Minicourse #6 (Part B) Introduction to computer graphics</td>
<td>Joan Wyzkowski</td>
</tr>
<tr>
<td>3:20 p.m.</td>
<td>INVITED ADDRESS: Elliptic curves and L-functions</td>
<td>Ralph Greenberg</td>
</tr>
</tbody>
</table>
Luncheon off the menu at a quality establishment, extra. Price per person: $20, includes admission to Sea Lion Caves. Departure 8:00 a.m., return by 6:00 p.m. Minimum per motorcoach: 40. A light jacket should be handy.

**Crater Lake National Park/August 15**

Crater Lake is Oregon’s crown jewel, set in the Cascade Range. Pictures do not do it justice; here is your economical opportunity to see it for yourself. Your luxury motorcoach travels from the campus in Eugene and up the Willamette River to the headwaters past farmlands, lakes and tall timber.

At the mile high summit, we cross into the Eugene via the Rim Village cafeteria, extra. Your luxury motorcoach travels from the famous trout stream is of Douglas fir. From the vantage points on the campus in Eugene and up the Willamette River to the caldera rim, your eyes can feast on the amazing blue depths and alpine surroundings before we return to Eugene via the Umpqua River Valley. Lunch in the Rim Village cafeteria, extra. Price per person: $15, includes park admission fee. Hours: 7:45 a.m. to about 6:30 p.m. Minimum per motorcoach: 40. Bring a light jacket and comfortable shoes.

**McKenzie River/August 15 and August 20**

For the more adventurous, whitewater rafting challenges and exhilarates as you glide through a green waterway of beauty. A full day on this famous trout stream is a treat complete with hearty lunch, shuttle from campus and return and all gear furnished. Four or five people paddle each raft over the rapids captained by a thoroughly experienced guide. Sunglasses, sun protection and wading sneakers desirable. Price per person: $35. Hours: 9:00 a.m. to about 5:00 p.m. Minimum 10, no maximum.

**Afternoon Tangents**

For the afternoon of August 16, Great Western Travel Adventures offers two short excursions. Both include shuttle transport from the Erb Memorial Union on campus and return.

Chase Gardens, one of the major producers of cut roses and floral stems in the Western Hemisphere, opens their greenhouse and commercial grading room to those interested. Groups of 15 at a time, limited to a maximum of 60 persons total, will depart hourly beginning at 1:00 p.m. Price per person: $4, including a rose for you!

A warm Willamette River raft trip over rapids and past parks concludes with a complete and fully catered Western hamburger barbecue at river’s edge. A great way to unwind on what we hope will be a HOT afternoon! Rafters can walk back to campus or to downtown from the picnic place or hop on the shuttle. Price per person: $26, includes all equipment, fully competent guides and the meal. Sunglasses, sun protection and wading sneakers desirable. Hours: 1:30 p.m. to about 6:00 p.m. Minimum 30, no maximum.

**Reservations**

Payment in full by personal check or money order payable to Great Western Travel Adventures due with written reservation for each activity. Final deadline for all activities is 8/15. Please note minimums; additional Oregon Coast and Crater Lake coaches will be available to accommodate demand. Post-conference excursions available by request for these and other destinations; inquire. Tours not meeting minimum may be cancelled at GWTA’s discretion with full refund to those affected. Discounts: Children under six, 50 percent; children 6 to 9, 15 percent discount on motorcoach tours. Please note: minimum age for whitewater rafting is 9 years.

**Brochures and additional information available from:**

Great Western Travel Adventures
2821 Oak Street
Eugene, Oregon 97405
503-344-4116
1-800-524-2424 (outside Oregon)
TELEX: 9104392027EUG

**Travel**

In August, Eugene is on Pacific Daylight Saving Time. There is regular airline service to Eugene’s Mahlon Sweet Airport by several major airline carriers. The airport is approximately 10 miles north and a little west of Eugene (a 20-minute ride).

The Eugene Limousine Company provides seven- and nine-passenger vans and limousines as well as taxis. Rates for the vans and limousines are $9 per person and $5.50 for two or more passengers. The limousine will take passengers anywhere in Eugene.

Persons staying in dorms should ask to be dropped off at Henderson Hall on 15th between Agate and Moss. Persons who wish to go the registration area should specify EMU (Erb Memorial Union) at 13th and University. Limousine rates for returning to the airport depend on the point of departure and are $4.50 from motels and hotels, $5.50 from campus. A cab to or from the airport will run $12 or $13. If planning to arrive by air, please supply this information where indicated on the preregistration/housing form.

Persons flying into Portland can get to Eugene as follows. A special bus system called DART goes from the airport to a few selected hotels, including the Portland Hilton. DART costs approximately $3. The Hilton is across the street from the Greyhound Bus Depot. Round trip to Eugene presently costs $26.05. The Greyhound Bus Depot in Eugene is about a mile west of campus. Eugene is also served by the Trailways Bus System.

AMTRAK station is located at 4th and Willamette about a mile from campus. There is daily service north to Seattle and south to Los Angeles, with connections to San Diego.

Persons approaching Eugene from the north or south on Interstate 5 should follow the signs directing them to the University of Oregon. These routes lead to Franklin Boulevard which runs adjacent to campus. Several motels and restaurants are also located on Franklin Boulevard. Persons approaching Eugene from the east or west on state highway 126 should stay on this highway until it becomes Franklin Boulevard.

**Weather**

The expected high in the Eugene area is 81°F. The expected low is 50°F. The average rainfall in August is 0.58 inches. Humidity ranges from 74 percent at 10:00 a.m. to 60 percent at 4:00 p.m. Pollen problem: weeds.

Frank T. Birtel
Associate Secretary

New Orleans, Louisiana

316
General Equilibrium Theory and the International Trade in Extractive Resources (Graciela Chichilnisky). General Equilibrium Theory is a branch of economics that uses the most advanced mathematical techniques, ranging from algebraic topology (fixed point theorems), differential topology (index theory) and global analysis (Sard's theorem and its infinite dimensional versions). Until recently, general equilibrium theory dealt almost exclusively with abstract economic issues, such as the existence, uniqueness and stability of the equilibria. In addition, until recently this theory was mostly applied to the study of perfectly competitive markets, thus limiting its applicability.

Recent work in this area has produced applications to current policy issues such as the pricing and macroeconomic effects of international trade in extractive resources. Such economic models involve more than one economy, and imperfectly competitive markets, since sometimes trade takes place under conditions of monopolistic competition. In addition, interesting questions include not just existence and uniqueness of solutions, but also welfare properties of the solutions: who gains and who loses from alternative trades. The purpose of this short course will be to present several recent models dealing with welfare issues in a general equilibrium analysis of the international trade in exhaustible resources. In order to obtain practical policy results, the models are restricted to contain five markets and four economic agents or groups. A technological innovation is that the models presented are solved analytically, and therefore the welfare properties are studied in qualitative as well as quantifiable terms. The results appear in the form of theorems involving the shapes and global properties of manifolds of solutions as underlying parameters vary. The results obtained are somewhat surprising, confirming the view that the behaviour of several markets, all interacting with each other, is not readily understood by the common wisdom one usually applies to a single market. Cross market effects, the very topic of general equilibrium theory, yield the most surprising results, and those which are perhaps most useful for policy. For instance, the existence of “cooperative pricing policies” which involve the game theoretical examination of the solutions of a general equilibrium model of trade in resources, can be proved in (and only in) a general equilibrium world. Such cooperative prices involve price changes (upward or downward) which benefit simultaneously both the seller and the buyer countries. Other examples include: positive impacts of lending on the lending region; negative effects of overspecialization on the export of an exhaustible resource, even though its cost of production is nil.


Capital Theoretic Aspects of Renewable Resource Management (Colin W. Clark). In terms of its value to society, any resource stock is a capital asset. In the case of an exhaustible resource, the asset can either be left intact, or consumed at some positive rate, possibly varying over time. The “reserves” are thus a nonincreasing function of time. A renewable resource, on the other hand, can be exploited at a constant rate without necessarily exhausting the resource. Indeed, by exploiting the resource at less than its natural rate of replenishment, the resource stock may be increased over time. Conversely, it may be possible to “overexploit” the resource, perhaps to the point of extinction. The economic theory of renewable resources is a (nontrivial) extension of the theory of exhaustible resources.

Two problems of immediate interest are: how can we characterize the “optimal” rate of use of renewable resource? And to what extent can we rely on normal economic forces to ensure such optimal utilization? In other words, will a private competitive economy ensure optimal resource use and conservation, or is government control necessary? In the latter case the question arises as to which management strategies are likely to be most effective.

In addressing these problems, the first task is to set up models which on the one hand are not too unrealistic, while on the other are simple enough to be analyzed and to provide useful insights. Different scientific disciplines may prefer different model structures—for example, diagrams (energy flow, etc.), computer simulations, or mathematical models. The latter approach will be taken in this lecture.

Applying Abstract Control Theory to Concrete Models (Frank H. Clarke).

A wide variety of models arising in resource management, economics, engineering and other disciplines give rise to mathematical problems which lie in the field of "optimal control theory". As the successor to the classical calculus of variations, optimal control theory can be said to have a history some three centuries old. Since it also has an active present, it follows that developing a broad grasp of the theory may be somewhat demanding, especially for those interested primarily in the applications. Perhaps for this reason, those faced with actual problems arising from applications have not always been able to exploit the theory fully and correctly. On the other hand, those engaged in theoretical research have not always sought to address individual problems.

The lecture will focus upon the main results, techniques and principles involved in analyzing specific problems of optimal control. The illustrative examples will be drawn largely from the field of resource management, and will serve to display in action the gamut of techniques. Among the metaquestions touched upon will be: what should we regard as a "solution" to the problem? What is the importance of an analytical solution? What is the role of mathematical rigor? Among the metapointes made will be:

(a) It is necessary to have working knowledge of a variety of abstract machinery, both of its scope and its limitations.

(b) There are pitfalls associated with incomplete analyses of problems.

(c) Nontrivial optimal control problems are hard (yes, this may be tantological).

The lecture will be formally self-contained, but it would certainly be an advantage to the participant to be familiar with at least some elements of standard control theory beforehand. Chapter 4 of Clark [1] is a minimally technical, brief introduction to the subject in the context of renewable resources. Any one of the books [4, 5, 6] will provide a broader, mathematically detailed introduction to standard optimal control theory. Many applications of the theory are gathered in Kamien and Schwartz [3]. The avid participant will have read Chapters 1, 3, 4 and 5 of Clarke [2], which contains some of the more recent examples and theory discussed in the lecture.


Economic Incentives for Pollution Control (Maureen Cropper). In any economy an important role of government is to determine appropriate levels of air and water quality and to provide incentives for firms to achieve these levels. In general the solution to this problem requires three types of information: the costs to firms of altering emission levels, the benefits to consumers of alternative levels of ambient air and water quality, and the relationship between emissions and ambient pollution levels. Given this information it is a simple matter to compute optimal emissions for each firm and, if emissions can be observed, to achieve this optimum through a set of emissions taxes (Baumol and Oates, Chapters 3 and 4, 1975).

What makes the regulation problem difficult is that the government has imperfect information about the costs of pollution abatement and can monitor emissions only at a substantial cost. Acquiring information from firms about emissions costs is difficult since firms have an incentive to misrepresent costs if they think this information will be used to determine taxes. The problem of inducing agents to truthfully reveal information is a general one in economics. It has been studied in the context of the demand for public goods (goods which an agent cannot be excluded from consuming once they have been provided for other agents) by Groves and Loeb (1975) and Groves and Ledyard (1977). The mechanisms developed in these articles to induce agents to truthfully reveal information have been applied to pollution regulation by Dasgupta, Hammond and Maskin (1980).

The government's inability to cheaply observe emissions and thus to monitor compliance with environmental regulations is also an example of a more general economic problem. Consider the situation in which a principal values an outcome (e.g., ambient air quality) which depends on the actions (emissions) of one or more agents and on random factors (weather conditions). Although the principal and agents can both observe the outcome, the principal cannot observe the actions taken by the agents. The principal's problem is to devise a payment scheme which induces the agents to take appropriate actions. An important question in the
principal-agent literature is under what conditions a payment scheme with desirable properties can be based solely on the observable outcome; i.e., under what conditions is it appropriate to tax firms based on ambient pollution levels rather than on emissions?

Many of the results of the principal-agent literature are summarized by Shavell (1979), who points out their implications for pollution control. Holmstrom (1982) discusses the single principal-multiagent problem.


**Classical Issues in the Management of Exhaustible Resources** (Geoffrey Heal). The classical problem associated with the management of exhaustible resources, is the selection of a rate of depletion, i.e., a time profile for the exhaustion of the resource stock. The aim is to do this in a way which in some precise sense allows society to obtain the greatest possible value from its asset, and which is at the same time fair in that it shares the benefits evenly amongst generations. This problem can be posed as a maximisation problem: select the depletion rate as a function of time in such a way as to maximise an objective functional reflecting the above considerations, subject to a constraint that the total, or integral of, consumption, should not exceed the initial stock, and to various other constraints of a technological nature. This gives rise naturally to an isoperimetric variational problem.

There are at least two difficult steps in this program. One is the formulation of an objective functional which reflects adequately the joint objectives of economic efficiency and of intergenerational equity. This raises the potentially controversial issue of the selection of a rate for discounting future benefits relative to present benefits. For essentially technical mathematical reasons, a positive discount rate is needed, for otherwise the problem is not well-posed. On the other hand, discounting future benefits is often held to have ethical implications which are unacceptable. Mathematically, the problem involves maximising a real-valued function over a space of functions (depletion rates as a function of time) defined by integral constraints. Such a space has naturally a Hilbert space structure, and the use of a positive discount rate is important in ensuring appropriate continuity and compactness properties for this problem to be well-posed.

