FOCUS

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Calculus for a New Century: MAA/NRC Symposium Sets Agenda

Three hundred years ago Newton's PRINCIPIA was published; two hundred years ago calculus became a regular subject in universities; one hundred years ago our sister society, the AMS was coming into being. The name of this article and of the symposium reported in it comes from this rough chronology.

Over six hundred mathematicians, scientists, and educators gathered at the National Academy in Washington, D.C. to discuss the direction of future teaching of calculus. The diverse groups with a stake in the future of calculus were represented variously by those attending: by the speakers, by official respondents, in the working sessions, and in the background papers commissioned for the symposium. The symposium was supported by the Alfred P. Sloan Foundation and coordinated by the MAA and the National Research Council acting through its Board on Mathematical Sciences and Mathematical Sciences Education Board.

The picture of the introductory course and the efforts to reform it is complex. The details can be found in MAA Notes 8, CALCULUS FOR A NEW CENTURY edited by Lynn Arthur Steen, published January, 1988. One challenge that emerges from this symposium is found at the end of the keynote speech of Robert M. White, President of the National Academy of Engineering. White concluded:

> "Calculus is a critical way-station for the technical manpower that this country needs. It must become a pump instead of a filter in the pipeline. It is up to you to decide how to do that.

Dr. White's image gave the symposium volume its subtitle, "A Pump, not a Filter."

A second strong theme comes from the graphic and symbol manipulating power that is now becomming available in handheld calculators and microcomputers. These signal both problems and opportunities for calculus teaching. Dr. White and others representing areas of application agreed: they want students to have a deep, practical grasp of calculus. They see deeper understanding as becoming more important, not less, as machines do more of the calculating. But behind this agreement there are vexing questions. As one participant wrote on an evaluation form for the symposium:

> "In this age of Velcro, digital watches, and the HP28C, must one still learn to tie shoes, read two-handed clocks, and solve quadratic equations?"

This is a stand-in for the question of exactly what constitutes a deep, practical grasp of calculus and how students may be given such understanding. But this must be resolved in answering Dr. White's challenge and in responding to the opportunities that computers offer. The answers must be conceptually and pedagogically sound.

How is all this fuss viewed by administrators? Historian S. Frederick Starr, President of Oberlin College, held out for calculus as part of the core of a liberal education. Starr called for the commuity to resolve conflicts between the service and core roles that calculus plays. He held that if the community could agree on what calculus should be as core material for a liberal education, then it would be possible to invent a course that could succeed not only with studens but even with one's colleagues from the liberal arts—a harder audience to reach, but one with which panelist Michael Reed of Duke had had some success.

Linda Bradley Salamon, Dean of Arts and Sciences at Washington University, had some good news. It is the chemistry department not the mathematics department at her school that raises the most student complaints. Her views were balanced. Yes, calculus instruction could and should be improved. Many of the means for improvement are already known (better and more attentive teaching, use of computers to help teach routine skills, good drop in "help" sessions, etc).

What resources might a dean offer? In speaking of increased staffing aimed at reducing class size Salamon said:

> "Double your teaching staff? No. But relief for a worthy experiment, to continue if it succeeds? Highly probable."

She concluded with the observation that the supply of mathematicians to teach calculus is imperiled by the discipline's failure to retain majors. Thus she observed that successful development of a calculus for a new century may be essential if we are to have mathematicians for a new century.

Daniel E. Ferritor, Chancellor of the University of Arkansas, reported no drive for calculus reform at his campus. However, he gave a clear picture of the careful attention that the course needs including:

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Would you like to start a Teacher Collaborative

In October 1988 the MAA and NCTM will jointly sponsor a national workshop designed to help local groups form Mathematics Teacher Collaboratives. An MT Collaborative is an ongoing local project which brings together teachers (K-12), college faculty, professionals from industry, and others on a collegial basis to refresh and improve the teaching of mathematics. If your area could benefit from such a Collaborative and you would like to help, see below for more details.

National Workshop To Develop Local Mathematics Teacher Projects A Call for Applications

The Mathematical Association of America and the National Council of Teachers of Mathematics are sponsoring a workshop for people interested in developing local mathematics teachers projects. Teachers, college and university faculty, and professionals from business and industry are invited to apply as teams for participation in the workshop (to be held in the Fall of 1988) and in follow-up activities over the next two years.

These projects will bring together elementary, middle, and high school teachers, college and university faculty, and mathematicians from business and industry as professional colleagues in an effort to stimulate excellence and creativity in pre-college mathematics teaching. They may have many different forms, but the essential ingredients are an extended exchange of new ideas about mathematics and its teaching and opportunities to experiment with some of these ideas in the classroom.

The organizers of the workshop plan to invite teams from about 20 "localities," each team consisting of 4–6 delegates who have indicated a serious desire to organize a Mathematics Project. A "locality" may be a metropolitan area, a county or group of counties, an area within a reasonable driving distance of a university, or another area sufficiently small to allow frequent professional gatherings. An ideal team will consist of a mathematics teacher, a university mathematician, a mathematician from business or industry. and a school official, although other combinations are acceptable and may be desirable. The workshop will acquaint the delegates with several successful existing projects and provide opportunities for the delegates and the directors of these "mentor" projects to discuss ways to organize and secure local support for new projects and to develop plans for getting started.

The workshop will be held October 21–23, 1988 at Airlie Conference Center in Virginia, and travel and subsistence for delegates invited to the conference will be provided.

Letters of intent should be submitted by March 15, 1988. Applications will be due May 16, 1988, and participants will be notified of their selection on June 15, 1988.

Application forms and further information may be obtained by writing to:

Philip Daro, Executive Director
The American Mathematics Project
University of California, Berkeley
2199 Addison Street, Room 359
Berkeley, California 94720
(415) 643–7310

Those wanting help or advice in assembling a delegation and obtaining expressions of support from their school systems or communities may call or write to Philip Daro. To the extent of our ability, we will try to facilitate the formation of local delegations.

The American Mathematics Project is funded by NSF, the Ford Foundation, and the Carnegie Corporation. We list the Project Steering Committee to show the broad support this effort has:

R.O. Wells, Jr. (Chair), Rice University; Philip Daro (Executive Director), California Mathematics Project; Henry L. Alder, UC Davis; Leon A. Henkin, UC Berkeley; Joaan Akers, San Diego County Office of Education; Barbara J. Janson, Janson Publications, Inc.; Glenda Lappan, Michigan State University; Steven Leinwand, Connecticut State Department of Education; Judith M. Kysh, Northern California Mathematics Project; Ivan Niven, University of Oregon; Elizabeth K. Stage, Bay Area Mathematics Project; Alfred B. Willcox, MAA; Eugene Meier, Oregon Mathematics Learning Center; Barbara Nelson, Ford Foundation; Thomas C. O'Brien, Southern Illinois University; Paul J. Sally, University of Chicago.

First Boston Workshop A Great Success

Thomas H. Barr

The first Boston Workshop for Mathematics Faculty was held July 31 through August 3, 1987 at Wellesley College. Organized by Gilbert Strang of M.I.T. and Frank Morgan of Williams College, its purpose was to strengthen the teaching of undergraduate mathematics—calculus, linear algebra, differential equations, and numerical analysis. Some sixty-six faculty, from across the U.S. as well as from Canada, Israel, and Greece, took part. In addition to presentations by the organizers and others, the group shared and debated ideas on curriculum, teaching methods, and computer use both in the classroom and by students. The workshop was clearly a success, and a second one will be held next August before the summer meetings in Providence.

To illustrate the introduction of applications into basic courses (and also to illustrate teaching itself) Professor Strang gave several lively and inspiring lectures. In one talk he presented a single example which brought together the fundamental ideas of introductory linear algebra, and in another he discussed the Fast Fourier Transform and graph theory in applied mathematics. He also described strange attractors, chaos, and fractals, and made a case for including them with differential equations. In the same spirit, Professor Morgan spoke about energy minimizing surfaces and soap films, and his "phase sphere" analysis of a tumbling box showed the instability of rotation about the box's intermediate axis. (See the American Mathematical Monthly, vol. 94, January 1987.) In addition Frank related his use of continuous probability in freshman calculus as an application of the definite integral. The emphasis was on current applications that can be introduced into *traditional* courses.

The group discussions were at times quite animated. A straw vote indicated that high school calculus could often be supplemented (or even supplanted) by discrete and combinatorial mathematics, and probability and statistics. While there was little question about the place of calculus as the college freshman's basic course, the group felt that changes in content would be appropriate: specifically fewer techniques of integration and more up-to-date applications.

There was much discussion but no agreement about the content and level of discrete mathematics courses—except to avoid packing in too

many topics. The use of computers as a tool for teachers and a learning implement for students received considerable attention. Many reported good results from using computers in lectures, and especially from hands-on experience by students. Others were concerned that extensive computing in mathematics classes will over commit time to technical features of the machines. But proponents countered that programming and computing are themselves effective ways to learn mathematics.

The cordial atmosphere, and the exchange of resources and ideas, benefited every participant. Clement New England summer weather added to the beautiful evironment of Wellesley College. It was a pleasure to attend. The second Boston Workshop is set for Friday, August 5 to Monday, August 8, 1988, again at Wellesley College (contact Room 2–240 at M.I.T.). In calculus, it will reflect the major activity this year to rethink the curriculum. In linear algebra, the new edition of Gilbert Strang's textbook will be a source of applications, and also the place of computing will be discussed—particularly in differential equations. The second workshop promises to be as stimulating and informative as the first.

Thomas H. Barr is an assistant professor in the Department of Mathematics and Computer Science at Rhodes College.

NAS Scientific Exchange Program with the U.S.S.R. and Eastern Europe

The National Academy of Sciences (NAS) invites applications from American scientists who wish to make visits beginning during the period January 1, 1989 through December 31, 1989 to the U.S.S.R., Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, Poland, Romania, and Yugoslavia. Long-term research visits of 3 to 12 months duration are encouraged, particularly if contact with colleagues in the other country has already been established. The minimum length of visits is one month in one country.

Applicants must be U.S. citizens and have a doctoral degree or its equivalent by June 1988. Fields include: physics; mathematics and computer science; engineering; science and technology policy; and those aspects of the economic and social sciences that involve quantitative analysis.

Requests for applications should reach the National Academy of Sciences not later than February 15, 1988. Completed applications must be postmarked by February 29, 1988. Address application requests to:

National Academy of Sciences; Office of International Affairs; Soviet and East European Affairs (GF-166); 2101 Constitution Avenue, NW; Washington, D.C. 20418; Telephone: (202) 334-2644.

ICME-6 Travel Grants

Mathematics educators, including precollege classroom teachers, may qualify for travel grants for ICME-6. The Sixth International Congress on Mathematical Education takes place 27 July-3 August 1988 in Budapest, Hungary. Call: 1-800-331-1MAA and ask for Alicia Bennett at the MAA. Deadline is 1 March 1988. Send no more than three recommendations.