Another difficult step is the formulation of the constraints on resource-use policy arising from future technological developments. It is generally hoped and expected that future technological changes will greatly reduce society's dependence on certain extractive resources, yet the nature and timing of those changes is very uncertain. Precisely how this is best modelled is an open question: certainly issues in the field of stochastic dynamic optimisation are raised.


**Applications of Mathematics in Insect Pest Management** (Richard E. Plant). The theory of insect pest management touches the theory of resource management in two ways. The first is the most direct. Insects are a pest of biological resources, and therefore a part of the management of these resources is the management of insects. The second way is more indirect. In controlling an insect population, one or more resources must frequently be consumed or altered. For example, pesticide residues may contaminate groundwater. The lecture will be divided into two parts, with each part focusing on one of these two theoretical problems. The first part deals with the problem of controlling an insect population in an agricultural crop. The second part focuses on the problem of resource consumption in pest control. The resource that we will consider is the susceptibility of the pest population to a particular pesticide. Each application of the pesticide may select for individuals who are resistant to that pesticide, and thus after many applications the frequency of resistant individuals may become so high that the pesticide no longer provides adequate control. Agricultural economists regard this process as the consumption of the resource of pesticide susceptibility. From the grower's point of view, pesticide susceptibility is probably the most economically important resource consumed in the process of controlling an insect pest population.

The modern theory of insect pest control is generally called integrated pest management, or IPM. Pest control practices may be divided into three categories. These are (1) chemical, such as the application of pesticides; (2) biological, such as the release of predators or parasites; and (3) cultural, such as the physical destruction of the pests or the rotation of crops. The fundamental idea behind IPM is that each crop in a given area should be considered as a managed ecosystem, and that a plan using a combination of chemical, biological, and cultural practices should be developed that will optimize the yield from that particular system. Entomologists
recognize the role of mathematical modeling in aiding in the development of these plans.

The lecture will attempt to describe the development of the mathematical theory of insect pest management within the IPM context. The goal is to acquaint mathematicians with some of the problems associated with this theory. The theory will be presented in as general a manner as possible. We will, however, focus on one particular crop, cotton, in one particular region, the San Joaquin Valley of California. This will add definiteness and will, I hope, provide a little more of the flavor of the field.

Suggestions are invited from mathematicians, either singly or in groups, for topics of the various conferences that will be sponsored by the Society in 1986. The deadline for receipt of these suggestions, and the name and address of the person to whom the information should be sent, as well as some relevant information about each of the conferences are outlined below. The accompanying form (or a facsimile thereof) is to be used when submitting suggested topic(s) for any of these conferences. Individuals willing to serve as organizers should be aware that the professional meeting staff in the Society’s Providence office will provide full support and assistance, before, during, and after each of these conferences. Organizers should also note that for all conferences except Summer Research Conferences, it is required that the proceedings be published by the Society, and that SRC’s are frequently published. A member of the Organizing Committee must be willing to serve as editor of the proceedings.

All suggestions must include (1) the names and affiliations of proposed members and chairman of the Organizing Committee; (2) a two- or three-page detailed outline of the subject(s) to be covered, including the importance and timeliness of the topic; (3) a list of the recent conferences in the same or closely related areas; (4) the names and affiliations of the proposed principal speakers; (5) a list of likely candidates who would be invited to participate and their current affiliations; and (6) any other observations which may affect the size of the conference and the amount of support required. Any suggestions as to sites and dates should be made as early as possible in order to allow adequate time for planning. By action of the AMS Board of Trustees, the Meetings Department of the Society is responsible for the final selection of the site for each conference, and for all negotiations with the host institution. Individuals submitting suggestions for the conferences listed below are requested to recommend sites or geographic areas which would assist the Meetings Department in their search for an appropriate site. In the case of Joint Summer Research Conferences in the Mathematical Sciences, a one-, two-, or three-week conference may be proposed.

1986 Symposium In Pure Mathematics

This four-day symposium in pure mathematics takes place in every even-numbered year in conjunction with a spring Central Sectional Meeting. The next such symposium will be held during the four days preceding the 1986 spring meeting at a location to be announced. Topics in recent years have been Relations between combinatorics and other parts of mathematics (1978); The mathematical heritage of Henri Poincaré (1980); Several complex variables (1982); and Pseudodifferential operators and Fourier integral operators with applications to partial differential equations (1984). Proceedings are published by the Society as volumes in the series Proceedings of Symposia in Pure Mathematics.

Deadline For Suggestions: August 15, 1984

Submit to: Professor William B. Johnson, Chairman, AMS Committee on Summer Institutes, Department of Mathematics, Ohio State University, Columbus, Ohio 43210.

1986 AMS Summer Institute

Summer institutes are intended to provide an understandable presentation of the state of the art in an active field of research in pure mathematics, and usually extend over a three-week period. Dates for a summer institute must not overlap those of the Society’s summer meeting (not known at this printing, but sometime in August) and, in fact, there should be a period of at least one week between them. Recent topics have been Singularities (1981); Recursion theory (1982); Nonlinear functional analysis and its applications (1983); and Geometric measure theory and the calculus of variations (1984). Proceedings are published by the Society as volumes in the series Proceedings of Symposia in Pure Mathematics.

Deadline For Suggestions: August 15, 1984

Submit to: Professor Robert Osserman, Chairman, AMS Committee on Summer Institutes, Department of Mathematics, Stanford University, Stanford, California 94305.

1986 AMS-SIAM Symposium

Some Mathematical Questions in Biology

This one-day symposium is generally held in conjunction with the Annual Meeting of the AAAS in May.

Some recent topics in these annual symposia have been Theoretical and experimental studies in cellular, developmental and population biology (1980), Biomechanics and mathematical models in developmental biology (1981), Neurobiology, the study of the nervous systems of organisms (1982), and Muscle physiology (1983). The 1984 Symposium will be on DNA Sequence Analysis in New York City and the 1985 Symposium will be on Plant Biology in Los Angeles. Papers from the symposia are published by the Society as volumes in the series Lectures on Mathematics in the Life Sciences.

Deadline For Suggestions: April 1, 1984

Submit to Dr. Robert M. Miura, Chairman, AMS-SIAM Committee on Mathematics in the Life Sciences,
Department of Mathematics, University of British Columbia, Vancouver, B.C., Canada.

1986 AMS-SIAM Summer Seminar

The goal of the summer seminar is to provide an environment and program in applied mathematics in which experts can exchange the latest ideas and newcomers can learn about the field. Recent topics are Algebraic and geometric methods in linear systems theory (1979), Mathematical aspects of physiology (1980), Fluid dynamical problems in astrophysics and geophysics (1981), Applications of group theory in physics and mathematical physics (1982), Large-scale computations in fluid mechanics (1983), and Nonlinear functional analysis and applications (1984). Proceedings are published by the Society as volumes in the series Lectures in Applied Mathematics.

Deadline for Suggestions: August 15, 1984

Submit to: Professor George Papanicolaou, Chairman, AMS-SIAM Committee on Applied Mathematics, New York University, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012.

1986 Joint Summer Research Conferences
in the Mathematical Sciences

These conferences are similar in structure to those held at Oberwolfach, and represent diverse areas of mathematical activity, with emphasis on areas currently especially active. Careful attention is paid to subjects in which there is important interdisciplinary activity at present. Topics for the third series of one-week conferences, being held in 1984, are New multivariate methods in statistics, Random matrices and their applications, The mathematics of phase transitions, Aspherical complexes, Group actions on rings, Diophantine problems, including diophantine equations, diophantine approximations, and transcendence, The Selberg trace formula and related topics, Linear algebra and its role in systems theory, Integral geometry, and Complex differential geometry and non-linear differential equations. Proceedings are scheduled to be published by the Society as volumes in the series Contemporary Mathematics.

Deadline for Suggestions: August 15, 1984

Submit to: Professor R. O. Wells, Jr., Chairman, Committee on Joint Summer Research Conferences in the Mathematical Sciences, Department of Mathematics, Rice University, Houston, Texas 77001.

1986 AMS Short Course Series

The AMS Short Courses consist of a series of introductory survey lectures and discussions ordinarily extending over a period of one and one-half days immediately prior to the Joint Mathematics Meetings held in January and August each year. Each of the courses is devoted to a specific area of applied mathematics or to areas of mathematics used in the study of a specific subject or collection of problems in one of the physical, biological, or social sciences. Topics in recent years have been Networks (August 1981), Tomography (January 1982), Statistical Data Analysis (August 1982), Computer Communications (January 1983), Population Biology (August 1983), Mathematics of information processing (January 1984), and Environmental and Natural Resource Mathematics (August 1984). Proceedings are usually published by the Society, in the series Proceedings of Symposia in Applied Mathematics, with the approval of the Editorial Committee.

Deadline for Suggestions: July 1, 1984 for January 1986 course and December 1, 1984 for August 1986 course

Submit to: Professor Stefan A. Burr, Chairman, AMS Short Course Subcommittee, Department of Computer Sciences, CUNY, City College, New York, New York 10031.

The \TeXbook

This is a guide to computer typesetting using \TeX, written by the system's creator. \TeX represents the state-of-the-art in computer typesetting. It is particularly valuable where the article, document, or book to be produced contains a lot of mathematical notation where the user is concerned with the quality of the mathematical displays. \TeX software offers both writers and publishers the opportunity to produce technical text with the speed and efficiency of a computer system. Novice and expert alike will gain from The \TeXbook the level of information they seek. \TeX contains the detail required for preparing complex mathematics once a user has become experienced.

1980 Mathematics Subject Classifications: 00A69, 00A20, 68B99, 68K05

The \TeXbook
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Suggested Topic For 1986 Conference (check one)

☐ AMS Symposium in Pure Mathematics (Held in conjunction with a spring Central Sectional Meeting)
   Submit this form before the August 15, 1984 deadline.

☐ AMS Summer Institute (In pure mathematics and usually held in July/August)
   Submit this form before the August 15, 1984 deadline.

☐ AMS Symposium on Some Mathematical Questions in Biology (Held in conjunction with AAAS Annual Meeting)
   Submit this form before the April 1, 1984 deadline.

☐ AMS-SIAM Summer Seminar (In applied mathematics and held in June/July)
   Submit this form before the August 15, 1984 deadline.

☐ Joint Summer Research Conferences in the Mathematical Sciences (Series of six to ten week-long conferences held in June/July/August)
   Submit this form before the August 15, 1984 deadline.

☐ AMS Short Course Series (Held in conjunction with Annual and Summer meetings)
   Submit this form before the July 1, 1984 and December 1, 1984 deadlines.

Please print or type your responses. Return completed application to chairman of appropriate committee by deadline listed.

I propose organizing an AMS conference in 1986, as specified above, on the following topic:

I suggest the following members and chairman of the Organizing Committee. These individuals have ☐ / have not ☐ been requested to serve on that committee.

(Prospective committee members, chairman, and their current affiliations.)

Submitted by _______________________________ Date __________________
Address _______________________________

N.B.: Please attach a two- or three-page detailed outline of the subject(s) to be covered, including the importance and timeliness of the topic, a list of the recent conferences in the same or closely related areas, the names and affiliations of the proposed principal speakers, and a list of appropriate candidates for invitations to participate and their current affiliations. Care and attention should be devoted to the size of the proposed conference and its relationship to limitations of funding support available. These limitations are very real at the present time, due to the general shortage of funds available for the support of research. Any extraordinary expenses should be supported by special justification.

4/84
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.

**Plymouth, June 1984**
- David Catlin
- Jonathan Rosenberg
- Amitai Regev

**Eugene, August 1984**
- Ralph Cohen
- Paul Seymour
- Ralph Greenberg
- Chiu-Lian Terng
- Yiannis Moschovakis
- Paul H. Rabinowitz
- David A. Vogan, Jr.
  (Colloquium Lecturer)

**Minneapolis, November 1984**
- Jerry L. Bona
- Naresh C. Jain
- I. Martin Isaacs
- Stephen C. Milne
- Charles Amrek
- Wei-Ming Ni
  (Nonlinear problems in mechanics)
- Robert Hardt
- William P. Ziemer
  (Variational methods in partial differential equations)
- Marian B. Pour-El
  (Logic)
- Joel L. Roberts
- Robert Speiser
  (Algebraic geometry)
- Dennis White
  (Enumerative combinatorics)

**San Diego, November 1984**
- Dragan Milicic
- John Guckenheimer

**Tucson, April 1985**
- George M. Bergman
- Gregory Brumfiel

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.

**June/July 1984 Meeting in Plymouth**
- Amitai Regev
  (Combinatorial ring theory)
- Jonathan Rosenberg
  (C*-algebras and topology/geometry)

**August 1984 Meeting in Eugene**
- Felix E. Browder
  (Variational methods in nonlinear problems)
- Ralph Cohen
  (Algebraic topology)
- Jacob E. Goodman
- Richard Pollack
  (Geometry of configurations)
- Eugene M. Luks
  (Computational complexity)
- Paul Seymour
  (Structures of graphs and matroids)
- Clifford H. Taubes
  (Gauge theories and applications)

**November 1984 Meeting in Minneapolis**
- Murray Gerstenhaber
  (Algebraic deformation theory)

**November/December 1984 Meeting in San Diego**
- J. D. Elwin
  (Applied graph theory)
- T. Enright
- J. A. Wolf
  (Representations of semi-simple Lie groups)
- Carl H. FitzGerald
- F. David Lesley
  (Complex analysis in honor of Stefan Warschawski)
- Peter Salamon
  (Differential geometry and mathematical physics)
- C.-H. Sung
  (Systems theory)

**Fall 1984 Meeting**
- Eastern Section
  (No meeting will be held)
- Southeastern Section
  (No meeting will be held)

**January 1985 Meeting in Anaheim**
- Murray Gerstenhaber
  (Algebraic deformation theory)

**March 1985 Meeting in Chicago**
- Central Section
  (No meeting will be held)

**April 1985 Meeting in Tucson**
- Far Western Section
  (No meeting will be held)

**Spring 1985 Meeting**
- Eastern Section
  (No meeting will be held)
- Southeastern Section
  (No meeting will be held)
Committee. They are administered by the Associate from the Society office in Providence. A proposed organizer issued through the Associate Secretary in charge of the meeting with staff assistance are held under the general supervision of the Program interested organizers or participants. Annual Meeting is limited to twelve. Proposals, Secretary. are welcomed by the Associate Secretaries. invited or offered, which are received at least proposals (specific deadlines for requesting 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. 

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

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

**Far Western Section (Pacific and Mountain)**
- Hugo Rossi, Associate Secretary
- Department of Mathematics
- Institute for Advanced Study
- Princeton, NJ 08540
  (Telephone 609-734-8157)

**Central Section**
- Robert M. Fossum, Associate Secretary
- Department of Mathematics
- University of Illinois
- 1409 West Green Street
- Urbana, IL 61801
  (Telephone 217-333-3975)

**Eastern Section**
- W. Wistar Comfort, Associate Secretary
- 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.

**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.

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.

The Society reserves the right of first refusal for the publication of proceedings of any special session. Titles appear in the book series *Contemporary Mathematics*.

**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.
Contemporary Mathematics
(ISSN 0271-4132)

Microlocal Analysis
M. Salah Baouendi, Richard Beals, and Linda Preiss Rothschild, Editors

This volume is the proceedings of the AMS-IMS-SIAM Joint Summer Research Conference on Microlocal Analysis and its Applications to Partial Differential Equations, held July 10–16, 1983 in Boulder, Colorado. It contains refereed articles which were delivered at the conference. Two of the papers are survey articles, one on uniqueness and non-uniqueness in the Cauchy problem and one on hypoanalytic structures; the rest are either detailed announcements or complete papers covering such areas as spectrum of operators, nonlinear problems, asymptotics, pseudodifferential operators of multiple characteristics and operators on groups and homogeneous spaces.

The volume should be useful to active mathematicians and graduate students working on linear and nonlinear partial differential equations and related areas.

I. Survey articles
S. Alinhac, Uniqueness and non-uniqueness in the Cauchy problem
F. Treves, Hypo-analytic structures

II. Spectrum of operators
G. Eskin, J. Ralston and N. Trubowitz, The multidimensional inverse spectral problem with a periodic potential
D. Jerison and J. Lee, A subelliptic, nonlinear eigenvalue problem and scalar curvature on CR manifolds
N. Stanton and D. Tartakoff, The heat equation for \( \Box_b \)

III. Nonlinear problems
S. Alinhac and G. Metivier, Propagation of analyticity for solutions of nonlinear partial differential equations
M. Beals, Nonlinear wave equations with data singular at one point
P. Godin, Nonlinear oblique derivative problems with nonsmooth solutions
J. Rauch and M. Reed, Ray-like solutions of semilinear wave equations

IV. Asymptotics
V. Ivrii, Global and partially global operators. Propagation of singularities and spectral asymptotics
R. Melrose, The trace of the wave group
M. Taylor, Airy operator calculus

V. Pseudodifferential operators of multiple characteristics
G. Mendoza, A necessary condition for solvability for a class of operators with involutive double characteristics
J. Nourrigat, Approximation of systems of pseudodifferential operators

VI. Operators on groups and homogeneous spaces
D. Geller, Toward analytic pseudodifferential operators for the Heisenberg group
K. Miller, Microhypoellipticity on step two nilpotent Lie groups
A. Unterberger, Symbolic calculi and the duality of homogeneous spaces

1980 Mathematics Subject Classification: 35-xx
Contemporary Mathematics
Volume 27, viii + 256 pages (soft cover)
List price $26, institutional member $21, individual member $16
ISBN 0-8218-5031-8; LC 84-2852
Publication date: April 1984
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Fluids and Plasmas:
Geometry and Dynamics
Jerrold E. Marsden, Editor

The AMS-IMS-SIAM Joint Summer Research Conference on Fluids and Plasmas: Geometry and Dynamics, held July 17 - 23, 1983, in Boulder, Colorado, was a highly successful effort to foster interaction among people working on mathematical, numerical and physical aspects of fluid and plasma dynamics. The organizing committee, consisting of J. Marsden (Chairman), P. Holmes and A. Majda, with A. Chorin and A. Weinstein as advisors, selected 27 speakers whom they felt would help achieve this interaction; the result was a fine sense of camaraderie, with the speakers making every effort to bridge communication gaps.
Researchers using this book will be brought up to date on work being done in these areas. The three groups of contributors are listed below.

Part I. Geometric-Analytic Methods (Hamiltonian structures, perturbation theory and nonlinear stability by variational methods)

B. Boghosian R. Dewar
Gerald Goldin Miroslav Grmela
Darryl Holm Allan Kaufman
Robert Littlejohn Jerrold Marsden
Minhard Mayer Richard Montgomery
Philip Morrison Tudor Ratiu
Alan Weinstein

Part II. Analytic and Numerical Methods (contour dynamics, spectral methods, and functional analytic techniques)

Tom Beale Robert Glassey
Andrew Majda Robert Miller
Peter Olver Harvey Segur
Philippe Spalart Walter Strauss
Yieh-Hei Wan Stephen Wollman
Norman Zabusky

Part III. Bifurcation and Dynamical Systems (experimental and numerical methods, bifurcation theory, and chaos)

John Crawford James Curry
John Guckenheimer P. Holmes
D. McLaughlin J. Moloney
Alan Newell Jürgen Scheurle
Eric Sigga James Swift
Harry Swinney E. Wayne

1980 Mathematics Subject Classifications: 58Fxx, 76Exx

Contemporary Mathematics
Volume 28, xvi + 448 pages (soft cover)
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Publication date: April 1984
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SIAM-AMS Proceedings
(ISSN 0080-5084)

Inverse Problems

D. W. McLaughlin, Editor

Inverse methods are fundamental to most measurement and detection problems in science, engineering, and technology. Such problems arise in diverse areas including tomography in medicine, image reconstruction and enhancement in astronomy, discovering oil deposits and general earth structure in seismology, interpretation of satellite observation, detection of ocean currents, climatology, and many more. A variety of mathematical techniques, with various degrees of sophistication, are used to attack these diverse physical problems which are generally categorized by the necessity of dealing with insufficient and/or inaccurate data of one sort or another.

This volume contains the proceedings of a symposium on inverse methods which was held on April 12 and 13, 1983, in New York City as a part of the sectional meeting of the American Mathematical Society. The organizing committee for the symposium consisted of Robert Burridge, New York University; Joseph B. Keller, Stanford University; R. B. Marr, Brookhaven National Laboratory; David W. McLaughlin (Chairman), University of Arizona; C. R. Smith, University of Wyoming. Their goal in organizing the conference was to illustrate the breadth of modern inverse problems, both with regard to the diversity of applications and the diversity of mathematical methods. From the many possible areas of inverse problems, the organizers chose several topics in which significant theoretical advances have recently been made, yet which have not had a high level of exposure at recent mathematics conferences.

The conference consisted of four half-day sessions on the following topics: (i) geophysical inverse problems, (ii) computer tomography and inverse problems in medicine, (iii) developments in mathematical inverse theory; (iv) methods of maximum information entropy. The ordering of papers in this volume is the same as the ordering of presentations at the meeting.

Contents

I. Geophysical Inverse Problems

Robert L. Parker, An inverse problem of electromagnetism arising in geophysics

D. C. Sticker, Application of the trace formula methods to inverse scattering for some geophysical problems

II. Computed Tomography and Inverse Problems in Medicine

A. M. Cormack, Radon’s problem—old and new

Kennan T. Smith, Inversion of the x-ray transform

James F. Greenleaf, Computed tomography from ultrasound scattered by biological tissues

F. Alberto Grünbaum, Some mathematical problems suggested by limited angle tomography

III. Developments in Mathematical Inverse Theory

Roger G. Newton, An inverse spectral problem in three dimensions

Gregory Eskin, James Ralston and Eugene Trubowitz, Isospectral periodic potentials on \( \mathbb{R}^n \)

William W. Symes, Some aspects of inverse problems in several-dimensional wave propagation

Robert V. Kohn and Michael Vogelius, Identification of an unknown conductivity by means of measurements at the boundary

IV. Methods of Maximum Information Entropy

C. Ray Smith, Ramarao Inguva and R. L. Morgan, Maximum-entropy inverses in physics

John E. Shore, Inversion as logical inference—Theory and applications of maximum entropy and minimum cross-entropy

327
1. Introduction
2. Periods of automorphic forms
3. Locally split extensions of flat vector bundles
4. Descent
5. Differential equations associated to automorphic forms
6. Examples

1980 Mathematics Subject Classifications: 10Dxx, 34A30, 14G10, 14J99
Memoirs of the AMS
Number 299, iv + 120 pages (soft cover)
List price $11, institutional member $9, individual member $7
ISBN 0-8218-2300-0; LC 84-3060
Publication date: May 1984
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Recurrence Relations, Continued Fractions and Orthogonal Polynomials
Richard Askey and Mourad Ismail
This work addresses the question of recovering the distribution function of a set of orthogonal polynomials from the three term recurrence relation satisfied by the polynomials. Four sets of orthogonal polynomials are investigated: The Al-Salam Chihara polynomials in Chapter 3, the Random Walk polynomials and their $q$-analogue in Chapters 6 and 7 respectively, and the case $q = -1$ of the associated continuous $q$-ultra-spherical polynomials in Chapter 8. For each polynomial set the authors obtain generating functions, derive explicit representations as ordinary or basic hypergeometric functions and determine their asymptotic behavior.

Generating functions and asymptotic formulas for the numerator polynomials are included, and the corresponding continued fractions and distribution functions are determined. Additionally, the associated Al-Salam Chihara polynomials are considered, and mention is made of connections with birth and death processes and random walks.

Contents

1. Introduction
2. Continued Fractions and Orthogonal Polynomials
3. The Al-Salam–Chihara Polynomials
4. Probability Theory and Orthogonal Polynomials
5. The Hadamard Integral
6. The Random Walk Polynomials $G_n(z; a, b)$
7. A $q$-Extension of the Random Walk Polynomials
8. The Polynomials $\{C_n(\alpha; \beta) - 1\}$
9. Comments and Further Problems

1980 Mathematics Subject Classifications: 33A65, 30E05, 30B70, 30E15, 44A15, 60J80
Memoirs of the AMS
Number 300, vi + 110 pages (soft cover)
List price $11, institutional member $9, individual member $7
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Publication date: May 1984
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Generalized Frobenius Partitions
George E. Andrews
This paper is devoted to the study of equilength two-line arrays of non-negative integers, called generalized Frobenius partitions. It is shown that such objects have numerous interactions with modular forms, Kloosterman quadratic forms, and the Lusztig-Macdonald-Wall conjectures as well as with classical theta functions and additive number theory.

Contents

1. Introduction
2. Frobenius's Idea
3. The Jacobi Triple Product Identity
4. Definitions and Simple Examples
5. Generating Functions
6. Finite Generating Functions
7. Hecke Modular Forms
8. $q$-Series
9. Kloosterman Quadratic Forms
10. Congruences
11. The Dyson Rank for $F$-Partitions
12. Partition Identities
13. Asymptotics
14. F. Franklin's Method
15. Conclusion and Open Problems
16. Tables

References
The Structure of Shock Waves in Magnetohydrodynamics
Mahmud Hesaaraki

In the presence of magnetic induction and electrical fields, several types of discontinuities may exist in an electrically conducting fluid. These phenomena can be described by the laws of conservation of mass, momentum, and energy, Maxwell's electromagnetic equations, and Ohm's law. Those discontinuities which can be characterized by the conditions that both the temperature and density change across them are different from zero are called magneto-hydrodynamic shock waves. This monograph is concerned with the study of such types of discontinuities.

The mathematical question of the existence of structure for "fast", "slow", "intermediate", "switch-on" and "switch-off" magnetohydrodynamic shock waves is stated in terms of a system of four ordinary differential equations which contains four non-negative viscosity parameters, $\mu, \nu, \mu_1$ and $\kappa$ and four constants $J, J < 0, \epsilon > 0$ and $E$. This system, under some hypotheses, admits (at most) four rest points, say, $u_i, 0 \leq i \leq 3$, ordered by increasing density. The properties considered are the following:

1. Showing that, for all values of the viscosities there is an orbit running from $u_0$ to $u_1$ (fast shocks) and likewise an orbit running from $u_2$ to $u_3$ (slow shocks).
2. Showing that, for the limiting case when $\epsilon = 0$, and for all values of the viscosities, there is an orbit running from $u_0$ to $u_1$ (switch-on shocks) and similarly, an orbit running from $u_2$ to $u_3$ (switch-off shocks). Here $u_i$ is the limit of $u_i$ as $\epsilon$ tends to 0.

3. Testing the investigation of the "lim sup" of the orbits running from $u_0$ to $u_{i+1}$ (for $i = 0$ and 2) corresponding to viscosity parameters $\lambda_n = (\mu_n, \nu_n, \mu_1, \kappa_n) > 0$, in the limiting cases $\lambda_n \to \lambda$, where $\lambda = (\mu, \nu, \mu_1, \kappa) \geq 0$.