WHAT IS CBMS? The Conference Board of the Mathematical Sciences is an umbrella organization of some sixteen mathematical societies. This is the first of a series of sketches that the CBMS societies will be preparing to better acquaint these sister societies with each other. These profiles will appear in FOCUS as they become available.

CBMS Profile of AMATYC

Karl J. Smith, President

During the late 1960's and the decade of the 1970's, two-year colleges blossomed and became recognized as an important educational alternative to the traditional four-year college in the United States. In 1974 a group of two-year college instructors met and drew up a constitution for a new organization called The American Mathematical Association of Two-Year Coleges (AMATYC). The fundamental purpose of this organization was established:

1. To provide a national forum for the exchange of ideas to further develop and improve the mathematics education of students in two-year colleges.
2. To coordinate activities of affiliated organizations on a national level.
3. To promote the professional development and welfare of its members.

Over the 12 years since its formation the organization has experienced phenomenal growth, and now has more than 1500 members nationwide. The committee structure of the organization (computer, developmental mathematics, technical mathematics, education, equal opportunity, and student mathematics league) has helped develop a sense of participation among the membership, as well as addressing the specific needs of two-year college faculty. On items of mutual concern AMATYC has worked on joint committees with both the MAA and NCTM. In addition to these joint committees, AMATYC is represented on the Conference Board of the Mathematical Sciences. An AMATYC member serves on the Mathematical Sciences Education Board at the National Research Council. AMATYC was represented at the Sloan Foundation sponsored forums, on two-year college mathematics and on the teaching of calculus. AMATYC has been consulted by various bodies including the planning committee for a national study of resources for colllegiate mathematics.

In the summer of 1975, AMATYC held its first summer institute at Ricks College and was able to secure a grant to provide stipends for those in attendance. Because of the success of this first summer institute, AMATYC expects to continue summer institutes at Ricks College on an annual basis as well as expand to other geographical areas. In the summer of 1987, AMATYC held a summer institute in Fresno, California, as well as the one at Ricks in Idaho.

Each year AMATYC holds an annual convention. The last one, in San Francisco, had over 55 sessions with over 700 attendees. Future conventions are planned for Kansas City (1987) and Calgary, Canada (1988).

For more information concerning AMATYC, its committees, conventions, institutes or publications, write to the secretary, Cheryl Cleaves, States Technical Institute, Memphis, TN 38134.

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proper placement of students, appropriate teaching, and offering a range of courses that meet the mathematical and career needs of a diverse student body. He characterized calculus for most students as:

> "The highest level of mathematical knowledge to which they aspire, while to many instructors, it is the lowest legitimate level of mathematical inquiry."

This shows what calculus looks like to one chancellor. But Ferritor ventured beyond the administrator's realm to urge his listeners to bring more discovery and excitement to calculus teaching giving their students that view of "Beauty bare" that Edna St. Vincent Millay allowed only to Euclid.

Homer A. Neal, chair of the Department of Physics at Michigan, former Provost of SUNY at Stony Brook, noted that the reentry of NSF into undergraduate education has come at a favorable time for the program to revitalize calculus. Neal's work as head of the National Science Board Task Committee on Undergraduate Science and Engineering Education helped move NSF back into this area. Neal spoke of the central role of mathematics in science and engineering education and the central role of calculus in that mathematical training. He notes the need for mathematicians seeking to reform calculus teaching to win the support of their colleagues and to go on to gain support from administrators and funding agencies. Judging from those present at the symposium, particularly from NSF Division of Mathematical Sciences Director Judith Sunley, much progress has been made in these areas.

Michael Reed, of Duke, spoke as a department chairman and as an applied mathematician. He found the texts "awful—but awful for a lot of understandable reasons." He faulted them as too technical, as containing too much material, as teaching little conceptual understanding, and as seriously lacking in word problems. He noted that students hate word problems, yet it is the ability to do them that makes mathematics applicable. Reed ventured that not a single member of Duke's physics department could correctly differentiate $x^{\sin x}$ and that none of these scientists would be embarrassed about this because such functions never occur in their work. Differentiating such a function is the sort of "plug-and-chug" exercise that pushes aside conceptual understanding in our courses, according to Reed.

Reed was concerned about applications and applicability. However, his wrap-up message was that the community should use the attention that calculus reform is generating to go out and get the additional support from departments and deans to innovate and develop a new and more successful calculus course. Salamon's talk indicated that such support was possible.

What did the users of calculus have to say? Henry Horn, of Princeton, speaking for biologists, and Herbert Moskowitz, of the Krannert Graduate School of Management at Purdue, speaking for the business and economic communities, both said that their disciplines needed to use a wide range of mathematical models. They urged that discrete or difference-equation versions be discussed in parallel with continuous models in calculus. Speaking for computer science, Anthony Ralston, of SUNY at Buffalo, went further, suggesting that discrete mathematics replace calculus at least for those going on in his discipline. This is a line that Ralston has argued persuasively for some time.

Horn gave a beautiful survey of the mathematics that he found useful as an empirical biologist with a "strong conceptual bias." He notes the need for attention to "the disciplines neighboring calculus: geometry, difference equations, nonlinear quantitative analysis, linear algebra, and statistics," and for an emphasis on proofs based on agreed-to intuitive principles rather than less-evident first principles.

Moskowitz presented a case study of the role of calculus in undergraduate and graduate degree programs at his school. The undergraduate program is more quantitative with calculus as an absolute requirement. But Moskowitz noted, "Calculus in the MBA program, for all intents and purposes, has essentially vanished—much to the delight of students." This shift has come about as computer modeling is used to explore the effects of shifts in operations rather than relying on calculus methods. When asked "How and when do managers use calculus?" Moskowitz answered "They don't." But he went on to say that students need a sense of the subject to understand expectations, least squares, and many other things. Here Moskowitz and Gordon Prichett, Dean of the Faculty at Babson College, agree. Gina Kolata quotes Prichett in her contribution to this volume as saying "If we are going to teach calculus in the business curriculum at all, it would be for breadth and for problem-solving ability." Thus Moskowitz and Prichett see calculus as a conceptual tool, part of an educated person's equipment and more as core material for the liberal arts than as a mere technical device. Here they strike a common note with President Starr of Oberlin. Professor Reed of Duke, and other speakers.

The engineering view was presented by W. Dale Compton, Senior Fellow at the National Academy of Engineering and a sixteen year veteran of Ford Motor Company, the last thirteen of those years as Vice President of Research. Compton was concerned about the supply of engineers, all whom must take calculus. In his words, "Calculus should encourage students to proceed to an engineering career—not by being easy but be being exciting." He also urged a calculus course that "includes examples that require the exercise of good judgement," feeling that such examples would not only help prepare a new generation of engineers but would also make the course more exciting.

Taken together these users of calculus come out for a more conceptual and less mechanical course and one in which discrete systems and approximations are taken into account. They show a strong interest in students being able to use alternative approaches and judge whether an answer is reasonable. These goals may seem modest, but they are as challenging as Dr. White's call to make a calculus course that draws students into the sciences rather than one that keeps them out. Calculation and $\frac{d}{dx} x^{\sin x}$ with all their terrors, are more appealing than being asked to use judgment or solve word problems—but as Compton and others note it is judgment that is of the greatest importance in the end.

The conference has not provided the answer, but it has put the issues into clear focus. This is what was needed and it was done.

See page 6 for Calculus Watch.

Michael Atiah Awarded the King Faisal Prize

In 1987, the King Faisal International Prize in Science was in the area of mathematics. It was awarded to Michael Atiah for his work in K-theory (with Hirzebruch), and his work on the index theorem (with Singer), and for his more recent work applying the methods of algebraic geometry to partial differential equations and to mathematical physics (instantons, Yang-Mills fields, and so on). Sir Michael's accomplishments were recognized earlier by his election to the Savilian Chair at Oxford as Professor of Engineering (1963) and by his having been awarded a Fields Medal (1966).

What's New at the MAA

Within roughly twelve months the MAA will have brought out ten books. Among these are some old classics in new form: paperbacked editions of Mark Kac's STATISTICAL INDEPENDENCE IN PROBABILITY, ANALYSIS, AND NUMBER THEORY, of E.T. Bell's MATHEMATICS: QUEEN AND SERVANT OF SCIENCE, and of Paul R. Halmos's I WANT TO BE A MATHEMATICIAN, new at the MAA. Each of these was well received in its former life and, in the view of our committees, deserved a new and wider market. The book by Mark Kac is the first of the Carus Monographs to be made as an inexpensive paperback. If it is successful other Carus Monographs will be put into paperback. The other two, by Bell and Halmos, are the lead books in the new MAA Spectrum series. This series has a flexible format to accommodate exciting projects outside the scope of our other series.

Recent or new titles in the Notes series are: TOWARD A LEAN AND LIVELY CALCULUS, edited by Ronald G. Douglas; UNDERGRADUATE PROGRAMS IN THE MATHEMATICAL AND COMPUTER SCIENCES: The 1985–1986 Survey, by Donald J. Albers, Richard D. Anderson, and Don O. Loftsgaarden; and CALCULUS FOR A NEW CENTURY, edited by Lynn A. Steen. The SURVEY gives a complete view of the undergraduate mathematics curriculum and departmental staffing. It is sobering reading. The two volumes on calculus give a clear picture of the background of the effort to improve the teaching of this course and of directions for future efforts. In addition, TEACHNING ASSISTANTS AND PART-TIME INSTRUCTORS: A Challenge, edited by Bettye Anne Case, has been published as an unnumbered Note. This is the initial report of the Committee on Teaching Assistants and Part-Time Instructors. Contains: contributions of eight mathematicians concerned with TA's and P-T I's, survey results on the extent and nature of departmental use of such instructors, and recommendations on how to meet the challenge of putting such personnel to best use. It will eventually be superceded by the committee's final report which is expected to be a regular numbered volume of the Notes series.

The New Mathematical Library has added its thirty-second volume: RIDDLES OF THE SPHINX and Other Mathematical Puzzle Tales by Martin Gardner. This is the first MAA book to be sold to a book club (Macmillan Science) and it has sold well in our prepublication offer. It is also the first NML that we have made available in hardcover and paperback. We will test the market for it in bookstores.

STUDIES IN THE HISTORY OF MATHEMATICS, edited by Esther R. Phillips, has been very well received, selling over a thousand copies in response to a prepublication offer. It is a strong addition to the MAA Studies.

A final best seller, with over a thousand copies sold in four months, is WRITING MATHEMATICS WELL, by Leonard Gillman. If these sales are a sign of more attention being given to exposition at all levels, this bodes well for all publications, books, and journals.