By using results of German together with a theorem of Conley and Smoller, Hesaaraki solves the above problems. Moreover, he shows that intermediate shocks between $u_1$ and $u_2$ cannot occur when $\epsilon$ is small, and obtains uniqueness results for most cases. Finally, he shows that "subshocks" can indeed occur, here it is necessary that $\mu_1 = 0$.

Contents

I. Introduction and background
II. Existence and uniqueness of structure for fast and slow shocks
III. Existence of structure for switch-on and switch-off shocks
IV. Subshocks and the existence of structure for fast and slow shock waves for singular viscosities

Multipliers of Radical Banach Algebras of Power Series
W. G. Bade, H. G. Dales and K. B. Laursen

This memoir is a study of the multiplier algebra $\mathfrak{M}(M)$ of the unique maximal ideal in the Banach algebra $\ell^1(\omega)$, where $\omega$ is a radical weight and multiplication is by convolution. Every multiplier is given by convolution by a sequence, and $\mathfrak{M}(M)$ is a Banach algebra of power series for the operator norm. Let $\mathcal{L}(M)$ be the closure of $\ell^1(\omega)$ in $\mathfrak{M}(M)$, and $J$ be the left shift. The following are equivalent: (a) $\mathfrak{M}(M) = L(M)$, (b) $L(M)$ is an algebra under convolution, and (c) there exists a constant $C$ such that $\omega(m + n + 1) \leq C\omega(m + 1)\omega(m + 1)(m, n \in \mathbb{Z}^+)$.

The following are also equivalent: (d) $\mathfrak{M}(M)$ is separable, and (e) $\mathfrak{M}(M) = \mathcal{L}(M)$. Moreover, (c) $\rightarrow$ (d) and if $\lim_{n \to \infty} \omega(n + 1)\omega(n) = 0$, then (a) $\rightarrow$ (e) are all equivalent, and equivalent to the condition: (f) $\mathcal{L}(M)$ is weakly sequentially complete.

The algebra $\mathfrak{M}(M)$ need not be a local Banach algebra: an $\omega$ is constructed for which there is a multiplier whose spectrum includes a neighborhood of zero. An example is given of an $\omega$ for which (a) fails, but for which the closed ideals of $\ell^1(\omega)$ are totally ordered (answering a question of Nikolskii).

The Banach space structure of $\mathfrak{M}(M)$ is investigated. If $\mathcal{L}(M)$ is properly contained in $\mathfrak{M}(M)$, then $\mathcal{L}(M)$ is uncomplemented in $\mathfrak{M}(M)$.

Contents

1. Preliminaries
2. A non-local multiplier algebra
3. Domar weights
4. Banach space structure of $\mathfrak{M}(M)$
5. Weak-star generators

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329
Personal Items

Alphonse Buccino, Deputy Director of the Office of Science and Engineering Education of the National Science Foundation, has been appointed dean of the College of Education at the University of Georgia.

Sorin Istrail has been appointed to an assistant professorship at Wesleyan University.

W. I. Layton of Newberry College received a certificate of commendation for meritorious service from the National Council of Teachers of Mathematics on February 18, 1984.

Ronald E. Rietz of Gustavus Adolphus College has been named chairman of the Mathematics and Computer Science Department at that university.

David M. Russell has been appointed to an assistant professorship at the University of North Carolina, Wilmington.

John Selden, Jr., of the Bayero University, Kano, Nigeria has been elected Dean of the Faculty of Science at that university for the period 1983–1985.

S. James Taylor, formerly of the University of Liverpool, currently visiting professor at the University of British Columbia, has been appointed Gordon T. Whyburn Professor of Mathematics at the University of Virginia.

Deaths

James Alexander of Chicago, Illinois died on October 30, 1983 at the age of 73. He was a member of the Society for 6 years.

Richard E. Bellman, professor of mathematics, electrical and biomedical engineering, and medicine at the University of Southern California, died on March 19, 1984, at the age of 63. He was a member of the Society for 42 years. In 1970 he received the first AMS-SIAM Norbert Wiener Prize in Applied Mathematics (see the April, 1971, issue of the Notices, page 491).

J. James Brown of Washington, D.C. died on January 7, 1984 at the age of 58. He was a member of the Society for 22 years.

Cheng-Tan Hsiao of National Chiao-Tung University, Taiwan died on April 20, 1983 at the age of 32. He was a member of the Society for 7 years.

Anthony P. Morse of the University of California, Berkeley died on March 6, 1984 at the age of 72. He was a member of the Society for 47 years.

Shakeel Ahmed Saigol of Alfred University died on January 8, 1984 at the age of 30. He was a member of the Society for 5 years.

Harlan R. Stevens of Pennsylvania State University died on December 3, 1983 at the age of 54. He was a member of the Society for 25 years.

Fred J. Toney, Jr., of the University of North Carolina, Wilmington died on January 1, 1984 at the age of 46. He was a member of the Society for 14 years.

Mary H. Turner of Bellevue, Washington died on November 16, 1983. She was a member of the Society for 46 years.

Maximal Functions
Measuring Smoothness

Ronald A. DeVore and Robert C. Sharpley

Maximal functions are most often used to control the size of a function. The best known example is the Hardy-Littlewood maximal function which gives bounds for estimates over cubes. More recently other maximal functions which measure oscillation or cancellation have found important application in the study of $H^p$ spaces and $BMO$. This monograph studies a third (but related) type of maximal function which measures smoothness. These maximal functions offer attractive alternatives to potential and fractional derivatives in the study of fractional order smoothness. This monograph develops the intrinsic properties of these maximal functions and their related smoothness spaces.

1980 Mathematics Subject Classifications: 26B35, 46E35, 26A15; 42B25

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### Doctorates Conferred (Supplementary List)

#### 1982–1983

The following list supplements the list of thesis titles published in the November 1983 issue of the Notices (see page 734 for an explanation of the numbers in parentheses).

**ALABAMA**

University of Alabama, Birmingham

(1;0,0,0,0,1,0,0)

Biostatistics and Biomathematics

DeMuth, Robert, *The development and application of a theory of discrete growth.*

**MASSACHUSETTS**

Massachusetts Institute of Technology

(13;0,0,0,3,1,0,9)

Management Science Group

Bier, Ciciki Marion, *A measure of uncertainty importance for components in fault trees.*

Chandru, Vijaya, *Complexity of super-group approach to integer programming.*

Cournoyer, Paul Edward, *Mobility of information systems personnel: An analysis of a large computer firm’s experience.*


Forrester, Nathan Blair, *A dynamic synthesis of basic macroeconomic theory: Implications for stabilization policy analysis.*

Glidden, Priscilla Anne, *How arbitrators maintain “acceptability”.*

Hawkins, Gregory D., *Essays on non-publicly issued debt: Revolving credit agreements and the pricing of privately placed debt.*

Homer, Jack Bernard, *A dynamic model for analyzing the emergence of new medical technologies.*

Lawrence, Barbara S., *The age grading of managerial careers in work organizations.*

McKinnon, Paul DeMar, *Management of long term research and development projects.*

Morgan, Sandra West, *The career management process in a university administrative career: Control, balance, and satisfaction.*


**MISSOURI**

Washington University

(7;0,0,0,1,6,0,0)

Systems Science and Mathematics

Chen, Cheng-Wu, *Optical tracking systems.*


Marino, Riccardo, *Feedback-equivalence of nonlinear systems with applications to power system equations.*

Seidu, Kala, *Parallel state estimation and meter placement in electric power systems.*

Tanikawa, Akio, *New techniques for nonconvex primal-dual decomposition of a large-scale separable optimization problem.*


Zavgren, John, *Stabilization of infinite-dimensional systems via periodic output feedback.*

**NEW JERSEY**

Princeton University

(2;0,2,0,0,0,0,0)

Statistics

Goldberg, Miriam, *Regression models as related to methods for assessing residential energy conservation.*

Zeger, Scott, *Frequency domain analyses of spatial time series with application to ozone.*

**NEW YORK**

CUNY, Graduate Center

(1;0,0,0,0,1,0,0)

Mathematics

Joffe, Peter, *Some properties of 3-polytopal graphs.*

Syracuse University

(1;1,0,0,0,0,0,0)

Mathematics

Burt, Earl Cushman, *A theoretical and numerical analysis of the general Poisson Boltzmann equation.*

**OKLAHOMA**

Oklahoma State University

(5;2,0,0,0,1,2,0)

Mathematics

Abedi, Farrokh, *Solvability of the conjugacy problem for HNN extensions of finitely generated free Abelian groups.*

Abotteen, Essam A., *Character formula of outer plethysms.*

Harris, Bennette Rodgers, *Dominance of solutions of linear differential equations.*

Mumbwa, Mathew Roman, *Selection of academic department heads in doctorate-grading universities.*

Townsend, Mark Allan, *An introduction to the acceleration of scalar sequences.*

**PENNSYLVANIA**

Carnegie-Mellon University

(1;0,0,0,0,1,0,0)

Mathematics

Boland, James Mathais, *Finite elements and the divergence constraint for viscous flows.*
A Computer-assisted Proof of Universality for Area-preserving Maps
Jean-Pierre Eckmann, Hans Koch and Peter Wittwer

Universality for period-doubling in 1-parameter families of area-preserving maps is proved in this paper. The main part of this proof consists in showing that a certain non-linear map in a Banach space is a contraction on a ball. The estimates necessary for this proof are so complicated that a computer has been used for their implementation. The underlying method of computer-assisted proofs is explained and documented in detail.

Contents

II. FUNCTIONAL ANALYSIS ON THE COMPUTER, 1. Interval and neighborhood arithmetics, 2. Spectral theory, 3. Interval and neighborhood arithmetics on a computer, List of correspondences

III. PROOFS, 1. Computer program, 2. Program output, Table 1

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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 specialised topics, as well as announcements of regularly scheduled meetings of national or international mathematical organisations. (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 additional 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), deadlines 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 for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the Notices prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.


Invited Speakers: Forman Williams (Princeton), Ingo Muller (Berlin), Herschel Rabbits (Princeton), Rutherford Aris (Minnesota), John Buckmaster (Illinois), Basil Nicolaenko (Los Alamos), Don Cohen (California Institute of Technology), Harry Dwyer (University of California, Davis).


MAY 1984


2–4. Optimization Days 1984, Concordia University, Montreal, Quebec, Canada. (November 1983, p. 799)


Information: Surinder Sehgal, Department of Mathematics, Ohio State University, Columbus, Ohio 43210.


4–6. Midwest Algebraic Geometry Conference, Purdue University, West Lafayette, Indiana. (October 1983, p. 672)


Information: B. Dawkins, Mathematics Department, Victoria University, Private Bag, Wellington, New Zealand.

7–11. Ecole de Geometrie et Analyse (EGA 84), Casablanca, Morocco. (February 1984, p. 195)


Organizer: Michel Duflo.

Information: Societe Mathematique de France, Boite postale 126-05, 75226 Paris Cedex 05, France.


Organizers: Probability Consortium of the Western Reserve, Case Western Reserve University and Cleveland State University.

Invited Speakers: Isaac Chavel (City College, City University of New York), Richard T. Durrett (University of California at Los Angeles), Alfred Gray (University of Maryland), Mark Pinsky (Northwestern University).

Information: John Chao, Cleveland State University, Cleveland, Ohio, 216-678-6498, or Wojbor A. Woycinski, Case Western Reserve University, Cleveland, Ohio, 216-368-2880.


Program: Norberto Salinas, University of Kansas, and Lawrence Brown, Purdue University, will each give two one-hour talks. There will also be half-hour talks by participants.

Information: Justin Peters, Department of Mathematics, Iowa State University, Ames, Iowa 50011.


14–18. Twenty-eighth Annual Meeting of the Australian Mathematical Society, Monash University, Victoria, Australia.
Information: H. Lausch, Secretary, Australian Mathematical Society 28th Annual Meeting, Department of Mathematics, Monash University, Clayton, Victoria 3168, Australia.


16–18. Colloque International sur la Modélisation et les Outils Logiciels d'Analyse de Performance, Paris, France. (January 1984, p. 84)

17–18. IMACS International Symposium on Modelling and Simulation of Electrical Machines and Converters, Liège, Belgium. (October 1983, p. 672)

18–31. Meeting on Graphs and Order, Banff Centre, Banff, Canada. (February 1984, p. 195)


28. Lecture Series in Probability and its Applications, Graduate School, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. (January 1984, p. 84)

28–June 1. Simulation Numérique de la Turbulence, Sophia-Antipolis, France. (January 1984, p. 84)


JUNE 1984

1–2. Colloque Inter-IREM de Géométrie, CIRM-Luminy, France.

Organizer: Jean Marion.

Information: Société Mathématique de France, Boîte postale 126-05, 75226 Paris Cedex 05, France.

1–10. Frontières Libres–Applications et Théories Problèmes à Frontières Libres–Applications et Théories, Montbéliard, France. (February 1984, p. 196)


Organizer: Daniel Lazard.

Information: Société Mathématique de France, Boîte postale 126-05, 75226 Paris Cedex 05, France.


Information and Registration: Yih-Hsing Pao, Department of Theoretical and Applied Mechanics, Cornell University, Ithaca, New York 14853, 607-256-2345.

4–8. Conference on Contact and Optimisation Problems in Elasticity, Villa Madruzzo, Trento, Italy.

Organizers: G. Anzellotti (Trento) and P. Villaggio (Pisa). Invited Lecturers: J. Bundurs (Evans ton), J. J. Kalker (Delft), D. Kinderlehrer (Minneapolis), R. V. Kohn (New York), P. Villaggio (Pisa).