What is expected in 1988? The New Mathematical Library has a book by Murray Klamkin in final editing. The Notes Committee has three projects that are almost ready to go to press. The Studies Committee has in hand an expanded and revised volume on differential geometry edited by S.S. Chern. Spectrum is looking at a wide range of projects, among them books by Ian Stewart and Martin Gardner. Altogether Donald J. Albers lists twenty-one completed manuscripts under review and fourteen proposals in hand in his report as chairman of the Committee on Publications. He attributes this spurt of activity to the energy and ideas of those on the Committee on Publications and to the efforts of your Associate Director. We list these with their chairs below and urge you to send your publishing ideas and suggestions to the appropriate subcommittee or to Donald Albers for the Committee as a whole.

CARUS MONOGRAPHS
Ralph Boas, Chair

DOLCIANI MATHEMATICAL EXPOSITIONS
Joe P. Buhler, Chair

MAA NOTES
Donald J. Albers, for the new Chair

MAA STUDIES IN MATHEMATICS
Meyer Jerison, Chair

THE NEW MATHEMATICAL LIBRARY
Ivan Niven, Chair

MAA SPECTRUM
Donald J. Albers, Chair

Anneli Lax

by Alan Tucker

Anneli Lax has been the technical editor of the New Mathematical Library series since its inception. The NML was started in 1958 by the School Mathematics Study Group as the SMSG Monograph Project. The volumes were published originally by Random House and the L. W. Singer company; the MAA took over the series in 1975. The series sought to parallel in mathematics the successful high school monograph series in the physical sciences of SMSG's physics counterpart, the Physical Sciences Study Committee. SMSG's founders were concerned at the lack of good mathematical writing accessible to young people. All that existed then were textbooks and advanced treatises on the one hand and popularizations, often mathematically shallow, on the other. In Europe there was a tradition of mathematicians writing elementary texts and expository books. This tradition gave us such gems as Rademacher and Toeplitz's THE ENJOYMENT OF MATHEMATICS, Steinhaus's MATHEMATICAL SNAPSHOTS, the Abbot's FLATLAND. The NML series sought to establish the same tradition in America.

The original 12-member NML Editorial Panel, chaired by Lipman Bers, was a very activist group that enlisted good authors, gave them extensive guidance, and critiqued submitted manuscripts in detail. They debated what was the appropriate level and mathematical approach for each manuscript, and consulted secondary school teachers to help. Like other SMSG writing projects, the NML series planned to disband after ten years or so, once a core set of authors

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had pointed the way and commercial publishers got more involved in elementary mathematical exposition. SMSG and its NSF funding is gone, the NML Editorial Committee has shrunk to five members, but the NML series is very much alive with Anneli Lax continuing its high standards of editorial activism.

During the early years of Lax's editorship, she was in a very touchy "political" situation. SMSG was headed by Ed Begle. Lax was a member of the NYU Mathematics Department chaired by Morris Kline. Kline and Begle disagreed vehemently about the proper direction for reform of school mathematics. Nonetheless she worked in both settings.

In the early days of NML, commercial publishers rarely had copy editors who knew some mathematics; so Lax copy-edited and even made page dummies from galleys, in addition to working with authors at rewriting portions of their books. In NML #3, INEQUALITIES, by Beckenbach and Bellman, each author thought the other had written the final chapter. The truth is that Lax wrote it.

Anneli Lax got her Bachelors degree at Adelphi College. As a graduate student, she served as a research associate on Courant's shock wave project (and met her husband Peter, a well-known mathematician). She received her Ph.D. in 1954 from NYU. Her thesis was on partial differential equations, written under Courant. Her work on the shock wave manual and on the English translation of Courant and Hilbert revealed editorial skills that led to her being recommended for the NML job by Lipman Bers.

Doyle and Snell

by Alan Tucker

The story behind RANDOM WALKS AND ELECTRICAL NETWORKS, Carus Monograph #22, by Peter Doyle and Laurie Snell, is itself a random walk among mathematicians and the interrelationships between mathematics and physics. The tale begins at the University of Wisconsin when Peter Ney assigned to a class of his a random walk problem from Feller's text on probability. A comment in this problem suggested that if some of the streets are blocked in a two dimensional infinite random walk, then the walk is still recurrent (i.e., all locations visited infinitely often). He asked his colleague David Griffeath for an easy way to prove this. Griffeath mentioned this question to Laurie Snell at Dartmouth. Snell mentioned it to a graduate student named Peter Doyle. Doyle discussed the problem with his father, a Dartmouth physicist, and between them they saw that recurrence of the infinite random walk was equivalent to the resistance to infinity in the corresponding electric network being infinite. Blocking some of the streets only increases resistance in the electrical network. Doyle observed that this argument was an application of Lord Rayleigh's "shorting and cutting principle" that Rayleigh had introduced in his investigation of the sounds produced by musical instruments.

Doyle realized that Rayleigh's principle was a powerful tool for solving the type problem for Riemann surfaces and decided to make this topic the subject of his thesis under Snell. Snell urged him first to apply Rayleigh's principle to the simple problem of deciding when a random walker on an infinite graph returns to his starting point. Rayleigh's principle also provided new insight and significant generalizations of Polya's elegant theorem that a random walker in one or two dimensions must return to his starting point but not in three dimensions. Finally, these results (quoting Snell) "gave us an excuse to write the monograph to expose the importance of combining physical concepts with probabilistic concepts in understanding the behaviors of random walkers on infinite graphs." The draft of the monograph was written by Doyle in Dartmouth and mailed for comments to Snell who was on sabbatical at Cambridge, England. Snell recalls, "It was great to have him showing me the insight that people like Rayleigh and Maxwell had while I was wandering around Cambridge."

Laurie Snell received his undergraduate and graduate training at the University of Illinois; his thesis advisor was J.L. Doob. He then went to Princeton and a few years later to Dartmouth where he has been ever since. Snell is known to the mathematics community for his finite mathematics text, written with John Kemeny and G.L. Thompson in 1958—twenty-five years before the current interest in "discrete mathematics."

Peter Doyle received his Ph.D. from Dartmouth in 1982. He then worked with John Kemeny for one year writing an enhanced BASIC compiler and next went for a year to the Institute for Mathematics and its Applications at Minnesota. Next he took a job at Bell Lab's Mathematics Research Center where he worked on an electrical tomography project (to find cracks in welds between pipes, one applies currents at one set of points near the welds and measures the electrical activity at another set of points). For the last two years he has been on leave from Bell at Princeton University on an NSF Postdoctoral Fellowship.

The 1987 MAA Awards for Expository Excellence

Authors That You Should Read

These awards bear the names Allendoerfer, Ford, Polya, and Hasse. They not only honor the exceptional contributions of past and present expositors and teachers, but also provide a reading list that shows the diversity and strength of our journals. We hope this occasion will give you reason to look at a journal that you may have otherwise neglected or to find a piece that you might have otherwise missed in one of the journals that you regularly read.

The Carl B. Allendoerfer Awards for articles in MATHEMATICS MAGAZINE. These went to Israel Kleiner and Paul Zorn for the following:

To Israel Kleiner of York University, Ontario, for "The Evolution of Group Theory" in the October 1986 issue, pages 195–215. The citation reads: "This well-presented, interesting paper provides a very useful historical view of the confluence of many 19th century strands which led to the centrality of group theory in mathematics. Its manner of presentation is superb. So is the bibliography."

To Paul Zorn of St. Olaf College for "The Bieberbach Conjecture" in the June 1986 issue, pages 131–148. The citation reads: "This paper is a paragon of expository writing. It places an important recent result in a historical setting which provides the motivation for its importance, the background needed to understand it, and the development of the mathematical tools used in its ultimate solution. It is accessible to the non-specialist. It is beautifully clear."

The Lester R. Ford Awards for articles in THE AMERICAN MONTHLY. These went to Stuart S. Antman; Joan Cleary, Sidney A. Morris, and David Yost; Peter M. Neumann; Jacob Korevaar; and Howard Hiller for the following:

To Stuart S. Antman of the University of Maryland for his review of Ann Hibler Koblitz's A CONVERGENCE OF LIVES—SOPHIA KOVALEVSKAIA: SCIENTIST, WRITER, REVOLUTIONARY in the February 1986 issue, pages 139–144. The committee comments that this review ". . . goes far beyond what one could normally hope for in the treatment of

a mathematical biography. It summarizes in a few paragraphs the life of the subject, cites original passages to differ with the author's account, gives an independent summary of Kovalevskaia's main mathematical accomplishments, and relates them to more contemporary mathematical settings . . . . It is a serious contribution to mathematical exposition in its own right, and deserves the admiration of the Association."

To Joan Cleary and Sidney A. Morris both of La Trobe University together with David Yost of Australian National University for their article "Numerical Geometry—Numbers for Shapes" in the April 1986 issue, pages 260–275. The committee noted that the authors ". . . have taken a surprising result published by O. Gross and have developed it into a paper which makes fascinating reading. The theorem itself, about compact, connected metric spaces, can be understood by advanced undergraduates. The startling nature of the result leads one to want to read further. The authors work out examples for familiar geometric shapes, prove the theorem as it becomes feasible to do so, and discuss generalizations. Sprinkled throughout are open questions. The exposition is particularly good because a high percentage of the text consists of clarifying remarks, observations about what is plausible but not true, and generally interesting conjectures and auxiliary issues."

To Peter M. Neumann of Queen's College, Oxford, for his review of Harold M. Edwards's GALOIS THEORY in the May 1986 issue, pages 407–411. The committee cites this "superb piece of exposition, in this case of a famous but rarely known piece of work. As Neumann points out, our notions of Galois theory are far different in form from what Galois wrote down, and Neumann provides careful background for Galois's work, especially his PREMIER MEMOIRE. The reviewer has also included, adroitly, not only the original referees' judgment of the MEMOIRE but also a reasoned assessment of their conclusion. The review pays appropriate attention to Edwards's book, but goes far beyond . . . to produce an excellent piece of exposition."

To Jacob Korevaar of the University of Amsterdam for his article "Ludwig Bieberbach's Conjecture and its Proof by Louis de Branges" in the August-September 1986 issue, pages 505–514. The committee called this ". . . a superb piece of writing about that very recent discovery in function theory which has received a great deal of attention and should be of interest to many, many readers . . . . Korevaar's paper contains a judicious amount of history of the problem, including the Littlewood-Paley conjecture whose disproof seemed to make the truth of the Bieberbach conjecture even more remote. He develops the Lebedev-Milin conjecture, and settles down to the chain of reasoning of de Branges's proof, through to the computer testing of the sequence of finite sums and the assistance of Gautschi and Askey. Throughout he manages to sustain a lanugage of excitement and doubt about the outcome. It is a masterful piece."

To Howard Hiller of Citicorp Investment Bank, New York, New York, for "Crystallography and Cohomology of Groups" in the December 1986 issue, pages 765–779. This work was chosen ". . . . because of its ambitious and largely successful treatment of a familiar subject from an advanced point of view. It includes an historical account of the space groups and of Bieberbach's solution to Hilbert's eighteenth problem. It then launches into an educational venture of building up to the correspondence between space and groups in a given arithmetic crystal class and orbits in a 1-dimensional cohomology group. Though there are few proofs, an active reader can gain a great deal of the subject just from checking the special cases which Hiller has set down. It is the kind of exposition which encourages the reader to study further . . . .

" The George Polya Awards for articles in THE COLLEGE MATHEMATICS JOURNAL went to Irl C. Bivens and Constance Reid for the following:

To Irl C. Bivens of Davidson College for "What a Tangent Line is When it isn't a Limit" in the March 1986 issue, pages 133–143. The committee's citation reads in part, "By defining the tangent line as the best linear approximation to the graph of a funtion near a point [Bivens] has narrowed the gap, always treacherous to students, between an intuitive idea and a rigorous definition. The subject of this article is fundamental to the first two years of college mathematics and should simplify things for students . . . ."

To Constance Reid of San Francisco, California, for her article "The Autobiography of Julia Robinson" in the January 1986 issue, pages 3–21. The committee notes that Julia Robinson cites MEN IN MATHEMATICS as giving her her first exposure to mathematics and mathematicians. It continues by noting, "Now students have the story of *her* life—and it is an affirmation of how inappropriate Bell's title would be today. 'The Autobiography of Julia Robinson' is not an autobiography, but a biography written by a sister who tried to 'write in her [Julia's] spirit, not my own.' Thanks to Constance Reid, we understand how a woman who had her share of trials could be 'very happy, really blissfully happy' because of her excitement about mathematics. Ironically, this 'Autobiography' ensures that Julia Robinson will be remembered for the woman she was and not merely, as she would have preferred, 'for the theorems I have proved and the problems I have solved.'"

The Merten M. Hasse Prize is not restricted by journal but rather by age. The author must have been under forty at the time of publication. This prize goes to Anthony Barcellos of Davis, California, for his article "The Fractal Geometry of Mandelbrot" that appeared in the March 1984 issue of THE COLLEGE MATHEMATICS JOURNAL, pages 95–114. This paper earned Barcellos a George Polya Award in August of 1985. This paper conveys the spirit of fractal constructions by examples and also gives the reader an understanding of how Hausdorff-Besicovitch dimension and other complexities fit into the picture. It is an unusually clear and compelling account of a topic of considerable current interest.

Focus Employment Advertisements

The advertising rates in FOCUS have been raised as of the November–December 1987 issue to reflect increased circulation (now over 28,000) and costs and design changes that will give our advertisers more words per running inch. Standard advertisements carried forward from previous issues will be charged at the old rates.

Rates for FOCUS Employment Ads are: 50 words or less: $37.50. More than 50 words: $45.00 per inch.

There is a 15% discount for the same ad in 3 consecutive issues (with contract in advance). An insertion order on institutional letterhead will be considered a contract. Charges will be billed after the first occurrence specified in the contract.

Anyone wishing to place an employment ad in FOCUS should write to: FOCUS Employment Ads, Mathematical Association of America, 1529 Eighteenth Street, N.W., Washington, D.C. 20036. Or for more information, call the MAA Washington Office at (202) 387-5200.

The deadline for submission for the March–April 1988 issue is March 1. The deadline for the May–June 1988 issue is April 8.

WAKE FOREST UNIVERSITY
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

Applications are invited for a tenure-track position as assistant professor of mathematics, beginning August 1988. A Ph.D. is required. Send resume to Marcellus E. Waddill, Chairman, Department of Mathematics and Computer Science, Wake Forest University, Box 7311, Winston-Salem, North Carolina, 27109. AA/EEO employer.

DEPARTMENT OF MATHEMATICS AND PHYSICAL SCIENCE
EMBRY-RIDDLE AERONAUTICAL UNIVERSITY
DAYTONA BEACH, FL 32014

Applications are being accepted for a position in mathematics at the assistant professor level for January 1988 or September 1988. A strong commitment to teaching excellence is essential, and a Ph.D. in applied mathematics is required. Teaching and other academic experience is desired. Salary is commensurate with experience. The department offers an Engineering Physics Degree and provides support courses to other degrees. A cover letter, a resume, and the names of three references should be sent to Dr. Elliot Jacobs, Chairman, Faculty Search Committee, Department of Mathematics and Physical Science, Embry-Riddle Aeronautical University, Daytona Beach, FL 32014. Embry-Riddle Aeronautical University is an EEO/AA employer.

PALM BEACH ATLANTIC COLLEGE, DEPT. OF MATHEMATICS
P.O. BOX 3353, WEST PALM BEACH, FL 33402-3353

Palm Beach Atlantic College, a fully accredited, 4-yr, Christian, liberal arts college of 1100 students is seeking a Ph.D. in pure or applied mathematics to fill a full-time position beginning either spring semester 1988 or fall semester 1988. The candidate must be a committed and active Christian. Duties include teaching, advising students, and committee work. Send vita, transcripts, and the names of 3 personal references to Dr. Bruce W. Atkinson, Chairman, at the above address. Telephone: (305) 650-7654 or (305) 650–7700.

UNIVERSITY OF ILLINOIS AT CHICAGO
MATHEMATICS AND COMPUTER EDUCATION

The Department of Mahematics, Statistics, and Computer Science invites applications for tenure-track or tenured positions in Mathematics and Computer Science Education. The Department offers the stimulating environment of a highly rated mathematics department coupled with a strong commitment to the improvement of pre-college education. Current programs in mathematics education include: two major N.S.F. grants for elementary school math and science curriculum development and implementation; private and state grants to support primary and secondary teacher enhancement programs; undergraduate and graduate programs for the certification of elementary and secondary teachers; M.S.T. and D.A. degree programs; and an extensive program of continuing education for teachers. The state has provided funding to expand and improve these actvities and to support research in the teaching and learning of mathematics. Applicants must have a Ph.D. or a D.A. in Mathematics, Mathematics Education, Computer Scinece, or related field; and outstanding research and publication record; experience in undergraduate and graduate teaching; and previous involvement with teacher education programs. Candidates with experience and interest in working directly with teachers and schools will be given preference. Applications are also invited for visiting positions for 1 or more quarters. Send vita and direct 3 letters of reference to Chair, Search Committee, Dept. of Mathematics, Statistics, and Computer Science, Univ. of Illinois at Chicago, Box 4348, Chicago, IL 60680. UIC is an affirmative action/equal opportunity employer.

ANTICIPATED VACANCY

Tenure-track position in the Department of Mathematics, September 1988. Earned doctorate and excellence in teaching required. Research potential/experience is desired. The selected candidate will join an established program with traditional and computer-oriented degrees and will have the opportunity to participate in developing mathematics courses for growing undergraduate and graduate programs of the CS Department. Application deadline: FEBRUARY 28, 1988. Applications , including resume, transcript, and three letters of reference should be sent to: RUFUS A. WINSOR, CHAIRPERSON DEPARTMENT OF MATHEMATICS SOUTHEASTERN MASSACHUSETTS UNIVERSITY NORTH DARTMOUTH, MASSACHUSETTS 02747. SMU is an Equal Opportunity/Affirmative Action Employer. Applications from Members of Minority Groups and Women are particularly encouraged.

CENTRE COLLEGE MATHEMATICS POSITION

Applications are invited for two tenure-track positions at the rank of assistant or associate professor beginning September, 1988. Candidates must have a Ph.D. and possess strong commitment to liberal arts education. The focus of one position is the teaching of a wide variety of courses in undergraduate mathematics; the ability to teach mathematical statistics is desirable. The duties of the other position will be divided between teaching computer science and mathematics. Applicants for this position should be prepared to teach CS1, CS2, CO1, CO2, EL9, and other CS topics (see ALM Liberal Arts Computer Sciences Curriculum). Excellent fringe benefit program including home mortgage plan and tuition scholarship program for dependent children. Applications, resumes, transcripts, and three letters of reference to Leonard DiLillo, Dean, Centre College, Danville, KY 40422. E.O.E.

MOORHEAD STATE UNIVERSITY
Mathematics Department. Moorhead, MN 56560

Tenure-track position at the rank of assistant or associate professor to begin September 1988. A Ph.D. in mathematics is required. Preference given to candidates with successful college teaching experience. Duties include teaching undergraduate courses in mathematics, advising students, and university and departmental committee work. First screening of applications on February 15, 1988. Applications accepted until filled. Apply to: Milton Legg, Chair, Mathematics Department. Moorhead State University is an equal opportunity educator and employer.

CALIFORNIA STATE UNIVERSITY, DOMINGUEZ HILLS
DEPARTMENT OF MATHEMATICS CARSON, CALIFORNIA 90747

An Assistant Professor, tenure-track position in Mathematics is anticipated for 1988–89. A Ph.D. in Mathematics and U.S. citizenship or permanent residency is required. Preference will be given to candidates with proven teaching experience and research interests in geometry, differential equaltions, or applied mathematics. Faculty teach 12 units of undergraduate courses per semester. Appointment effective: August 22, 1988. Committee will begin review of applications on March 1, 1988. Send resume and three letters of recommendation to Dr. Jackson N. Henry at address listed above.

SUNY, COLLEGE AT ONEONTA, Dept. of Math. Sciences,
Oneonta, NY 13820.

TWO POSITIONS, subjects to budgetary approval. COMPUTER SCIENCE: Ph.D. in Computer Science or related area. Master's level expertise in Computer Science necessary. Preferred specialization in System Software, Operating Systems or Data Base Systems. Background in discrete mathematics and/or numerical analysis desirable. Available August, 1988. Modern Applied Mathematics: Ph.D. in Mathematics and excellent teaching qualifications. Specialization in combinatorics, graph theory, modeling, numerical analysis. Computer science background desirable. Available August, 1988. Rank and salary negotiable/competitive. Duties: undergraduate instruction and related work. Send resume, three letters of recommendation and transcript to chair, address above. AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

MATHEMATICS DEPARTMENT
INDIANA UNIVERSITY OF PENNSYLVANIA

invites applications for a permanent tenure-track position at the Assistant/Associate Professor rank in Mathematics, beginning September, 1988. Duties include teaching 12 semester hours of undergraduate and graduate courses per semester, to assist in course and

curriculum revision, to advise students and to serve on faculty committees, and to participate in other academic and professional activities of the department. Requirements: A doctorate (or degree nearing completion) is required in Mathematics or Applied Mathematics. Teaching experience is preferred. Send letter of application, resume, transcripts, and three letters of reference to Search Committee B, Department of Mathematics, Indiana University of Pennsylvania, Indiana, PA 15705. Review of applications will begin on January 10, 1988, and continue until the position is filled. IUP is an Affirmative Action-/Equal Opportunity Employer.approval, Mills College is an Affirmative Action/Equal Opportunity Employer. Send vita and direct three letters of reference to: Professor Richard Bassein Chair of the Mathematics Search Committee Mills College Oakland, CA 94613 Deadline for application: January 15. 1988