Information: A. Micheletti, Secretary of CIRM, Istituto Trentino di Cultura, I-38050 Povo (TN), Italy.

4–8. Teaching Mathematics via APL, Salisbury State College, Salisbury, Maryland. (February 1984, p. 196)


7–8. Meeting of the Canadian Society for the History and Philosophy of Mathematics, University of Guelph, Guelph, Ontario, Canada. (February 1984, p. 196)


Organizers: V. Ancona (Firenze), A. Silva (Trento).

Invited Lecturers: E. Arbarello (Roma I), H. Grauert (Göttingen).

Information: A. Micheletti, Secretary of CIRM, Istituto Trentino di Cultura, I-38050 Povo (TN), Italy.

11–15. Short Course on Computational Complexity, University of Maine, Orono, Maine.

Program: The course will consist of ten lectures on some combinatorial and geometric aspects of optimization. Topics to be covered include combinatorial optimization, computational complexity of certain integer and nonlinear programming problems, convex polytopes and the computational complexity of linear programming.

Principal Lecturer: Victor Klee (University of Washington).

Sponsors: Northeast Section, Mathematical Association of America; the University of Maine.

Information: Granting Murphy, Department of Mathematics, University of Maine at Orono, Orono, Maine 04469; or Don Small, Department of Mathematics, Colby College, Waterville, Maine 04901.


11–16. First International Symposium on Ordered Algebraic Structures, CIRM-Luminy, Marseilles, France. (February 1984, p. 196)


12–14. Tenth International Symposium on Machine Processing of Remotely Sensed Data, Purdue University, West Lafayette, Indiana. (October 1983, p. 673)


13–15. 1984 Conference sur les Modèles Economiques Dynamiques et le Contrôle, Nice, France. (February 1984, p. 196)


18–20. International Conference on Qualitative Theory of Differential Equations, University of Alberta, Edmonton, Alberta, Canada. (January 1984, p. 84)

18–20. Twenty-sixth International Meeting of the Institute of Management Sciences, Copenhagen, Denmark. (November 1983, p. 799)
18–22. NSF-CBMS Regional Conference on Analysis on Non-Riemannian Symmetric Spaces, University of Georgia, Athens, Georgia.

Principal Lecturer: M. Flenslod-Jensen.

Information: Kenneth Johnson, Department of Mathematics, University of Georgia, Athens, Georgia 30602, 404-542-2211.

18–22. NSF-CBMS Regional Conference on Extremal Graph Theory, Emory University, Atlanta, Georgia.

Program: Della Bollobas (University of Cambridge) is the principal speaker and will deliver ten lectures. Four other one-hour invited lectures will be given.

Support: Some support for travel and accommodation is provided by the NSF under the CBMS Regional Conference Program.

Information: Extremal Graph Theory Conference, Department of Mathematics and Computer Science, Emory University, Atlanta, Georgia 30322.

18–22. Sixth International Conference on Trends in the Theory and Practice of Nonlinear Analysis, University of Texas at Arlington, Arlington, Texas. (January 1984, p. 84)


Organizers: Gerard Letac, A. Rasigu, France.

Information: Societe Mathematique de France, Boite postale 126-05, 75226 Paris Cedex 05, France.

19–21. Sixieme Conference Internationale Analyse et Optimisation des Systemes, Nice, France. (January 1984, p. 84)


19–23. Seventh Summer Symposium in Real Analysis, Saint Olaf College, Northfield, Minnesota. (February 1984, p. 197)


Scientific Selection Committee: H. Farahat (Chairman), J. Timourian, J. Lawrence, J. Walsh, R. Kane, J. Arthur.

Program: There will be invited speakers and special sessions as well as contributed papers. There will also be a special mathematical education session titled "The Resurrection of the Math Major", to be held on June 21. Speakers at this session will be John Poland (Carleton), Jack Macki (Edmonton), and Peter Hilton (Binghamton). Information on this session can be obtained from Peter D. Taylor, Department of Mathematics and Statistics, Queen's University, Kingston, Ontario K7L 3N6, Canada.

Information: H. I. Freedman, Organiser, Department of Mathematics, University of Alberta, Edmonton, Alberta, Canada.

21–24. Conference on Bertrand Russell's Early Technical Philosophy, Trinity College, University of Toronto, Toronto, Canada. (February 1984, p. 197)

24–July 3. Analytic Number Theory and Diophantine Problems, Department of Mathematics, Oklahoma State University, Stillwater, Oklahoma. (February 1984, p. 197)


25–29. NSF-CBMS Regional Conference on Factorisation of Linear Operators and Geometry of Banach Spaces, University of Missouri, Columbia, Missouri. (February 1984, p. 197)


25–July 6. La Mecanique Non Lineaire, Bruxe sans Nappe, France. (January 1984, p. 84)

26–July 7. Canadian Mathematical Society Summer Seminar on Lie Algebras and Related Topics, University of Windsor, Windsor, Ontario, Canada. (January 1984, p. 84)


JULY 1984


Program: The main topics will be model theory of algebra and arithmetic, and there will be short courses of lectures given by A. Macintyre, L. van den Dries, K. McAloon and A. Wilkie. There will also be lectures on set theory, complexity theory and the philosophy of language.


Information: Logic Colloquium '84, Department of Mathematics, The University, Oxford Road, Manchester M13 9PL, England.

16–20. 1984 Mathematical Sciences Lecture Series, Department of Mathematical Sciences, Johns Hopkins University, Baltimore, Maryland. (February 1984, p. 198)


16–27. Fifth International Conference on Probability in Banach Spaces, Tufts University, Medford, Massachusetts. (January 1984, p. 85)

16–27. Seventh Latin American School of Mathematics, Universidad Simón Bolívar, Caracas, Venezuela. (January 1984, p. 85)

20–22. Differential Equations Conference, Utah State University, Logan, Utah.
Principal Speakers: W. N. Everitt (Birmingham, England), A. M. Krall (Penn State), A. Zettl (Northern Illinois), K. Schmitt (Utah), J. Bebernes (Colorado).
Program: There will be a session for contributed talks on Friday, July 20; deadline for submission of abstracts is June 15, 1984.
Organizing Committee: Jerry Ridenhour, Russell Thompson, Lance Littlejohn.
Information: Lance Littlejohn, Department of Mathematics, UMC 41, Utah State University, Logan, Utah 84322, 801-750-2819.

23–27. Conference on Complex Analysis and Approximation Theory, State University of Campinas, Campinas, São Paulo, Brazil. (November 1983, p. 800)

23–August 8. NATO-ASI Conference on Computational Mathematical Programming, Bad Windsheim, Federal Republic of Germany. (November 1983, p. 800)


23–August 10. Séminaire de Mathématiques Supérieures—NATO Advanced Study Institute (SMS-NATO ASI) on Universal Algebra and Relations, Université de Montréal, Montréal, Québec, Canada. (January 1984, p. 85)


30–August 3. Fourth Brazilian Conference on Algebraic Topology, IME-Universidade de São Paulo, Brazil. (February 1984, p. 198)


AUGUST 1984

1–3. Second Workshop on Hadronic Mechanics, Center A. Volta, Villa Olmo, Como Lake, Italy. (February 1984, p. 198)


6–10. International Conference on Approximation Theory and Applications, Memorial University of Newfoundland, St. John’s, Newfoundland, Canada. (February 1984, p. 198)


Information: C. E. Praeger, Department of Mathematics, University of Western Australia, Nedlands, Western Australia, 6009.

13–18. Nineteenth Nordic Congress of Mathematicians, Reykhavik, Iceland. (February 1984, p. 198)


19–September 5. XIVeme Ecole D'Eté de Calcul des Probabilités, Saint-Flour, Cantal, France. (February 1984, p. 199)

20–25. Fourth International Conference on Representations of Algebras, Carleton University, Ottawa, Canada. (February 1984, p. 199)


SEPTEMBER 1984


10–14. VIII Escola de Álgebra, Rio de Janeiro, Brazil.
Information: Otto Endler, Organizing Committee, VIII Escola de Álgebra, Instituto de Matemática Pura e Aplicada, Estrada Dona Castorina 110, BR-22460 Rio de Janeiro, Brasil.


Sponsor: The Institute of Mathematics and its Applications.
Information: Deputy Secretary, Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2YJ, England.

12–17. Tenth International Conference on Nonlinear Oscillations, Varna, Bulgaria. (February 1984, p. 199)


23–October 6. Course on Computation Theory, Udine, Italy. (February 1984, p. 199)

Topics: Ordinary, partial and functional differential equations, numerical analysis, applications.
Call for Papers: Title and abstracts should be sent to the address below by June 30, 1984.


Information: Cynthia Hay, Conference Secretary, Faculty of Mathematics, The Open University, Walton Hall, Milton Keynes, MK7 6AA, England.


OCTOBER 1984

8–10. Association for Computing Machinery 1984 Annual Conference, San Francisco Hilton Hotel, San Francisco, California. (February 1984, p. 200)

10–12. International Conference on Special Functions: Theory and Computation, University of Turin, Turin, Italy.


Sponsors: Seminario Matematico dell'Università e del Politecnico di Torino, and the Italian Research Council.

Organizing Committee: G. Allasia (University of Turin), L. Gatteschi (University of Turin), W. Gautschi (Purdue University), and G. Monegato (Politecnico di Torino).

Information: L. Gatteschi, Dipartimento di Matematica, Università di Torino, Via Carlo Alberto, 10, 10123 Turin, Italy.


Information: Thomas F. Banchoff, Department of Mathematics, Brown University, Providence, Rhode Island 02912, 401-863-3319.


Program: Lectures will be given by Allan Krall (Pennsylvania State University), Paul Waltman (Emory University), and Glenn Webb (Vanderbilt University). In addition there will be sessions for twenty-minute contributed talks.

Information: John Baxley, Department of Mathematics, Wake Forest University, Winston-Salem, North Carolina 27109, 919-761-5336 or 919-761-5354.


16–18. Symposium on Viscoelasticity and Rheology, Mathematics Research Center, University of Wisconsin, Madison, Wisconsin.

Invited Speakers: R. C. Armstrong; R. B. Bird; B. Coleman; C. Dafermos; H. W. Giesekus; O. Hassager; Dan Joseph; A. S. Lodge; R. C. MacCamy; David Malkus; M. Renardy; R. Tanner, E. Walsh; W. D. Williams; L. J. Zapas.

Information: Mrs. Gladys Moran, Conference Secretary, Mathematics Research Center, University of Wisconsin-Madison, 610 Walnut Street, WARP Building, Madison, Wisconsin 53705.


Program: Topics of the conference will include numerical analysis, information management, graphics, artificial intelligence, statistics, and computer architecture. There will be a panel discussion on changes taking place in statistics education. There will also be invited presentations and discussion groups, as well as contributed papers and poster presentations.

Invited Speakers: G. W. Stewart (University of Maryland), Malvin H. Kalos (Courant Institute), Douglas B. Lenat (Stanford University), William A. Gale (Bell Labs), John E. Dennis, Jr. (Rice University), Toby J. Mitchell (Union Carbide), Ramanathan Gnanadevan (Bell Operating Companies), Jerome H. Friedman (Stanford University), Harold K. T. Wong (Lawrence Berkeley Laboratory), Richard Littlefield (Pacific Northwest Laboratories), Douglas M. Bates (University of Wisconsin-Madison), Andreas Bujals (University of Washington), William F. Eddy (Carnegie-Mellon University), Allan R. Wilks (Princeton University).

Deadline for Abstracts: June 1, 1984.


Organizer: John Miller, Trinity College, University of Dublin.

Purpose: The purpose of the conference is to bring together a cross-section of people from business, industry and the academic world who share an interest in computer-aided text processing systems.

Topics: Computer-aided generation of generalized copy; computer-generated book-quality masters for print production; interactive editing systems; interactive document composition; computer-aided typography.

Invited Speakers: (Tentative). Brian Kernighan (Bell Laboratories); Pierre MacKay (University of Washington); Brian Reid (Stanford University); Vincent Quint (University of Grenoble and INRIA); Irving Wieselman (Data Products Corporation).

Deadline for Abstracts: June 1, 1984.

Information: PROTEXT I Organizing Committee/Boole Press Limited, P.O. Box 5, 51 Sandycombe Road, Dun Laoghaire, Co Dublin, Ireland.


26–27. Festschrift Symposium in Honor of Stan Ulam, Northwestern State University, Natchitoches, Louisiana.

Theme: Historical notes, research and viewpoints fostered by Stan Ulam.

Principal Speakers: Mark Kac, Gian-Carlo Rota, R. D. Anderson, Jan Mycielecki, Dan Mauldin.

Information and Papers: Donald E. Ryan, Mathematics Department, Northwestern State University, Natchitoches, Louisiana 71497.

29–November 2. Second Southeast Asian Logic Conference, Bangkok, Thailand.


Information: Mark Tamthai, Department of Philosophy, Chulalongkorn University, Bangkok 10500, Thailand.

NOVEMBER 1984


Program: The following topics will be included: distributed computation, approximate solutions of hard problems, applied mathematics, signal processing, numerical analysis, computer vision, remote sensing, fusion of information, prediction, estimation, control, decision theory, mathematical economics, optimal recovery, seismology, information theory, design of experiments, and stochastic scheduling. Contributed papers are welcomed.

Invited Speakers: (Tentative). Leonid Hurwicz; David Johnson; Jay Kadane; Richard M. Karp; H. T. Kung; Christos H. Papadimitriou; Michael Rabin; Steven Smale; Henryk Wozniakowski.

Information: J. F. Traub, Computer Science Department, 450 Computer Science, Columbia University, New York, New York 10027.