FURMAN UNIVERSITY
Greenville, SC 29609

Two tenure track positions in mathematics beginning September 1988. A Ph.D. in a mathematical science or mathematics education is required. Excellence in teaching and continued scholarly activity are expected. Rank and salary will be based on qualifications. All areas of specialization are acceptable. Individuals with expertise in mathematics education are encouraged to apply for one of the positions. Vita, graduate and undergraduate transcripts, and three letters of recommendation should be sent to Dr. Robert Fray, Department of Mathematics. Application deadline: February 1, 1988. EOE/AAE

MATHEMATICS DEPARTMENT
INDIANA UNIVERSITY OF PENNSYLVANIA

invites applications for a permanent tenure-track position at the Assistant/Associate Professor rank in Mathematics, beginning September, 1988. Duties are to teach undergraduate and graduate courses with emphasis on courses in Operations Research or Applied Mathematics, to provide leadership in the implementation of a newly designed M.S. program in Applied Mathematics, to give direction to a graduate internship program and to graduate student projects in Applied Mathematics, and to participate in other academic and professional activities of the department and the discipline. Qualifications: A Ph.D. in an Applied Mathematics field or a Ph.D. in Mathematics with experience in Operations Research or Applied Statistics is required. Teaching and/or field experience preferred, but not required. Send letter of application, resume, transcripts, and three letters of reference to Search Committee A, Department of Mathematics, Indiana University of Pennsylvania, Indiana, PA 15705. Review of applications will begin on January 10, 1988 and will continue until the position is filled. IUP is an affirmative action/equal opportunity employer

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DEPARTMENT OF COMPUTER SCIENCE

The DUKE UNIVERSITY Center of Computer Science, the recipient of a NSF CER Grant, has junior faculty positions available for the 1988–89 academic year in theoretical computer science and scientific computing. Applicants must demonstrate excellence in research or exhibit the promise of excellence. The department currently has 17 tenure track faculty, approximately 200 undergraduate majors and 70 graduate students pursuing masters and/or doctoral degrees. The department has major research efforts in scientific computing with emphasis on numerical linear algebra, the solution of PDE's, and VLSI simulation; computer systems with emphasis on computer architectures, modeling of fault-tolerent systems, systems performance, and communications; artificial intelligence, particularly in the areas of natural language interface, search methodologies, and expert systems; and theory and algorithms with emphasis on combinatorial and graph-theoretic studies. Special motivation for the research efforts comes from the areas of medical applications (in collaboration with the Duke Medical Center), and VLSI (in collaboration with the Microelectronics Center of N.C.), of which Duke is a Participating Institution. Interested applicants should send copies of their resume and other supporting material by January 31, 1988 to: Professor Donald J. Rose, Department of Computer Science, DUKE UNIVERSITY, Durham, N.C. 27706. Duke University is an Equal Opportunity/Affirmative Action Employer.

Mathematics—at least one full-time, tenured-track position beginning August 1988. Masters degree in Mathematics required, doctorate prefered, college teaching experience preferred. NSU is primarily an undergraduate teaching institution with graduate programs for teachers. Initial review of applicants begins March 1, 1988. Submit letter of application, resume, and three letters of recommendation to: Personnel Services, Northeastern State University, Tahlequah, OK 74464. An Equal opportunity/affirmative action employer.

UNIVERSITY OF WISCONSIN-MADISON-MATH EXTENSION & OUTREACH (UW ME&0). APPLY TO MATH EXT. SEARCH COMM., MATH DEPT., 480 LINCOLN DR., MADISON, WI 53706

Applications solicited for a tenure-track position directing & teaching in the UW ME&O program beginning 7/1/88. The app't will be as an ass't. prof. in the Math Dept. unless qualifications & experience require app't. at a higher rank. Responsibilities include administration & development of & teaching in out-reach programs & a limited amount of teaching in the Math Dept. Outreach includes correspondence study & non-credit continuing-education courses with a large audience throughout the state at high school & univ. levels. The faculty member will have the challenge of developing continuing & professional education programs designed to introduce new developments in mathematical sciences to the public at all career levels. AA/EOE. Deadline for full consideration 1/1/88.

U. S. NAVAL ACADEMY
Department of Mathematics

Applications are invited for several tenure-track appointments at the rank of Assistant, Associate, or Full Professor commencing in August of 1988. The initial salary will be competitive and commensurate with experience and qualifications. Research opportunities exist for augmenting salary during the summer intersessional period. Specialization in applied mathematics or operations research is of particular interest. Applicants must possess an earned Ph.D. by the date of appointment, have a commitment to excellence in teaching, and be capable of pursuing an independent program of research. Inquires and applications should be sent to Prof. J.M. D'Archangelo, Mathematics Department, U.S. Naval Academy, Annapolis, MD 21402-5002. Required of all applicants are a resume, transcripts of academic records, and at least three letters of recommendation from persons familiar with the applicants's teaching and research. The Naval Academy is an EO/AA employer.

TENURE-TRACK POSITION FALL 1988 BARD COLLEGE DEPARTMENT OF MATHEMATICS

Applications are invited for a tenure-track position in Mathematics at Bard College for the Fall of 1988. Bard is a Liberal Arts College with a young and expanding Mathematics Department. We are seeking someone with a strong interest in building an innovative mathematics program in a liberal arts context. Candidates must have a Ph.D. by the Fall of 1988, and a commitment to teaching and continued mathematical activity. Salary and rank depending on experience. To apply, submit a resume, a statement of teaching and research interests, and 3 letters of recommendation (at least one concerning teaching) to Prof. Ethan Bloch, Mathematics Search Committee, Box 91, Bard College, Annandale-on-Hudson, NY 12504. Deadline for applications is 1/15/88; late applications will be considered until the position is filled, Bard College is an Affirmative Action/Equal Opportunity Employer.

Mississippi University for Women
POSITION IN MATHEMATICS

The Mississippi University for Women invites applications for a tenure-tract position as assistant or associate professor of mathematics, beginning August, 1988. Candidates for the position must have a Ph.D. degree and a strong interest in all areas of undergraduate mathematics, especially mathematical statistics. Evidence of interest in research and publication will be given special consideration. Rank and salary will be dependent upon qualifications and experience. Send letter of application, resume, transcripts, and names and addresses of three references to Dr. Carol Ottinger, Mathematics Search Committee, Box W-100, Mississippi University for Women, Columbus, MS, 39701. Completed applications must be received by February 15. The Mississippi University for Women is located in Columbus, an east-central Mississippi community of 35,000. The University has an enrollment of about 2,000 students, of which 20 percent are men. An equal opportunity, affirmative action employer.

Allegheny College
Mathematics Department
Meadville, PA 16335

Receiving applications for at least one tenure-track position beginning September 1988. Applicants should have a Ph.D. in mathematics and strong commitments to the teaching of undergraduate students and to continued professional development. Rank and salary are competitive and commensurate with qualifications and experience. Fringe benefits include TIAA-CREF, health and life insurance, full tuition benefits for family, and IBM PC's in faculty offices. There may also be a one year position open to persons with at least a Master's degree and teaching experience. Screening of applicants will begin December 7, and continue until all positions are filled. Send application, vita, graduate transcripts, and three letters of recommendation to Dr. Anthony LoBello, Search Committee Chairman. Allegheny College is an Equal Opportunity Employer.

SOUTHWESTERN UNIVERSITY—GEORGETOWN, TEXAS 78626

Applications are being invited for a tenure track position in Mathematics at the Assistant Professor level beginning Fall semester 1988. Ph.D. required. Southwestern is a selective liberal arts undergraduate college with 1100 students. Faculty are expected to have a strong commitment to excellence in undergraduate teaching, to maintain an active interest in scholarly pursuits, and to possess an appreciation of liberal arts education. Please send a letter of application, vita, and names and addresses of at least three current references to Theodore D. Lucas, Associate Provost.

Miami University, Middletown, Ohio
Department of Mathematics and Statistics

Anticipates authorization of an assistant professor (tenure track) position and an instructor position beginning in August 1988. Miami University Middletown is a two-year regional campus. Duties for the assistant professor include teaching 12 hours per semester, service and scholarship. Applicants should have a doctorate in mathematics, mathematics education or statistics by August 1988 and a strong interest in teaching. Duties for the instructor include teaching 12 hours per semester, and service. Applicants should have a master's degree in mathematics, mathematics education or statistics. Teaching experience is desirable. Send a vita, graduate transcript and three reference letters to John Skillings, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056 by February 1, 1988. Late applications may be considered. Women and minorities are encouraged to apply. AA/EOE.

URSINUS COLLEGE
Department of Mathematics and Computer Science
Collegeville, PA 19426

Anticipated opening, Fall 1988. Tenure Track position at the Asst. Prof. level. Ph.D. desired and required for tenure. Twelve hours per week teaching load, full range of courses in the mathematical sciences. Salary open. Standard fringe benefits. Independent coed liberal arts college with about 1,200 students founded in 1869. Campus of 140 acres about 30 miles from Philadelphia. Send application and 3 letters of recommendation to John W. Shuck, Chairman. Good teaching references essential. Ursinus does not discriminate on grounds of race, color, national origin, sex, age, or handicap.

MINOT STATE UNIVERSITY MATH AND COMP. SCI. DEPT.
MINOT, ND 58701

Tenure track position beginning Fall, 1988. All specialities considered (Mathematics, Computer Science, Mathematics Education). Doctorate and Computer Science background desirable. Strong commitment to quality teaching. Teaching primarily at the undergraduate level with a continuing interest in scholarly activity and service expected. Applications accepted until the position is filled. Send letter of application, resume, transcripts, and three letters of recommendation to Robert L. Holmen, Chairman. MSU is an AA/EO employer.

WASHINGTON AND LEE UNIVERSITY
DEPARTMENT OF MATHEMATICS
LEXINGTON, VIRGINIA 24450

Ine tenure-track position at assistant professor level. Ph.D. in mathematics expected. Field: numerical analysis, or other if program includes the equivalent of at least one year of coursework in numerical analysis. W&L is a privately endowed, undergraduate college emphasizing quality instruction in small classes. Send resume, three letters of reference (one should address teaching experience and potential), and transcript to Search Committee at address above. EQUAL OPPORTUNITY EMPLOYER.

Chairman and Professor
Mathematics & Computer Science

Gordon College invites applications for this position. The appointment is for 1988–89 academic year; possibility of summer employment. The Chairman will teach three courses per quarter in mathematics and/or computer science to freshman and sophomore college students. Requirements: Ph.D. in mathematics or computer science. Five years effective teaching experience and successful administrative experience preferred. Salary range is $38,000-$40,000 for rank of Professor. By February 26, 1988, send resume to Dr. James O. Richards, Dean of the College, Gordon College, Barnesville, GA 30204 or phone 404-358-1700. Gordon College is an AA/EOE.