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AUGUST 1986


PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS

Complex Analysis of Several Variables

Yum-Tong Siu, Editor

These proceedings contain a collection of papers presented at the Symposium on Several Complex Variables held in Madison, Wisconsin from April 12 to April 15, 1982. At the Symposium there were one-hour survey talks by H. Grauert, J. J. Kohn, M. Schneider, H. Skoda, and S. T. Yau on major areas of important recent developments. In addition, there were more than forty specialized half-hour talks by other participants. Quite a number of talks are not included in these proceedings because detailed papers containing the results presented at the Symposium have already appeared elsewhere. On the other hand, included in these proceedings are some papers submitted by invited speakers who were unable to attend the Symposium.

Contents

Steve Bell, Local boundary behavior of proper holomorphic mappings

Thomas Bloom, Polynomial interpolation for entire functions on C^n

A. Boggess, The first and second Levi forms and CR extension

David W. Catlin, Global regularity of the \( \overline{\partial} \)-Neumann problem

John D'Angelo, Intersection theory and the \( \overline{\partial} \)-Neumann problem

K. Diederich, J. E. Fornaess and G. Herbort, Boundary behavior of the Bergman metric

John Erik Fornaess and Berit Stensønes Henriksen, Peak sets for \( A^p(D) \)

Robert E. Greene and Steven G. Krantz, Stability of the Carathéodory and Kobayashi metrics and applications to biholomorphic mappings

Gary A. Harris, Function theory and geometry of real submanifolds of \( C^n \) near a CR singularity

F. R. Harvey and J. C. Polking, The \( \overline{\partial} \)-Neumann kernel in the ball in \( C^n \)

J. J. Kohn, A survey of the \( \overline{\partial} \)-Neumann problem

László Lempert, Intrinsic metrics

Ngaiming Mok, A survey on complete noncompact Kähler manifolds of positive curvature

Michael Schneider, On the number of equations needed to describe a variety

H. Skoda, A survey of the theory of closed, positive currents

Yue Lin Tong, Special cycles, harmonic forms and invariant theory

S. M. Webster, Analytic discs and the regularity of C-R mappings of real submanifolds in \( C^n \)

R. O. Wells, Jr., Extensions of holomorphic vector bundles and coupled cohomology equations

B. Wong, A class of compact complex manifolds with negative tangent bundles

Hit-Mann Wong, On umbilical hypersurfaces and uniformization of circular domains

H. Wu, On certain Kähler manifolds which are q-complete

P. Yang, Geometry of tube domains

Shing Tung Yau, A survey of Kähler-Einstein manifolds

Stephen S.-T. Yau, Criteria for right-left equivalence and right equivalence of holomorphic functions with isolated critical points

1980 Mathematics Subject Classifications: 32-XX, 14C99, 53C55, 53C55, 53C55, 53C59

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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.

Hugo Rossi (1985) has been appointed by Cathleen S. Morawetz, Chairman of the Board of Trustees, to the Committee on the Publication Program. Other members of the committee are Murray Gerstenhaber (1984), chairman, Barbara Janson, consultant, William E. Kirwan II (1985), William J. LeVeque (ex officio), R. James Milgram (1984), Everett Pitcher (ex officio), and Elias M. Stein (1985).

Hyman Bass (1987) has been elected to the Executive Committee of the Council by the Council members. The other members of the Executive Committee are Paul R. Halmos (1985), Melvin Hochster (1986), Irving Kaplansky (ex officio), Everett Pitcher (ex officio), Julia B. Robinson (ex officio) and Elias M. Stein (1984).

Andrew M. Odlyzko (1985) has been elected by the Council to Editorial Committee of the Proceedings. He replaces David M. Goldschmidt.

Lynn Steen has been elected to serve as chairman for 1984 on the Committee to Monitor Problems in Communication.

Ramesh Gangolli (1985) has been appointed by President Julia B. Robinson to the Committee to Select Hour Speakers for Far Western Sectional Meetings. Other members of the committee are Paul J. Cohen (1984), chairman, Tsit-Yuen Lam (1984), Hugo Rossi (ex officio) and Masamichi Takesaki (1985).


The name of the AMS-MAA-SIAM Joint Concerns Committee for Mathematics has been changed to the AMS-MAA-SIAM Joint Policy Board of Mathematics. Members of the committee are I. Edward Block (SIAM ex officio), Hirsh G. Cohen (SIAM ex officio), William J. LeVeque (AMS ex officio), Ivan Niven (MAA ex officio), Robert E. O'Malley (SIAM 1984), Julia B. Robinson (AMS ex officio), Kenneth A. Ross (MAA 1984), Dana S. Scott (AMS 1984), and Alfred B. Willcox (MAA ex officio).

Irreducible Triangular Algebras
Baruch Solel

This memoir is devoted to the study of the structure of irreducible triangular algebras generated by a maximal abelian algebra and an ordered semigroup of unitary operators acting on the maximal abelian algebra.

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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.)

SEND AD AND CHECK TO: Advertising Department, AMS, P. O. Box 6248, Providence, Rhode Island 02940. Individuals are requested to pay in advance, institutions are not required to do so.

POSITIONS AVAILABLE

Dept. of Math & Computer Science
TOUGALOO COLLEGE

Permanent position possibly available beginning fall 84. Ph.D. and analysis preferred. Emphasis upon teaching with some opportunities for research. Interest in teaching a variety of undergraduate math courses needed. Persons completing graduate study will be considered. Rank and salary commensurate with degree and experience. Applicants please send resume and three letters of recommendation to: Dr. John Hwang, Chair, Math & CS, Tougaloo College, Tougaloo, Mississippi 38674. A member of UNCF and EO/AAE.

COMPUTER SCIENCE

Tenure-track faculty position beginning August 1984. Responsibilities—undergraduate teaching (12 semester hours per semester) in a program leading to a B.A. or a B.S. in Computer Science. Required: M.S. in Computer Science. Rank and salary dependent on qualifications and experience. Send resume, three letters of reference and graduate transcripts prior to April 30, 1984 to Personnel Coordinator, St. Ambrose College, 518 West Locust Street, Davenport, Iowa 52803. EQUAL EMPLOYMENT OPPORTUNITY.

MATHEMATICAL SCIENCES

Tenure-track faculty position beginning August 1984. Responsibilities—teaching 12 semester hours per semester in a program leading to a B.S. in Mathematics. Required: Ph.D. in a field of mathematical sciences. Preferred: background in computer science. Rank and salary dependent on qualifications and experience. Send resume, three letters of reference and graduate transcripts prior to April 30, 1984 to Personnel Coordinator, St. Ambrose College, 518 West Locust Street, Davenport, Iowa 52803. EQUAL EMPLOYMENT OPPORTUNITY.

Head, Department of Computer Science
Northeast Louisiana University

Tenure-track appointment beginning July 1, 1984. Newly formed department offering the Bachelor of Science degree in Computer Science to approximately 400 majors. Rank and salary open. Qualifications are a Ph.D. in Computer Science and/or Mathematics, evidence of scholarly activity, and experience in teaching and conducting research in computer science. Candidates should have a minimum of 5 years of full-time university level teaching and some administrative experience. Equal opportunity/affirmative action employer. Application deadline: May 1, 1984. Apply to:
Dr. Daniel E. Dupree, Dean
College of Pure and Applied Sciences
Northeast Louisiana University
Monroe, LA 71209

STATE UNIVERSITY OF NEW YORK COLLEGE AT NEW PALTZ

has tenure track positions available beginning September 1984 for persons capable of making substantial contributions to a Computer Science curriculum at the undergraduate and beginning graduate levels. The rank is open and the salary is competitive. Applicants should either have or be about to complete a Ph.D. Persons with backgrounds in Computer Science, one of the other mathematical sciences, or in any discipline related to Computer Science, broadly defined, are encouraged to apply. The College is located 75 miles north of New York City in a region known for its natural beauty and abundant recreational facilities. IBM has several major installations in the area. Send vita and three letters of reference which give evidence of teaching effectiveness and scholarly ability to Paul Zuckerman, Chairman, Department of Math. & Comp. Sci., Box 10, State Univ. of NY, New Paltz, NY 12561 by May 1, 1984. An Equal Opportunity/ Affirmative Action Employer.

WASHBURN UNIVERSITY

MATHEMATICS AND INFORMATION SCIENCES DEPARTMENT: Faculty position. Instructor/Assistant/Associate Professor for tenure-track position open Fall semester 1984. Ph.D. in statistics preferred (ABD considered). Expertise in statistics, linear models, and applied mathematics. Other qualifications include strong commitment to quality teaching in the undergraduate level; previous college teaching experience is preferred; and any indicated interest in research is desirable. Responsibilities: teach 12-hours in mathematics and statistics per semester; assume leadership in developing additional courses in statistics; and share in the normal University advising and committee activities. Salary is competitive depending on qualifications and experience. Application deadline is April 30, 1984. Send vita, graduate transcripts, and the names of three references to: Dr. A. Allan Riveland, Chairman, Search Committee, Mathematics and Information Sciences Department, Washburn University of Topeka, Topeka, KS 66621. Washburn University is an equal opportunity/affirmative action employer.

OHIO NORTHERN UNIVERSITY, DEPT. OF MATHEMATICS AND COMPUTER SCIENCE, ADA, OHIO 45810

Ph.D. in some area of the mathematical sciences for a 9 month tenure track position with a 12 hour teaching load. The department offers majors in math and computer science; preference will be given to those persons willing to assist with computer science instruction. The university is private, coed, and has colleges of Arts & Sciences, Law, Pharmacy, Engineering, and Business. Benefits include tuition remission for dependents and spouses in any of the colleges. Rank and salary open. Send a résumé and 3 letters of reference to Dr. Jeffrey L. Spielman, Chairman by April 1984. ONU is EOE/AAE.

341
DEPARTMENT HEAD
DEPARTMENT OF MATHEMATICAL SCIENCES

Purdue University Calumet seeks applicants for the position of Head of the Department of Mathematical Sciences, which has responsibility for Mathematics, Statistics, and Computer Science. A doctorate in one of these areas is required. Applicants should have a successful record of teaching and research, and qualify for appointment as Professor or Associate Professor. Substantial interpersonal and administrative skills are required. A background in applied mathematics or computer science is preferred.

Duties include administration of a Department of twenty, teaching appropriate courses, and leading the continuing development of programs in applied mathematics and computer science. The Department currently offers a variety of programs at the Baccalaureate and Master's Degree levels. Salary is open and competitive. TIAA/CREF is included in an excellent fringe-benefit package.

The campus serves nearly eight thousand commuter students at a suburban location in Northwest Indiana, approximately 45 minutes from downtown Chicago.

Applications should forward a resume and the names of three references by June 1, 1984, to:

Professor D. J. Troy, Chairperson
Department Head Selection Advisory Committee
Department of Mathematical Sciences
Purdue University Calumet
Hammond, Indiana 46323
Telephone (219) 844-0520, ext. 273

Purdue University Calumet is an Equal Opportunity/Affirmative Action Employer.

CALIFORNIA STATE UNIVERSITY
NORTH RIDGE, CALIFORNIA 91330

Department of Mathematics

Applications are invited for a tenure-track position with open rank (Assistant, Associate or Full Professor). The Ph.D. in mathematics is essential. Evidence of teaching ability, and a record of research accomplishment appropriate to the rank of the appointment are required.

Starting date: August 27, 1984
Salary: $20,148 - $38,664 depending on rank

Applications must be received by May 15, 1984 to be considered. Send letters of application and resume to:

Philip Emig, Chair
Department of Mathematics
California State University, Northridge
Northridge, California 91330

CSUN is an equal opportunity/affirmative action employer, Title IX, Section 504 employer.

COMPUTER SCIENCE/PROVIDENCE COLLEGE

Applications are invited for a tenure-track position in the Department of Mathematics and Computer Science at Providence College. This position becomes available in September 1984 and a doctorate in Computer Science or its equivalent is required.

Providence College is a four year, co-educational, very selective, liberal arts college conducted under the auspices of the Dominican Fathers. It enrolls 3500 students of which approximately 200 are mathematical science majors. Many of these majors seek our Mathematics-Computer Science degree which requires substantial course work in mathematics and computer science.

The duties of this position include 9-12 hours of teaching in Computer Science, the pursuit of research interests and participation in the growth of our rapidly expanding department. Salary (AAUP Class I) and rank are commensurate with qualifications.

Applications will be considered until the position is filled. Please send vita, transcripts and three references to:

Search Committee
Department of Mathematics and Computer Science
Providence College
Providence, Rhode Island 02918

Providence College is an equal opportunity/affirmative action employer.

UNIVERSITY OF CENTRAL FLORIDA

Department of Mathematics

Applications are invited for a tenure-track assistant professor in Mathematics beginning August 1984 on UCF Brevard Campus. Ph.D. degree in Mathematics, with research potential and dedication to teaching at undergraduate level required. Preferred research areas include applied mathematics, analysis in the broad sense. Candidates should send a detailed resume and arrange to have at least three letters of recommendation and a transcript sent to Dr. Lokenath Deb Nath, Chairman, Department of Mathematics, University of Central Florida, Orlando, Florida, 32816-6990, not later than May 4, 1984. The University is an Equal Opportunity/Affirmative Action Employer.

The Department of Computer and Information Sciences, State University College of Arts and Science at Potsdam has a tenure-track position open for a person holding the Ph.D. in Linguistics, Mathematics, or Philosophy and having expertise in one of the following areas: (1) formal, mathematical, or computer linguistics, (2) category theory, universal algebras, or combinatory logic, (3) algebraic and symbolic computation. Applicants should have a strong interest and experience in some area of computer science. Rank and salary will be commensurate with qualifications. Starting date: 1 September 1984.