The Calvin College

Department of Mathematics and Computer Science will have tenure track openings and temporary openings for the 1988–89 academic year. Applicants in Mathematics, Mathematics Education, Computer Science, and Mathematical Statistics are encouraged to apply. The department currently has 18 full-time faculty positions and nearly 100 majors at the junior-senior level. Calvin College is a Christian liberal arts college, and each faculty member is expected to demonstrate a Reformed and Christian perspective in her or his teaching and other professional activities. To apply, contact Professor T. Jager, Chairman, Dept. of Mathematics and Computer Science, Calvin College, Grand Rapids, MI 49506. Calvin College is an equal opportunity, affirmative action employer.

EMORY & HENRY COLLEGE
Emory, Virginia 24327

Tenure-track Assistant Professor in mathemaics for Fall 1988. Ph.D. required. Strong interest in teaching. Ability/inclination to teach broad range of undergraduate mathematics courses, including statistics and beginning computer science courses. Send resume, transcripts, and three letters of recommendation by January 30, 1988 to Richard Pfau, Dean. AA/EOE.

EMORY UNIVERSITY
Mathematics

The Department of Mathematics and Computer Science has three openings in mathematics to begin September 1, 1988. The positions are at the level of tenure-track assistant professor, or higher, in the case of exceptional candidates. Applicants must have a Ph.D. in mathematics and a strong record (or promise) of research. The following areas are of particular interest to us: geometric analysis, numerical analysis, combinatorics, and applied mathematics (differential equations). Applications will be considered, however, from candidates with strong research credentials in any area of mathematics. The department presently has 20 permanent members comprising several active research groups. Our graduate program offers the Ph.D. in mathematics and master's degrees in mathematics and computer science. Teaching requirements are 6 hours per week, including graduate and undergraduate courses. Salaries are competitive, and commensurate with experience. Send vita and names of three references to: Prof. Peter Winkler, Dept. of Mathematics and Computer Science, Emory University, Atlanta, GA 30322. Please have reference letters forwarded to us. Screening of application will begin Feb. 1, 1988. Emory University is an equal opportunity/affirmative action employer

KENYON COLLEGE
MATHEMATICS DEPARTMENT
GAMBIER, OH 43022

Two tenure-track positions starting 88–89. One Asst. Prof. or beginning Assoc. Prof., other Asst. Prof. Must have PhD by 8/88. Must have broad background in math. For one position, preference for candidates in prob/stats. Some background in CS or numerical analysis or combinatorics or modeling is an asset. Strong commitment to undergrad teaching and scholarship is required. Teach 3 courses per sem. Write or call for more information promptly. Write to Stephen Slack at the above address or call (614)427-5267. Candidates will be considered until the positions are filled. Kenyon is an EOE and encourages applications from women and nimority candidates.

KENYON COLLEGE
MATHEMATICS DEPARTMENT
GAMBIER, OH 43022

Two year sabbatical replacement position starting 88–89. Inst. or Asst. Prof. Must have masters in math by 8/88; PhD preferred. Must have broad background in math. Background in CS or numerical analysis or combinatorics or modeling is an asset. Strong commitment to undergrad teaching is required. Teach 3 courses per sem. Please write of call for more info promptly. Write to Stephen Slack at the above address or call (614)427-5267. Candidates will be considered until the position is filled. Kenyon is an EOE, and encourages applications from women and minority candidates.

ROLLINS COLLEGE, DEPT OF MATHEMATICAL SCIENCES
Winter Park, FL 32789

One tenure track position, preferably at the Assistant Professor level, is available for Sept 1988. The area of specialization is open but a doctorate, a strong commitment to teaching undergraduates and continued professional activity are required. The Department offers majors in mathematics and computer science and an ability to teach in both areas is viewed as a plus. The Department also has a strong interest in the instructional use of computers, particularly computer algebra systems. The teaching load is 8–10 hours per week. Winter Park, a delightful city of 40,000 is located in the greater Orlando area. To insure full consideration, applications must be complete by 15 Feb. 1988. Send resume, transcripts and 3 letters of recommendation (at least one of which must comment on teaching) to : David Kurtz, Chair. Rollins is committed to equal opportunity/affirmative action.

NORTHERN KENTUCKY UNIVERSITY

The Department of Mathematical Sciences anticipates having two tenure-track positions. The positions will begin August, 1988. One position is in computer science, and one position is in statistics. Each position requires a doctorate. Responsibilities include a twelve hour-/semester teaching load with emphasis on quality undergraduate teaching, continuing scholarly activity, and service to the department and to the university. The department has 25 full-time and 14 part-time faculty members and 335 majors. NKU is located seven miles from Cincinnati, OH. Review of applicants will begin February 15, 1988, and continue until the positions are filled. Apply to: Professor Charles Frank, Chair of Search Committee, Department of Mathematical Sciences, Northern Kentucky University, Highland Heights, KY 41076. NKU is an Affirmative Action/Equal Opportunity Employer and actively seeks the candidacy of minorities and women.

LEBANON VALLEY COLLEGE
ANNVILLE, PA, 17003

Department of Mathematical Sciences Tenure track opening fall 1988. Become part of an amiable, dynamic department of six, with 100 majors in Mathematics, Actuarial Science, and Computer Science comprising over 11% of the student body. One third of departmental majors rank above 95th percentile in HS class. Applicant should be willing to teach a wide range of undergraduate courses from Mathematics, Applied Mathematics and Computer Science. Interest in upper level Statistics and/or upper level Computer Science desired. Ph.D. required. Starting date August 25, 1988. Lebanon Valley College, a small, selective Liberal Arts College emphasizing Leadership is dedicated to teaching. Lebanon Valley College is located near Hershey, Pennsylvania, within three hours of New York, Philadelphia, amd Washington, D.C. Applications received by January 31, 1988 will be assured consideration. Send resume and three letters of reference to Horace W. Tousley, Chairman, Mathematical Sciences, Lebanon Valley College, Annville, Pa. 17003-0501.

THE COLORADO COLLEGE, MATHEMATICS DEPARTMENT
COLORADO SPRINGS, CO 80903

One year position available beginning Sept. 1988 in a department where research and teaching are both valued. Required: Ph.D. as well as strong ability and interest in undergraduate teaching. Desirable: ability to teach some computer science. Salary and rank commensurate with experience. The Colorado College is an equal opportunity employer; the college encourages applications from women and minorities. Send vita and 3 letters of recommendation (at least two concerning teaching ability) to Steven Janke, Mathematics Department. Applications accepted until the position is filled.

Mathematics Department
Presbyterian College
Clinton, South Carolina 29325

Tenure track position to teach all levels of mathematics in a liberal arts college. Ph.D. in mathematics preferred; M.A. or M.S. required. Any specialization considered. Begins August, 1988. Upon receipt of a letter indicating your interest in the position, more information about the college, the position, and completing your application will be sent to you. Send letters to Dr. E.W. Womble, Presbyterian College, Clinton, SC 29325. Presbyterian College is affiliated with the Presbyterian

Church (USA) and is an equal opportunity employer. Respond by December 15, 1987.

MATHEMATICS/COMPUTER SCIENCE CHAIR: Ph.D. in mathematics, statistics, or related area; commitment to excellence in teaching; evidence of scholarly and professional activity; and expression of faith in Jesus Christ (as understood in the Reformed tradition) are required. ABD and experience will be considered if degree expected in one year. Responsible to adminster small department with major and minor in mathematics and minor in computer science and to teach broad range of undergraduate courses in mathematics. Rank open. Salary competitive. Contact Dr. Owen Elder, Vice President for Academic Affairs, Belhaven College, Jackson, Mississippi 39202, telephone (601) 968-5916.

Lafayette College
Mathematics Department Easton, PA 18042

Tenure track positions beginning in late August, 1988. Associate Professor, Assistant Professor (Ph.D. required), or Instructor (near-Ph.D.). Rank depends on qualifications. Teach undergraduate mathematics, help develop undergraduate mathematics program, pursue an active program of scholarly development. Teaching load is 3 courses per semester. Liberal arts and engineering in a small (2000) college close to Philadelphia and New York. Salary competitive (1987 AAUP salary rating 1* in all ranks). Women and minorities are encouraged to apply. Lafayette is an Equal Opportunity Employer. Send resume, 3 reference letters, and telephone numbers to Chair, Mathematics Search Committee. Review of applications will begin on January 15, 1988 and will continue until positions are filled.

CALIFORNIA STATE UNIVERSITY, LONG BEACH
Department of Mathematics & Computer Science

Eight tenure-track positions beginning Fall, 1988: Algebra, Funtional Analysis, or Diff. Eq. (3 positions); Numerical Analysis, applied PDE or applied Probability (2 positions); Statistics (1 position); Math Education (1 position); Computer Science (1 position). All positions require completed PhD, evidence of excellent teaching, strong research record or potential. Asst. or Assoc. Prof. preferred; applicants with distinguished records in teaching and research may be considered for Professor. Must be US citizen or permanent resident prior to offer of appointment. Further details of duties, salary range, specialty and degree requirements provided on request. Applicants not selected for tenure-track, and applicants not meeting specialty or citizen/resident requirement may be considered for 1-year temporary appointment as Lecturer, but must have visa valid for term of appointment prior to offer. Positions open until filled, but selection begins from applicants with complete files (resume, transcript, 3 reference letters) 12–1-87 for tenure-track, 3–15–88 for Lecturer. Apply to C.W. Austin, Chair, Math. & Computer Science, CSU, Long Beach, CA 90804. CSULB is an Affirmative Action/Equal Opportunity Employer.

The University of Scranton
Department of Mathematics/Computer Science

The University of Scranton is a Jesuit university with over 3500 undergraduates. At least one tenure track position is available in Fall 1988 for faculty interested in a teaching environment. Individuals with expertise in any area of mathematics or computer science will be considered. Research is encouraged and supported through a strong faculty development program. Rank and salary are open and competitive. The department currently has 20 full time faculty and about 400 majors. The University has a campus-wide commitment to computing including a faculty PC purchase program. Submit a vita, transcripts, and three references to Mathematics/Computer Science Search Committee, University of Scranton, Scranton, PA 18510 or phone (717) 961-7774. An AA/EO Employer and Educator.

Department of Mathematics/Computer Science
Marymount College
Tarrytown, NY 10591

Tenure-track specialist in remedial mathematics beginning 9/88 (subject to budget approval). 9 hours teaching through calculus each semester plus supervision of the developmental program. A doctorate, or near completion, is required. Send graduate transcript and three reference letters to Dr. Doris Appleby, Chairman, by Feb. 1, 1988 AA/EEO employer.

MILLS COLLEGE
Department of Mathematics and Computer Science
Oakland, California 94613

Mills College is seeking outstanding candidates for a tenure-track position as Assistant Associate, or Full Professor of Mathematics commencing Fall 1988. Candidates must submit evidence of superior teaching and research abilities, and demonstrate a commitment to become involved in a highly innovative and energetic department. Rank and salary will depend on experience and qualifications. The initial contract will be for three years subject to final administrative approval, Mills College is an Affirmative Action/Equal Opportunity Employer. Send vita and direct three letters of reference to: Professor Richard Bassein Chair of the Mathematics Search Committee Mills College Oakland, CA 94613 Deadline for application: January 15, 1988.

MATHEMATICS:

Tenure track position available for Fall 1988. Duties include teaching freshman and sophomore math courses. Minimum qualifications include a Master's degree in mathematics and a strong commitment to teaching. Preferred qualifications: a Ph.D. in mathematics or an Ed.D. in math education. Salary and rank commensurate with qualifications and experience. Send vita, transcripts, and 3 letters of recommendation by January 22, 1988 to: Dr. Bob Nerbun; Chairman of Science, Mathematics, and Engineering; University of South Carolina at Sumter; Sumter, S.C. 29150-2498. USC-Sumter is an Affirmative Action/Equal Opportunity Employer. Applications from minorities and women encouraged.

BELOIT COLLEGE
Department of Mathematics and Computer Science
Beloit, WI 53511

Two tenure track positions beginning August 1988 to teach mathematics and/or computer science in a liberal arts enviroment. We need people who are excellent teachers and scholars, interested in particpating in an active department. Ph.D. required. For one position, ability to teach computer science courses at the level of Programming Languages or Operating Systems. One position may be at Associate Professor level. Deadline is January 15, but we will continue to accept applications until both positions are filled. Send letter of application, resume, and three reference letters to Philip Straffin, Chair. Beloit College is an equal opportunity/affirmative action employer.

MAA Volumes in China

The four MAA volumes MODULES IN APPLIED MATHEMATICS edited by W. F. Lucas and published by Springer-Verlag in 1983 have been translated into Chinese and will be published there in late 1987. These books contain most of the 60 modules resulting from the 1976 MAA Summer Workshop at Cornell University, as well as chapters from the 1976 CUPM volume CASE STUDIES IN APPLIED MATHEMATICS edited by Maynard Thompson.

In Memoriam

Vaughn A. Aandahl, teacher, Denver Public Schools, died in April 1987 at the age of 49. He was an MAA member for 3 years.

Anders Bager, lecturer, Hjorring Gymnasium, Denmark, died 2 September 1987 at the age of 68. He was an MAA member for 9 years.

Ruel V. Churchill, Professor Emeritus, University of Michigan, died in October 1987 at the age of 87. He was an MAA member for 56 years.

James Dagnall, Professor, Hartnell College, died in June 1987 at the age of 53. He was an MAA member for 7 years.

Alice B. Dickinson, Professor Emeritus, Smith college, died in June 1987 at the age of 66. She was an MAA member for 38 years.

Andrew P. Guinand, Professor Emeritus, Trent University, died in April 1987 at the age of 75. He was an MAA member fpr 11 years.

Eduardo Innes, teacher, Holland Public Schools, died 27 September 1987 at the age of 43. He was an MAA member for 1 year.

Edmondo Morgantini, Professor, Seminario Matematico, University of Padua, died 13 June 1987 at the age of 70. He was an MAA member for 12 years.

Aaron Shapiro, retired, died in June 1987 at the age of 84. He was an MAA member for 42 years.

James Simpson, Assistant Professor, Montana State University, died in October 1987 at the age of 67. He was an MAA member for 33 years.

Eric K. Van Douwen, Associate Professor, North Texas State University, died in July 1987 at the age of 41. He was an MAA member for 3 years.

John F. Wagner, Vice President Development, N.S.S., died 10 February 1986 at the age of 43. He was a member for 1 year.

Word has also been received on the deaths of the following MAA members:

James W. Bergquist, mathematician, IBM; **Julia J. Grice**, teacher, Washington, D.C. Public Schools; **J.J. Hinrichsen**, Professor Emeritus, Iowa State University; **Edward H. Kingsley**, retired; **Donald E. Richmond**, retired; **Joseph Tomasovic**, Associate Professor, College of Misericordia; **G. Harvey Van Arkel**, retired.

New Computer Algebra Newsletter

The Mathematics Department at Colby College has begun a newsletter on computer algebra systems (such as Maple, MAC-SYMA, SNP, and MuMath) as used in the undergraduate mathematics curriculum. To receive the newsletter, send a request to: CASE-Newsletter, Department of Mathematics, Colby College, Waterville, ME 04901.

People in the News

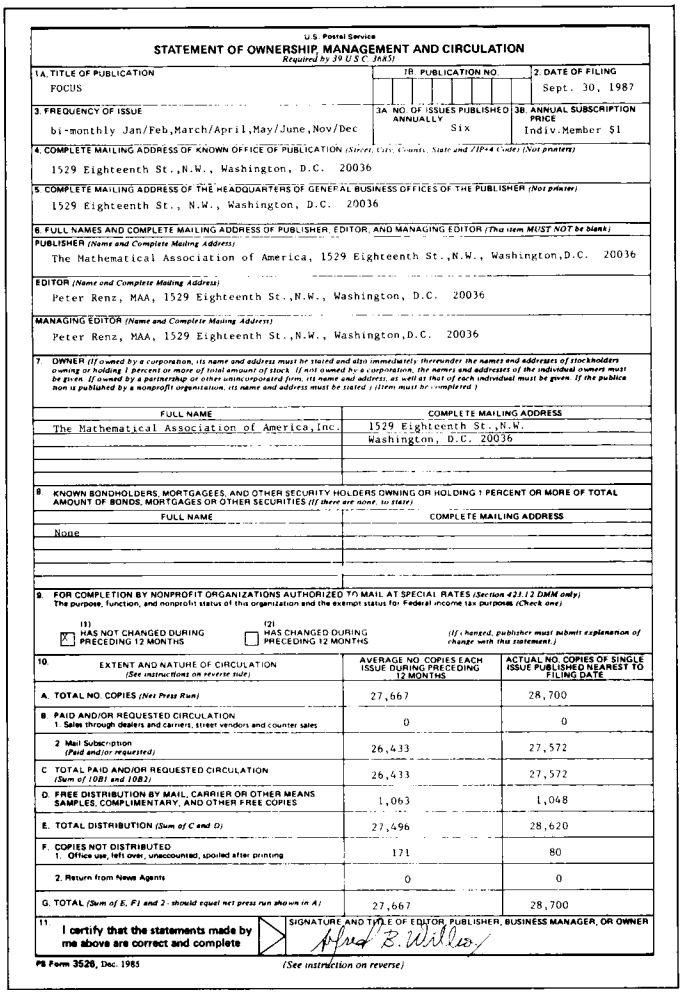
J. Fred Bucy has accepted the Chairmanship of the MS 2000 Committee of the National Research Council. Bucy is the retired Chief Executive Officer and President of Texas Instruments, Inc., a member of the National Academy of Engineering, and a physicist trained at Texas Tech and the University of Texas.

Dr. Lawrence Cox, a Senior Mathematical Statistician with the Bureau of the Census, has succeeded Frank Gilfeather as Staff Director of the Board on Mathematical Sciences at the National Research Council. Gilfeather returns to his faculty position at the University of Nebraska.

Shoshichi Kobayashi of the University of California at Berkeley has been awarded the first Geometry Prize of the Mathematical Society of Japan.

Mohammad Javad Larijani, an MAA member from 1984 through 1986, now holds the post of Deputy Foreign Minister of Iran. From 1974 until 1981, he studied mathematics at the University of California at Berkeley, and did research in mathematical logic, including Ph.D. work, under the supervision of Professor Robert L. Vaught.

Uri Treisman's work that led to the University of California at Berkeley's Professional Development Program earned for him the $50,000 Charles A. Dana Award in 1987 for pioneering achievement in higher education. Treisman's workshop approach has been remarkably successful in helping minority students to excel in mathematics. This program has also been a model for similar programs at UCLA and California State Polytechnic University at Pomona.



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Alfred B. Willcox

PS Form 3526, Dec. 1985 (See instruction on reverse)

Accreditation Committee Update — January 1987, August 1987

The ad hoc Committee on Accreditation of the MAA is gathering background information in order to recommend whether or not the MAA (or some other organization) should undertake accreditation of mathematics programs and what form accreditation should take if it is recommended. It has begun a fact-finding relative to the various types of accrediting or certifying activities of other professional organizations in other disciplines, particularly computer science. All standards, position papers, and policy statements from the MAA Board of Governors in the last five or so years which might be related to mathematics curricula, faculty, library, or accreditation are being reviewed. Relevant standards of the regional accrediting associations are being examined.

At the January AMS/MAA meeting in San Antonio, Bernie Madison presented to the JPBM meeting of department chairs results of the Committee's straw poll of mathematical sciences department chairs concerning their views on accreditation. Based on a 45% response rate to 495 questionnaires sent to mathematics department chairs, teaching load data and information about class size were items of significant (comparative) concern while information about women and minorities in mathematics was an item of significant and embarrassing (comparative) disinterest. Madison indicated that the chairs gave an average "Neutral" response to the question "Should there be an accreditation program for Mathematics departments?" and an average response of "Agree" to the question "Is additional material about teaching loads, salaries, remedial courses, computational resources, etc., needed?" Realizing the importance of such data, the Committee plans to gather and evaluate information relative to the resources at colleges and universities for teaching undergraduate mathematics. Bernie Madison will make available to the Committee as much information as he gleans in leading the MS 2000 project, a joint effort by the Board of Mathematical Sciences and the Mathematical Sciences Education Board in preparing a National Studies of Resources for College Mathematics. The committee reacted favorably to a suggestion that the MAA, perhaps in conjunction with the AMS, reissue the publication, "Guidebook to Departments in Mathematical Sciences," last published in 1975.

The discussion following Madison's presentation was both pro and con relative to accreditation and was indicative of strong feelings about the issue yet a lack of specificity and definition of terms. Part of the Committee's job is to clarify the issues. Accreditation or certification might improve undergraduate education in mathematics and this is the rationale for the Committee's undertaking a serious study of the issue. Currently, collegiate education is receiving widespread national attention and much of the attention is focused on undergraduate education in mathematics. But public attention may focus sharply on an issue for a period of time and then move on quickly to another issue. A window of opportunity seems to exist for a favorable reception to MS 2000 and the related issue of accreditation. Thus, while the Committee will not hastily judge the issue of accreditation in undergraduate mathematics, it will move expeditiously in the matter. Ideas and opinions are earnestly solicited by the Committee and may be addressed to the Committee chair.

CORRECTION. Half a line was lost from the bottom of page 3 to the top of page 6 of Leonard Gillman's article in the September FOCUS. Here is the correct text: I suppose it is an improvement to go from outmoded methods of teaching ill-prepared students a ragged curriculum to outmoded methods of teaching ill-prepared students a spruced-up curriculum, but we can set our sights higher.

FOCUS Schedule

FOCUS has grown from a total of 92 pages a year to 136 pages in 1986 and was reaching toward 160 pages in 1987. This growth, together with new commitments that the present Editor has working with the MAA's book program, led to severe delays toward the end of 1987. We have made a three-pronged attack on these problems. First, we have strengthened our staff. Harry Waldman, Editorial Manager for the MAA's Washington office joins us as Managing Editor for FOCUS. Our advertising manager is now Siobhán Chamberlin. Second, we are combining material from the final 1987 issue, which will disappear in the process, with that for the first 1988 issue, which you now hold in your hands. Third, in every issue of FOCUS we will publish our final copy deadlines and our dates for mailing the next six issues. This will help keep our contributors and our staff on schedule.