Potsdam is located near Adirondack State Park in northern New York, approximately equidistant from Lake Placid, Montreal, and Ottawa. The area offers a wide selection of outdoor recreation, both summer and winter.

SUNY Potsdam is one member of a four-college consortium (Clarkson College, St. Lawrence University, Canton ATC) situated in Potsdam and nearby Canton. SUNY Potsdam is the site of the Crane School of Music, which provides for continual high-quality events in music and the performing arts. The Department of Computer and Information Sciences is a large (over 500 majors), active department supporting a wide range of scientific interests. The four-college consortium offers faculty members numerous opportunities for professional collaboration, development, and continuing education.

Address inquiries and resumes to Dr. Charles D. Marshall, Chairman, Department of Computer and Information Sciences, SUNY Potsdam, Potsdam, New York 13676. An Equal Opportunity/Affirmative Action Employer.
POSITIONS AVAILABLE

North Carolina State University
Raleigh, NC

Position: Assistant or Associate Professor—Educational Research—Tenure track—Tenure not awarded on initial appointment.

Qualifications: Doctorate in Educational Research. Also training and/or experience in educational administration would be beneficial.

Appointment: Nine month opportunity for summer teaching.

Job Description: Person will be expected to teach a graduate introductory course conveying a variety of research paradigms such as classical, experimental, quasi-experimental, ethnographic, historic, survey, and theoretical. Also person to teach two advanced graduate courses in research.

Person will be expected to serve on departmental, school, and university committees as a service responsibility.

Person will be expected to conduct independent research for publication and serve on graduate student committees as part of scholarly expectations.

Salary: Competitive

Appointment: August, 1984

Contact: Applicant should send letter and current vita to: Dr. Bruce Beezer, Chair, Search Committee, Dept. of ELPE, School of Education, North Carolina State University, Raleigh, North Carolina 27695-7801

Time: Initial review of applicants will be on March 12, 1984. Search will continue until position is filled.

North Carolina State University is an Equal Employment/Affirmative Action employer.

Applications are invited for several tenure track Assistant Professorships, available for September 1984, and for some senior level positions at the ranks of Professor and Associate Professor. Recent Ph.D.'s are expected to teach two courses per semester, and must show strong research promise. Applicants for senior level positions should have an outstanding record of research and scholarly achievements. Persons specializing in Statistics and areas of Applied Mathematics are especially encouraged to apply. Applications should be addressed to Chairman, Search Committee, University of Southern California, Department of Mathematics, DRB 306—1113, Los Angeles, California 90089-1113.

Northwestern State University of Louisiana

One or more tenure-track positions at the Assistant level are anticipated in mathematics. Teaching responsibilities include all undergraduate levels of mathematics. Applicants should have a Ph.D. with an emphasis in applied mathematics and a strong commitment to excellence in teaching. Send résumé, transcript, and three letters of recommendations to Austin L. Temple, Jr., Head, Mathematics Department, Northwestern State University, Natchitoches, LA 71457. Northwestern State University is an AA/EEO employer.

DEPARTMENT OF MATHEMATICS
UNIVERSITY OF CALIFORNIA
RIVERSIDE, CALIFORNIA

Applications are invited for a faculty position in mathematics or computer science beginning September 1984. This position is unrestricted as to level of appointment and area of specialization within mathematics and computer science. Candidates must have demonstrated research ability and a commitment to excellence in teaching at the undergraduate and graduate levels. Candidates should send vita and arrange for at least three letters of recommendation to be sent to: Professor David E. Rush, Chair, Search Committee, Department of Mathematics, University of California, Riverside, California 92521.

Applications should be received by May 1, 1984. The University of California is an Equal Opportunity/Affirmative Action Employer.

Applications are invited for two tenure-track positions in mathematics at the assistant professor level effective July 1, 1984 (subject to availability of funds). Requirements are a Ph.D. and proven ability or demonstrated potential for research and teaching. Outstanding applicants in any area of mathematics will be seriously considered but preference will be given to applicants whose research interests substantially complement present department strengths. Send vitae and names of three references to: Dr. K. A. Dunn, Chairman, Department of Mathematics, Statistics and Computing Science, Dalhousie University, Halifax, N. S., Canada B3H 4H8. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

Dalhousie has a policy of affirmative action with respect to employment of women.

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
CALIFORNIA STATE UNIVERSITY
LOS ANGELES, CALIFORNIA 90032

Assistant or Associate Professor, tenure-track position. Ph.D. in Mathematics or Ph.D. in Computer Science with a background in Mathematics required. Strong computer science background desirable. Starting date: September 1984.

Salary: $21080—$30560. Evaluation of applicants will begin February 1, 1984. Send inquiries to Wayne Bishop, Chair, at the above address.

An Equal Opportunity, Affirmative-Action, Handicapped Title IX Employer.

MATHEMATICS/COMPUTER SCIENCE: The Virginia Military Institute, a state supported undergraduate college, anticipates an opening at the assistant or assistant professor level in the Department of Mathematics in August 1984. Preference will be given to candidates with a Ph.D. in mathematics or with a M.S. in computer science. The applicant should have a strong interest in teaching undergraduates and in participating in the development of a strong computer science program. Send your résumé to Professor W. A. Woyczynski, Chairman. An affirmative action, equal opportunity employer.

CASE WESTERN RESERVE UNIVERSITY

Tenure track positions to begin August 5, 1984. Outstanding research record, and/or proven research potential, and teaching excellence required. Rank open. The Virginia Military Institute, Lexington, Virginia 24450. AA/EEO Employer.

UNIVERSITY OF EDINBURGH
COLIN MACLAURIN CHAIR OF MATHEMATICS

Following the retirement of Professor F. F. Bonsall, F. R. S., the University is hoping to make an appointment to start on 1 October 1984. Enquiries should be made to Professor E. G. Rees, Department of Mathematics, James Clerk Maxwell Building, University of Edinburgh, Edinburgh EH9 3JZ, Scotland, U. K.
The Department of Mathematics and Statistics at McGill University wishes to sponsor a strong candidate for the NSERC 1984–1985 University Research Fellowship Competition. These Fellowships are five year research positions (with renewal for the third year), in the nature of Research Assistant Professorships, and carry a teaching load of at most one course throughout the academic year. Applicants should have shown some substantial research ability beyond their doctoral thesis. They should be Canadian Citizens or landed immigrants by October 15, 1984.

Interested candidates should send their curricula vitae to: Professor Michael Herschorn Department of Mathematics and Statistics McGill University 805 Sherbrooke Street West Montreal, Quebec, Canada H3A 2K6

They should also arrange for at least two letters of reference from competent referees to be sent directly to the same address. All documentation should reach the department by September 1, 1984. Preference may, however, be given to those whose files are complete by July 1, 1984. The department will make its recommendations to NSERC early in October 1984. NSERC announces its final choice by March in each year.

DREXEL UNIVERSITY DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE — PHILADELPHIA, PENNSYLVANIA 19104 At least three tenure-track openings are anticipated for 1984–85. Areas of particular interest include applied mathematics, classical and modern analysis, computational mathematics, computer science, probability and statistics. In addition, one Drexel Fellow position will be available (2-3 year appointment) for a junior mathematician interested in training for a career in computer science. Salaries are competitive. Fringe benefits include moving expenses and tuition remission for dependents. Address applications to Dr. Loren Argabright, Head.

UNIVERSITY OF WISCONSIN-PARKSIDE Applications are invited for a visiting assistant professorship in mathematics during the 1984–85 academic year. Duties include 10–12 hours per week of teaching, conducting research in mathematics, and minimal participation in University service. Qualifications sought are a Ph.D. in mathematics or the equivalent and a commitment to excellence in undergraduate education and mathematical research. Applications are invited from persons in any research area. Active research interests at UW-Parkside include infinite group theory, ring theory, topology and geometry of manifolds, computer applications, and related areas.

UW-Parkside is located near Lake Michigan, 30 miles south of Milwaukee and 55 miles north of Chicago. Enrollment is 5500 students, with 3600 full time equivalent. Library and computing facilities are excellent for both instruction and research.

Applicants should submit a current vita and have three letters of recommendation sent to Leo Comerford, Mathematics Recruitment Chairman, University of Wisconsin-Parkside, Box 2000, Kenosha, Wisconsin 53141; telephone 414-553-2541. Screening of applicants will begin May 10, and continue until the position is filled. UW-Parkside is an affirmative action/equal opportunity employer.

Educational Testing Service, Princeton NJ 08541 seeks Developer of Mathematics, Computer Science, Quantitative Aptitude Tests. At least Master's in Mathematics, 6 years experience, teaching/testing necessary, administrative experience desirable. $25,000–$44,110.

DEAN FOR THE COLLEGE OF SCIENCE

Florida Atlantic University at Boca Raton, Florida invites applications or nominations for the position of Dean of the College of Science. Candidates should qualify for a tenurable appointment at the rank of Professor in one of the departments of the College (Biological Sciences, Chemistry, Geology, Mathematics, Physics or Psychology), demonstrate potential for academic leadership, and provide evidence of scholarly achievement in teaching and research. Previous administrative experience is necessary. The appointment will be effective September 1, 1984, or shortly thereafter.

FAU is part of the Florida State University System. The College of Science is one of six colleges in the University and has 55 faculty and 700 students. Although currently an upper division university, FAU will begin admitting freshmen in the Fall of 1984. FAU offers a variety of bachelor's and master's degrees, and doctoral programs are in the planning stages.

The duties of the Dean of the College of Science include coordinating the academic and administrative affairs of the College as well as generating outside financial support for science programs. The new Dean will be expected to lead the College of Science in the development of doctoral programs, the expansion of computer oriented programs, and the development of strong ties with local industry.

Applicants should submit a complete résumé with cover letter and a list of at least three references to: Dr. Manley L. Boss, Chairman College of Science Dean Search Committee Department of Biological Sciences FAU Boca Raton, Florida 33431

Completed applications must be received by May 1, 1984. Florida Atlantic University is an Affirmative Action, Equal Opportunity Employer. Minorities and Women are encouraged to apply.

SKIDMORE COLLEGE Mathematics and Computer Science Department ASSOCIATE/ASSISTANT PROFESSOR OF COMPUTER SCIENCE to develop curriculum to enhance computer science minor. Candidates should be able to develop and teach data structures, database management, graphics and systems design courses. Applicants should possess a Ph.D. in computer science or related discipline.

ASSISTANT PROFESSOR OF MATHEMATICS to teach undergraduate mathematics courses and introductory computer science courses. Candidates should have a Ph.D. in mathematics with some background in computer science. Skidmore College operates a DEC VAX 11-750 with 40 micro computers to support academic computing. Please send a letter of application, résumé and at least three references by May 15 to Mark Hubregtse, Chair, Department of Math & Computer Science, Skidmore College, Saratoga Springs, NY 12866-0851. An Affirmative Action/Equal Opportunity Employer.

Elmhurst College Department of Mathematics

Applicants are invited for a tenure track position at Elmhurst College. Elmhurst College is a private liberal arts, church related college in suburban Chicago. With 1970 students in the Day Session and over 1600 students in adult education programs, it is the largest private undergraduate college in Illinois. Applicants should have or be completing a Ph.D. in mathematics and be committed to excellence in teaching as well as continued scholarly activity. Vita as well as three letters of reference should be sent to: Dr. Donald K. Mason, Department of Mathematics, Elmhurst College, Elmhurst, IL 60126.

An Equal Opportunity Employer.
POSITIONS AVAILABLE

UNIVERSITY OF EDINBURGH

“New Blood”

Lectureship in Global Analysis

A position from 1 October 1984. Inquiries should be made to Professor E. G. Rees, Department of Mathematics, James Clerk Maxwell Building, University of Edinburgh, Edinburgh, Scotland, UK. EH9 3JZ.

Queen Mary College (University of London)

School of Mathematical Sciences

Applications are invited for two University Lectureships (these are tenure-track positions): one in Pure Mathematics in the area of Algebra and related fields; and one in non-linear Dynamics. Further details and application forms are available from: The College Secretary, Queen Mary College, Mile End Road, London E1 4NS, England. Closing date for applications is 4 May 1984.

FOR SALE

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FACULTY POSITIONS
MATHEMATICS

The U.S. Coast Guard Academy invites applications for a tenure-track position in the Department of Mathematics at the assistant/associate professor level beginning August 1984. Responsibilities include teaching a full spectrum of undergraduate mathematics courses as well as introductory computer science courses. The ideal candidate should possess an earned doctorate in mathematics, computer science or a related field and college-level teaching experience. Salary and academic rank dependent upon applicant's qualifications. US citizenship required. Send vita, list of publications and three letters of reference to: U.S. Coast Guard Academy, Civilian Personnel Management Branch, P.O. Box A-4702, New London, CT 06320. Applications must be received by May 18, 1984.

UNIVERSITY OF WARWICK
Coventry, England
Tenured Lectureship in
ALGEBRAIC GEOMETRY
Applications are invited for the above post, which is a British Government “New Blood” lectureship for candidates under the age of 35. The post initially carries a reduced teaching load, to provide more time for research. Further information and application forms can be obtained from...

THE REGISTERAR
University of Warwick
Coventry CV4 7AL
England
Applications, with curriculum vita and names of referees, should be submitted to the above by 31st May 1984.

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The McConnell Bernhard Professorship in Mathematics

UNIVERSITY OF VIRGINIA

The Department of Mathematics wishes to fill the McConnell-Bernard Professorship in Mathematics. Applications for this senior position are invited from distinguished research mathematicians. Nominations for candidates are also welcome. All areas of pure and applied mathematics will be considered.