The dates of publication of our journals and of our newsletter are the mailing dates. In this we follow the practices of AAAS's *Science* and run counter to that of *Scientific American* and many other commercial magazines. The present schedule is constrained by the earliest dates at which meeting or other information can be obtained and by the need to get such information to our readers as soon as possible. These requirements give us publication dates that do not perfectly match issue names such as "March–April." We will bring these into agreement in 1989, after revising our postal permit to reflect these constraints on our schedule.

1988 FOCUS Issues	Copy Due	Issue Mailed
January–February	1/15	2/6
March–April	3/4	3/25
May–June	4/8	5/6
September	7/29	8/19
October	8/26	9/20
November–December	9/23	10/14

Calculus Watch

This box will be a continuing feature to help readers follow new initiatives in calculus. This is a joint effort of the MAA (Contact: FOCUS Editor, Peter Renz) and the NRC's MS2000 Project (Contact: Project Director, Bernard Madison). We ask those holding conferences or workshops on calculus to inform either of these offices. Both offices will keep and distribute an up-to-date joint listing of all such activities. A brief listing will appear regularly in FOCUS. We also ask those holding conferences to send us and to make available to others lists of participants. This will help us and others build up a calculus network.

Watch for further news and keep our copy deadlines for 1988 in mind (see page 6). Activities now noted are:

MAA Arkansas-Oklahoma Section Workshop, April 15, 1988. Contact John Watson at Arkansas Technical University (501-968-0295) for details.

MAA Southwestern Section Meeting, April 22–23 in Flagstaff, Arizona. Session on MS2000 and a panel on CALCULUS FOR A NEW CENTURY. Contact John Hagood, Northern Arizona University (602-523-3481) for details.

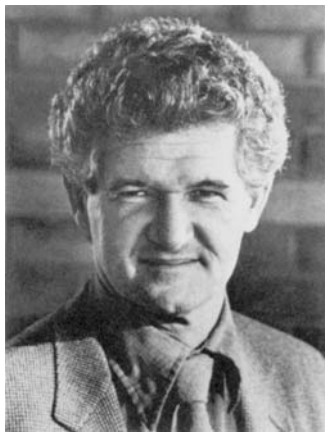
Ito and Lax Share 1987 Wolf Prize

The Wolf Prize Committee in Mathematics for 1987 unanimously recommended that this hundred thousand dollar award be shared equally by Professor Kiyoshi Ito of Koyoto University and Professor Peter D. Lax of the Courant Institute. In making this recommendation, the Committee cited their contributions as follows:

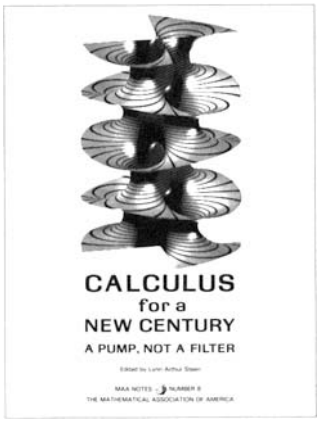
Professor Ito has given us a full understanding of the infinitesimal development of Markovian sample paths. This may be viewed as Newton's law in the stochatic realm, providing a direct translation between the governing partial differential equation and the underlying probalistic mechanism. Its main ingredient is the differential and integral calculus of probability, both pure and applied. In addition, Professor Ito has been the inspirer and teacher of a whole generation of Japanese probalilists.

A graduate of the Courant Institute, Professor Lax embodies the best traditions of Hilbert as continued by Courant. Among his many contributions are the solution of the Cauchy problem with oscillatory data, the clarification of the role of stability of a numerical scheme, the comprehensive develoment of scattering theory, the theory of non-linear conservation laws, and a deep insight into the Korteweg-de Vries equation. Professor Lax's influence has been profound and decisive in both pure and applied mathematics.

Professor Kiyoshi Ito of Koyoto University



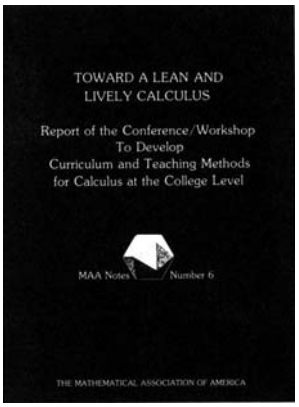
Professor Peter D. Lax of New York University



"...the topic is very timely and well presented. . . .I found this colloquium proceedings to be first rate. Good people are involved, complete coverage of the issues is given, and lively and thoughtful essays are presented. I can certainly give this proceedings my highest recommendation."

Phillip A. Griffiths
Chair of the Board on
Mathematical Sciences

New Century is packed with over 250 pages of material on where calculus is and where it might go. It is available for $12.50 plus $1.50 handling as is the companion volume TOWARD A LEAN AND LIVELY CALCULUS. Ten percent discount on both volumes if ordered together. Postage and handling free on prepaid orders.



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Calendar

National MAA Meetings

72nd Annual Meeting, Phoenix, Arizona, January 11–14, 1989. (Board of Governors, January 10, 1989).

73rd Annual Meeting, Louisville, Kentucky, January 24–27, 1990. (Board of Governors, January 23, 1990).

Sectional MAA Meetings

Allegheny Mountain, Bethany College, Bethany, West Virginia, April 22–23, 1988.

Eastern Pennsylvania & Delaware, Ursinus College, Collegeville, Pennsylvania, April 9, 1988.

Florida, Rollins College, Winter Park, Florida, March 4–5, 1988.

Illinois, Bradley University, Peoria, Illinois, April 29–30, 1988.

Intermountain, Utah State University, Logan, Utah, April 15–16, 1988.

Iowa, Grinnell College, Grinnell, Iowa, April 15–16, 1988.

Kansas, Fort Hays State University, Hays, Kansas, April 15–16, 1988.

Kentucky, Georgetown College, Georgetown, Kentucky, April 15–16, 1988.

Louisiana—Mississippi, Northwestern State University, Natchitoches, Louisiana, February 26–27, 1988.

Maryland-DC-Virginia, Mount Saint Mary's College, Emmitsburg, Maryland, April 23, 1988

Metro. New York, Concord Resort Hotel, Kiamesha Lake, New York, April 22–24, 1988.

Michigan, Eastern Michigan University, Ypsilanti, Michigan, May 6–7, 1988; Hope College, Holland, Michigan, May 12–13, 1989.

Missouri, Washington University, St. Louis, Missouri, April 8–9, 1988.

Nebraska, Kearney State College, Kearney, Nebraska, April 15–16, 1988.

New Jersey, Ocean County College, Toms River, New Jersey, Spring, 1988; St. Peter's College, Jersey City, New Jersey, Spring, 1989.

North Central, College of St. Thomas, St. Paul, Minnesota, April 1988; Concordia College, Moorhead, Minnesota, October, 1988; Mankato State University, Mankato, Minnesota, April, 1989.

Northeastern, St. Michael's College, Winooski, Vermont, June 10–11, 1988; Rhode Island College, Providence, Rhode Island, November 18–19, 1988.

Northern California, St. Mary's College, Moraga, California, March 5, 1988.

Ohio, Kent State University, Canton, Ohio, April 29–30, 1988; Wittenberg University, Springfield, Ohio, Fall 1988; Ohio State University, Columbus, Ohio, Spring, 1989.

Oklahoma-Arkansas, Hendrix College, Conway, Arizona, Spring 1988.

Southeastern, Furman University, Greenville, South Carolina, April 15–16, 1988.

Southwestern, Northern Arizona University, Flagstaff, Arizona, Spring 1988.

Texas, Trinity University, San Antonio, Texas, April 14–16, 1988.

Wisconsin, University of Wisconsin-La Crosse, La Crosse, Wisconsin, April 22–23, 1988.

Other Meetings

February 1988

15–19. **The Nineteenth Southeastern International Conference on Combinatorics, Graph Theory, and Computing**, Louisiana State University, Baton Rouge, Louisiana. Information available after October 15, 1987 from K.B. Reid, Chairman, Department of Mathematics, Louisiana State University, Baton Rouge, Louisiana, 70803

March 1988

18–19. **Pi Mu Epsilon Student Conference**, St. John's University, Collegeville, Minnesota 56321. Open to all mathematicians and mathematics students including those not members of Pi Mu Epsilon. Principal speaker will be Sherman Stein of the University of California at Davis. For more information, contact: Jennifer Galovich at (612) 363–3192, Jerry Lenz at (612) 363–3193, or Michael Gass at (612) 363–3155.

April 1988

17–19. **Eleventh Annual Symposium on Developmental/Remedial Education**, Nevele Country Club, Ellenville, New York. Dr. Jacqueline Fleming, author of BLACK STUDENTS, will give keynote address. Other speakers include May Garland on Supplemental Instruction; Cynthia Selfe on Uses of Computers in the Learning Center and in Instruction; Stephen Brown on Critical Thinking/Problem Solving Across the Curriculum; and David Bartholomae on Reading and Writing. For more information contact: Susan Huard, Developmental Studies Division, Community College of the Finger Lakes, Canandaigua, New York 14424, (716) 394–3500 ext. 389.

28–29. **11th Annual Idaho State University Spring Conference in Mathematics:** "Applied and Computational Linear Algebra," Idaho State University, Pocatello, Idaho. Dr. Charles R. Johnson of the College of William and Mary and Dr. Stephen F. McCormick of the University of Colorado-Denver will be the invited speakers. Those interested in contributing a 20 minute talk should provide an abstract by March 31, 1988. For more information, contact: Larry Ford, Department of Mathematics, Idaho State University, Pocatello, Idaho 83209, (208) 236–3465 or 3350.

May 1988

26–28. **Third Lehigh University Geometry and Topology Conference**, Bethlehem, Pennsylvania. For more information, contact: D. Davis or D. Johnson, Department of Mathematics, Lehigh University, Bethlehem, Pennsylvania 18015, (215) 758–3730.

July 1988

13–15. **Ohio Section Short Course:** "Using Computer Algebra Systems to Teach Calculus," Denison University, Granville, Ohio. Course includes brief introduction to a computer algebra system (Maple), hands-on experience using Maple on a Sun Microsystem, and a discussion of the role of computer algebra systems in teaching calculus. For additional information, contact; Andrew Sterrett, Denison University, Granville, Ohio, (614) 587–6484.

23-Aug. 3. **Sixth International Congress on Mathematical Education (ICME 6).** See FOCUS, Volume 7, Number 1, page 3 for details.

Participants wishing to tour the USSR for 2 weeks after leaving Budapest should contact Alan Hoffer at (202) 357-7539. Cost: $2100 from US including Budapest and USSR.

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