Submit vita and names of references to:

Chairman
Department of Mathematics
Mathematics-Astronomy Building
University of Virginia
Charlottesville, Virginia 22903

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Applications are invited from suitably qualified persons, regardless of sex, race, colour or national origin, for appointment to posts in the Department of Applied Mathematics.

Three posts are available in the Department of Applied Mathematics for persons with research interests in any of the following areas: theory and control of dynamical system, biomathematics, optimisation, numerical analysis. The University will also consider contract appointments.

Current research in the Department includes all the above areas in addition to strong groups in mathematical physics and theoretical mechanics. The Department also has challenging service teaching commitments and contracts with other departments have stimulated interdisciplinary research.

The salary ranges in respect of the posts are:

- **Professor**: R23 109 - R30 255 per annum
- **Senior Lecturer**: R16 557 - R24 045 per annum
- **Lecturer**: R12 657 - R22 173 per annum

A pensionable allowance of 12% is also payable. The initial salary notch will be determined according to the qualifications and experience of the successful applicant.

Applicants should indicate the level of post for which they would wish to be considered.

Benefits for full-time permanent staff include pension and medical aid fund membership, an annual bonus, generous leave privileges, 75% remission of tuition fees for dependants attending the University and a housing subsidy (if eligible). Removal, travel and settling-in allowances may be payable to the successful applicants.

Applications should be lodged not later than 30 April 1984.

Interested persons should obtain the information sheet relating to these posts from the Assistant Registrar (Academic Staffing),

UNIVERSITY OF THE WITWATERSRAND
1 Jan Smuts Avenue, Johannesburg 2001.
South Africa.

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MAA Seeking Projects Officer

The Mathematical Association of America has an opening for a Projects Officer in its headquarters in Washington, D.C., beginning September 1, 1984 or as soon as possible thereafter. The duties of the Projects Officer will include helping the Association identify and find funding for projects for the improvement of mathematics education at the collegiate and other levels, assisting the Executive and Associate Directors in providing staff liaison with project personnel, and collecting and disseminating information about educational projects in mathematics throughout the United States. Graduate training and teaching experience in mathematics are desirable. Salary will be commensurate with the experience and training of the candidate.

Applicants should send a curriculum vitae and should also arrange to have three letters of recommendation sent directly to:

Dr. Alfred B. Willcox, Executive Director
Mathematical Association of America
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Erratum


$$y = 1 + t + t^2 + (4/3)t^3 + \ldots$$

which makes the superior accuracy as well as the computability quite evident. A one-page errata sheet is available to all past buyers by writing to me at the Center for Applied Mathematics, University of Georgia (Tucker Hall), Athens, GA 30602. New purchases from Academic will contain the correction. I apologize to all buyers for the inconvenience. G. Adomian
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- A Primer of Probability Theory

1984
Mathematical Sciences
Professional Directory

This directory, published annually, lists key personnel—officers and committee members—of over thirty 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.

TABLE OF CONTENTS

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Other Professional Organizations
   American Mathematical Association of Two-Year Colleges
   American Statistical Association
   Association for Computing Machinery
   Association for Physical and System Mathematics
   Association for Symbolic Logic
   Association for Women in Mathematics
   Biometric Society
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   Casualty Actuarial Society
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   International Mathematical Union
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   National Council of Teachers of Mathematics
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Conference on Modern Analysis and Probability
(1982, Yale University)
Richard Beals, Anatole Beck, Alexandra Bellow
and Arshag Hajian, Editors

The Conference in Modern Analysis and Probability in honor of Professor Shizuo Kakutani was held on June 8–11, 1982, at Yale University on the occasion of his retirement. In these Proceedings the papers that were submitted for this Conference are presented. Initial funding was provided by the National Science Foundation.

The three major areas of mathematics on which the Conference focused were functional analysis, probability theory, and ergodic theory. Most of the articles presented were works by the respective authors on problems that were pioneered by Professor Kakutani in the past. Questions in Brownian motion, induced transformations, representation of $M$-spaces, and fixed point theorems were discussed.

Contents
Roy L. Adler and Leopold Flatto, Cross section map for the geodesic flow on the modular surface
M. A. Akcoglu and L. Sucheston, On identification of superadditive ergodic limits
J. R. Baxter and R. V. Chacon, The equivalence of diffusions on networks to Brownian motion
A. Bellow and V. Losert, On sequences of density zero in ergodic theory
J. van den Berg and M. Keane, On the continuity of the percolation probability function
Felix E. Browder, Coincidence theorems, minimax theorems, and variational inequalities
J. R. Choksi, Recent developments arising out of Kakutani's work on completion regularity of measure
J. R. Choksi and S. J. Eigen, An automorphism of a homogeneous measure algebra which does not factorize into a direct product
Daniel I. A. Cohen, Another generalization of the Brouwer fixed point theorem
Yael Naim Dowker, An ergodic theorem
Nathaniel A. Friedman, Higher order partial mixing
Hillel Furstenberg, IP-systems in ergodic theory
Arshag Hajian and Yuji Ito, Induced transformations on a section
Edwin Hewitt, Conjugate Fourier series on the character group of the additive rationals
Kiyosi Itô, A stochastic differential equation in infinite dimensions
Kinrad Jacobs, Ergodic theory and combinatorics
William B. Johnson and Joram Lindenstrauss, Extensions of Lipschitz mappings into a Hilbert space
Robert R. Kallman, A uniqueness result for a class of compact connected groups
L. A. Karlovitz, Two extremal properties of functions
Robert Kaufman, On Bernoulli convolutions
Harvey B. Keynes and Mahesh G. Nerurkar, Generic theorems for lifting dynamical properties by continuous affine cocycles
Bruce Kitchens, Linear algebra and subshifts of finite type
Anthony Lo Bello, The etymology of the word ergodic
Peter A. Loeb, A functional approach to nonstandard measure theory
Dorothy Maharam, On positive operators
Brian Marcus, Kari Petersen and Susan Williams, Transmission rates and factors of Markov chains
I. Namioka, Ellis groups and compact right topological groups
William Parry and Klaus Schmidt, Invariants of finitary isomorphisms with finite expected code-lengths
Marina Ratner, Ergodic theory in hyperbolic space
Haskell P. Rosenthal, Embedding of $L^1$ in $L^1$
Daniel J. Rudolph, Inner and barely linear time changes of ergodic $R^d$-actions
M. J. Sharpe, Processes evolving from the indefinite past
Erik G. F. Thomas, An infinitesimal characterization of Gelfand pairs
Nils Tongring, Multiple points of Brownian motion
Benjamin Weiss, Measurable dynamics
Kosaku Yosida and Shigetake Matsuura, A note on Mikusiński's proof of the Titchmarsh convolution theorem
Robert J. Zimmer, Ergodic actions of arithmetic groups and the Kakutani-Markov fixed point theorem

1980 Mathematics Subject Classifications: 46Bxx, 60Gxx, 28Dxx

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S. M. Nikol’skii, Editor

Abstract

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Contents

G. G. Akopyan, Sequences of cubature formulas for differentiable functions on domains with degenerate corners
O. V. Besov, Weighted estimates of mixed derivatives in a domain
V. I. Burenkov, On exact constants in inequalities for the norms of intermediate derivatives on a finite interval
E. A. Volkov, An efficient cubic mesh method for solving Laplace’s equation on a parallelepiped under discontinuous boundary conditions
M. L. Gol’dman, A covering method for describing general spaces of Besov type
G. A. Kalyabin, Descriptions of functions in classes of Besov-Lizorkin-Triebel type
I. A. Kipriyanov and B. M. Bogachev, On the properties of functions in a weighted space on differentiable manifolds
L. D. Kudryavtsev, On the construction of a sequence of compactly supported functions approximating functions from weighted classes
P. I. Lizorkin, Estimates of mixed and intermediate derivatives in weighted $L_p$-norms
M. K. Potapov, Imbedding theorems in a mixed metric
S. G. Samko, Generalized Riesz potentials and hypersingular integrals with homogeneous characteristics, their symbols and inversion
B. V. Tandit, On boundary properties of functions in the space $W^1_{r,p}$

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I. A. Afineinberg and A. P. Yuzhakov

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I. Integral representations and the logarithmic residue
II. Integral representations of special form for holomorphic functions
III. The theory of residues
IV. Applications to implicit functions, systems of nonlinear equations, computation of the multiplicity of a zero, and combinatorics
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G. P. Egorychev

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Contents
1. The method of integral representation of combinatorial sums
2. Integral representation and computation of one-dimensional combinatorial sums
3. Inversion and classification of linear relations in combinatorial analysis
4. Combinatorial interpretation, integral representation, and estimation of certain sums in combinatorial analysis
5. Integral representation and computation of multi-dimensional sums
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Summer List of Applicants

Instructions for Applicant Form on facing page

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The forms should be carefully typed using a fresh black ribbon. The best results are obtained with a carbon-coated polyethylene film ribbon, but satisfactory results may be obtained using a ribbon made of nylon or other woven fabric if suitable care is exercised. It is important that the keys be clean and make a sharp, clear impression. Use a correcting typewriter or correction tape or fluid if necessary. Submit the original typed version only. Hand lettered forms are acceptable if prepared carefully.

The summary strip. Information provided here will be used to prepare a printed list of applicants for distribution to employers. Please supply all information requested, and confine your characters to the boxes provided. Use the codes below. Circled letters identify corresponding items on the form and the strip.

Address forms to the Mathematics Meetings Housing Bureau, P. O. Box 6887, Providence, RI 02940. The deadline for receipt is July 1, 1984. See pages 298 and 303 for more information.

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Significant achievements or projects, including role

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Other (e.g., paper to be presented at THIS meeting)

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C Degree Year Institution

D No. of abstracts, internal reports

E No. of papers accepted

F No. of books and patents

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G Employer

Present

Previous

Previous

Position

Duties

Years to

to

to

**DESIRED POSITION:**

I Duties

J Available mo./yr. Location Salary

K References (Name and Institution)

L Citizenship

M I plan to attend the Summer Meeting yes ☐ no ☐

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<table>
<thead>
<tr>
<th>Family Name</th>
<th>First Name</th>
<th>Mailing Address</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Address (cont’d.)</th>
<th>Address (cont’d.)</th>
<th>State &amp; Zip Code</th>
<th>Specialties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D Career objectives</th>
<th>C Highest Degree</th>
<th>H Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>G Most recent employer</th>
<th>I Present duties</th>
<th>J Desired duties</th>
<th>K Available mo./yr.</th>
<th>L</th>
</tr>
</thead>
</table>
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358
**PREREGISTRATION AND HOUSING FORM, EUGENE, OREGON**

AMS Short Course  
August 14–15, 1984

Joint Mathematics Meetings  
August 16–19, 1984

MAA Minicourses  
August 16–19, 1984

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### REGISTRATION FEES

<table>
<thead>
<tr>
<th>Joint Mathematics Meetings</th>
<th>At Meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preregistration (by mail prior to 7/1)</td>
<td>$47</td>
</tr>
<tr>
<td>*Student, Unemployed or Emeritus</td>
<td>$12</td>
</tr>
<tr>
<td>Nonmember</td>
<td>$71</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AMS SHORT COURSE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Member/Nonmember</td>
<td>$25</td>
</tr>
<tr>
<td>*Student or Unemployed</td>
<td>$5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAA MINICOURSES #1 through #8 (per course, payable at meeting)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 #2 #3 #4 #5 #6 #7 #8</td>
<td>$0</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Joint Meetings</th>
<th>AMS Short Course</th>
<th>MAA Minicourses #1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
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16) TOTAL AMOUNT ENCLOSED FOR 9 through 15 $  

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NOTE: A $5 charge will be imposed for invoices prepared when preregistration/housing forms are submitted without an accompanying check for appropriate payments or an insufficient amount.

[ ] Check here if you will not require a room.

PLEASE BE SURE TO COMPLETE THE SECTION ON NEXT PAGE IF YOU WILL REQUIRE HOUSING.
PREREGISTRATION AND HOUSING REQUEST FORM (continued)

Please read sections on housing and room rates in meeting announcements.

I. UNIVERSITY HOUSING SECTION: 

Please reserve the following residence hall accommodations and send confirmation to me at address indicated below. Full prepayment for room and board is required. Please make checks payable to AMS. Canadian checks must be marked "In U.S. Funds".

ADULTS — 16 years of age and older — rates include breakfast and lunch:

Singles  ___________ night(s) @ $23.50
Doubles  ___________ night(s) @ $18.50 per person

CHILDREN — 5 through 15 years of age — rates include breakfast and lunch:

Singles  ___________ night(s) @ $20.50
Doubles  ___________ night(s) @ $15.50 per person

CHILDREN — over 2 and under 5 years of age — bed only; meals are free
$11.50 per child (must share room with a parent)

NOTE: Room occupancy is limited to two persons only.

II. I will arrive on _________ at _______ a.m./p.m., and depart on _________ at _______ a.m./p.m.

I will share a double room with ____________________________, who will arrive on _________
at _______ a.m./p.m., and depart on _________ at _______ a.m./p.m.

Please list ages and sex(ies) of accompanying children ____________________________

III. ADDRESS FOR CONFIRMATION OF ROOM RESERVATION

__________________________________________________________

Telephone number: _________________________________ (area code)

TRAVEL INFORMATION

[ ] I plan to arrive by plane on ________________ scheduled to arrive at Eugene airport on
_________________________ (airline flight and number) (date)

at _______ a.m./p.m.

[ ] I plan to drive to the meeting.
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(Applied Mathematical Sciences, Vol. 15)
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